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SECTION 01 14 00.05 20

WORK RESTRICTIONS FOR DESIGN-BUILD
11/05

PART 1 GENERAL

1.1 SUBMITTALS

The use of a "G" following a submittal indicates that a Government approval/action is required. Submit the following in accordance with Section 01 33 10.05 20, DESIGN SUBMITTAL PROCEDURES and Section 01 33 00.05 20, CONSTRUCTION SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

List of contact personnel; G

1.2 SPECIAL SCHEDULING REQUIREMENTS

a. Have materials, equipment, and personnel required to perform the work at the site prior to the commencement of the work.

b. The adjacent buildings, roads, and other facilities shall remain in operation during the entire construction period. Conduct operations so as to cause the least possible interference with normal operations of the activity.

c. Permission to interrupt any Activity roads and/or utility service shall be requested in writing a minimum of 15 calendar days prior to the desired date of interruption.

d. The work under this contract requires special attention to the scheduling and conduct of the work in connection with existing operations. Identify on the construction schedule each factor which constitutes a potential interruption to operations.

1.3 CONTRACTOR ACCESS AND USE OF PREMISES

See additional requirements established in Section 01 57 19.05 20, ADDITIONAL TEMPORARY CONTROLS.

1.3.1 Activity Regulations

Ensure that Contractor personnel employed on the Activity become familiar with and obey Activity regulations including safety, fire, traffic and security regulations. Keep within the limits of the work and avenues of ingress and egress. To minimize traffic congestion, delivery of materials shall be outside of peak traffic hours (6:30 to 8:00 a.m. and 3:30 to 5:00 p.m.) unless otherwise approved by the Contracting Officer. Wear hard hats in designated areas. Do not enter any restricted areas unless required to do so and until cleared for such entry. The Contractor's equipment shall be conspicuously marked for identification.

1.3.1.1 Subcontractors and Personnel Contacts

Riverine and Combatant Craft Operations Facility, Stennis Space Center, MS
Furnish a list of contact personnel of the Contractor and subcontractors including addresses and telephone numbers for use in the event of an

emergency. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

1.3.1.2 Identification Badges

Identification badges will be furnished without charge. Application for and use of badges shall be as directed by the Contracting Officer. Contractor shall immediately report all instances of lost or stolen badges to the Contracting Officer and Stennis Space Center (SSC) Security. Identification badges will be issued to all Contractor and subcontractor employees in accordance with SSC Security regulations. A copy of these regulations may be obtained from SSC Security. All badges must be returned to SSC Security upon expiration of the badge or contract or termination of the employee.

1.3.2 Working Hours

Regular working hours can consist of up to a 9 1/2 hour period between 7:00 a.m. and 4:30 p.m., Monday through Friday, excluding Government holidays.

1.3.3 Work Outside Regular Hours

Work outside regular working hours requires Contracting Officer approval. Make application 15 calendar days prior to such work to allow arrangements to be made by the Government, giving the specific dates, hours, location, type of work to be performed, contract number, and project title. Based on the justification provided, the Contracting Officer may approve work outside regular hours. During periods of darkness, the different parts of the work shall be lighted in a manner approved by the Contracting Officer.

1.3.4 Occupied and Existing Buildings

The Contractor shall be working around existing buildings which are occupied. Do not enter the buildings without prior approval of the Contracting Officer.

1.3.5 Utility Cutovers and Interruptions

a. Make utility cutovers and interruptions after normal working hours or on Saturdays, Sundays, and Government holidays.Conform to procedures required in the paragraph "Work Outside Regular Hours."

b. Ensure that new utility lines are complete in all regards (including all required testing, except for the actual connection) before interrupting existing service.

c. Interruption to water, sanitary sewer, storm sewer, telephone service, electric service, data communications, air conditioning, heating, fire alarm, and compressed air shall be considered utility cutovers pursuant to the paragraph entitled "Work Outside Regular Hours." Such interruption shall be limited to 8 hours. This includes time for deactivation and reactivation.

d. Operation of Installation Utilities: The Contractor shall not operate nor disturb the setting of control devices in the installation utilities system, including water, sewer, electrical, and communication services. The Government will operate the control devices as required for normal conduct of the work. The Contractor shall notify the Contracting Officer giving reasonable advance notice when such operation is required.

1.3.5.1 Location of Underground Utilities

The Contractor is responsible for locating and marking all underground utilities. Prior to starting work, scan the construction site with electromagnetic or sonic equipment, and mark the surface of the ground or paved surface where existing underground utilities or utilities encased in pier structures are discovered. Verify the elevations of existing piping, utilities, and any type of underground or encased obstruction not indicated or specified to be removed but indicated or discovered during scanning in locations to be traversed by piping, ducts, and other work to be conducted or installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

a. Notification Prior to Excavation: Notify the Contracting Officer at least 7 days prior to starting excavation work. Contact Miss Utility 48 hours prior to excavating. Contractor is responsible for marking all utilities not marked by Miss Utility.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 20 00.05 20
PRICE AND PAYMENT PROCEDURES FOR DESIGN-BUILD
11/05

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EP-1110-1-8 (2003) Construction Equipment Ownership and Operating Expense Schedule, Vol 1-12

1.2 SCHEDULE

1.2.1 Schedule Instructions

Payments will not be made until the Network Analysis System (NAS) has been submitted to and accepted by the Contracting Officer. Identify the cost for site work, and include incidental work to the 5 foot line. Identify costs for the building(s), and include work out to the 5 foot line. Work out to the 5 foot line shall include construction encompassed within a theoretical line 5 feet from the face of exterior walls and shall include attendant construction, such as cooling towers, placed beyond the 5-foot line.

1.2.2 Schedule Requirements for HVAC TAB

The field work required by Contractor edited Section 23 08 00.00 20, HVAC TESTING/ ADJUSTING/ BALANCING shall be broken down in the NAS by separate line items which reflect measurable deliverables. Specific payment percentages for each line item shall be determined on a case-by-case basis for each contract. The line items shall be as follows:

a. Approval of Design Review Report

b. Approval of the pre-field engineering report

c. Season I field work

d. Approval of Season I report

e. Completion of Season I field QA check

f. Approval of Season II report

1.3 CONTRACT MODIFICATIONS

In conjunction with the Contract Clause "DFARS 252.236-7000, Modification Proposals-Price Breakdown," and where actual ownership and operating costs of construction equipment cannot be determined from Contractor accounting records, equipment use rates shall be based upon the applicable provisions of the EP-1110-1-8.

1.4 CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT

1.4.1 Content of Invoice

Requests for payment will be processed in accordance with the Contract Clause "FAR 52.232-27, Prompt Payment Construction Contracts," and shall include items required by FAR 52.232-5, "Payments under Fixed-Price Construction Contracts" and the following:

a. The Contractor's invoice certified by QC, on the form furnished by the Government for this purpose, showing in summary form, the basis for arriving at the amount of the invoice. Submit original and five copies.

b. The Contract Performance Statement on the form furnished by the Government for this purpose, showing in detail, the estimated cost, percentage of completion, and value of completed performance for each of the construction categories. Submit original and two copies.

c. Final invoice shall be accompanied by Final Release Form. If the Contractor is incorporated, the release shall contain the corporate seal. An officer of the corporation shall sign the release and the corporate secretary shall certify the release.

d. Updated network mathematical analysis (three copies).

e. Contractor Safety Self Evaluation Checklist (original).

f. Monthly Work-Hour Report.

g. Solid Waste Disposal Report.

1.4.2 Mailing of Invoices

a. All invoices shall be forwarded with specific marking on the envelope. This marking shall be in the front lower left hand corner, in large letters, "INVOICES ENCLOSED."

b. Invoices not completed in accordance with contract requirements will be returned to the Contractor for correction of the deficiencies.

c. Final invoices not accompanied by Final Release Form will be considered incomplete and will be returned to the Contractor.

1.5 PAYMENTS TO THE CONTRACTOR

Payments will be made on submission of itemized requests by the Contractor which comply with the requirements of this section, and will be subject to reduction for overpayments or increase for underpayments made on previous payments to the Contractor.

PART 2 PRODUCTS Not used.

PART 3 EXECUTION Not used.

-- End of Section --

SECTION 01 30 00.05 20
ADMINISTRATIVE REQUIREMENTS FOR DESIGN-BUILD
11/05

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

15 CFR 772 Definition of Terms

15 CFR 773 Special Licensing Procedures

1.2 SUBMITTALS

The use of a "G" following a submittal indicates that a Government approval/action is required. Submit the following in accordance with Section 01 33 10.05 20, DESIGN SUBMITTAL PROCEDURES and Section 01 33 00.05 20, CONSTRUCTION SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

Insurance; G

1.3 MINIMUM INSURANCE REQUIREMENTS

Procure and maintain during the entire period of performance under this contract the following minimum insurance coverage:

a. Comprehensive general liability: $500,000 per occurrence.

b. Automobile liability: $200,000 per person, $500,000 per occurrence for bodily injury, $20,000 per occurrence for property damage.

c. Workmen's compensation as required by Federal and state workers' compensation and occupational disease laws.

d. Employer's liability coverage of $100,000, except in states where workers compensation may not be written by private carriers.

e. Others as required by the state.

1.4 CONTRACTOR PERSONNEL REQUIREMENTS

1.4.1 Subcontractor Special Requirements

1.4.1.1 HVAC TAB

All contract requirements of the Contractor edited Section 23 08 00.00 20, HVAC TESTING/ ADJUSTING/ BALANCING shall be accomplished directly by a first tier subcontractor. No work required by Section 23 08 00.00 20 shall be accomplished by a second tier subcontractor.

1.5 SUPERVISION

Have at least one qualified supervisor capable of reading, writing, and conversing fluently in the English language on the job site during working hours. In addition, the Quality Control (QC) representative shall also have fluent English communication skills.

1.6 AVAILABILITY OF CADD DRAWING FILES

After award and upon request, the electronic "Computer-Aided Drafting and Design (CADD)" drawing files will be made available to the Contractor for use in preparation of construction drawings and data related to the referenced contract subject to the following terms and conditions.

Data contained on these electronic files shall not be used for any purpose other than as a convenience in the preparation of construction drawings and data for the referenced project. Any other use or reuse shall be at the sole risk of the Contractor and without liability or legal exposure to the Government. The Contractor shall make no claim and waives to the fullest extent permitted by law, any claim or cause of action of any nature against the Government, its agents or sub consultants that may arise out of or in connection with the use of these electronic files. The Contractor shall, to the fullest extent permitted by law, indemnify and hold the Government harmless against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic CADD drawing files are not construction documents. Differences may exist between the CADD files and the corresponding construction documents. The Government makes no representation regarding the accuracy or completeness of the electronic CADD files, nor does it make representation to the compatibility of these files with the Contractors hardware or software. Use of these CADD files does not relieve the Contractor of duty to fully comply with the contract documents, including and without limitation, the need to check, confirm and coordinate the work of all contractors for the project.

If the Contractor uses, duplicates and/or modifies these electronic CADD files for use in producing construction drawings and data related to this contract, all previous indicia of ownership (seals, logos, signatures, initials and dates) shall be removed.

1.7 CLEANUP

Leave premises "broom clean." Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces; vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition. Replace filters of operating equipment. Clean debris from roofs, gutters, downspouts, and drainage systems. Sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish and construction facilities from the site.

PART 2 PRODUCTS
Not used.

PART 3 EXECUTION
Not used.

-- End of Section --

SECTION 01 31 19.05 20
POST AWARD MEETINGS
02/06

PART 1 GENERAL

1.1 SUMMARY

This document includes post-award requirements for project kickoff and subsequent design and preconstruction meetings.

1.2 SUBMITTALS

The use of a "G" following a submittal indicates that a Government approval action is required. Submit the following in accordance with Section 01 33 10.05 20, DESIGN SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

CDW Facilitator Experience Resume; G

CDW Preliminary Concept Design; G

CDW Basis of Design with Cost Estimate; G

CDW Concept Design Report; G

1.3 POST AWARD KICKOFF MEETING

The Post Award Kickoff (PAK) meeting is made up of Contract Administration, Design Presentation, Partnering, and Scheduling. If mutually beneficial to the Contractor and the Government, these four elements may be addressed in a single meeting or multiple meetings. Additionally, the Contractor may conduct the Concept Design Workshop (CDW) in conjunction with the PAK.

1.3.1 PAK Meeting Location

Within 21 calendar days after contract award, and prior to commencing work, meet with the Contracting Officer for the PAK meeting(s). The meeting shall be at a mutually agreed to time and location.

1.3.2 PAK Meeting Outcomes

The meeting(s) outcomes are:

a. Integrate the Contractor and all client representatives into the project team.

b. Achieve consensus from the project team on any issues and concerns with the Contractor's technical proposal.

c. Establish and explain policies and procedures for completion of a successful project.

d. Establish clear lines of communication and points of contact for Government and Contractor team members.

e. Obtain an acceptable conceptual design including floor and site plans signed by the client, Contractor, and other key team members.

f. Establish clear expectations for the Concept Design Workshop (CDW).

g. Establish project design schedule, design submittal packaging, and preliminary construction schedule.

h. Establish clear expectations for facility turnover.

i. Establish procedure for design package reviews, Contractor's resolution to comments, and Government's role in review of packages.

1.3.3 PAK Meeting Attendees

The following Contractor key personnel shall attend the PAK: Project Manager, Project Scheduler, Design Staff representing each architectural/engineering discipline, Superintendent, QC Manager, and DQC Manager. Optional attendees include: Principal, Assistant Project Manager, major subcontractors, and specialized supplemental QC personnel.

1.3.4 Contract Administration

Contract administration roles and responsibilities will be addressed.

1.3.5 Concept Design Workshop (CDW)

Provide as specified in Appendix 01006-1, Concept Design Workshop. Attendees shall be similar to those listed above for the PAK meeting.

1.3.6 Partnering Meeting

LEVEL A PARTNERING: The Contractor shall conduct quarterly partnering sessions with key personnel of the project team, including Contractor's personnel and government personnel. The Contractor shall pay all costs in connection with the partnering effort.

To most effectively accomplish this contract, the Government requires the formation of a cohesive partnership with the Contractor and its subcontractors. Key personnel, including the client who will occupy the facility, the Designer of Record, principal individuals from NAVFAC (Echelon III and/or IV) and from the ROICC office, the project sponsor, and representative(s) of the facility owner will be invited to participate in the partnering process. Key members of the prime and subcontractors teams, including senior management, must participate.

The initial session will be one-day minimum and the follow-on sessions, held at a minimum of once every three months or as agreed to by the partners, will be half-day minimum. The initial partnering session shall be held away from the project site at a location acceptable to the Contractor and to the Government; the follow-on sessions can be held at locations agreed to by the partners.

The Contractor shall pay all costs associated with the partnering effort including facilitator, meeting room and other incidental items. Before the partnering session, the Contractor shall coordinate with the facilitator requirements for incidental items (audio-visual equipment, two easels, flipchart paper, colored markers, note paper, pens/pencils, colored flash

cards, etc.) and have these items available at the partnering session.

The Contractor will copy documents for distribution to all attendees. The facilitator must be acceptable to both the Contractor and the Government. The participants shall bear their own costs for meals, lodging, and transportation associated with partnering.

1.3.7 Scheduling Meeting

Provide in accordance with Section 01325N, NETWORK ANALYSIS SCHEDULES (NAS) FOR DESIGN-BUILD.

1.4 DESIGN QUALITY ASSURANCE MEETINGS

After Government Quality Assurance (QA) of each Design Submittal has been completed, meet with the Government for a one-day conference to discuss review comments for the specific design submittal.

Provide consolidated copies of all Government comments with annotations of Contractor's action beside them. Notify the Contracting Officer in writing within five (5) days after receipt of Government's comments if the Contractor disagrees with comments technically or interprets comments to exceed the requirements of the contract.

1.4.1 Design QA Meeting Attendees

The following Contractor key personnel shall attend the design QA meetings: Project Manager, QC Manager, DQC Manager, and Contractor's Design Staff (architect and engineering disciplines related to topics to be discussed).

1.4.2 Design QA Meeting Location

Meetings shall be located at the office of the Contracting Officer's QA Team or may be conducted at other locations or by other electronic means if mutually acceptable to all parties.

1.4.3 Minimum Design QA Meeting Agenda

Address all Government comments that are unresolved and present clarification or supporting information requested by the Contracting Officer's QA team during the previous meeting.

1.5 PRE-CONSTRUCTION MEETING

Meet with the Contracting Officer to discuss construction items of concern to the Government and the Contractor such as outages, storage, trailer location, disposal of construction debris, etc. at a location to be determined by the Contracting Officer. The pre-construction meeting may take place with the PAK meeting or at any time prior to mobilization and before any construction work begins.

1.6 FACILITY TURNOVER PLANNING MEETINGS (NAVFAC RED ZONE - NRZ)

Key personnel will meet to identify strategies to ensure the project is carried to expeditious closure and turnover to the Client. Start the turnover process at the PAK Meeting and convene the Facility Turnover Meetings once the project has reached approximately 75% completion or three to six months prior to Beneficial Occupancy (BOD), whichever comes first. The Contracting Officer's Representative will lead the meetings and guide

the discussions based on an agenda provided by the Government. The Facility Turnover effort shall include the following:

a. PAK Meeting - Contracting Officer's Technical Representative (COTR) will provide the NRZ Checklist (a preliminary copy is included in Appendix 01006-2, NRZ Checklist), and the Contractor, Client, and NAVFAC Representatives will compare Contractor's schedule to NRZ Checklist to ensure all Contractor Checklist Items are included in the schedule and to discuss the scheduling impact of Client and NAVFAC Checklist Items.

b. Facility Turnover Meetings -

1. Fill in the NRZ Checklist including Contractor, Client, and NAVFAC Checklist Items and assign a person to be responsible for each item and a due date. The Contracting Officer's Representative will facilitate the assignment of responsibilities and fill out the NRZ Checklist.

2. Review the Contractor's updated schedule. The Contracting Officer's Representative shall develop a POAM for the completion of all Contractor, Client, and NAVFAC Checklist items.

3. Confirm that all NRZ Checklist items will be completed on time for the scheduled Facility Turnover.

1.6.1 Facility Turnover Meeting Attendees

The following key personnel shall attend the Facility Turnover Meetings: Contractor QC Manager, Design Quality Control Manager, Superintendent, Major Subcontractors, Designer-of-Record, Contracting Officer's Representative, Representative(s) of NAVFAC, the Facility Owner, and the Client.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

- End of Section -

Appendix 01006-1
CONCEPT DESIGN WORKSHOP (CDW)

Provide the following information:

a. CDW Facilitator Experience Resume

b. CDW Preliminary Concept Design

c. CDW Basis of Design with Cost Estimate

d. CDW Concept Design Report

.1. General

1.1 Methodology. A Concept Design Workshop will be conducted for

this project. This effort will examine project functions and requirements, quality and life safety costs, analyze alternate design concepts, expose and resolve project issues, and develop the final conceptual design.

1.2 Facilitator. The Contractor will provide a Facilitator who is experienced in conducting Concept Design Workshops. He or she will be responsible for leading the team in a timely manner, making sure that issues are pursued and resolved to the maximum extent possible, documenting meetings, organizing the design concept documents for on-site approval, and providing the Concept Design Workshop Report.

1.3 Contractor's Design Team. The primary functions of the Design Team will be to investigate, develop and present alternate design solutions. The entire Design Team will participate in all phases of the Concept Design Workshop effort and provide assistance to the Facilitator in development of the Concept Design Workshop Report, including most of the required documentation.

1.4 Concept Design Workshop Report. Produced almost entirely on-site, the Concept Design Workshop Report will summarize the final conceptual design.

1.5 Award Amount. At each contract stage, the Contractor shall verify that the concept is within the contract award amount.

2. Procedure

2.1 Preliminary Work. The Contractor's Design Team shall complete the following prior to the on-site workshop:

a. Review the contract documents and references explaining the project scope and history.

b. At the Post Award Kickoff meeting, the User(s) makes a presentation of their functional requirements.

c. Prepare and submit, at least 7 days in advance of the Concept Design Workshop, 15 copies of a preliminary concept design (Concept #1), a Basis of Design, and a statement that the concept provided is within the award amount.

d. Make arrangements for and provide an appropriate conference room convenient to the project site and/or Users for use by the Design Team and government participants during the workshop.

e. Incorporate government comments in a revised Concept #1 and produce at least 20 copies of the revised Concept #1 documents for distribution at the workshop.

f. Facilitator has discussions with NAVFAC representatives before the Concept Design Workshop to review preparations, relationships, and the status of work to be accomplished.

2.2 On-Site Workshop. The Design Team shall accomplish the following items during the on-site phase of the Concept Design

Workshop. (Typically conducted in two to three working days, minimizing breaks so as to maintain momentum. The Design Team should expect longer than normal workdays.)

a. At the beginning of the workshop, meet with the using activity, Station and other Government representatives. The Facilitator will describe the Concept Design Workshop process and review the workshop agenda. The user(s) will provide a functional presentation. This is to reiterate to all participants the User(s) needs and desires. The intent is to make the design solution and issue resolution function-oriented.

b. Present the revised Concept #1 and respond to questions.

c. Participate in a comment/creative session to generate ideas to improve this project in the areas of function, quality and total life cycle cost, issue resolution and sustainable design within the award amount. It is often helpful to request User comments in writing so they may be considered, responded to, and presented at subsequent presentations.

d. Create a new concept design. Design concepts shall include drawings, sketches, and other graphics as necessary to fully describe the concept. Prepare at least 20 copies for distribution at all presentations.

e. Repeat applicable steps as necessary. Usually, at least two concepts are required. The final concept must be within the contract award amount.

f. The final concept shall include the following:

(1) Site Plan: Show the layout of the proposed facility in relation to major landmarks. Show all buildings, access roads, parking, pedestrian walkways, roads, sidewalks, landscaping, and major utilities. Indicate major dimensions and orientation. Provide a building code analysis, relating the proposed building site, size, and construction type to maximum allowable limits of the International Building Code.

(2) Building Floor Plans: Provide floor plans depicting functional utilization of spaces and furniture and equipment layout. Show room sizes or dimensions. Provide a Life Safety

Code® analysis with the floor plan to identify required life safety and egress features.

(3) Perspective Sketches: Provide at least one sketch to show a perspective of major buildings. The sketch should not be elaborate but must show the proposed form and massing, colors to be used, and an indication of materials used.

(4) Mechanical Plans: Provide plans as necessary to show the essential work and intent of the design. Suggestions include equipment layouts, zones, etc.

(5) Electrical Plans: Provide plans as necessary to show the essential work and intent of the design. Suggestions include special light fixture types, locations, switching, power outlets

and panelboard location. Provide electrical distribution single line diagram.

(6) Cost Estimate: Provide a statement that the concept presented can be constructed within the award amount.

(7) Basis of Design: Describe, in layman's terms, the intent of the design by discipline. Address material quality, energy efficiency and life cycle costs.

(8) Sustainable Design: Demonstrate ability to achieve LEED self-certification.

(9) System Safety Engineering

g. Prepare 20 copies of the final concept (drawings, basis of design and statement that the concept is within the award amount) for distribution at the final presentation.

h. Dependent upon the project, the Concept Design Workshop Report is provided by the Facilitator, includes all items included in the final concept design and the following:

(1) Endorsements: Include a copy of the signature/endorsement sheet.

(2) Comments: Include comments and resolutions concerning the final concept design.

(3) Executive Summary: Summarize the workshop, including how the various concepts differed and were improved during the workshop.

(4) Special Design Features: Identify and describe unique project needs and features, e.g., pile foundations, physical security, intrusion detection systems, access control, construction in humid climates, pollution abatement, tempest, HEMP, etc.

(5) Architectural Compatibility Statement: Identify architectural style, materials, and color scheme; and indicate their compatibility with installation planning and design concepts established in the Base Exterior Architectural Plan.

(6) Environmental Summary: Provide a summary of environmental issues, listing completed actions and items requiring further coordination, waivers or permits.

(7) Supporting Project Documentation: Include data to support the development of the concept design, layout, and special features. Items should include: project scope discussion, minutes of meetings, function analysis work sheets, and economic and technical analyses if alternatives evaluated.

i. Except for final comments, responses and endorsements, the final report should be completed on site, before the final presentation. If requested by the NAVFAC Project Manager, be prepared to present up to 10 hard copies of the report at the conclusion of the workshop.

j. Conduct a "front-to-back" comprehensive presentation of the final concept. Obtain user signatures on a conceptual design endorsement sheet, signifying approval of the concept design, subject to the final comments and their resolutions agreed to at the final presentation meeting.

2.3 Concept Design Workshop Report

Within 14 calendar days of completion of the on-site Concept Design Workshop, the Design Team shall submit to the NAVFAC Project Manager an electronic copy of the Concept Design Workshop Report as one file in *.PDF format.

Resource Document for B-1.6.11 18 March 2008
NRZ Checklist/POAM Items

The tables below provide typical NRZ checklist items for contractor, Client, and NAVFAC actions (Tables 1, 2, and 3, respectively). Items listed on the checklists are required to remain on the checklists if they are part of the project/contract or required by construction convention. Items not listed on the checklists, but required in the contract or by construction convention, must be added to the checklists by the contractor, Client and NAVFAC. Checklists are applicable to all contracts no matter what Category of Work. The Point of Contact and due date shall initially be determined during the Facility Turnover Planning Meeting by the NAVFAC, client and contractor leads. During execution of the NRZ process, for each item on the entire list, the Construction Manager (CM) shall indicate date completed and initial to indicate completion of the item. If a party fails to complete an item by the due date, this should be noted on the checklist and new due date established and indicated. The completed NRZ Checklist/POAM shall be placed in the contract file.

Table 1

Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Contractor Checklist Items

a. Construction Completion Schedule - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

b. Facility Delivery Closeout:

Duct Air Leakage Testing - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

HVAC System Test & Balance - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

ACATS Controls Testing - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Conduct Second Seasons TAB - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Electrical Systems Testing - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Final Utility Systems Connections (power, water, etc.) - Point of Contact,

Due Date, Actual Complete Date, CM Initials, Notes

Superchlorination of Potable Water Systems - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Plumbing / Other Mechanical Testing - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Elevator Certification(s) - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Specialized Equipment & Systems Inspections (Boilers, UPV, etc.) - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

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Contractor Checklist Items

Fire Protection Systems Inspections and Performance Verification - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Communications / IT Systems Testing - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Security Systems Testing - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Other Specified Building Performance Requirements - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

c. Other Contractor Items:

Delivery of O&M Manuals - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Delivery of Equipment/Product Warranty List/Tag - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

O&M/OMSI Training of Navy Personnel - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Site Restoration, if applicable - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Landscaping Complete - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Pre-Final Inspection - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Final Inspection and Acceptance - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Delivery of Spare Parts, Extra Stock, Special Tools, etc - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Delivery of As-Built Drawings - Point of Contact, Due Date, Actual Complete

Date, CM Initials, Notes

Delivery of Utility Record Drawings (if applicable) - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Delivery of Utility As-Built Drawings (if applicable) - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Beneficial Occupancy Date (BOD) - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Final Demobilization and Clean-up Completed - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Remove Construction Fence & Associated Coordination - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Pre-warranty Conference - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Project Close-out Meeting - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Coordination and Delivery of Facility Signage - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Final Cleaning - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Replace Construction Lock Cores and Re-keying - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Punch List Completion - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Provide DD1354 to Government CM - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Resource Document for B-1.6.11 18 March 2008

Table 2

Client Checklist Items

Modification to FSC or BOSC to maintain/service new facility -Telephone service contract - Utilities service contract -Custodial service contract - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Installation of communications for phones and computers - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

NMCI Installations or other networks - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Delivery and installation of client furnished furniture - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Delivery and installation of client furnished equipment - Point of Contact,

Due Date, Actual Complete Date, CM Initials, Notes

User move-in - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

GFE status/delivery schedule (GFCI, GFGI)- Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Coordination of Intrusion Detection Systems and Physical Security Equipment - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Process operating permits - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Recycled/recovered materials report - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Coordination of IT and Communication Infrastructure and Devices (incl. CAT IV) - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Ribbon-cutting ceremony - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Resource Document for B-1.6.11 18 March 2008

Table 3

NAVFAC Checklist Items

Client walk-thru prior to pre-final inspections, if appropriate - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Schedule client satisfaction post BOD follow-up - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Schedule Government inspections of specialized equipment (e.g., Boiler/pressure vessels, elevators, UPS, SCIF shielding requirements, medical certifications, generators/switchgear) - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Provide keying plan to contractor - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Confirm utilities availability for final connections by contractor - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Startup utilities - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Mechanical Acceptance - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Resolve contract modifications & requests for equitable adjustment - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Contractor final release - Point of Contact, Due Date, Actual Complete

Date, CM Initials, Notes

Return unobligated funds - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Process final payment - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Process recycled/recovered materials report - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Closeout actions on construction permits (e.g., NPDES) - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

A-E and Construction Contractor Evaluations (ACASS/CCASS) - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Contractor QC Evaluation - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

Complete Installed Property List and DD 1354

Sign & provide Interim DD1354 to activity Real Property Accountability Officer NLT BOD - Point of Contact, Due Date, Actual Complete Date, CM Initials, Notes

SECTION 01 32 17.05 20
NETWORK ANALYSIS SCHEDULES (NAS) FOR DESIGN-BUILD
11/05

PART 1 GENERAL

1.1 DESCRIPTION

The scheduling of all design, procurement, and construction shall be the responsibility of the Contractor. All design and construction increments will be interrelated on a single schedule that represents the entire project duration from Contract Award to the Contract Completion Date. Schedule updates will build upon each other and will include design and construction increments. Typical activities to be included in the schedule shall be Design, Procurement, Government activities, construction quality control(CQM) activities, and construction activities. Submission of progress and revision data will be used to measure work progress, aid in the evaluation for requests for time extensions, and to provide the basis of all progress payments. The Critical Path Method (CPM) of network calculation shall be used to generate the project schedule and will utilize the Precedence Diagram Method (PDM) to satisfy both time and cost applications. All progress payment amounts will be derived from and tied to the cost-loaded schedule activities.

1.2 SUBMITTALS

The use of a "G" following a submittal indicates that a Government approval/action is required. Submit the following in accordance with Section 01 33 10.05 20,DESIGN SUBMITTAL PROCEDURES and Section 01 33 00.05 20, CONSTRUCTION SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

Network Analysis Schedule (NAS) and Reports; G

SD-06 Test Reports

Time Impact Analysis; G

SD-07 Certificates

Monthly Network Analysis Updates; G

SD-11 Closeout Submittals

Final Schedule; G

1.3 SOFTWARE

The scheduling software to be used shall be Primavera Project Planner (P3)TM or Primavera SureTrakTM by Primavera Systems, Inc. Discuss autocost rules with Contracting Officer prior to schedule development.

1.4 NETWORK SYSTEM FORMAT

The system shall consist of time scaled logic diagrams and specified reports. Show the order and interdependence of activities and the sequence in which the work is planned to be accomplished.

CPM schedule activities shall be "task" type. Once an activity exists on the schedule, it may not be deleted or renamed, and must remain in the logic. Each activity shall have predecessor and successor ties. The diagram shall clearly show the activities of the critical path. No more than 20 percent of the activities may be critical or near critical. Each activity shall be cost-loaded for payment purposes; the total of all cost-loaded activities shall be equal to 100 percent of the value of the contract. Show the following information on the diagrams for each activity:

a. Activity ID

b. Activity Description

c. Original Duration in Work Days

d. Remaining Duration

e. Actual Duration in Work Days

f. Early Start Date

g. Early Finish Date

h. Total Float

Schedule activity duration(s) shall include normal anticipated adverse weather conditions from the National Oceanic and Atmospheric Association's(NOAA) historical monthly averages for the last five years for the NOAA location closest to the contract site.

1.4.1 Schedule Software Settings and Restrictions

Activity Constraints: Date/time constraint(s), other than those required by the contract, will not be allowed unless accepted by the Contracting Officer. Identify any constraints proposed and provide an explanation for the purpose of the constraint in the Narrative Report.

1.4.2 Required Tabular Reports

The following reports shall be included with the schedule submittals and in each updated schedule submission provided on disk by the Contractor:

a. Earned Value Report: List all activities showing budget amount and cost.

b. Log Report: List all changes made between the previous schedule and current updated schedule.

c. Activity ID Report: Show the current status of all activities.

1.4.3 Correspondence

All correspondence (e.g. letters, Requests for Information (RFIs), e-mails, meeting minute items, Production and QC Daily Reports, material delivery tickets, photographs, etc.) shall reference the Schedule Activity Number(s)that are being addressed.

1.5 SUBMISSION AND ACCEPTANCE

The Contractor is responsible for scheduling, sequencing, and prosecuting the work to comply with the requirements of the contract documents. Prior to the preparation of the Network Analysis Schedule (NAS) for acceptance; the Contracting Officer and Contractor shall participate in a preliminary meeting to discuss the proposed schedule and requirements of this section prior to submission of the network. The schedule shall include an appropriate number of design, procurement, Government, CQM, and construction activities. Appropriate costs shall be apportioned to these activities.

Submit two copies of the Network Analysis Schedule (NAS) and Reports defining the planned operations during the contract.

Once review comments are resolved and the Contracting Officer has approved the Network Analysis Schedule, provide the following within 5 calendar days:

Two copies of the network diagrams.

Two copies of the reports listed in paragraph entitled "Required Tabular Reports."

Two sets of data disks containing the project schedule.

1.5.1 Monthly Network Analysis Updates

At monthly intervals the Contractor and Government representatives will meet to jointly update the project schedule and agree on percentage of payment for each activity progressed during the update period. All progress payment amounts will be derived from and tied to the cost-loaded schedule activities. The submission of an error free, acceptable updated schedule to the Government is a condition precedent to the processing of the Contractor's pay request.

a. Identify activities started and completed during the previous period and enter the Actual Start and Actual Finish dates.

b. Reflect changes in the network diagram.

c. Submit two copies of a Narrative Report describing: 1) Progress; 2) Changes in the following: activities, original durations, logic interdependencies, milestones, critical path, and resource loading; 3) Pending items; 4) Status of Contract Completion Date and interim milestones; 5) Current and anticipated delays; and 6) Description of current and future schedule problem areas. Each entry in the narrative report will cite the respective Activity ID.

d. Submit two copies of the reports listed in paragraph entitled "Required Tabular Reports," two hard copies of the network diagrams and two sets of data disks.

1.5.2 Final Schedule

As a condition precedent to the release of retention and making final payment, submit a "Final Schedule," which is the last schedule update showing all activities at 100 percent completion. This schedule shall reflect the exact manner in which the project was actually constructed.

1.6 CONTRACT MODIFICATION

When a contract modification to the work is required, submit proposed revisions to the network with a fragnet and a cost proposal for each proposed change. All modifications shall be incorporated into the scheduleas separate identifiable activities broken down and inserted appropriately on the first update following issuance of a directive to proceed with the change.

1.7 FLOAT

Float available in the schedule, at any time shall not be considered for the exclusive use of either the Government or the Contractor. Project Float will be a resource available to both the Government and the Contractor. No time extensions will be granted nor delay damages paid unless a delay occurs which impacts the Project's critical path. Use of float suppression techniques is prohibited.

1.7.1 Time Impact Analysis

The Time Impact Analysis method (for forward negotiating) or Windows Analysis (for after-the-fact negotiating) will be used by the Contracting Officer and Contractor in determining if a time extension or reduction to the contract milestone date(s) is justified. Provide a Time Impact Analysis or Windows Analysis to the Contracting Officer for any proposed contract change or as support for a Value Engineering Proposal, Variance Request, Claim, or Request for Equitable Adjustment by the Contractor. Submit three copies of the Time Impact Analysis schedule or Windows Analysis, reports, etc. on disk and as a printed/plotted hardcopy.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

-- End of Section --

SECTION 01 33 00.05 20
CONSTRUCTION SUBMITTAL PROCEDURES
02/06

PART 1 GENERAL

1.1 SUMMARY

This section covers construction submittals that are not included in the design submittals. Submit design submittals in accordance with Section 01 33 10.05 20, DESIGN SUBMITTAL PROCEDURES.

1.2 SUBMITTAL DESCRIPTIONS (SD)

Government approval is required for submittals with a "G" designation. Submittal requirements are specified within technical sections. Submittals are identified by SD numbers and titles as follows:

SD-01 Preconstruction Submittals

Certificates of insurance; G

Surety bonds; G

List of proposed subcontractors; G

List of proposed products; G

Construction Progress Schedule; G

Submittal register; G

Schedule of values; G

Health and safety plan; G

Work plan; G

Quality control plan; G

Environmental protection plan; G

SD-02 Shop Drawings

Drawings, diagrams, and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions, and brochures illustrating size, physical appearance, and other

characteristics of materials or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Physical examples of materials, equipment, or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project. Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

SD-05 Design Data

Calculations, mix designs, analyses, or other data pertaining to a part of work.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)

Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports.

Daily checklists.

Final acceptance test and operational test procedure.

SD-07 Certificates

Statements signed by responsible officials of manufacturer of product, system, or material attesting that product, system, or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a supplier, installer, or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and Material Safety Data sheets concerning impedances, hazards, and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

Factory test reports.

SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer or the system provider to the equipment operating and maintenance personnel. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism. OMSI manuals submitted at various stages and progression of construction.

1.3 SUBMITTALS The use of a "G" following a submittal indicates that an approval/action is required, either by the Government or by the Contractor's Designer of Record (DOR) or QC Specialist.

Submit the following in accordance with the requirements of this section.

SD-01 Preconstruction Submittals

Submittal Register; G

1.4 CONSTRUCTION QUALITY CONTROL

1.4.1 Contractor Reviewing, Certifying, Approving Authority

The QC organization is responsible for reviewing and certifying that submittals are in compliance with the contract requirements. The Contractor's DOR or QC Specialist is the approving authority for submittals with a "G" designation in Part 4 PERFORMANCE TECHNICAL SPECIFICATIONS and in Part 5 PRESCRIPTIVE SPECIFICATIONS, unless indicated otherwise. Submittals not having a "G" designation are for Contractor Quality Control approval.

1.4.2 Government Approving and Reviewing Authority

1.4.2.1 Submittals Reserved for Government Approval

Government approval is required for submittals with a "G" designation in RFP Part 2 GENERAL REQUIREMENTS, Division 01 Specification Sections.
In addition to the RFP Part 2 Division 01 Government approvals, the following submittals shall be certified by the QC Manager and the DOR and approved by the Contracting Officer:

a. Boiler(s)

b. Chiller(s)

c. DDC System(s)

d. Fire Suppression Systems

e. Fire Alarm Systems

f. Pad-Mounted Service Transformer(s)

g. Generator(s)

1.4.2.2 Submittals Reserved for Government Surveillance

Only send submittals stamped "APPROVED" by the DOR or QC Specialist. Submittals shall be stamped "FOR SURVEILLANCE ONLY." Submit 2 copies of Surveillance submittals to the Government prior to starting work for that item.

a. Submit fire protection related submittals pertaining to spray-applied fire proofing and fire stopping, exterior fire alarm reporting systems, interior fire alarm & detection systems, and fire suppression systems including fire pumps and standpipe systems.

1.4.3 Constraints

a. Submittals shall be complete for each definable feature of work; components of definable feature interrelated as a system shall be submitted at same time.

b. Approval of a separate material, product, or component does not imply approval of assembly in which item functions.

1.4.4 Scheduling

Except as specified otherwise, allow review period, beginning when Government receives submittal from the QC organization, of 20 working days for return of submittal to the Contractor. Period of review for submittals with contracting officer approval begins when Government receives submittal from QC organization. Period of review for each resubmittal is the same as for initial submittal.

1.4.5 Variations

Variations from contract requirements require Government approval and will be considered where advantageous to the Government.

1.4.5.1 Considering Variations

Variations from contract requirements including the solicitation, the accepted proposal, and the final design, require Government approval and will be considered where advantageous to the Government. Variations to the contract requirements must be approved by the Designer of Record prior to submittal to the Government for approval of the Variation.

1.4.6 Contractor's Responsibilities

Ensure no work has begun until submittals for that work have been "approved" or "approved as noted."

1.4.7 QC Organization Responsibilities

a. Stamp each sheet of each submittal with QC certifying statement or approving statement, except that data submitted in bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only.

(1) When approving authority is Contracting Officer, QC organization will certify submittals forwarded to Contracting Officer with the following certifying statement:

"I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with Contract Number (insert contract number here), is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

Certified by DQC Manager _____, Date _____

Certified by QC Manager _____, Date __ ____"

b. Sign certifying statement or approval statement. The person signing certifying statements shall be QC organization member designated in the approved QC plan. The signatures shall be in original ink. Stamped signatures are not acceptable.

c. Update submittal register database as submittal actions occur and maintain the submittal register at project site until final acceptance of all work by contracting officer.

d. Retain a copy of approved submittals at project site, including Contractor's copy of approved samples.

1.4.8 Government's Responsibilities When approving authority is Contracting Officer, the Government will:

a. Note date on which submittal was received from QC Manager, on each submittal for which the Contracting Officer is approving authority.

b. Review submittals for compliance with contract documents.

1.4.8.1 Government Actions Submittals will be returned with one of the following notations:

a. Submittals marked "approved" or "approved as submitted" authorize Contractor to proceed with work covered.

b. A submittal marked "not reviewed" will be returned with an explanation of the reason it was not reviewed.

c. Submittals marked "approved as noted" or "approval except as noted; resubmission not required" authorize Contractor to proceed with work as noted provided Contractor takes no exception to the notations.

d. Submittals marked "revise and resubmit" or "disapproved" indicate submittal is incomplete or does not comply with design concept or requirements of the contract documents and shall be resubmitted with appropriate changes. No work shall proceed for this item until resubmittal is approved.

e. Submittals required for surveillance will be returned only if corrective actions are required.

1.5 FORMAT OF SUBMITTALS

1.5.1 Transmittal Form

Transmit submittals with transmittal form prescribed by Contracting Officer and standard for project.

1.6 QUANTITY OF SUBMITTALS

Submit four (4) copies of submittals of shop drawings requiring review and approval by Contracting Officer if not electronically submitted in WebCM.

1.6.1 Submittals Reserved for Government Surveillance Submit two (2) copies of submittals specified for surveillance to the Contracting Officer if not electronically submitted in WebCM.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 33 10.05 20
DESIGN SUBMITTAL PROCEDURES
02/06

PART 1 GENERAL

1.1 SUMMARY

This section includes requirements for Contractor-originated design documents and design submittals.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. The latest version of the publication at time of award shall be used.

U.S. GREEN BUILDING COUNCIL USGBC LEED GBRS LEED Green Building Rating System

USGBC LEED RG LEED Reference Guide

U.S. DEPARTMENT OF DEFENSE (DoD)

UFC 1-200-01 General Building Requirements

UFC 1-300-08 Criteria for Transfer and Acceptance of Military Real Property Handbook

UFC 1-300-09N Design Procedures

UFC 1-300-10N Electronic Design Deliverables

UFC 3-100-10N Unified Facilities Criteria - Design: General Architectural and Interiors Requirements(DGAIR)

UFC 3-200-10N Unified Facilities Criteria - Design: General Civil, Geotechnical Landscape Requirements(DGCGLR)

UFC 3-300-10N Unified Facilities Criteria - Design: General Structural Requirements (DGSR)

UFC 3-400-10N Unified Facilities Criteria - Design: General Mechanical Requirements (DGMR)

UFC 3-500-10N Unified Facilities Criteria - Design: General Electrical Requirements (DGER)

UFC 3-600-01 Unified Facilities Criteria - Design: Fire Protection Engineering for Facilities (DFPEF)

UFC 3-600-10N Unified Facilities Criteria - Design: General Fire Protection Requirements (DGFPR)

UFC 3-800-10N Unified Facilities Criteria - Design: General Environmental Requirements (DGEVR)

1.3 GENERAL DOCUMENTATION REQUIREMENTS

Contractor-originated design documents shall represent a project design that complies with the Request for Proposal (RFP), UFC 1-300-09N, UFC 1-300-10N, and the architectural and engineering discipline UFCs design guidance listed below. Provide design documentation in the English language and utilize English (foot-pound) measures and dimensions.

a. UFC 1-200-01 General Building Requirements

b. UFC 3-100-10N DGAIR

c. UFC 3-200-10N DGCGLR

d. UFC 3-300-10N DGSR

e. UFC 3-400-10N DGMR

f. UFC 3-500-10N DGER

g. UFC 3-600-01 DFPEF

h. UFC 3-600-10N DGFPR

i. UFC 3-800-10N DGEVR

1.4 SUBMITTALS

Submit design submittals, including shop drawings used as design drawings,to the Government for approval. The use of a "G" following a submittal indicates that a Government approval action is required. Submit the following in accordance with Section 01 33 10.05 20, DESIGN SUBMITTAL PROCEDURES and Section 01 33 00.05 20, CONSTRUCTION SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals Submittal Register; G

SD-05 Design Data

Design Drawings; G

Specifications; G

Design Analysis; G

Contractor Data Required for DD Form 1354; G

Design Submittals; G

Sustainable Design; G

SD-07 Certificates

LEED Green Building Rating System (GBRS); G

SD-11 Closeout Submittals

Record Documents; G

1.5 DESIGN QUALITY CONTROL

1.5.1 Contractor Reviewing and Certifying Authority

The QC organization is responsible for reviewing and certifying that design submittals are in compliance with the contract requirements.

1. 1.5.2 Government Approving Authority The Contracting Officer is the approving authority for design submittals.

2. 1.5.3 Contractor Construction Actions

Upon approval of sealed and signed design documents certified by the Design Quality Control (DQC) and the Quality Control (QC) Managers, the Contractor may proceed with material and equipment purchases, fabrication and construction of any elements covered by that submittal, except as specified in the following paragraph.

1.5.4 Contractor's Responsibilities

.a. Indicate on the transmittal form accompanying submittal which design submittals are being submitted as shop drawings.

.b. Advise Contracting Officer of variations, as required by paragraph "Variations."

.c. Provide an updated, cumulative submittal register with each design package that identifies the design and construction submittals required by that design package and previous submittals.

1.5.5 QC Organization Responsibilities

.a. Both the DQC and the QC Manager must certify design submittals for compliance with the contract documents.

.b. QC organization shall certify submittals forwarded by the Designer of Record (DOR) to the Contracting Officer with the following certifying statement:

"I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with Contract Number (insert contract number here), is in compliance with the contract documents, and is submitted for Government approval.

Certified by Design Quality Control Manager _____, Date _____

Certified by QC Manager_____,Date _____"

.c. Sign certifying statement. The persons signing certifying statements shall be the QC organization members designated in the approved QC plan. The signatures shall be in original ink. Stamped signatures are not acceptable.

.d. Update submittal register as submittal actions occur and maintain the submittal register at project site until final approval of all work by Contracting Officer.

.e. Retain a copy of approved submittals at project site.

1.5.6 Government Responsibilities

The Government will:

.a. Note date on which submittal was received from QC Manager, on each submittal.

.b. Perform a quality assurance (QA) review of submittals. Upon completion, Government will sign and return electronic copy to the Contractor.

1.5.6.1 Actions Possible

Submittals will be returned with one of the following notations:

.a. Submittals may be marked "approved."

.b. Submittals marked "not reviewed" will indicate submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and certified by Contractor, or is not complete. Submittal will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

.c. Submittals marked "revise and resubmit" or "disapproved" indicate submittal is incomplete or does not comply with design concept or requirements of the contract documents and shall be resubmitted with appropriate changes. If work has been started on the unacceptable portion of the design submittal, the Contractor shall propose corrective action. No further work shall proceed until the issue is resolved in a manner satisfactory to the Government.

1.6 DESIGN DRAWINGS

1.6.1 Shop Drawings Used as Design Drawings Design drawings may be prepared more like shop drawings to minimize construction submittals after final designs are approved. Therefore, the Contractor is encouraged to prepare and submit with the design drawings, appropriate connection, fabrication, layout, and product specific drawings.

1.6.2 Drawing Format for Shop Drawings Used as Design Drawings
The Contractor-originated drawings will be used as the basis for the record drawings. Shop drawings included as design documents shall comply with the same drawing requirements such as drawing form, sheet size, layering, lettering, and title block used in design drawings.

1.6.3 Identification of Shop Drawings Used as Design Drawings
The Contractor's transmittal letter shall indicate which shop drawings are being submitted as design drawings.

1.6.4 Drawing Standards

Prepare, organize, and present design drawings in accordance with the requirements of UFC 1-300-09N and UFC 1-300-10N.

Submit all CADD files for the final drawings on CD-ROM disks in AutoCAD 2006 format. Drawing files shall be full files, uncompressed and unzipped.

1.6.5 Naval Facilities (NAVFAC) Engineering Command Drawing Numbers

Number the final Contractor-originated design drawings consecutively with NAVFAC drawing numbers. Determine the total number of sheets required for the

complete set of drawings before requesting the NAVFAC drawing numbers from the Contracting Officer.

1.6.6 Seal on Documents

All final Contractor-originated design drawings shall be signed, dated, and bear the seal of a registered architect or a registered engineer. This seal shall be the seal of the Designer of Record for that drawing. A principal or authorized licensed or certified employee shall electronically sign and date final drawings and cover sheet, in accordance with UFC 1-300-10N.

1.7 SPECIFICATIONS

Provide a Contractor-originated design specification that, in conjunction with the drawings, demonstrates compliance with materials, equipment, execution, and field quality control requirements of the RFP. The specified products, equipment, fixtures, devices, and systems submitted by the Contractor and approved by the Contracting Officer shall be used to construct the project. Prescriptive Technical Sections contained in Part 5 of this RFP shall become a part of the Contractor-originated specification without any changes and as provided in the RFP.

1.7.1 Specifications Format

Unless the use of a UFGS section is required, the Contractor may prepare design specifications that include manufacturer specific data and catalog cuts in lieu of prescriptive specifications. Organize the specifications using Construction Specification Institute (CSI) Masterformat TM. A prescriptive specification is required for all items for which the Contractor has not made final materials and equipment choices. Provide specifications to include the following:

a. Cover sheet and table of contents.

b. Specification sections.

c. Manufacturer's product data.

1.7.2 Fire Protection Specifications

Specifications pertaining to spray-applied fire proofing and fire stopping, exterior fire alarm reporting systems, interior fire alarm and detection systems, and fire suppression systems, including fire pumps and standpipe systems shall be either prepared by, or reviewed and approved by the Fire Protection Designer of Record.

1.7.3 Identification of Manufacturer's Product Data Used as Specifications

Provide complete and legible catalog cut sheets, product data, installation instructions, operation and maintenance instructions, warranty, and certifications for products and equipment for which final material and equipment choices have been made. Indicate, by prominent notation, each product that is being submitted including optional manufacturer's features, and indicate where the product data shows compliance with the RFP.

1.7.4 Submittal Register

Provide cumulative register in format prescribed by the Government and that identifies the design and construction submittals required by that design

package and previous submittals. To obtain Government approval of the final design package, complete all fields in the submittal register.

1.7.5 Specification Software

Submit the final specification source files in either MS Word or SpecsIntact.

1.8 DESIGN ANALYSIS

Prepare, organize, and present design analysis in accordance with the requirements of UFC 1-300-09N. The design analysis shall be a presentation of facts to demonstrate the concept of the project is fully understood and the design is based on sound engineering principles. Provide design analyses for each discipline and include the following:

a. Basis of design that includes:

.(1) An introductory description of the project concepts that addresses the salient points of the design;

.(2) An orderly and comprehensive documentation of criteria and rationale for system selection; and

.(3) The identification of any necessary licenses and permits that are anticipated to be required as a part of the design and/or construction process. The "Permits Record of Decision" (PROD) form shall be used for recording permits.

.b. Code and criteria search shall identify all applicable codes and criteria and highlight specific requirements within these codes and criteria for critical issues in the facility design.

.c. Calculations as specified and as needed to support this design.

.d. Section titled "Sustainable Design" that addresses sustainable concepts and LEED Rating Analysis Report prepared by a LEED Accredited Professional recognized by the U.S. Green Building Council.

.e. Section titled "Antiterrorism" that documents the antiterrorism features.

1.8.1 Basis of Design Format

The basis of design for each design discipline shall include a cover page indicating the project title and locations, contract number, table of contents, tabbed separations for quick reference, and bound in separate volumes for each design discipline.

1.8.2 Design Calculations

Place the signature and seal of the designer responsible for the work on the cover page of the calculations for the respective design discipline.

1.8.3 Sustainable Design

Provide integrated sustainable design strategies and features to minimize the energy consumption of the facilities; conserve resources; minimize adverse effects to the environment; and improve occupant productivity,health, and comfort. In accordance with NAVFAC Instruction 9830.1, the facility and all

site features shall be designed and constructed to meet a minimum of "Certified" in the U.S. Green Building Council USGBC LEED GBRS.The constructed facility shall be Self Certified by NAVFAC as having met all prerequisites and at least 26 additional credits in the LEED-NC (New Construction) rating system.

The minimum sustainable design requirement for the project is to meet LEED certified level (26 credits). The design effort shall seek out integrated design solutions that provide the best value for the facility, and do not increase the overall cost of the project beyond the available budget. Provide documentation as required and coordinate the sustainable features of the design to assure they are properly installed during construction.

Information and resources on sustainable design principles and guidelines are explained in the "Whole Building Design Guide" that can be found at www.wbdg.org.

1.8.3.1 LEED Green Building Rating System (GBRS) Submittals - Self-Certification

Provide an analysis of the U.S. Green Building Council's LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED) criteria as it applies to the design of this project and include updated information with each design submittal.The Navy endorses the principles of sustainable design contained in the USGBC LEED GBRS (and USGBC LEED RG) and will utilize this system as a means of measuring the degree of implementation of sustainable principles. Include the following in the analysis report:

a. A completed LEED Project Checklist indicating all LEED USGBC Prerequisites and Credits to be implemented into the facility design and the total anticipated LEED GBRS score for the project.

b. Description of how each anticipated LEED Prerequisite and Credit point will be achieved.

Sustainable Verification Documentation signed by the LEED Accredited Professional stating that the analysis report items provide an accurate estimate of the LEED GBRS rating that the U.S. Green Building Council would assign to the project design.

Submit the following:

(1) For the Basis of Design submittal, provide a Preliminary Statement.

(2) For each design submittal, provide Progress Statement. Deviations from previously reported LEED rating score shall be documented, highlighted, and submitted with the design submittal for Government approval.

(3) For 100% design submittal, provide preliminary LEED documentation, in the form of a three-ring binder, of all LEED Prerequisites and Credits to be obtained as required by the USGBC LEED-NC Rating System.

.4) For final design submittal, update the LEED documentation binder with any changes.

1.8.3.2 Sustainable Designer

The design team shall include at least one LEED Accredited Professional as recognized by the U.S. Green Building Council. The LEED Accredited

Professional shall have an active role in the design of the facility and be responsible for implementation and documentation of sustainable strategies and materials in the project.

1.8.3.3 EPA Designated Products

Use products that meet or exceed the minimum requirements of this RFP and the EPA guideline standards for recovered content to the maximum practicable extent in the performance of the contract. See www.epa.gov/cpg/products.htm for a list of EPA designated products and a list of manufacturers and suppliers of EPA designated products.

1.9 RECORD DOCUMENTS

1.9.1 Record Drawings The as-built modifications shall be accomplished by electronic drafting methods on the Contractor-originated .DWG design drawings to create a complete set of record drawings.

a. For each record drawing, provide CADD drawing identical to signed Contractor-originated .PDF drawings, that incorporates modifications to the as-built conditions. In addition, copy initials and dates from the Contracting Officer approved .PDF documents to the title block of the record CADD .DWG drawings. The RFP reference or definitive drawings are not required for inclusion in the record set of drawings.

b. After all as-built conditions are recorded on the CADD .DWG files, produce a .PDF and .TIF file of each individual recorded drawing in conformance with UFC 1-300-09N and UFC 1-300-10N. Electronic signatures are not required on record drawings.

1.9.2 Source Documents

Provide the specifications, design analysis, reports, surveys, calculations, and any other contracted documents on the CD-ROM disk with the record drawings.

1.9.3 DD Form 1354

Complete and submit the form CONTRACTOR DATA REQUIRED FOR DD FORM 1354 that is included as an attachment in Part 6. An electronic version of this form is available upon request.

PART 2 PRODUCTS

2.1 CONFORMED CONTRACT DOCUMENTS

Within two weeks after contract award provide 4 electronic copies on CD-Rom and 10 hard copies of a conformed RFP document reflecting all amendments. Identify the changes with the "Red-Lining" or "Change Tracking" feature of SpecsIntact or MS Word to highlight the modifications to the contract.

2.2 DESIGN SUBMITTALS

Complete the Contractor-originated design submittals as defined by this contract, and coordinate with the approved design network analysis schedule.

2.2.1 Design Submittal Packages

The Government prefers to review for Quality Assurance (QA) as few

submittal packages as possible. Site and Building Design Submittal Packages are required.

2.2.1.1 Site Design

The Site Design typically includes the following components:

a. Master Site Plan

b. Demolition

c. Site work, Environmental, and Civil

d. Utilities Plan

e. Geotechnical

2.2.1.2 Building Design The Building Design typically includes the following components:

a. Foundation

b. Structural

c. Building Enclosures

d. Remaining Work

e. Furniture/Equipment

2.2.2 Required Design Submittals

The following Design Submittals are required, comprehensive, multi discipline design packages and shall include all design documentation for all project elements fully developed to the design stage indicated.

a. Concept Design presented at PAK Meeting - 14 calendar day Government review.

b. Design Development, 50-60 percent - 21 calendar day Government review.

c. 100 percent (Prefinal) Design - 28 calendar day Government review.

d. Final Design - 14 calendar day Government review.

2.2.3 Review Copies of Design Submittal Packages

Provide copies of each design submittal package for review to the following reviewers. Addresses for mailing will be furnished at the PAK meeting. Send all submittals via overnight mail.

a. 4 copies to NAVFAC Southeast.

b. 2 copies to ROICC Gulfport, Stennis Satellite Office (PaulMullins).

c. 5 copies to Public Works Gulfport.

d. 1 copy to CIH

e. 3 copies to LY Croke, NSW Group 3, Little Creek NAB, VA.

f. 1 copy to Sam Martindale, Code N4412, Naval Special Warfare Command, 2000 Trident Way, Bldg. 624, San Diego, CA 92155.

g. 4 copies to URS.

Quantities of copies for resubmittals shall be the same as specified for each design submittal.

2.3 IDENTIFICATION OF DESIGN SUBMITTALS

Provide a title sheet to clearly identify each submittal, the completion status, and the date. The title sheet shall use the standard format indicated in the UFC 1-300-09N/UFC 1-300-10N for title sheets. The title sheet shall be unique to a particular design submittal. Submit the project title sheet with design status and date for the design submittals.

PART 3 EXECUTION

3.1 CONTRACTOR'S RESOLUTION OF COMMENTS

Provide written responses to all written comments by the Government. Resubmittal of an unacceptable design submittal shall be a complete package that includes all the required, specified components of that design submittal. Government required resubmittal for conformance to the contract is not a delay in the contract.

3.2 VARIATIONS

Variations from contract requirements require Government approval and will be considered where advantageous to the Government. The Designer of Record must approve any proposed variation prior to submittal to the Government.

3.3 THE CONTRACT AND ORDER OF PRECEDENCE

3.3.1 Contract Components

The contract consists of the solicitation, the approved proposal, and the final design.

3.3.2 Order of Precedence

In the event of a conflict or inconsistency between any of the requirements of the various portions of the contract, precedence shall be given in the following order: 3.3.3 Government Approval

a. Any portions of the approved proposal or approved final design that exceed the requirements of the solicitation.

b. As between the approved final design and the approved proposal:

(1) Any portion of the approved proposal that exceeds the approved final design.

(2) Any portion of the approved final design that exceeds the approved proposal.

c. The requirements of the solicitation.

d. Those portions of the approved proposal or approved final design that meet but do not exceed the solicitation requirement.

Government review or approval of any portion of the proposal or final design shall not relieve the Contractor from responsibility for any errors or omissions with respect thereto.

-- End of Section --

SECTION 01 35 13.05 20
SPECIAL PROJECT PROCEDURES FOR DESIGN-BUILD
11/05

PART 1 GENERAL

1.1 SUBMITTALS

The use of a "G" following a submittal indicates that a Government approval/action is required. Submit the following in accordance with Section 01 33 10.05 20 DESIGN SUBMITTAL PROCEDURES and Section 01 33 00.05 20 CONSTRUCTION SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

Watercraft list; G

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 HARBOR WATERWAYS

In addition to "DFARS 252.236-7002, Obstruction of Navigable Waterways, "obtain from the Contracting Officer, permission to use waterways and the regulations and directives governing such usage. Submit a watercraft list with a description of crafts, including sizes, types, numbers and boat crew for approval.

3.1.1 Hazards to Navigation

Maintain complete control of the movement of floating equipment and material. Loose floating equipment and material are not permitted. Keep in readiness at all times a powered craft capable of moving, securing and disposing of floating equipment which may get loose and become a hazard to navigation.

-- End of Section --

SECTION 01 35 29.05 20
SAFETY AND OCCUPATIONAL HEALTH REQUIREMENTS FOR DESIGN-BUILD
11/05

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ASME INTERNATIONAL (ASME)

ASME B30.3 (1996) Construction Tower Cranes

ASME B30.22 (2000) Articulating Boom Cranes

ASME B30.5 (2004) Mobile and Locomotive Cranes

ASME B30.8 (2004) Floating Cranes and Floating Derricks

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241 (2000) Safeguarding Construction, Alteration,and Demolition Operations NFPA 51B (2003) Fire Prevention During Welding, Cutting, and Other Hot Work

NFPA 70 (2005) National Electrical Code

NFPA 70E (2004) Electrical Safety in the Workplace

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2003) Safety -- Safety and Health Requirements

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.146 Permit-required Confined Spaces

29 CFR 1926 Safety and Health Regulations for Construction

1.2 SUBMITTALS

The use of a "G" following a submittal indicates that a Government approval/action is required. Submit the following in accordance with Section 01 33 10.05 20,DESIGN SUBMITTAL PROCEDURES and Section 01 33 00.05 20, CONSTRUCTION SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals Crane Critical Lift Plan; G

SD-06 Test Reports

Reports

Accident Reports

Monthly Work-Hour Reports

Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."

SD-07 Certificates

Contractor Safety Self-Evaluation Checklist; G

Submit one copy of each permit/certificate attached to each Daily Production Report.

1.3 DEFINITIONS

Weight Handling Equipment (WHE) Accident. A WHE accident occurs when anyone or more of the six elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; and/or collision,including unplanned contact between the load, crane, and/or other objects.A dropped load, derailment, two-blocking, overload, and collision are considered accidents even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure)is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g.,dropped boom, dropped load, roll over, etc.).

1.4 CONTRACTOR SAFETY SELF-EVALUATION CHECKLIST

Contracting Officer will provide a "Contractor Safety Self-Evaluation checklist" to the Contractor at the pre-construction conference. The checklist will be completed monthly by the Contractor and submitted with each request for payment voucher. An acceptable score of 90 or greater i is required. Failure to submit the completed safety self-evaluation checklist or achieve a score of at least 90, will result in a retention of up to 10 percent of the voucher.

1.5 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, work performed shall comply with USACE EM 385-1-1, and the following Federal, state, and local laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria ,ordinances, regulations, and referenced documents vary, the most stringent requirements shall apply.

1.6 SITE QUALIFICATIONS, DUTIES AND MEETINGS

1.6.1 Personnel Qualifications

1.6.1.1 Site Safety and Health Officer (SSHO)

Site Safety and Health Officer (SSHO) shall perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor. The assignment of the SSHO contractually does not relieve the

Contractor from the regulatory requirements governing safety responsibility. The Contractor Quality Control (QC) person cannot be the SSHO on this project, even though the QC has safety inspection responsibilities as part of the QC duties. The SSHO shall meet the following requirements:
Level 5:

An Associate Safety Professional (ASP), Certified Safety Trained Supervisor (STS), and/or Construction Health & Safety Technician (CHST). The ASP, STS, and/or CHST can be a collateral position with the Environmental Manger; however the person in this position must have the following experience and training:

A minimum of 10 years safety work of a progressive nature with at least 5 years of experience on similar projects. 30-hour OSHA construction safety class or equivalent within the last 5 years.

An average of at least 24 hours of formal safety training each year for the past 5 years with training for competent person status for at least the following 4 areas of competency: Excavation; Scaffolding; Fall Protection; and Hazardous Energy.

1.6.2 Personnel Duties

1.6.2.1 Site Safety and Health Officer (SSHO)
In addition to duties required in EM 385-1-1, perform the following duties:

a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Safety inspection logs shall be attached to the Contractors' daily production report.

b. Attend the pre-construction conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.

Failure to actively apply an acceptable safety program will result in dismissal of the superintendent and/or SSHO, and a project work stoppage.The project work stoppage will remain in effect pending approval of a suitable replacement.

1.7 REPORTS

1.7.1 Accident Reports

a. For recordable injuries and illnesses, and property damage accidents resulting in at least $2,000 in damages, the Prime Contractor shall conduct an accident investigation to establish the root cause(s) of the accident, complete the Navy Contractor Significant Incident Report (CSIR) form and provide the report to the Contracting Officer within 5 calendar day(s) of the accident. The Contracting Officer will provide copies of any required or special forms.

b. For any weight handling equipment accident (including rigging gear accidents) the Prime Contractor shall conduct an accident investigation to establish the root cause(s) of the accident,complete the WHE Accident Report (Crane and Rigging Gear) form and provide the report to the Contracting Officer within 30 calendar days of the accident. Crane operations shall not proceed until cause is determined and corrective actions have been

implemented to the satisfaction of the contracting officer. The Contracting Officer will provide a blank copy of the accident report form.

1.7.2 Accident Notification

Notify the Contracting Officer as soon as practical, but not later than four hours, after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than $2,000, or any weight handling equipment accident. Information shall include Contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted.

1.7.3 Monthly Work-Hour Reports

Monthly work-hour reporting to the Contracting Officer is required to be attached to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both prime and subcontractor. The Contracting Officer will provide copies of any special forms.

1.8 HOT WORK

Prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, a written permit shall be requested from the Fire Division. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. It is mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch shall be trained in accordance with NFPA 51B and remain on-site for a minimum of 30 minutes after completion of the task or as specified on the hot work permit.
Obtain services from a NFPA Certified Marine Chemist for "HOT WORK" within or around flammable materials (such as fuel systems, welding/cutting on fuel pipes) or confined spaces (such as sewer wet wells, manholes, vaults, etc.)that have the potential for flammable or explosive atmospheres.

PART 2 PRODUCTS

2.1 CONFINED SPACE SIGNAGE

The Contractor shall provide permanent signs integral to or securely attached to access covers for permit-required confined spaces provided by this contract. Signs wording: "DANGER--PERMIT-REQUIRED CONFINED SPACE - DO NOT ENTER" in bold letters a minimum of one inch in height and constructed to be clearly legible with all paint removed. The signal word "DANGER" shall be red and readable from 5 feet.

PART 3 EXECUTION

3.1 CONSTRUCTION AND/OR OTHER WORK

The Contractor shall comply with USACE EM 385-1-1, NFPA 241, the APP, the AHA, Federal and/or State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard shall prevail.

3.1.1 Hazardous Material Use

Each hazardous material must receive approval prior to being brought onto the job site or prior to any other use in connection with this contract. Allow a minimum of 10 working days for processing of the request for use of a hazardous material.

3.1.2 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with USACE EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocynates, lead-based paint are prohibited. The Contracting Officer, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials.

3.1.3 Unforeseen Hazardous Material

The design should have identified materials such as PCB, lead paint, and friable and non-friable asbestos. If additional material, not indicated,that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the Contracting Officer immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

3.2 PRE-OUTAGE COORDINATION MEETING

Contractors are required to apply for utility outages at least 15 work days in advance. As a minimum, the request should include the location of the outage, utilities being affected, duration of outage, and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, the Contractor shall attend a pre-outage coordination meeting with the Contracting Officer to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.3 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

The Contractor shall establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. The program shall include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures.

3.3.1 Fall Protection for Roofing Work

Fall protection controls shall be implemented based on the type of roof being constructed and work being performed. The roof area to be accessed shall be evaluated for its structural integrity including weight-bearing capabilities

for the projected loading.

a. Low Sloped Roofs: A safety monitoring system is not adequate fall protection and is not authorized.

b. Steep-Sloped Roofs: Work on steep-sloped roofs requires a personal fall arrest system, guard rails with toe-boards, or safety nets.This requirement also includes residential or housing type construction.

3.4 EQUIPMENT

3.4.1 Weight Handling Equipment

a. Crane Critical Lift Plan: Prepare and sign weight handling critical lift plans for lifts over 75 percent of the capacity of the crane or hoist at any radius of lift; lifts involving more than one crane or hoist; lifts of personnel; and lifts involving non-routine rigging or operation, sensitive equipment, or unusual safety risks. The plan shall be submitted 15 calendar days prior to on-site work and include the requirements of USACE EM 385-1-1, paragraph 16.C.18. and, for lifts of personnel, the plan shall demonstrate compliance with the requirements of 29 CFR 1926.550(g).

b. Certificate of Compliance: The Contractor shall provide a Certificate of Compliance for each crane entering an activity under this contract (see Contracting Officer for a blank certificate).Certificate shall state that the crane and rigging gear meet applicable OSHA regulations (with the Contractor citing which OSHA regulations are applicable, e.g., cranes used in construction , demolition, or maintenance shall comply with 29 CFR 1926 and USACEEM 385-1-1 section 16 and Appendix H. Certify on the Certificate of Compliance that the crane operator(s) is qualified and trained in the operation of the crane to be used. The Contractor shall also certify that all of its crane operators working on the DOD activity have been trained in the proper use of all safety devices(e.g., anti-two block devices). These certifications shall be posted on the crane.

c. The Contractor shall notify the Contracting Officer 15 days in advance of any cranes entering the activity so that necessary quality assurance spot checks can be coordinated. Prior to cranes entering federal activities, a Crane Access Permit must be obtained from the Contracting Officer. A copy of the permitting process will be provided at the Preconstruction Conference. Contractor's operator shall remain with the crane during the spot check.

d. The Contractor shall comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Erection shall be performed under the supervision of a designated person (as defined in ASME B30.5). All testing shall be performed in accordance with the manufacturer's recommended procedures.

e. The Contractor shall comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, and ASME B30.8 for floating cranes and floating derricks.

f. Under no circumstance shall a Contractor make a lift at or above 90% of the cranes rated capacity in any configuration.

g. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and shall follow the requirements of USACE EM 385-1-1 section 11 and ASME B30.5 or ASME B30.22

as applicable.

h. The Contractor shall use cribbing when performing lifts on outriggers.

i. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.

j. Certification records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review by Contracting Officer personnel.

k. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by Contracting Officer personnel.

l. Certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

m. Take steps to ensure that wind speed does not contribute to loss of control of the load during lifting operations. Prior to conducting lifting operations the Contractor shall set a maximum wind speed at which a crane can be safely operated based on the equipment being used, the load being lifted, experience of operators and riggers, and hazards on the work site. This maximum wind speed determination shall be included as part of the activity hazard analysis plan for that operation.

## 3.5 EXCAVATIONS

### 3.5.1 Utility Locations

All underground utilities in the work area must be positively identified by a private utility locating service in addition to any station locating service and coordinated with the station utility department. Any markings made during the utility investigation must be maintained throughout the contract. Locate utilities in accordance with Section 01 14 00.05 20, WORK RESTRICTIONS FOR DESIGN-BUILD

### 3.5.2 Utility Location Verification

The Contractor must physically verify underground utility locations by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system. Digging within 2 feet of a known utility must not be performed by means of mechanical equipment; hand digging shall be used. If construction is parallel to an existing utility the utility shall be exposed by hand digging every 100 feet if parallel within 5 feet of the excavation.

## 3.6 UTILITIES WITHIN CONCRETE SLABS

Utilities located within concrete slabs or pier structures, bridges, and the like, are extremely difficult to identify due to the reinforcing steel used in the construction of these structures. Whenever contract work involves concrete chipping, saw cutting, or core drilling, the existing utility location must be coordinated with station utility departments in addition to a private locating service. Outages to isolate utility systems shall be used in circumstances where utilities are unable to be positively identified. The

use of historical drawings does not alleviate the Contractor from meeting this requirement.

## 3.7 ELECTRICAL

### 3.7.1 Conduct of Electrical Work

Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Positive cable identification must be made prior to submitting any outage request for electrical systems. Arrangements are to be coordinated with the Contracting Officer and Station Utilities for identification. The Contracting Officer will not accept an outage request until the Contractor satisfactorily documents that the circuits have been clearly identified. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method. When working in energized substations, only qualified electrical workers shall be permitted to enter. When work requires Contractor to work near energized circuits as defined by the NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts, coveralls, face shields, and safety glasses. In addition, provide electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA.

## 3.8 WORK IN CONFINED SPACES

In addition to the requirements of Section 06.I of USACE EM 385-1-1, OSHA 29 CFR 1910.146 and OSHA 29 CFR 1926.21(b)(6) the Contractor shall comply with the following. Any potential for a hazard in the confined space requires a permit system to be used.

a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. (See Section06.I.06 of USACE EM 385-1-1 for entry procedures.) All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.

b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level.

c. Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

-- End of Section --

SECTION 01 45 00.05 20
DESIGN AND CONSTRUCTION QUALITY CONTROL
02/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E 329 (2002) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2003) Safety -- Safety and Health Requirements

1.2 SUBMITTALS

The use of a "G" following a submittal indicates that a Government approval/action is required. Submit the following in accordance with Section 01 33 10.05 20, DESIGN SUBMITTAL PROCEDURES and Section 01 33 00.05 20, CONSTRUCTION SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

Design Quality Control (DQC) Plan; G

Submit a DQC Plan prior to the Post Award Kickoff Meeting.

Construction Quality Control (CQC) Plan; G

Submit a Construction QC Plan prior to start of construction.

SD-07 Certificates

Preliminary Inspections and Final Acceptance Testing; G

Final Life Safety/Fire Protection Certification; G

SD-11 Closeout Submittals

Training Course Outline; G

Training Video Recording; G

1.3 QC PROGRAM REQUIREMENTS

Establish and maintain a QC program that is administered by a Design and Construction Quality Control organization, using Quality Control (Design and Construction) Plans, meetings, a Coordination and Mutual Understanding Meeting, three phases of control, submittal review and approval, testing, completion inspections, and QC certifications and documentation necessary to

provide design, materials, equipment, workmanship, fabrication, construction and operations which comply with the requirements of this contract. The QC program shall cover on-site and off-site work. No construction work or testing may be performed unless the QC Manager is on the work site.

1.3.1 Design and Construction Quality Control Plans
The Contractor shall provide a project specific Design Quality Control (DQC)Plan and Construction Quality Control (CQC) Plan, for review and acceptance by the Government. The Contractor shall perform no construction under this contract until the Contracting Officer accepts the DQC Plan and the CQC Plan. The Contractor's plan shall include the following:

a. The QC organization for this contract, including member resumes.

b. A letter from an officer of the company designating the QC Manager, Alternate QC Manager, and DQC Manager, and their authority.

c. QC Manager qualifications.

d. DQC Manager qualifications.

e. List of Definable Features of Work (DFOW) including list of design submittal packaging. DFOW is a task that is separate and distinct from other tasks and has control requirements and work crews unique to the task.

f. Plan to implement the "Three Phases of Control" for each DFOW.

g. Testing Plan, log and list of personnel and accredited laboratories that will perform tests. Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation with the testing plan.

h. Submittal Log including design submittals, listing personnel who will review submittals and noting submittals for Government review.

i. Procedures for submitting and reviewing variations prior to submission to the Government.

j. A plan for implementing the applicable requirements of the International Building Code (IBC), Chapter 17 "Structural Tests and Special Inspections." As a part of the plan, a statement of Special Inspections shall be prepared by the Designer of Record (DOR) describing a complete list of materials and work requiring special inspections, the inspections to be performed and any applicable quality assurance plans and structural observations. The plan will include a listing of the individuals, approved agencies or firms that will be retained for conducting the required special inspections accompanied by a description of individual inspector's experience and a copy of all required certifications. Structural tests and special inspections, as outlined in Chapter 17 of the IBC shall be conducted by individuals and agents that are under the direct supervision of a Registered Design Professional(RDP) and meet the requirements of ASTM E 329.

1.3.2 Quality Control Spreadsheets

The Quality Control Manager (QCM) shall create and maintain two quality control spreadsheets or databases, and use them together to manage the quality control inspection and rework processes. The Government Quality Assurance Manager (QAM) will use the same information to manage the quality

assurance processes.

After approval of the definable features of work list, the inspection spreadsheet will be formatted with definable features of work as column headings and every interior and exterior space as row titles. To facilitate data manipulation and reporting, each definable feature of work column shall be further subdivided into six (6) sub-columns, as follows: foreman's initials, foreman's certification date, QCM's initials, QCM certification date, QAM initials, and QAM certification date. The spreadsheet shall be updated daily by the project foreman and the QCM, and will be updated at least weekly by the Government QAM.

The rework spreadsheet shall be used in conjunction with the inspection spreadsheet. The spreadsheet shall be formatted with each row from the inspection spreadsheet as a separate tab. Each tab shall have the following columns: work item, foreman's initials, foreman's certification date, QCM initials, QCM certification date, QAM initials, and QAM certification date.When a foreman certifies on the inspection spreadsheet that a definable feature of work is complete in an area, the QCM shall inspect that work on the next business day and develop a rework list. The field list shall be transferred to the rework spreadsheet and managed to completion and certification by all parties listed above. When the rework items are complete, the QCM may certify on the inspection spreadsheet that the work is complete and ready for QAM inspection. If additional rework is identified in the QAM inspection, this process shall be repeated as described above.

1.4 QC ORGANIZATION

The QC organization and supporting staff shall meet all of the following performance requirements.

Provide a QC Manager at the work site to implement and manage the QC Program. The QC Manager shall report to an officer of the firm and shall not be subordinate to the Project Superintendent or the Project Manager. The full time and only duties and responsibilities of the QC Manager are to manage and implement the QC Program on this Contract.

The Contracting Officer may require the QC Manager, or the DQC Manager, be removed and replaced, if the Contracting Officer determines that either is not performing satisfactorily.

1.4.1 QC Manager

QC Manager qualifications:

a. Complete the course entitled "Construction Quality Management (CQM)for Contractors."

b. Ten (10) years of combined experience as a Superintendent, QC Manager, Project Manager, or Project Engineer on similar size and type construction contracts, and at least two (2) years experience as a QC Manager.

c. Familiar with requirements of USACE EM 385-1-1, and experience in the areas of hazard identification and safety compliance.

QC Manager responsibilities:

a. Participate in the Post Award Kickoff, Partnering, Design Development, and Coordination and Mutual Understanding Meetings.

b. Implement the "Three Phase of Control" plan for each DFOW and notify the Contracting Officer at least 3 business days in advance of f each Preparatory and Initial Phase meeting. Submit respective checklists to the Contracting Officer the next business day.

c. Ensure that no construction begins before the DOR has finalized the design for that segment of work, and construction submittals are approved as required.

d. Inspect all work and rework, using International Conference of Building Officials certified QC specialists as applicable, to ensure its compliance with contract requirements. Maintain a rework log.

e. Immediately stop any segment of work, which does not comply with the contract plans and specifications, and direct the removal and replacement of any defective work.

f. Remove any individual from the site who fails to perform their work in a skillful, safe and workmanlike manner or whose work does not comply with the contract plans and specifications.

g. Prepare daily QC Reports.

h. Ensure that Contractor Production Reports are prepared daily.

i. Hold weekly QC meetings with the DQC, DOR (or representative), Superintendent and the Contracting Officer; participation shall be suitable for the phase of work. Post minutes of these meetings.

j. Ensure that Safety Officer inspections are performed. Attend weekly Tool box meetings.

k. Ensure that design and construction submittals are reviewed and approved, as required by the contract, prior to allowing material on site and work to proceed with these items. Maintain a submittal log.

l. Update As-built drawings daily, maintaining up-to-date set on site.

m. Maintain a testing plan and log. Ensure that all testing is performed per the contract. Review all test reports and notify the Contracting Officer of all deficiencies, along with a proposal for corrective action.

n. Maintain deficiency log on site, noting dates deficiency identified, and date corrected.

o. Certify and sign statement on each invoice that all work to be paid under the invoice has been completed in accordance with contract requirements.

p. Perform Punch-out and Pre-final inspections, and participate in Final Inspections. Submit list of deficiencies to the Contracting Officer for each inspection. Correct all deficiencies prior to the Final inspection. Notify Contracting Officer prior to Final Inspection to establish a schedule date acceptable by the Contracting Officer.

q. Ensure that all required keys, operation and maintenance manuals, warranty certificates, and the As-built drawings are correct and complete, per the contract, and submitted to the Contracting Officer.

r. Assure that all applicable tests, special inspections, and observations required by the contract are performed.

s. Coordinate all factory and on-site testing, Testing Laboratory personnel, QC Specialists, and any other inspection and testing personnel required by this contract.

t. Notify the Contracting Officer of any proposed changes to the QC plan.

1.4.2 DQC Manager

DQC Manager qualifications:

a. A minimum of five (5) years experience as a design Architect or Engineer on similar size and type designs or design-build contracts. Provide education, experience, and management capabilities on similar size and type contracts.

b. Be a registered professional engineer or architect with active registration in the State in which the project will be constructed. Provide proof of registration as part of the resume submittal package.

QC Manager responsibilities:

a. Be responsible for the design integrity, professional design standards, and all design services required.

b. Be a member of the Designer of Record's (DOR) firm.

c. Be responsible for development of the design portion of the QC Plan, incorporation and maintenance of the approved Design Schedule, and the preparation of DQC Reports and minutes of all design meetings.

d. Participate in the Post Award Kick-Off meeting, all design planning meetings, design presentations, and partnering.

e. Implement the DQC plan and shall remain on staff and involved with the project until completion of the project.

f. Be cognizant of and assure that all design documents on the project have been developed in accordance with the Contract, and have been properly coordinated.

g. Perform submittal review and approval functions for the QC Manager.

h. Coordinate all training issues and shall validate that the testing and training requirements of this contract are accomplished.

i. Provide QC certification for design compliance.

1.4.3 QC Specialists

QC Specialists shall assist and report to the QC Manager and may perform production related duties but must be allowed sufficient time to perform their assigned quality control duties. QC Specialists are required to attend the Coordination and Mutual Understanding Meeting, QC meetings and be physically present at the construction site to perform the three phases of

control and prepare documentation for each definable feature of work in their area of responsibility at the frequency specified below.

1.4.3.1 Fire Protection QC Specialist

The Fire Protection QC Specialist shall be a U.S. Registered Fire Protection Engineer (FPE) and shall be an integral part of the Prime Contractor's Quality Control Organization. This FPE shall have no business relationships (owner, partner, operating officer, distributor, salesman, or technical representative) with any fire protection equipment device manufacturers, suppliers or installers for any such equipment provided as part of this project. The Fire Protection Designer of Record may serve as the lead Fire Protection QC Specialist.

a. Qualifications/Experience: The FPE shall have obtained their professional registration by successfully completing the Fire Protection Engineering discipline examination. This FPE shall have a minimum of 5 years full time and exclusive experience in every aspect of facility design and construction as it relates to fire protection, which includes, but is not limited to, building code analysis, life safety code analysis, design of automatic detection and suppression systems, passive fire protection design, water supply analysis, and a multi-discipline coordination reviews, and construction surveillance.

b. Area of Responsibility: The FPE is responsible for assuring the proper construction and installation of life safety and fire protection features across all disciplines and trades. The FPE shall be responsible for assuring that life safety and fire protection features are provided in accordance with the design documents, approved construction submittals, and manufacturer's requirements. Examples include, but are not limited to, water distribution systems including fire pumps and fire hydrants, fire resistive assemblies such as spray-applied fire proofing of structural components and fire rated walls/ partitions, fire alarm and detection systems, fire suppression and standpipe systems,emergency and exit lighting fixtures, etc.

c. Construction Surveillance: The FPE shall visit the construction site as necessary to ensure life safety and fire protection systems are being constructed, applied, and installed in accordance with t he approved design documents, approved construction submittals,a nd manufacturer's requirements. Frequency and duration of the field visits are dependent upon particular system components,system complexity, and phase of construction. At a minimum, field visits shall occur just prior to installation of suspended ceiling system to inspect the integrity of passive fire protection features and fire suppression system piping, preliminary inspections of fire alarm/ detection and suppression systems, and final acceptance testing of fire alarm/detection and suppression systems.

(1) Preliminary Inspections and Final Acceptance Testing: FPE shall personally witness all preliminary inspections of fire alarm/ detection and suppression systems. Once preliminary inspections have been successfully completed, the FPE shall submit a signed certificate to the QC Manager that systems are ready for final inspection and testing. The NAVFAC Southeast FPE will witness formal tests and approve all systems before they are accepted. The QC Manager shall submit the request for formal inspection at least 15 work days prior to the date the inspection is to take place. The QC Manager shall provide10 work days advance notice to the Contracting Officer and the activity Fire Inspection Office of scheduled final inspections.

(2) Final Life Safety/Fire Protection Certification Documentation: The FPE

shall provide certification that all life safety and fire protection systems have been installed in accordance with the contract documents, approved submittals, and manufacturer's requirements. This certification shall summarize all life safety and fire protection features, and shall bear the professional seal of the fire protection engineer.

1.5 THREE PHASES OF CONTROL

The Three Phases of Control shall adequately cover both on-site and off-site work and shall include the following for each DFOW.

1.5.1 Preparatory Phase

Notify the Contracting Officer at least two work days in advance of each preparatory phase meeting. The meeting shall be conducted by the QC Manager and attended by the QC Specialists, the Project Superintendent, and the foreman responsible for the DFOW. When the DFOW will be accomplished by a subcontractor, that subcontractor's foreman shall attend the preparatory phase meeting. Document the results of the preparatory phase actions in the daily Contractor Quality Control Report and in the Preparatory Phase Checklist. Perform the following prior to beginning work on each DFOW:

a. Review each paragraph of the applicable specification sections;

b. Review the Contract drawings;

c. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required;

d. Review the testing plan and ensure that provisions have been made to provide the required QC testing;

e. Examine the work area to ensure that the required preliminary work has been completed;

f. Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data;

g. Discuss construction methods, construction tolerances, workmanship standards, and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each DFOW; and

h. Review the APP and appropriate Activity Hazard Analysis (AHA) to ensure that applicable safety requirements are met, and that required Material Safety Data Sheets (MSDS) are submitted.

1.5.2 Initial Phase

Notify the Contracting Officer at least two work days in advance of each initial phase. When construction crews are ready to start work on a DFOW, conduct the initial phase with the QC Specialists, the Project Superintendent, and the foreman responsible for that DFOW. Observe the initial segment of the DFOW to ensure that the work complies with Contract requirements. Document the results of the initial phase in the daily CQC Report and in Initial Phase Checklist. Repeat the initial phase for each new crew to work on-site, or when acceptable levels of specified quality are not being met. Perform the following for each DFOW:

a. Establish the quality of workmanship required;

b. Resolve conflicts;

c. Ensure that testing is performed by the approved laboratory, and

d. Check work procedures for compliance with the APP and the appropriate AHA to ensure that applicable safety requirements are met.

1.5.3 Follow-Up Phase

Perform the following for on-going work daily, or more frequently as necessary, until the completion of each DFOW and document in the daily CQC Report:

a. Ensure the work is in compliance with Contract requirements;

b. Maintain the quality of workmanship required;

c. Ensure that testing is performed by the approved laboratory; and

d. Ensure that rework items are being corrected.

1.5.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same DFOW if the quality of ongoing work is unacceptable, if there are changes in the applicable QC organization, if there are changes in the on-site production supervision or work crew, if work on a DFOW is resumed after substantial period of inactivity, or if other problems develop.

1.5.5 Notification of Three Phases of Control for Off-Site Work

Notify the Contracting Officer at least two weeks prior to the start of the preparatory and initial phases.

1.6 COMPLETION INSPECTIONS

The Contractor shall perform the necessary prefinal inspections, compile punchlists, and correct deficiencies. Notify the Contracting Officer 5 calendar days prior to the prefinal inspection to provide Contracting Officer option to attend. Notify the Contracting Officer at least 14 calendar days prior to the date a final acceptance inspection can be held. The Government will perform final inspection to verify that the facility is complete and ready to be occupied. All items previously identified on the prefinal punchlist will have been corrected and acceptable.

1.7 TRAINING

The DQC Manager shall provide a comprehensive project-specific Government personnel training program for the systems of the facility specified in the technical specifications of this Contract. The core of this training will be based on manufacturer's recommendations and the operation and maintenance support information (OMSI) provided as a part of this Contract. Training shall include classroom discussion as well as hands on maintenance, replacement of typical components and repair type maintenance training for parts typically replaced or repaired in the field, such as:

1. 1. Plumbing systems, including temperature actuated thermostatic water mixing valve

2. 2. HVAC Systems, including chillers, boilers, heat pumps, air handling equipment, hot and chilled water pumping system

3. 3. Direct Digital Controls/Space Temperature Controls

4. 4. Fire protection systems, including fire alarm systems and sprinkler systems

5. 5. Site electrical utilities, including transformers.

6. 6. Sanitary lift stations, including pumps, valves, controls, and monitoring systems

Provide each trainee in the course a written training course outline. Submit outline for approval at least 90 calendar days prior to training session. Provide to the Contracting Officer two copies of the training video recording in DVD format. Confirm media format required with the using activity. The recording shall capture, in video and audio, all instructors training presentations including question and answer periods with the trainees.

1.8 DOCUMENTATION

Maintain current and complete records of on-site and off-site QC program operations and activities.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 50 00.05 20
TEMPORARY FACILITIES AND CONTROLS FOR DESIGN-BUILD
10/05

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C511 (1997) Reduced-Pressure Principle Backflow Prevention Assembly

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR List (Continuously Updated) List of Approved Backflow Prevention Assemblies

FCCCHR Manual (9th Edition) Manual of Cross-Connection Control

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241 (2000) Safeguarding Construction, Alteration, and Demolition Operations

NFPA 70 (2005) National Electrical Code

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

FHWA SA-89-006 (1988) Manual on Uniform Traffic Control Devices for Streets and Highways

ONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 247 Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2 SUBMITTALS

The use of a "G" following a submittal indicates that a Government approval/action is required. Submit the following in accordance with Section 01 33 10.05 20,DESIGN SUBMITTAL PROCEDURES and Section 01 33 00.05 20, CONSTRUCTION SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

Traffic control plan; G

Construction site plan; G

SD-03 Product Data

Backflow Preventers

SD-06 Test Reports

Backflow Preventer Tests; G

SD-07 Certificates

Backflow Tester Certification; G

Backflow Preventers Certificate of Full Approval

1.3 EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

There are many products listed in 40 CFR 247 which have been designated or proposed by EPA to include recycled or recovered materials that may be used by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. These non-construction products contain the highest practicable percentage of recycled or recovered materials and can be recycled when no longer needed.

1.4 CONSTRUCTION SITE PLAN

Prior to the start of work, submit a site plan showing the locations of temporary facilities (including layouts and details, equipment and material storage area (on-site and off-site)), and access and haul routes used for this contract. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary sanitary facilities, and worker parking areas.

1.5 BACKFLOW PREVENTERS CERTIFICATE

Certificate of Full Approval from FCCCHR List, University of Southern California, attesting that the design, size and make of each backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. Certificate of Provisional Approval will not be acceptable.

1.5.1 Backflow Prevention Training Certificate

The Contractor shall submit a certificate recognized by the State or local authority that states the Contractor has completed at least 10 hours of training in backflow preventer installations. The certificate must be current.

1.6 TEMPORARY UTILITIES

Reasonable amounts of the following utilities will be made available to the Contractor at prevailing rates:

Electricity

Potable Water The point at which the Government will deliver such utilities or services and the quantity available shall be coordinated with the Contracting Officer. The Contractor shall pay all costs incurred in connecting, converting, and transferring the utilities to the work. The Contractor shall make connections, including providing backflow-preventing devices on connections to domestic water lines; and providing transformers; and make disconnections. Under no circumstances will taps to base fire

hydrants be allowed for obtaining domestic water.

1.7 BACKFLOW TESTER CERTIFICATION

Prior to testing, submit to the Contracting Officer certification issued by the State or local regulatory agency attesting that the backflow tester has successfully completed a certification course sponsored by the regulatory agency. Tester shall not be affiliated with any company participating in any other phase of this contract.

1.8 WEATHER PROTECTION

Take necessary precautions to ensure that roof openings and other critical openings in the building are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental weather is imminent, and at the end of each workday.

1.8.1 Building and Site Storm Protection

When a warning of gale force winds is issued, take precautions to minimize danger to persons, and protect the work and nearby Government property. Precautions shall include, but are not limited to, closing openings; removing loose materials, tools and equipment from exposed locations; and removing or securing scaffolding and other temporary work. Close openings in the work when storms of lesser intensity pose a threat to the work or any nearby Government property.

1.8.1.1 Hurricane Condition of Readiness

a. Destructive winds may occur at any time of year, but most frequently prevail during the period 01 June - 30 November,which is designated as "Hurricane Season." Throughout this season the Contractor must maintain a state of readiness consistent with sound precautionary judgment; good housekeeping is essential. Near the beginning of Hurricane Season all Contractors shall attend an hour long All Contractors Meeting to review Contractor requirements during Hurricane Season. All Project Managers, Superintendents, and Quality Control Managers shall be in attendance. Time and date of the meeting shall be determined by the Contracting Officer.

b. The TROPCON requirements set forth below are a minimum. The intent of the requirement is to mitigate, to the extent practicable, storm damage potential to the job site and surrounding Government Property. In the event of storm damage,the prime Contractor's responsibility will include any damage to materials and work performed (including Government furnished items).

c. Prime Contractors shall identify two key persons, in writing; a primary and an alternate, to serve as the government's point of contact should a hurricane threat arise. Home, office, and cell phone numbers for 24-hour contact shall be provided.

d. A storm protection plan shall be addressed, as an appendix, in the Contractor's Accident Prevention (Safety) Plan required by this contract. This storm plan shall address the specifics of how the Contractor will comply with each of the TROPCONs listed below and shall also include a contingency plan in the event that subcontractors fail to secure their materials and equipment. The Prime Contractor is ultimately responsible to the government for the condition of their jobsite.

e. Unless directed otherwise, comply with:

1. TROPCON FIVE (Normal Condition 01 June - 30 November):Dumpsters will remain relatively empty at all times and debris cleaned up and removed from the site daily (as required) during the entire hurricane season. Maintain good housekeeping practices. The Contractor shall provide, on the jobsite, hurricane gear such as ropes, stakes, and tarpaulins, to securely fasten all unfinished construction, stockpiles, tools,and equipment in the event of destructive weather.

2. TROPCON FOUR (Hurricane force winds possible within 72 hours): When TROPCON FOUR is set an All Contractors Meeting will be held at the ROICC Office. It will normally held be within 4 work-hours of notification. Each Contractor Superintendent and QC Manager (if applicable) shall attend. Exact time and date of the meeting to be determined by the Contracting Officer. Commence securing operations and stow all gear and portable equipment. Cease all routine activities, until the requirements of this TROPCON are fulfilled. Normal operations may resume and continue contingent on maintaining TROPCON FOUR readiness. If the Contractor fails to maintain readiness levels, normal work will be halted. All loose material and equipment must be compactly piled in stacks less than 4 feet high, and securely tied down to a piece of construction equipment, secured inside a structure, or to a large unmovable object at the jobsite to prevent missile hazards. Reinforce or remove formwork and scaffolding.

3. TROPCON THREE (Hurricane force winds possible within 48 hours): Complete all securing operations. All permitted Hot Work shall cease. Cease routine activities until securing operation is complete. Notify the ROICC for inspection when jobsite is secure and ready for evacuation. A work crew shall be maintained until released by the ROICC.

4. TROPCON TWO (Hurricane force winds possible within 24 hours): Leave Government premises.

5. TROPCON ONE (Hurricane force winds possible within 12hours): All jobsites secure.

1.9 STATION OPERATION EFFECT ON CONTRACTOR OPERATIONS

1.9.1 Special Restrictions Regarding Access of Vehicles and Parking

1.9.1.1 Interruption of Vehicular Traffic

If during the performance of work, it becomes necessary to modify vehicular traffic patterns at any locations, notify the Contracting Officer at least 15 calendar days prior to the proposed modification date, and provide a Traffic Control Plan detailing the proposed controls to traffic movement for approval. The plan shall be in accordance with State and local regulations and the FHWA SA-89-006, Part VI. Make all notifications and obtain any permits required for modification to traffic movements outside Station's jurisdiction. Provide cones, signs, barricades, lights, or other traffic control devices and personnel required to control traffic. Do not use foil-backed material for temporary pavement marking because of its potential to conduct electricity during accidents involving downed power lines.

1.10 STORAGE AREAS

Contractor shall be responsible for security of his property. The Contract Clause entitled FAR 52.236-10, Operations and Storage Areas and the following apply:

1.10.1 Storage in Existing Buildings

The Contractor shall be working around existing buildings; the storage of material will not be allowed in the buildings. Provide 8 foot high security fence with a lockable gate around the storage area. Remove at the completion of work.

1.11 TEMPORARY SANITARY FACILITIES

Provide temporary sewer and sanitation facilities that are self-contained units with both urinals and stool capabilities. Ventilate the units to control odors and fumes and empty and clean them at least once a week or more often if required by the Contracting Officer. The doors shall be self-closing. The exterior of the unit shall match the base standard color. Locate the facility behind the construction fence or out of the public view.

1.12 TEMPORARY BUILDINGS

Temporary facilities (including trailers) shall be in like new condition and shall be maintained throughout the project. Locate these facilities where directed and within the indicated operations area. Failure to maintain storage trailers or buildings to these standards shall result in the removal of non-complying units at the Contractor's expense. A sign not smaller than 24 by 24 inches shall be conspicuously placed on the trailer depicting the company name, business phone number, and emergency phone number. Trailers shall be anchored to resist high winds and must meet applicable state of local standards for anchoring mobile trailers. Storage of material/debris under such facilities is prohibited. Contractor shall be responsible for the security of the stored property.

1.12.1 Quality Control Manager Records and Field Office

Provide on the jobsite an office with minimum 200 square feet of useful floor area for the exclusive use of the QC Manager. Provide a weathertight structure with adequate heating and cooling, toilet facilities, lighting, ventilation, a 4 by 8 foot plan table, a standard size office desk and chair, computer station, and working communications facilities. Provide a window-mounted heat pump rated at 9,000 Btus minimum for cooling/heating. Provide a door with a cylinder lock and windows with locking hardware. Make utility connections. Locate as directed. File quality control records in the office and make available at all times to the Government. After completion of the work, remove the entire structure from the site.

PART 2 PRODUCTS

2.1 BACKFLOW PREVENTERS

Reduced pressure principle type conforming to the applicable requirements AWWA C511. Provide backflow preventers complete with 150 pound flanged bronze mounted gate valve and strainer, 304 stainless steel, internal parts.The particular make, model/design, and size of backflow preventers to be installed shall be included in the latest edition of the List of Approved Backflow prevention assemblies issued by the FCCCHR List and shall be accompanied by a Certificate of Full Approval from the FCCCHR List.

2.2 PROJECT SIGN

Prior to initiating any work on site, provide one project identification sign

at the location coordinated with the Contracting Officer. Construct the sign in accordance with project sign detail attached at the end of this section. Maintain sign throughout the life of the project. Upon completion of the project, remove the sign from the site.

2.2.1 Project Identification Signboard (Navy)

A project identification signboard shall be provided in accordance with attached Plates 1, 3, and 4. The signboard shall be provided at a conspicuous location on the job site where directed by the Contracting Officer.

a. The field of the sign shall consist of a 4 by 8 foot sheet of exterior plywood.

b. The entire signboard and supports shall be painted. The lettering and sign work shall be performed by a skilled sign painter using paint known in the trade as bulletin colors. The colors, lettering sizes, and lettering styles shall be as indicated.

c. NAVFAC logo shall be a sticker/decal with either transparent or white background or paint the logo by stencil onto the sign.T he weather resistant sticker/decal film shall be rated for a minimum of 2-year exterior vertical exposure. NAVFAC logo colors and dimensional proportions must be chosen in accordance with the NAVFAC Brand and Style Guide. Brand and Style Guide is available at:
https://portal.navfac.navy.mil/portal/page?_pageid=34,35749,34_35755&_dad=ptl&_schema=PTLP

d. Sign paint colors:

.(1) Blue = To match dark blue color in the NAVFAC logo.

.(2) White = To match Brilliant White color in the NAVFAC logo.

PART 3 EXECUTION

3.1 TEMPORARY PHYSICAL CONTROLS

3.1.1 Access Controls

3.1.1.1 Temporary Barricades

Contractor shall provide for barricading around all work areas to prevent public access.

3.1.1.2 Fencing

Temporary safety fence, including gates and warning signs, shall be provided along the construction site and at all open excavations and tunnels to control access by unauthorized people and to protect the public from construction activities. The safety fence shall match the base standard color (or bright orange where it protects excavated areas), shall be made of high density polyethylene grid or approved equal or plastic fence from recovered materials containing 60-100 percent recovered content level plastic, a minimum of 42 inches high, supported and tightly secured to steel posts located on minimum 10 foot centers. Remove the fence from the work site upon completion of the contract.

If the Contractor desires for protection of Contractor materials and

equipment, enclose the Contractor lay-down area with an 8 foot high chainlink fence and gates. Remove the fence upon completion and acceptance of the work.

3.1.1.3 Signs

Place warning signs at the construction area perimeter designating the presence of construction hazards requiring unauthorized persons to keep out. Signs must be placed on all sides of the project, with at least one sign every 300 feet. All points of entry shall have signs designating the construction site as a hard hat area.

3.1.1.4 Traffic Work

All work around/involving roadways, to include roadway excavations and utility crossings, will be conducted in accordance with Manual of Traffic Control Devices. Contractors shall provide and ensure appropriate road closure and detour signs are established as necessary for motor traffic management. All road closures shall be coordinated with the Contracting Officer in advance. Self-illuminated (lighted) barricades shall be provided during hours of darkness. Brightly-colored (orange) vests are required for all personnel working in roadways. Road closures shall require a road closure plan showing the location of signage.

3.2 TEMPORARY WIRING

Provide temporary wiring in accordance with NFPA 241 and NFPA 70, Assured Equipment Grounding Conductor Program. Program shall include frequent inspection of all equipment and apparatus.

3.3 REDUCED PRESSURE BACKFLOW PREVENTERS

Provide an approved reduced pressure backflow prevention assembly at each location where the Contractor taps into the Government potable water supply.

A certified tester(s) shall perform testing of backflow preventer(s) for proper installation and operation and provide subsequent tagging. Backflow preventer tests shall be performed using test equipment, procedures, and certification forms conforming to those outlined in the latest edition of the Manual of Cross-Connection Control published by the FCCCHR Manual. Test and tag each reduced pressure backflow preventer upon initial installation (prior to continued water use) and quarterly thereafter. Tag shall contain the following information: make, model, serial number, dates of tests,results, maintenance performed, and signature of tester. Record test results on certification forms conforming to requirements cited earlier in this paragraph.

-- End of Section --

SECTION 01 57 19.00 20
TEMPORARY ENVIRONMENTAL CONTROLS
03/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI Guideline K (1997) Containers for Recovered Fluorocarbon Refrigerants

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.1200 Hazard Communication

49 CFR 178 Shipping Container Specification

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 832-R-92-005 Storm Water Management for Construction Activities

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910 Occupational Safety and Health Standards

40 CFR 112 Oil Pollution Prevention

40 CFR 241 Guidelines for Disposal of Solid Waste

40 CFR 243 Guidelines for the Storage and Collection of Residential, Commercial, and Institutional Solid Waste

40 CFR 258 Subtitle D Landfill Requirements

40 CFR 261 Identification and Listing of Hazardous Waste

40 CFR 262 Generators of Hazardous Waste

40 CFR 263 Transporters of Hazardous Waste

40 CFR 264 Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities

40 CFR 265 Interim Status Standard for Owners and Operators of Hazardous Waste Treatment,Storage, and Disposal Facilities

40 CFR 266 Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities

40 CFR 268 Land Disposal Restrictions

40 CFR 273 Universal Waste Management

40 CFR 279 Used Oil Regulations

40 CFR 300 National Oil and Hazardous Substances Pollution Contingency Plan

40 CFR 355 Emergency Planning and Notification

40 CFR 372-SUBPART D EPA Toxic Chemical Release Reporting Regulations

40 CFR 82 Protection of Stratospheric Ozone

49 CFR 171 General Information, Regulations, and Definitions

49 CFR 172 Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

49 CFR 173 Shipments and Packagings

1.2 DEFINITIONS

1.2.1 Sediment

Soil and other debris that have eroded and have been transported by runoff water or wind.

1.2.2 Solid Waste

Discarded material (except hazardous waste, hazardous construction debris, regulated waste, and industrial waste as defined in paragraphs entitled "Hazardous Waste", "Hazardous Construction Debris", "Regulated Waste" and "Industrial Waste", including solid, liquid, semisolid, or contained gaseous materials.

a. Green waste: The vegetative matter from landscaping, land clearing and grubbing, including, but not limited to, grass, bushes, scrubs, small trees and saplings, tree stumps and plant roots. Marketable trees, grasses and plants that are indicated to remain, be relocated, or be re-used are not included.

b. Construction and Demolition Debris: Non-hazardous solid material generated during the construction, demolition, or renovation of a structure which exceeds 2.5 inch particle size that is: a manufactured object or natural geologic material (e.g. cobbles and boulders). A mixture of debris and other material such as soil or

sludge is also subject to regulation as construction and demolition debris if the mixture is comprised primarily of debris by volume, based on visual inspection.

(1) Surplus Soil: Existing soil that is in excess of what is required for this work, including aggregates intended, but not used, for on-site mixing of concrete, mortars and paving. Contaminated soil meeting the definition of hazardous material or hazardous waste is not included.

(2) Inert Construction and Demolition Debris: Broken or removed concrete, masonry products, asphalt paving materials; ceramics; roofing paper and shingles. Inert materials may be reinforced with or contain ferrous wire, rods, accessories and weldments.

(3) Wood: Dimension and non-dimension lumber, plywood, chipboard, hardboard, pallets, dunnage, and formwork. Wood painted with lead based paint is not included unless the waste stream determination indicates that the wastes are non-hazardous.

(4) Scrap Metal: Scrap and excess ferrous and non-ferrous metals such as re-enforcing steel, structural shapes, pipe and wire, banding straps, fastners, shipping spreaders, door and window frames that are recovered or collected and disposed of as scrap. Scrap metal meeting the definition of hazardous material or hazardous waste is not included, except where specific exemptions allow recycling.

(5) Empty Cans: Metal or plastic cans that are empty of chemicals, paints, solvents, thinners, and adhesives. A container is empty if all contents have been removed using practices commonly employed to remove materials from that type container, e.g., pouring, pumping, and aspirating. Air-drying of cans is not permitted. Aerosol cans are not included if pressurized.

(6) Recyclables/Reusable Material: Materials, equipment and assemblies such as doors, windows, door and window frames, plumbing fixtures, glazing and mirrors that are recovered and sold as recyclable. Metal meeting the definition of lead contaminated or lead based paint contaminated may be included as recyclable if sold to a scrap metal company. Paint cans may be included as recyclable if sold to a scrap metal company.

Material not regulated as solid waste are: nuclear source or byproduct materials regulated under the Federal Atomic Energy Act of 1954 as amended; suspended or dissolved materials in domestic sewage effluent or irrigation return flows, or other regulated point source discharges; regulated air emissions; and fluids or wastes associated with natural gas or crude oil exploration or production.

Where state or local regulatory definitions for waste differ from those stated in this section, the state or local definitions shall be used for this contract.

1.2.3 Garbage Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.2.4 Hazardous Waste

A waste as defined in 40 CFR 261, or as defined by applicable State and local regulations. May include, but is not limited to, hazardous construction and demolition debris, unusable special coatings, lead containing paint, spent solvents, and rags contaminated with hazardous materials.

1.2.4.1 Hazardous Construction and Demolition Debris

As defined in paragraph entitled "Construction and Demolition Debris" of this section, debris that contains listed hazardous waste (either on the debris surface, or in its interstices, such as pore structure) per 40 CFR261; or debris that exhibits a characteristic of hazardous waste per 40 CFR261.

1.2.4.2 Universal Waste

Specific hazardous wastes defined by 40 CFR 273 or by applicable State and local regulations. The categories of these wastes are Batteries, Pesticides,

Thermostats, and Lamps. Common items that are managed as Universal Wastes include, but is not limited to, spent lead-acid batteries, nickel-cadmium rechargeable batteries, NiMH (nickel-metal-hydride) batteries, lithium ion batteries, fluorescent lamps, high intensity discharge lamps, neon lamps, mercury vapor lamps, high pressure sodium lamps, metal halide lamps, and thermostats containing mercury ampoules.

### 1.2.5 Industrial Wastes

Solid waste or waste by-products containing hazardous constituents that are generated incidental to or derived from construction and demolition activities. Items included in this category include, but are not limited to, used rags, cleaning materials and residue, used protective sheeting (paper or plastic), unusable partially filled paint cans or coating containers, paint brushes and rollers, disposable personal protective equipment (PPE) not used in asbestos or lead removal, and non-hazardous pressurized aerosol cans. This category does not include construction and demolition debris or any other discarded materials designated as regulated waste or hazardous waste.

#### 1.2.5.1 Petroleum Contaminated Waste

Surface water, groundwater, soil, or sediment that has the presence of petroleum or petroleum products or their chemical constituents (except hazardous waste as defined in the paragraph entitled "Hazardous Waste") in quantities that exceed the applicable cleanup target levels.

### 1.2.6 Regulated Waste

Those wastes, other than Hazardous Wastes and Industrial Wastes, that have specific additional Federal, state, or local regulatory requirements for handling, storage, or disposal. Includes, but is not limited to, asbestos containing materials and PCB contaminated materials.

### 1.2.7 Class I Ozone Depleting Substance (ODS)

Class I ODS is defined in Section 602(a) of The Clean Air Act and includes the following chemicals:

chlorofluorocarbon-11 (CFC-11) chlorofluorocarbon-213 (CFC-213)
chlorofluorocarbon-12 (CFC-12) chlorofluorocarbon-214 (CFC-214)
chlorofluorocarbon-13 (CFC-13) chlorofluorocarbon-215 (CFC-215)
chlorofluorocarbon-111 (CFC-111) chlorofluorocarbon-216 (CFC-216)
chlorofluorocarbon-112 (CFC-112) chlorofluorocarbon-217 (CFC-217)
chlorofluorocarbon-113 (CFC-113) halon-1211
chlorofluorocarbon-114 (CFC-114) halon-1301
chlorofluorocarbon-115 (CFC-115) halon-2402
chlorofluorocarbon-211 (CFC-211) carbon tetrachloride
chlorofluorocarbon-212 (CFC-212) methyl chloroform

### 1.2.8 Hazardous Materials

Any material that is regulated as a hazardous material in accordance with 49CFR 171, 49 CFR 172, and 49 CFR 173, requires a Material Safety Data Sheet(MSDS) in accordance with 29 CFR 1910.1200, or which during end use, treatment, handling, storage, transportation or disposal meets or has components which meet or have the potential to meet the definition of a Hazardous Waste in accordance with 40 CFR 261. Throughout this specification, hazardous material includes hazardous substances.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 10.05 20, DESIGN SUBMITTAL PROCEDURES, and Section 01 33 00.05 20, CONSTRUCTION SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

Contractor and Sub-Contractor Company Name list for ECATTS; G

Environmental Protection Plan; G

Pre-construction Survey; G

Dirt and Dust Control Plan; G

Certifying Professional Engineer Data; G

Licenses and Permits; G

Hazardous Materials List; G

Waste Stream Determination Documentation; G

Waste stream determination documentation or waste profile Laboratory Analysis and Accreditation Certificate/License; G

Solid Waste Disposal Permit Contractor 40 CFR Employee Training Records

SD-06 Test Reports

Laboratory analysis

SD-07 Certificates

Regulatory Notification; G

Solid Waste Disposal Report

Contractor Hazardous Material Inventory Log; G

Storm water Pollution Prevention Plan; G

Erosion And Sediment Control Inspection Reports

Field Report(s); G

Construction completion certifications; G

SD-11 Closeout Submittals

Disposal Documentation For Hazardous And Regulated Waste; G

Notice of Termination; G

Environmental Records Binder; G

1.4 REPORTS

1.4.1 Pre-construction Survey

Perform a pre-construction survey of the project site with the Contracting Officer, and take photographs showing existing environmental conditions on and adjacent to the site. Include this survey as a part of the Environmental Protection Plan as prescribed elsewhere in this section.

1.4.2 Dirt and Dust Control Plan

Prepare a map showing truck and material haul routes along with a plan for controlling and removing dirt and debris from base roadways. As a minimum, identify in the plan the equipment to be used for cleaning along the haul route and measures to reduce dirt and debris accumulation on roadways. Identify who is responsible for cleaning up dirt and debris. Identify other operations that will generate dust and describe the controls planned for dust control. Include this plan as a part of the Environmental Protection Plan as prescribed elsewhere in this section.

1.4.3 Certifying Professional Engineer Data

Submit the name, address, telephone number, registration number, and state of registration for all Professional Engineers that will inspect and certify work performed under this contract. Certifications include, but are not limited to, construction permits completion certificate.

1.4.4 Licenses and Permits

Submit copies of all licenses and permits obtained for this project, including related correspondence, to the Contracting Officer. Related correspondence includes, but is not limited to, application forms, drawings,and letters to and from appropriate agencies.

1.4.5 Hazardous Materials List

The Contractor is required by specification Section 01526, SAFETY AND OCCUPATIONAL HEALTH REQUIREMENTS FOR DESIGN-BUILD, to prepare and include in the Accident Prevention Plan an inventory of Hazardous Materials to be used during this contract with estimated quantities and copies of Material Safety Data Sheets (MSDS). This data shall be called the Hazardous Materials List, submit this list for approval prior to bringing hazardous materials on Base.

1.4.6 Waste Stream Determination Documentation

The Contractor shall complete a Waste Stream Determination Documentation form or Waste Profile for all wastes to be generated. (Copies of forms are attached at the end of this section. If there are base specific forms, they will be provided at the pre-construction conference.) Waste stream determinations are required at the point of generation and must sufficiently document whether the waste will be a solid waste, hazardous waste, industrial waste, or regulated waste. The waste stream determination must be based upon the following: a constituent listing from the manufacturer or visual identification of waste, combined with consideration of the process by which the waste was generated and any laboratory analysis necessary to complete the determination. Material Safety Data Sheets (MSDS) by themselves are not adequate. The Contractor shall bear the cost of the waste stream determinations.

A Waste Stream Determination Documentation form must be provided for wastes

resulting from construction, renovation, and demolition activities and/or the use of products such as the following (this listing is not all inclusive): oil and latex based paints and caulking, solvents, adhesives, aerosols, petroleum based materials, and all original product containers.

1.4.6.1 Laboratory Analysis and Accreditation Certificate/License

Submit a copy of a laboratory analysis of waste and debris used to support any waste determination. Analysis must use EPA approved methods. Laboratories shall be accredited by the appropriate national accreditation authority described in Section 01 45 00.05 20, DESIGN AND CONSTRUCTION QUALITY CONTROL and licensed in the jurisdiction where the work is to be performed if required by state or local regulation. Submit the certificate of accreditation and license to the Contracting Officer for approval.

1.4.7 Solid Waste Disposal Permit

Submit one copy of a permit or license showing the appropriate agency(s) approval of the disposal plan before transporting wastes off Government property.

1.4.8 Contractor 40 CFR Employee Training Records

Prepare and maintain employee-training records throughout the term of the contract meeting applicable 40 CFR requirements. Submit these training records prior to the start of the activity requiring the training.

1.4.9 Regulatory Notification

The Contractor is responsible for all regulatory notification requirements in accordance with Federal, State and local regulations and permits obtained by the Contractor and Contracting Officer. The Contractor shall submit notification documents via the Contracting Officer to regulatory agencies, allowing the appropriate agency processing time prior to the scheduled commencement of work activities and 5 additional days for the Contracting Officer. Typically, regulatory notifications must be provided for the following (this listing is not all inclusive): demolition, renovation, NPDES defined site work, remediation of controlled substances (asbestos, hazardous waste, lead paint), the installation of or removal of petroleum storage tank systems, and the installation, replacement, or removal of equipment that generate air emissions, such as paint booths, boilers, emergency generators,etc.

1.4.10 Solid Waste Disposal Report

Monthly the Contractor shall submit a solid waste disposal report to the Contracting Officer. For each waste stream, the report shall state the classification (using the definitions provided in this section), amount, location, and name of the business receiving the solid waste. The Contractor shall include copies of the waste handling facilities' weight tickets, receipts, bills of sale, and other sales documentation. In lieu of sales documentation, the Contractor may submit a statement indicating the disposal location for the solid waste, signed by an officer of the Contractor firm authorized to legally obligate or bind the firm. The sales documentation or Contractor certification shall include the receiver's tax identification number and business, EPA or State registration number, along with the receiver's delivery and business addresses and telephone numbers. For each solid waste retained by the Contractor for his own use, the Contractor shall

submit on the solid waste disposal report the information previously described in this paragraph. Prices paid or received shall not be reported to the Contracting Officer unless required by other provisions or specifications of this Contract or public law.

1.4.11 Contractor Hazardous Material Inventory Log

Submit a "Contractor Hazardous Material Inventory Log" to the Contracting Officer on the 10th day of each month for the preceding month. (Copies of forms are attached at the end of this section. If there are base specific forms, they will be provided at the pre-construction conference.) This form provides information required by the Environmental Protection Community Right-to-Know Act (EPCRA). Attach a copy of the Material Safety Data Sheet(MSDS) for each item listed and maintain a file copy of these logs and MSDSs at the job-site at all times in the Environmental Records Binder. Submit a copy of all previous logs and MSDSs at the end of construction, or December 31 of each calendar year during the life of the contract which ever comes first.

Hazardous Materials are defined in paragraph 1 of this section. Typical types of materials requiring MSDSs and quantity reporting include, but are not limited to, acids, adhesives, alkalies/bases/caustics, cleaning compounds, compressed gases, corrosion prevention compounds,detergents/soaps, greases, hydraulic fluids, inspection penetrants, lubricants /oils, paint materials, polish/wax compounds, solvents, water test/treatment chemicals, oxidizers, fuels, batteries, pesticides, aerosol can products, admixtures, curing compounds, and other petroleum-based products.

Documentation for any spills/releases, environmental reports or off-site transfers may be requested by the Contracting Officer.

1.4.12 Storm Water Pollution Prevention Plan (SWPPP)

Prepare and implement a Storm Water Pollution Prevention Plan (SWPPP) to meet the requirements of the State of Mississippi general permit for storm water discharges from construction sites.

Submit the SWPPP along with any required Notice of Intents (NOI), via the Contracting Officer, to the appropriate State agency for approval, a minimum of 20 calendar days prior to the start of construction.
The approved SWPPP shall become a part of the Environmental Protection Plan prescribed elsewhere in this section and shall be kept at the construction on-site office. Continually update the SWPPP as regulations require to reflect current site conditions.

Submit Notice of Termination (NOT), via the Contracting Officer, to the appropriate State agency for approval, after completion of soil disturbing activities and final stabilization is achieved, but prior to final acceptance.

1.4.12.1 Erosion and Sediment Control Inspection Reports

Submit "Erosion and Sediment Control Inspection Reports" (copies of the form is attached at the end of this section or base specific forms will be provided at the pre-construction conference) to the Contracting Officer once every 7 calendar days and within 24 hours of a storm event that produces 0.5 inch or more of rain.

1.4.13 Disposal Documentation for Hazardous and Regulated Waste

Submit a copy of the applicable EPA and State permit(s), manifest(s), or license(s) for transportation, treatment, storage, and disposal of hazardous and regulated waste by permitted facilities.

1.5 ENVIRONMENTAL RECORDS BINDER

Maintain on-site, a separate three-ring binder(s) with approved copies of all submittals required in this section and submit at the completion of construction.

1.6 CLASS I ODS PROHIBITION

Class I ODS as defined and identified herein will not be used in the performance of this contract, nor be provided as part of the equipment. This prohibition will be considered to prevail over any other provision, specification, drawing, or referenced documents.

1.7 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with Federal, State, and local regulations pertaining to the environment, including water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution.

Each Contractor and Sub-contractor performing construction work on this project shall complete "Environmental Compliance Assessment Training and Tracking System (ECATTS)" training. This training is web-based and can be accessed from any computer with Internet access using the following instructions. NOTE: Prior to registration and completion of training the Contractor or Sub-Contractor Company Name and Contract Number must be in the training database. Contractors shall submit a list of Company Names of all sub-contractors (Contractor and Sub-Contractor Company Name list) doing work on this Contract Number to the Contracting Officer immediately after award of a contract. This list shall be updated and re-submitted as sub-contracts are awarded.

NAVFAC Southeast's Environmental Compliance Assessment and Training System HOW TO REGISTER FOR NAVFAC Construction TRAINING

Log on to http://icldnv.ecatts.com/At the Welcome page, click Enter In the New Users box, enter the registration password: efdsouth Click Create an Account Step 1 -Your Name and Contact Information: Enter the requested information (please include an e-mail address if you have one in case you forget your password and to get notification of updated training) and click Next Step Step 2 -Next Step Account Information: Enter the requested information and click Step 3 -User Type From the drop down menu, select ROICC Training click Next Step Select the NAVFAC Construction User Type that describes the type work that your company is performing on this contract click Next Step Step 4 -Organizational Information From the drop down menu, select the ROICC Office managing your contract From the drop down menu, select your Company Name Enter your employee ID (optional - DO NOT ENTER your

Social Security No.) click Next Step Step 5 -User Agreement: Read the User Agreement and click I Agree Complete Registration On the next screen, click Continue You will be directed to the Log In page. You can now log in to the ECATT system using the User ID and password you selected in Step 1 and begin the training by clicking on Go To My Training Modules.

Personnel in the positions listed below shall complete ECATTS Training prior to starting their respective portions of on-site work under this contract. If personnel changes occur for any of these positions after starting work, replacement personnel shall complete ECATTS training within 14 days of assignment to the project.

Prime Contractor

Project Manager

Project Superintendent

Quality Control Manager

Environmental Manager (as specified in this specification)

Sub-Contractors

Project Manager (or equivalent office person)

Superintendent (or equivalent job-site person)

The Contractor and each subcontractor performing work on this project shall have a letter on file in the Environmental Records binder at the job site certifying that all required personnel have completed this training. This training has been structured to allow contractors to receive credit under this contract for ECATTS training from previous NAVFAC Southeast construction contracts containing these requirements and also to carry forward credit to future contracts. Contractors or sub-contractors shall ensure that all personnel review their training plans for new modules or updated training requirements prior to beginning work. Some training modules are tailored for specific State regulatory requirements, therefore, Contractors working in multiple states will be required to re-take modules tailored to the state where the contract work is being performed.

1.7.1 Facility Hazardous Waste Generator Status

The Navy SOF Facilities, Stennis Space Center, Mississippi is designated as a Small Quantity Generator. All work conducted within the boundaries of this activity must meet the regulatory requirements of this generator designation. The Contractor will comply with all provisions of Federal, State and local regulatory requirements applicable to this generator status regarding training and storage, handling, and disposal of all construction derived wastes.

1.7.2 Licenses and Permits

Obtain licenses and permits pursuant to the "Permits and Responsibilities" FAR Clause except for the following permits which will be obtained by the Contracting Officer:
None

For Contractor obtained permits, submit all permit applications, via the

Contracting Officer, to the applicable Federal, State, or Local agency.

The Contractor shall submit start of construction notifications, perform quality control inspections of the work in progress, and submit construction completion certifications to the applicable regulatory agency, via the Contracting Officer, for all permits, including those obtained by the government.

The inspections and construction completion certifications shall be provided through the services of a Professional Engineer, registered in the State where the work is being performed. The Certifying Engineer shall prepare a Field Report for each inspection and submit to the Contracting Officer as an attachment to the Contractors Production Report.

Each permit shall be a Definable Feature of Work (DFOW) and shall be included in the Network Analysis Schedule. The scheduled activities shall include, but not be limited to, application preparation and submission, government review and agency processing time, regulatory notifications, Certifying Engineer inspections, and construction completion certification submission.

1.7.3 Contractor Liabilities for Environmental Protection

The Contractor is advised that this project and the station are subject to Federal, State, and local regulatory agency inspections to review compliance with environmental laws and regulations. The Contractor shall fully cooperate with any representative from any Federal, State or local regulatory agency who may visit the job site and shall provide immediate notification to the Contracting Officer, who will accompany them on any subsequent site inspections. The Contractor shall complete, maintain, and make available to the Contracting Officer, station, or regulatory agency personnel all documentation relating to environmental compliance under applicable Federal, State and local laws and regulations. The Contractor shall immediately notify the Contracting Officer if a Notice of Violation (NOV) is issued to the Contractor.

The Contractor shall be responsible for all damages to persons or property resulting from Contractor fault or negligence as well as for the payment of any civil fines or penalties which may be assessed by any Federal, State or local regulatory agency as a result of the Contractor's or any subcontractor's violation of any applicable Federal, State or local environmental law or regulation. Should a Notice of Violation (NOV), Notice of Noncompliance (NON), Notice of Deficiency (NOD), or similar regulatory agency notice be issued to the Government as facility owner/operator on account of the actions or inactions of the Contractor or one of its subcontractors in the performance of work under this contract, the Contractor shall fully cooperate with the Government in defending against regulatory assessment of any civil fines or penalties arising out of such actions or inactions.

1.8 ENVIRONMENTAL MANAGER

The Contractor shall appoint in writing an Environmental Manager for the project site. The Environmental Manager shall be directly responsible for coordinating contractor compliance with Federal, State, local, and activity environmental requirements. This can be a collateral position with the Site Safety and Health Officer; however the person in this position must be trained to adequately accomplish the following duties:

The Environmental Manager shall implement the Environmental Protection Plan; ensure that all environmental permits are obtained, complied with, and closed out; ensure compliance with Storm Water Management regulations and inspection requirements; ensure compliance with Hazardous Materials storage, handling, and reporting requirements; and shall coordinate any remediation of regulated substances (lead, asbestos, PCB, etc).

The Environmental Manager shall ensure waste segregation and storage compatibility requirements are met; ensure compliance with Hazardous Waste identification, handling, storage, manifesting, and disposal requirements; inspect and manage Waste Accumulation areas, if required; ensure only authorized personnel add wastes to containers; ensure all Contractor personnel are trained in 40 CFR requirements in accordance with their position requirements; and coordinate removal of waste containers.

The Environmental Manager shall maintain the Environmental Records binder.

1.9 ENVIRONMENTAL PROTECTION PLAN

Meet with the Contracting Officer to discuss the proposed Environmental Protection Plan and develop a mutual understanding relative to the details of environmental protection, including measures for protecting natural resources, required reports, and other measures to be taken. The Environmental Protection Plan will be submitted in the following format and will, at a minimum, address the following elements (also refer to paragraph entitled "Protection of Natural Resources" in this section):

a. Description of the Environmental Protection Plan

(1) General overview and purpose

(2) General site information, include Pre-Construction site survey

(3) A letter signed by an officer of the firm appointing the Environmental Manager and stating that he/she is responsible for managing and implementing the Environmental Program as described in this contract. Include in this letter the

Environmental Manager's authority to direct the removal and replacement of non-conforming work.

b. Protection of Natural Resources

(1) Land resources

(2) Tree protection

(3) Replacement of damaged landscape features

(4) Temporary construction

(5) Stream crossings

(6) Fish and wildlife resources

(7) Wetland areas

c. Protection of Historical and Archaeological Resources

(1) Objectives

(2) Methods

d. Storm Water Management and Control, address the following as a minimum:

(1) Ground cover

(2) Erodible soils

(3) Temporary measures

(a) Mechanical retardation and control of runoff

(b) Vegetation and mulch

(c) Sediment Basins

(4) Include the approved Stormwater Pollution Prevention Plan(SWPPP), prescribed elsewhere in this section, here. The plan shall follow the appropriate regulatory agency format and contain, at a minimum, the following:

(a) Description of the site and potential sources of pollution which may be reasonably expected to affect the quality of storm water discharge from the site.

(b) A map showing site drainage, discharge points, location of control measures.

(c) Describe the control measures to be used. Use "Best Management Practices" (BMP) from EPA 832-R-92-005

(d) Describe the inspection procedures and reports.

(e) Describe maintenance procedures for control measures during the life of the contract.

e. Dirt and Dust Control
Include the approved Dirt and Dust Control Plan here.

f. Prevention of Spills and Releases to the Environment
(1) Procedures to prevent spills and releases to the environment
(2) Notifications in the event of a spill or release to the environment

g. Pollution Prevention and Hazardous Waste minimization
(1) Procedures to reduce potential for Hazardous Waste generation.
(2) Protection of the Environment from Waste generated during Construction/Renovation and Demolition Operations

h. Control and disposal of solid waste

i. Control and disposal of construction and demolition debris

j. Control and disposal of Hazardous Waste, Universal Waste, and Hazardous Construction and Demolition Debris (see Hazardous Waste Management Section). This item shall consist of the management procedures for all hazardous waste

to be generated. As a minimum, include the following:

(1) Procedures to be employed to ensure a written waste stream determination or waste profile is made for all wastes which are to be generated

(2) Sampling/analysis plan for waste stream determination

(3) Methods of accumulation (i.e., in tanks and/or containers) and designation of individual responsible for waste accumulation sites

(4) Management procedures for identification, storage, labeling,transportation, and disposal of hazardous waste and universal waste (treatment of waste is not allowed unless specifically noted)

(5) Management procedures and regulatory documentation ensuring disposal of hazardous waste complies with Land Disposal Restrictions (40 CFR 268)

(6) Management procedures for recyclable hazardous materials

(7) Used oil and used oil filter management procedures in accordance with 40 CFR 279

(8) Plans for the disposal of hazardous waste by permitted facilities

(9) Procedures to be employed to ensure all required employee training records are maintained

k. Control and disposal of Industrial Waste, including petroleum contaminated waste

l. Control and disposal of Regulated Waste

1.9.1 Environmental Protection Plan Review

Fourteen days after the environmental protection plan meeting, submit the proposed Environmental Protection Plan for further discussion, review, and approval. Commencement of work will not begin until the environmental protection plan has been approved.

1.10 UNFORESEEN HAZARDOUS OR REGULATED MATERIAL

All known hazardous or regulated materials are indicated in the contract documents. If material that is not indicated in the contract documents is encountered that may be dangerous to human health upon disturbance during construction operations, stop that portion of work and notify the Contracting Officer immediately. Intent is to identify materials such as PCB, lead paint, mercury, petroleum products, and friable and non-friable asbestos. Within 14 calendar days the Government will determine if the material is hazardous. If the material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If the material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to"FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore to an equivalent or improved condition upon completion of work. Confine construction activities to within the limits of the work indicated or specified.

3.1.1 Land Resources

Except in areas to be cleared, do not remove, cut, deface, injure, or destroy trees or shrubs without the Contracting Officer's permission. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages unless authorized by the Contracting Officer. Where such use of attached ropes, cables, or guys is authorized, the Contractor will be responsible for any resultant damage.

3.1.1.1 Protection of Trees

Protect existing trees, which are to remain and which may be injured, bruised, defaced, or otherwise damaged by construction operations. Remove displaced rocks from uncleared areas. By approved excavation, remove trees with 30 percent or more of their root systems destroyed.

3.1.1.2 Replacement

Remove trees and other landscape features scarred or damaged by equipment operations, and replace with equivalent, undamaged trees and landscape features. Obtain Contracting Officer's approval before replacement.

3.1.2 Water Resources

3.1.2.1 Stream Crossings

The Contracting Officer's approval is required before any equipment will be permitted to ford live streams. In areas where frequent crossings are required, install temporary culverts or bridges. Obtain Contracting Officer's approval prior to installation. Remove temporary culverts or bridges upon completion of work, and repair the area to its original condition or as indicated or as specified.

3.1.2.2 Oily and Hazardous Substances

Prevent oil or hazardous substances from entering the ground, drainage areas, or navigable waters. In accordance with 40 CFR 112, surround all temporary fuel oil or petroleum storage tanks with a temporary berm or containment of sufficient size and strength to contain the contents of the tanks, plus 10 percent freeboard for precipitation. The berm will be impervious to oil for 72 hours and be constructed so that any discharge will not permeate, drain, infiltrate, or otherwise escape before cleanup occurs.

3.1.3 Fish and Wildlife Resources

Do not disturb fish and wildlife. Do not alter water flows or otherwise significantly disturb the native habitat adjacent to the project and critical to the survival of fish and wildlife, except as indicated or specified.

3.2 HISTORICAL AND ARCHAEOLOGICAL RESOURCES

Carefully protect in-place and report immediately to the Contracting Officer historical and archaeological items or human skeletal remains discovered in the course of work. Stop work in the immediate area of the discovery until directed by the Contracting Officer to resume work. The Government retains ownership and control over historical and archaeological resources.

3.3 EROSION AND SEDIMENT CONTROL MEASURES

3.3.1 Burnoff

Burnoff of the ground cover is not permitted.

3.3.2 Protection of Erodible Soils

Immediately finish the earthwork brought to a final grade, as indicated or specified. Immediately protect the side slopes and back slopes upon completion of rough grading. Plan and conduct earthwork to minimize the duration of exposure of unprotected soils.

3.3.3 Temporary Protection of Erodible Soils

Use the following methods to prevent erosion and control sedimentation:

3.3.3.1 Mechanical Retardation and Control of Runoff

Mechanically retard and control the rate of runoff from the construction site. This includes construction of diversion ditches, benches, berms, and use of silt fences and straw bales to retard and divert runoff to protected drainage courses.

3.3.3.2 Vegetation and Mulch

Provide temporary protection on sides and back slopes as soon as rough grading is completed or sufficient soil is exposed to require erosion protection. Protect slopes by accelerated growth of permanent vegetation, temporary vegetation, mulching, or netting. Stabilize slopes by hydro seeding, anchoring mulch in place, covering with anchored netting, sodding, or such combination of these and other methods necessary for effective erosion control.

3.4 CONTROL AND DISPOSAL OF SOLID WASTES

Pick up solid wastes, and place in covered containers which are regularly emptied. Do not prepare or cook food on the project site. Prevent contamination of the site or other areas when handling and disposing of wastes. At project completion, leave the areas clean. Recycling is encouraged and can be coordinated with the Contracting Officer and the activity recycling coordinator. Remove all solid waste from Government property and dispose off-site at an approved location or facility. Solid waste disposal off-site must comply with the most stringent local, State, or Federal requirements including 40 CFR 241, 40 CFR 243, and 40 CFR 258.

3.4.1 Dumpsters

Equip dumpsters with a secure cover. Keep cover closed at all times, except when being loaded with trash and debris. Locate dumpsters behind the construction fence or out of the public view. Empty site dumpsters at least

once a week or as needed to keep the site free of debris and trash. If necessary, provide 55 gallon trash containers to collect debris in the construction site area. Locate the trash containers behind the construction fence or out of the public view. Empty trash containers at least once a day. For large demolitions, large dumpsters without lids are acceptable but should not have debris higher than the sides before emptying.

3.5 CONTROL AND DISPOSAL OF HAZARDOUS WASTES

3.5.1 Hazardous Waste/Debris and Universal Waste Management

The Contractor shall identify all construction activities which will generate hazardous waste, hazardous construction and demolition debris, and universal wastes. The Contractor shall provide a documented waste determination for all resultant waste streams. Hazardous waste, hazardous c&d debris, and universal wastes shall be identified, labeled, handled, stored, and disposed of in accordance with all Federal, State, and local regulations, including 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40CFR 265, 40 CFR 266, and 40 CFR 268.

Hazardous waste shall also be managed in accordance with the approved "Control and Disposal of Hazardous Waste, Universal Waste, and Hazardous Construction and Demolition Debris" Section of the Environmental Protection Plan. Store hazardous wastes in approved containers in accordance with 49CFR 173 and 49 CFR 178. Hazardous waste generated within the confines of Government facilities shall be identified as being generated by the Government. Prior to Contractor removal of any hazardous waste from Government property, all hazardous waste manifests must be signed by activity personnel from the Station Environmental Office. No hazardous waste shall be brought onto Government property.

Provide to the Contracting Officer a copy of waste stream determination documentation or waste profile for any solid waste streams that have any potential to be hazardous waste or contain any chemical constituents listed in 40 CFR 372-SUBPART D. For hazardous wastes spills, verbally notify the Contracting Officer immediately.

3.5.1.1 Hazardous Waste/Industrial Waste/Regulated Waste Storage Areas

If the work requires the temporary storage/collection of regulated or hazardous wastes, the Contractor shall request the establishment of a Regulated Waste Storage Area, a Satellite Accumulation Area, or a 90 Day Storage Area at the point of generation. The Contractor shall submit a request in writing to the Contracting Officer providing the following information:

Contract Number _____ Contractor _____
Responsible Individual _____ Phone Number _____
Type of Waste _____ Source of Waste _____
Emergency POC _____ Phone Number _____
Location of the Site:

(Attach Site Plan to the Request)

Attach a waste stream determination form or waste profile. Allow ten working days for processing this request.

3.6 CONTROL AND DISPOSAL OF INDUSTRIAL WASTES

3.6.1 Industrial Waste Management

The Contractor shall identify all construction activities which will generate industrial waste. The Contractor shall provide a documented waste stream determination or waste profile for all resultant waste streams. Industrial waste shall be identified, labeled, handled, stored, and disposed of in accordance with all Federal, State, and local regulations. Industrial waste shall also be managed in accordance with the approved "Control and Disposal of Industrial Waste" Section of the Environmental Protection Plan. Store industrial waste in approved containers. Industrial waste generated within the confines of Government facilities shall be identified as being generated by the Government. Prior to Contractor removal of any industrial waste from Government property, all shipping documents must be signed by activity personnel from the Base Environmental Office. No industrial waste shall be brought onto Government property. Provide to the Contracting Officer a copy of waste stream determination documentation or waste profile for any solid waste streams that have any potential to be industrial waste. For industrial waste spills, verbally notify the Contracting Officer immediately.

3.7 CONTROL AND DISPOSAL OF REGULATED WASTES

3.7.1 Regulated Waste Management

The Contractor shall identify all construction activities, which will generate regulated waste. The Contractor shall provide a documented waste stream determination or waste profile for all resultant waste streams. Regulated waste shall be identified, labeled, handled, stored, and disposed of in accordance with all Federal, State, and local regulations. Regulated waste shall also be managed in accordance with the approved "Control and Disposal of Regulated Waste" Section of the Environmental Protection Plan. Store regulated waste in approved containers. Regulated waste generated within the confines of Government facilities shall be identified as being generated by the Government. Prior to Contractor removal of any regulated waste from Government property, all waste shipment records, manifests, or shipping documents must be signed by activity personnel from the Station Environmental Office. No regulated waste shall be brought onto Government property. Provide to the Contracting Officer a copy of waste stream determination documentation or waste profile for any solid waste streams that have any potential to be regulated waste. For regulated waste spills, verbally notify the Contracting Officer immediately.

3.8 POLLUTION PREVENTION AND HAZARDOUS WASTE MINIMIZATION

The Contractor shall actively pursue minimizing the use of hazardous materials and the generation of hazardous waste while on base. The Environmental Protection Plan shall include the Contractor's procedures for pollution prevention and hazardous material minimization. For preparing this part of the plan, the Contractor may request information from the Contracting Officer and obtain a copy of the activity's pollution prevention and hazardous material minimization plan for reference material. The Contractor shall describe the types of the hazardous materials expected to be used in the construction when requesting information.

3.9 PETROLEUM PRODUCTS

Conduct the fueling and lubricating of equipment and motor vehicles in a manner that protects against spills and evaporation. All used oil generated on site will be managed in accordance with 40 CFR 279. The Contractor will determine if any used oil generated while on-site exhibits a characteristic

of hazardous waste. In addition, used oil containing 1000 parts per million of solvents will be considered a hazardous waste and disposed of at Contractor's expense. Used oil mixed with a hazardous waste will also be considered a hazardous waste. All hazardous waste will be managed in accordance with the paragraph entitled "Hazardous Waste/Debris and Universal Waste Management" of this section and in accordance with the approved Environmental Protection Plan.

3.10 RELEASES/SPILLS OF OIL AND HAZARDOUS SUBSTANCES

Take precautions to prevent releases/spills of oil and hazardous materials.In the event of any releases of oil and hazardous materials, chemicals, or gases; immediately (within 15 minutes) notify the Base or Activity Fire Department, and the Contracting Officer. The Base Environmental Office shall make verbal and written notifications as required by the federal 40 CFR 355, State, local regulations and Navy Instructions. The Contractor shall collect and provide information as needed to the Contracting Officer. Spill response shall be in accordance with 40 CFR 300 and applicable State and local regulations. Contain and clean up these spills without cost to the Government. If Government assistance is requested or required, the Contractor shall reimburse the Government for such assistance.

3.11 HAZARDOUS MATERIAL CONTROL

The Contractor is required by specification Section 01526, SAFETY AND OCCUPATIONAL HEALTH REQUIREMENTS FOR DESIGN-BUILD, to include hazardous material control procedures in the Accident Prevention Plan. The procedures shall address and ensure the proper handling of hazardous materials, including the appropriate transportation requirements. The Contractor shall also ensure that hazardous materials are utilized in a manner that will minimize the amount of hazardous waste that is generated. The Contractor shall ensure that all containers of hazardous materials have NFPA labels or their equivalent. The Contractor shall certify that all hazardous materials removed from the site are hazardous materials and do not meet the definition of hazardous waste per 40 CFR 261.

3.12 OZONE DEPLETING SUBSTANCES CONTROL AND MANAGEMENT

Prevent discharge of Class I and Class II ODS to the atmosphere.

3.12.1 Air Conditioning Equipment

Remove air conditioning equipment identified for removal without releasing chlorofluorocarbon refrigerants to the atmosphere in accordance with the Clean Air Act Amendment of 1990.

Recover all refrigerants prior to removing air conditioning equipment and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)". Turn in salvaged Class I ODS refrigerants as specified in paragraph, "Turn-In Of Class I ODS".

3.12.2 Cylinders and Canisters

Remove all fire suppression system cylinders and canisters and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

3.12.3 Disposal of Ozone Depleting Substance (ODS)

Remove and capture all Class I ODS refrigerants in accordance with the Clean Air Act Amendment of 1990, and turn in to the Navy by shipping the refrigerant container to the Defense Logistics Agency at the following address:

Defense Depot Richmond VA (DDVA)
SW0400
Cylinder Operations
800 Jefferson Davis Highway
Richmond, VA 23297-5000

3.12.3.1 Special Instructions

Each container shall have in it no more than one type of ODS. A warning/hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

a. Activity name and unit identification code

b. Activity point of contact and phone number

c. Type of ODS and pounds of ODS contained

d. Date of shipment

e. Naval stock number (for information, call (804) 279-4525)

3.12.3.2 Fire Suppression Containers

Fire suppression system cylinders and canisters with electrical charges or initiators shall be deactivated prior to shipment. Also, safety caps shall be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

3.12.3.3 Transportation Guidance

Shipment of all ODS containers shall be in accordance with MIL-STD-129, DLA 4145.25 (also referenced one of the following: Army Regulation 700-68, Naval Supply Instruction 4440.128C, Marine Corps Order 10330.2C, and Air Force Regulation 67-12), 49 CFR 173.301, and DOD 4000.25-1-M.

3.13 DUST CONTROL

Keep dust down at all times, including during nonworking periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming will not be permitted. Instead, use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing will be permitted only for cleaning nonparticulate debris such as steel reinforcing bars. Only wet cutting will be permitted for cutting concrete blocks, concrete, and bituminous concrete. Do not unnecessarily shake bags of cement, concrete mortar, or plaster.

3.14 ABRASIVE BLASTING

3.14.1 Blasting Operations

The use of silica sand is prohibited in sand blasting.

Provide tarpaulin drop cloths and windscreens to enclose abrasive blasting operations to confine and collect dust, abrasive, agent, paint chips, and other debris. Perform work involving removal of hazardous material in accordance with 29 CFR 1910.

3.14.2 Disposal Requirements

Submit analytical results of the debris generated from abrasive blasting operations per paragraph entitled Laboratory Analysis of this section. Hazardous waste generated from blasting operations will be managed in accordance with paragraph entitled "Hazardous Waste/Debris and Universal Waste Management" of this section and with the approved Environmental Protection Plan. Disposal of non-hazardous abrasive blasting debris will be in accordance with paragraph entitled, "Control and Disposal of Solid Wastes" of this section.

3.15 NOISE

Make the maximum use of low-noise emission products, as certified by the EPA. Blasting or use of explosives will not be permitted without written permission from the Contracting Officer, and then only during the designated times. Confine pile-driving operations to the period between 8 a.m. and 4 p.m., Monday through Friday, exclusive of holidays, unless otherwise specified.

-- End of Section --

SECTION 01571N
ADDITIONAL TEMPORARY CONTROLS
03/06

PART 1 GENERAL

1.1 CITIZENSHIP

All employees working at Stennis Space Center, MS shall be citizens of the United States.

1.2 PERSONNEL AND VEHICLE ACCESS

The Contractor shall be required to obtain Contractor tradesman passes for all personnel to access the Installation and Government property. Provide a list of employees (prime and subcontractors) on company letterhead for clearance into the project work area. The list shall be provided to the Contracting Officer a minimum of 5 working days prior to scheduled work to be performed. Additionally, the list shall be maintained and updated a minimum of 5 working days prior to the time new employees need access to the jobsite. The list shall contain the contract number and the full employee name, date of birth, place of birth, and citizenship of each employee.

The Contractors request for badges shall be given to the Contracting Officer or his representative prior to issuance of any badges and passes. All persons shall show one proof of identification (pictured driver's license, pictured State ID card, birth certificate, U.S. Citizenship certificate). It is the Contractor's responsibility to provide any modifications and/or request changes to the request for badges as conditions change. The Contractor is responsible for and shall ensure the return of all passes/badges to the Contracting Officer upon termination of contract and/or changes in employment. All Contractor employees shall wear passes on the front left-hand side of the outer garment, between the shoulder and the waistline so it is plainly visible at all times while entering, working on, and departing the Installation. Failure to display passes is considered a violation of Base Security Regulations and will result in their confiscation. Repeated violations may result in permanent debarment from the Installation. Pass processing lasts approximately fifteen minutes per individual. However, the Security Pass and ID Office processes individuals on a first-come, first-served basis. Processing might be delayed. All Contractor-owned vehicles shall be marked with their Company name at all times while entering, operating on, or departing the Installation. For those Contractor personnel needing a badge for longer than 180 total days, additional information is required. The Contracting Officer will provide this information/guidance to the Contractor.

1.3 HAZARDOUS OPERATIONS PERMIT

Prior to performing any "hot work" (welding, burning, lead melting, blow torches, tar pots, and similar flame producing operations), obtain a Hazardous Operations Permit from the Station Fire Department, via the Contracting Officer.

PART 2 PRODUCTS Not used.

PART 3 EXECUTION Not used.

-- End of Section --

SECTION 01 62 35
RECYCLED / RECOVERED MATERIALS
12/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 247 Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2 OBJECTIVES

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. EPA designated products specified in this contract comply with the stated policy and with the EPA guidelines. The Contractor shall make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

1.3 EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Various sections of the specifications contain requirements for materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials. These items, when incorporated into the work under this contract, shall contain at least the specified percentage of recycled or recovered materials unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the designated item requirements apply only if the designated item is used in the work.

1.4 EPA PROPOSED ITEMS INCORPORATED IN THE WORK

Products other than those designated by EPA are still being researched and are being considered for future Comprehensive Procurement Guideline (CPG) designation. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

1.5 EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

There are many products listed in 40 CFR 247 which have been designated or proposed by EPA to include recycled or recovered materials that may be used

by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTIION

Not used.

-- End of Section --

SECTION 01 74 19.05 20
CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT FOR DESIGN-BUILD
10/05

PART 1 GENERAL

1.1 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction, and use of facilities. As part of the implementation of that policy the Contractor shall: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from land fills and incinerators and to facilitate their recycling or reuse.

1.2 PLAN

A waste management plan shall be submitted within 15 days after notice to proceed and prior to initiating any site preparation work. The plan shall include the following:

a. Name of individuals on the Contractor's staff responsible for waste prevention and management.

b. Actions that will be taken to reduce solid waste generation.

c. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas and equipment to be used for processing, sorting, and temporary storage of wastes.

d. Characterization, including estimated types and quantities, of the waste to be generated.

e. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.

f. Identification of local and regional reuse programs, including nonprofit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity.

g. List of specific waste materials that will be salvaged for resale, salvaged and reused, or recycled. Recycling facilities that will be used shall be identified.

h. Identification of materials that cannot be recycled/reused with an explanation or justification.

i. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

1.3 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. The records shall be

made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction.

1.4 DISPOSAL

Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

1.4.1 Reuse

First consideration shall be given to salvage for reuse since little or nore-processing is necessary for this method, and less pollution is created when items are reused in their original form. Sale or donation of waste suitable for reuse shall be considered. Salvaged materials, other than those specified in other sections to be salvaged and reinstalled, shall not be used in this project.

1.4.2 Recycle

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling whenever economically feasible.

1.4.3 Waste

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 78 24 05 20
FACILITY OPERATION AND MAINTENANCE SUPPORT INFORMATION
11/05

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

This section provides the requirements for operation and maintenance support information (OMSI). OMSI contains detailed as-built information describing the efficient, economical and safe operation and maintenance, and repair of the facility. OMSI is provided as hard copy, manuals, .pdf files, and computerized maintenance management system (CMMS) data. The OMSI is to be factual, concise, comprehensive and written to be easily used by maintenance personnel. Descriptive matter and theory must include technical details that are essential for a comprehensive understanding of the operation, maintenance and repair of the system. The OMSI preparer shall ensure that OMSI reflect changes to systems and equipment, made during construction. The words "system", "systems", and "equipment", when used in this document refer to as-built systems and equipment.

1.1.1 Organization of OMSI

Prepare the OMSI in three parts. PART I - Facility Information, PART II -Primary Systems Information, and PART III - Product Data. Cross-referencing within or between OMSI Parts must be specific.

1.1.2 Sources of Data

The sources of data needed to prepare the OMSI include but are not limited to, the design plans and specifications, field visits, approved construction submittals and manufacturer's catalog data for materials, methods, and systems used in this contract.

1.2 SUBMITTALS

The use of a "G" following a submittal indicates that a Government approval/action is required. Submit the following in accordance with Section 01 33 10.05 20 DESIGN SUBMITTAL PROCEDURES and Section 01 33 00.05 20 CONSTRUCTION SUBMITTAL PROCEDURES.

SD-06 Test Reports

Validation Site Visit and Presentation; G

SD-11 Closeout Submittals

OMSI, Preliminary Submittal; G

OMSI, 100% -Prefinal Submittal; G

OMSI, Final Submittal; G 1.3 SUBMITTAL FORMAT

1.3.1 Hard Copies

Bind the OMSI in durable, hard cover, three-ring, water and grease resistant binders, which hold 8.5" X 11" sheets. Binders shall have clear pockets

located on the front and on the spine that hold printed sheets. Parts I, II, and III are separate binders with white, blue, and red spine inserts (respectively). Use high quality paper and dividers of heavy-duty paper with plastic reinforced holes and integrated tabs. Tabs must be of varying size and color to distinguish organization. Use plain tabs to show the UNIFORMAT II number and title in Part III, Product Data. Provide a Master Table of Contents for each OMSI binder. Identify each binder on both the cover insert sheet and the spine insert sheet with the following information:

1. 1. OMSI Part I, II or III with appropriate titles

2. 2. Building Number

3. 3. Project Title

4. 4. Activity and Location

5. 5. Construction Contract Number

6. 6. Prepared For: (Contracting Agency)

7. 7. Prepared By

8. 8. Volume Number - Each binder is a single volume. Number each volume consecutively.

1.3.2 Electronic Format (PDF)

Provide the OMSI on Compact Disk using Adobe Acrobat 5.0 or similar software capable of producing PDF (Portable Document Format) files. The PDF file is duplicate of the hard copy format. The PDF files shall be indexed by part(Facility Information, Primary Systems Information, and Product Data) and each entry identified in the table of contents.

1.3.3 Computerized Maintenance Management System (CMMS) Data
Provide data in format that can be imported into Single Platform Maximo CMMS.

1.4 SUBMITTAL REQUIREMENTS

1.4.1 Preliminary Submittal

Submit the Preliminary submittal when construction is 50% complete. Provide two hard copies to the Contracting Officer. Present the submittal in sufficient detail to evaluate the data collection and arrangement process. One of these copies, reviewed by the Contracting Officer, with review comments, will be returned to the Contractor for preparation of the 100% submittal. Include in the submittal, as a minimum, all available Part I, Facility Information; all systems of Part II, Primary Systems Information(at least one system shall be essentially complete and the remaining systems shall be at least 50% complete); and at least two divisions of Part III, Product Data.

1.4.2 100% - Prefinal Submittal

Provide two hard copies to the Contracting Officer. The 100% - Prefinal submittal is due 30 days prior to Beneficial Occupancy Date (BOD). This submittal shall be a complete, working document that can be used to operate and maintain the facility.

1.4.3 Final Submittal

Provide two hard copies and two sets of electronically formatted information to the Contracting Officer. The final submittal is due 90 days after BOD.

PART 2 PRODUCTS

2.1 DESCRIPTION OF WORK

2.1.1 OMSI Part I - Facility Information

.a. General Facility and System Description - Describe the function of the facility. Detail the overall dimensions of the facility, number of floors, foundation type, expected number of occupants, and facility Category Code. List and generally describe all the facility systems listed in Part II, Primary Systems Information and any special building features (for example, HVAC Controls, Sprinkler Systems, cranes, elevators, and generators). Include photographs marked up and labeled to show key operating components and the overall facility appearance.Include a copy of the final "Completion Certification" which certifies completion and compliance of construction by the Contractor. This documentation will be provided by the Construction Quality Control Manager.

b. Basis of Design - Include the Basis of Design that shows the basic design scope of work, assumptions and the original intentions of the design A/E. Include a copy of the final "Design Quality Control Report Certification" which verifies conformance of the project design to the Request for Proposal. This documentation shall be provided by The Design Quality Control Manager, or the EIC.

c. Safety Hazards - List all residual hazards identified in the Requirements Hazard Analysis as prepared by the design A/E. Provide recommended safeguards for each identified hazard.

d. Floor Plans - Provide uncluttered, legible 11" x 17" floor plans. Include only room numbers, type or function of spaces, and overall facility dimensions on the floor plans. Do not include construction instructions, references, frame numbers, etc.

e. Utility Connection and Cutoff Plans - Provide utility site plans and floor plans that indicate the main interior and exterior connection and cutoff points for all utilities. Include enough information to enable someone unfamiliar with the facility to locate the connection and cutoff points. Indicate the room number, panel number, circuit breaker, valve number, etc., of each connection and cutoff point, and what that connection and cutoff point controls. These plans are in addition to Floor plans.

f. Equipment Warranty Tags and Guarantor's Local Representative - Provide with each warranty the name, address, and telephone number of the guarantor's representative nearest to the location where the equipment and appliances are installed. The guarantor's representative, upon request of the station representative, shall honor the warranty during the warranty period, and shall provide the services prescribed by the terms of the warranty. At the time of installation, tag each item of warranted equipment with a durable, oil- and water-resistant tag approved by the Contracting Officer. Attach tag with copper wire and spray with a clear silicone waterproof coating. Leave the date of acceptance and QC's signature blank until project is accepted for beneficial occupancy. Tag shall show the

following information:

EQUIPMENT/PRODUCT WARRANTY TAG

Type of Equipment/Product _____

Warranty Period _____ From _____ To _____

Contract No. _____

Inspector's Signature _____ Date Accepted

Contractor:

Name: _____

Address: _____

Telephone: _____

Warranty Contact: _____

Name: _____

Address: _____

Telephone: _____

STATION PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE

g. Extended Warranty Information - List and include copies of all warranties for products, equipment, components, and subcomponents whose duration exceeds one year. Cross-reference the list to the warranty copies included in Part III, Product Data. For each warranty listed indicate the applicable specification section, duration, start date, end date, and the point of contact for warranty fulfillment. Also, list or reference all specific operation and maintenance procedures that must be performed to keep the warranty valid.

h. Equipment and Warranty Tags Listing - Provide a table that lists the major equipment shown on the design equipment schedules and written warranties for equipment/products provided. Show the item descriptions, warranty information, locations, model numbers; and the names, addresses, and telephone numbers of the manufacturers, suppliers ,contractor and subcontractors.

i. HVAC Filters - Provide a table that lists the quantity, type, size, and location of each HVAC filter.

j. Floor Coverings, Wall Surfaces, Ceiling Surfaces - Provide a table that lists by room number (including hallways and common spaces), the type, and area of finish. The table will include a facility summary of the total area for each type of space and floor, wall, or ceiling finish.

k. Windows - Provide a table that lists by room number (including hallways and common spaces), the type of window, window size, number of each size and type, and special features. The table will include a facility summary of the total number for each type and size of window.

l. Light Fixtures - Provide a table that lists by room number (including hallways and common spaces), type of light fixture, number of light fixtures, type of bulbs or tubes, and number of bulbs or tubes. The table will include a facility summary of the total number of fixtures of each type and number of bulbs or tubes of each type.

m. Plumbing Fixtures - Provide a table that lists by room number, the number and type of plumbing and bathroom plumbing fixtures (for example, sinks, toilets, urinals, showers and drinking fountains).

n. Roofing - Provide the total area of each type of roof surface and system. Provide the name of the roofing product and system; manufacturer's, supplier's, and installer's names, addresses, and phone numbers. For each type of roof, provide a recommended inspection, maintenance and repair schedule that details checkpoints, frequencies, and prohibited practices. List roof structural load limits.

2.1.2 Part II - Primary Systems Information

OMSI Part II, Primary Systems Information requires using a systems approach. This approach requires that consideration be given to the entire system (that is, the interfaces of equipment, connections and material flow within the system). Use Notes, Cautions and Warnings throughout the Part II, Primary Systems Information to emphasize important and critical instructions and procedures.

OMSI Part II, Primary Systems Information are required for the primary systems listed below that are applicable and provided for the project;

1. Plumbing systems, including temperature actuated thermostatic water mixing valve

2. HVAC systems, including chillers, boilers, heat pumps, air handling equipment, hot and chilled water pumping system

3. Direct Digital Controls/Space Temperature Controls

4. Fire protection systems, including fire alarm systems and sprinkler systems

5. Security systems, including access control, intrusion detection, and closed-circuit television.

6. Sanitary lift stations, including pumps, valves, controls, and monitoring.

7. Site electrical utilities, including transformers.

For each system, address;

a. Operation

(1) System Description - Provide a detailed discussion of the system composition and operation. Include technical details that are essential for an understanding of the system.

(2) Start-Up and Shutdown Procedures - Provide step by step instructions to bring systems from static to operational configurations and from operating to shutdown status.

(3) Normal and Emergency Operating Instructions - Provide a discussion of the normal and emergency operation and control of the system. Address operating norms (for example, temperatures, pressures, and flow rates) expected at each zone or phase of the system. Supplement the discussion with control and wiring diagrams and data. Include shutdown instruction for fires, explosions, spill, or other contingencies.

(4) System Flow Diagrams - Provide a flow diagram indicating system liquid, air or gas flow during normal operations. Integrate all system components into the diagram. A compilation of non-integrated, flow diagrams for the individual system components are not acceptable.

(5) Diagrammatic Plans - Provide floor plans indicating the location of equipment and configuration of the system installation. Include the configuration of associated piping or wiring. Subordinate structural features to utility features.

(6) Field Test Reports - Provide Field Test Reports (SD-06) that apply to equipment associated with the system.

(7) Operator Servicing Requirements - Provide instructions for services to be performed by the operator such as lubrication, adjustments, and inspection.

(8) Valve List - Provide a list of all valves associated with the system. Show valve type, identification number, function, location and normal operating position.

b. Preventive Maintenance - Preventive Maintenance Procedures, and Schedules - Provide Task Card for each individual maintenance task identified on the PM plan and Schedule. Include detailed PM procedures, safety instructions and precautions including lockout/tag out precautions, required skill level, number of personnel needed, frequency, special tools needed, parts needed, and estimated time required to complete the task. Include lubrication schedules indicating types, grades and capacities.

c. Troubleshooting Guides and Diagnostic Techniques - Provide step by step procedures for isolating the cause of system malfunctions. The procedures shall clearly state indications or symptoms of trouble; the sequential instructions, including checks and tests to be performed and conditions to be sought, to determine the cause; and remedial measures to bring the equipment and system to operating condition. Identify special test equipment required to perform the procedures. Start the troubleshooting guide at the system level and proceed to a level where detailed manufacturer's troubleshooting procedures for equipment and components can be referenced. Provide clear references to repair procedures included in Part III, Product Data.

2.1.3 PART III - Product Data

Provide a record of O&M data, materials, and equipment information used in the facility construction. Include; the O&M data referenced in the Operation & Repair sections of Part II, drawings, illustrations, and technical information furnished by manufacturers for equipment and system components.

PART 3 EXECUTION

3.1 VALIDATION AND PRESENTATION

Provide a validation presentation of the OMSI Prefinal submittal to the users and field verify the OMSI's completeness and accuracy. Perform the validation site visit at the 100% - Prefinal OMSI submittal stage. Contact the Contracting Officer for the exact date.

The Designer Quality Control (DQC) manager shall attend and provide a certifying statement that validation site visit and presentation is complete.

-- End of Section --

SECTION 03 11 14.00 10

FORMWORK FOR CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C 1077 | (2008) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation |
| ASTM C 31/C 31M | (2008a) Standard Practice for Making and Curing Concrete Test Specimens in the Field |
| ASTM C 39/C 39M | (2005e1e2) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens |

1.2 DESIGN REQUIREMENTS

The design, engineering, and construction of the formwork shall be the responsibility of the Contractor. The formwork shall be designed for anticipated live and dead loads and shall comply with the tolerances specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE. However, for surfaces with an ACI Class A surface designation, the allowable deflection for facing material between studs, for studs between walers and walers between bracing shall be limited to 0.0025 times the span. The formwork shall be designed as a complete system with consideration given to the effects of cementitious materials and mixture additives such as fly ash, cement type, plasticizers, accelerators, retarders, air entrainment, and others. The adequacy of formwork design and construction shall be monitored prior to and during concrete placement as part of the Contractor's approved Quality Control Plan.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings

Drawings and design computations for all formwork required shall be submitted at least 7 days either before fabrication on site or before delivery of prefabricated forms. If reshoring is permitted, the method, including location, order, and time of

erection and removal shall also be submitted for review.

SD-03 Product Data

Materials

Manufacturer's literature shall be submitted for form accessories, prefabricated forms, form coating.

SD-04 Test Reports

Inspection

The Contractor shall submit field inspection reports for concrete forms and embedded items.

## 1.4 SHOP DRAWINGS

The shop drawings and data submitted shall include the type, size, quantity, and strength of all materials of which the forms are made, the plan for jointing of facing panels, details affecting the appearance, and the assumed design values and loading conditions.

## 1.5 SAMPLE PANELS

Panels shall be of sufficient size to contain joints and shall be not less than 6 feet long and 4 feet wide. The panels shall be of typical wall thickness and constructed containing the full allocation of reinforcing steel that will be used in the structure, with the forming system that duplicates in every detail the one that will be used in construction of the structure. The same concrete mixture proportion and materials, the same placement techniques and equipment, and the same finishing techniques and timing shall be used that are planned for the structure.

# PART 2 PRODUCTS

## 2.1 MATERIALS

### 2.1.1 Form Coating

Form coating shall be commercial formulation that will not bond with, stain, cause deterioration, or any other damage to concrete surfaces. The coating shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds. If special form liners are to be used, the Contractor shall follow the recommendation of the form coating manufacturer.

## 2.2 ACCESSORIES

Ties and other similar form accessories to be partially or wholly embedded in the concrete shall be of a commercially manufactured type. After the ends or end fasteners have been removed, the embedded portion of metal ties shall terminate not less than 2 inches from any concrete surface either exposed to view or exposed to water. Plastic snap ties may be used in locations where the surface will not be exposed to view. Form ties shall be constructed so that the ends or end fasteners can be removed without spalling the concrete.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Form Construction

Forms shall be constructed true to the structural design and required alignment. The form surface and joints shall be mortar tight and supported to achieve safe performance during construction, concrete placement, and form removal. The Contractor shall continuously monitor the alignment and stability of the forms during all phases to assure the finished product will meet the required specified tolerances specified in paragraph DESIGN REQUIREMENTS. Failure of any supporting surface either due to surface texture, deflection or form collapse shall be the responsibility of the Contractor as will the replacement or correction of unsatisfactory surfaces. When forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be re-used if there is any evidence of defects which would impair the quality of the resulting concrete surface. All surfaces of used forms shall be cleaned of mortar and any other foreign material before reuse.

3.1.2 Chamfering

All exposed joints, edges and external corners shall be chamfered by molding placed in the forms unless the drawings specifically state that chamfering is to be omitted or as otherwise specified. Chamfered joints shall not be permitted where earth or rockfill is placed in contact with concrete surfaces. Chamfered joints shall be terminated twelve inches outside the limit of the earth or rockfill so that the end of the chamfers will be clearly visible.

3.1.3 Coating

Forms for exposed or painted surfaces shall be coated with form oil or a form-release agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's instructions. Forms for unexposed surfaces may be wet with water in lieu of coating immediately before placing concrete, except that, in cold weather when freezing temperatures are anticipated, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.2 FORM REMOVAL

Forms shall not be removed without approval. The minimal time required for concrete to reach a strength adequate for removal of formwork without risking the safety of workers or the quality of the concrete depends on a number of factors including, but not limited to, ambient temperature, concrete lift heights, type and amount of concrete admixture, and type and amount of cementitious material in the concrete. It is the responsibility of the Contractor to consider all applicable factors and leave the forms in place until it is safe to remove them. In any case forms shall not be removed unless the minimum time or minimum compressive strength requirements below are met, except as otherwise directed or specifically authorized. When conditions are such as to justify the requirement, forms will be required to remain in place for a longer period. All removal shall be accomplished in a manner which will prevent damage to the concrete and

ensure the complete safety of the structure. Where forms support more than one element, the forms shall not be removed until the form removal criteria are met by all supported elements. Form removal shall be scheduled so that all necessary repairs can be performed. Evidence that concrete has gained sufficient strength to permit removal of forms shall be determined by tests on control cylinders. All control cylinders shall be stored in the structure or as near the structure as possible so they receive the same curing conditions and protection methods as given those portions of the structure they represent. Control cylinders shall be removed from the molds at an age of no more than 24 hours. All control cylinders shall be prepared and tested in accordance with ASTM C 31/C 31M and ASTM C 39/C 39M at the expense of the Contractor by an independent laboratory that complies with ASTM C 1077 and shall be tested within 4 hours after removal from the site.

### 3.2.1 Formwork Not Supporting Weight of Concrete

Formwork for walls, columns, sides of beams, gravity structures, and other vertical type formwork not supporting the weight of concrete shall not be removed in less than 24 hours after concrete placement is completed.

### 3.2.2 Formwork Supporting Weight of Concrete

Formwork supporting weight of concrete and shoring shall not be removed until structural members have acquired sufficient strength to safely support their own weight and any construction or other superimposed loads to which the supported concrete may be subjected. As a minimum, forms shall be left in place until control concrete test cylinders indicate evidence the concrete has attained at least 75% percent of the compressive strength required for the structure.

### 3.2.3 Tunnel Forms

Tunnel lining bulkhead forms shall not be removed in less than 12 hours and tunnel lining forms in not less than 16 hours.

## 3.3 INSPECTION

Forms and embedded items shall be inspected in sufficient time prior to each concrete placement by the Contractor in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

-- End of Section --

SECTION 03 20 01.00 10

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

| | |
|---|---|
| ACI 318 | (2008; Errata 2008) Building Code Requirements for Structural Concrete and Commentary |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.4 | (2005; Errata 2005) Structural Welding Code - Reinforcing Steel |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 184 | (2006) Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement |
| ASTM A 185 | (2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete |
| ASTM A 53 | (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A 615 | (2008b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM A 706 | (2008a) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement |
| ASTM A 82 | (2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement |

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

| | |
|---|---|
| CRSI 10MSP | (2001; 27Ed) Manual of Standard Practice |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control

approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Reinforcement G

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

SD-03 Product Data

Welding

A list of qualified welders names.

1.3 WELDING

Welders shall be qualified in accordance with AWS D1.4.

1.4 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 DOWELS

Dowels shall conform to ASTM A 675, Grade 80. Steel pipe conforming to ASTM A 53, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184.

2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615 or ASTM A 706, grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 82.

2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185.

2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

2.6 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI 10MSP and shall be galvanized steel.

## PART 3 EXECUTION

### 3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

#### 3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

#### 3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318 and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to AWS D1.4. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

### 3.2 WELDED-WIRE FABRIC PLACEMENT

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated.

Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports.

### 3.3 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at

right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

-- End of Section --

SECTION 03 31 00.00 10

CAST-IN-PLACE STRUCTURAL CONCRETE

PART 1 GENERAL

1.1 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

| | |
|---|---|
| ACI 117 | (2006) Standard Specifications for Tolerances for Concrete Construction and Materials |
| ACI 211.1 | (1991; R 2002) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete |
| ACI 211.2 | (1998; R 2004) Standard Practice for Selecting Proportions for Structural Lightweight Concrete |
| ACI 213R | (2003) Guide for Structural Lightweight Aggregate Concrete |
| ACI 214R | (2002) Recommended Practice for Evaluation of Strength Test Results of Concrete |
| ACI 301 | (2005; Errata 2008) Specifications for Structural Concrete |
| ACI 303R | (2004) Guide to Cast-In-Place Architectural Concrete Practice |
| ACI 305R | (1999; Errata 2006) Hot Weather Concreting |
| ACI 318 | (2008; Errata 2008) Building Code Requirements for Structural Concrete and Commentary |
| ACI 318M | (2008) Metric Building Code Requirements for Structural Concrete and Commentary |

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO M 182 | (2005) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C 1017 | (2007) Standard Specification for Chemical |

| | |
|---|---|
| | Admixtures for Use in Producing Flowing Concrete |
| ASTM C 1059 | (1999; R 2008) Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete |
| ASTM C 1064 | (2008) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete |
| ASTM C 1077 | (2008) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation |
| ASTM C 1107 | (2008) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) |
| ASTM C 1116 | (2008) Standard Specification for Fiber-Reinforced Concrete |
| ASTM C 1240 | (2005) Standard Specification for Silica Fume Used in Cementitious Mixtures |
| ASTM C 1260 | (2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method) |
| ASTM C 131 | (2006)Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| ASTM C 136 | (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM C 143 | (2008) Standard Test Method for Slump of Hydraulic-Cement Concrete |
| ASTM C 150 | (2007) Standard Specification for Portland Cement |
| ASTM C 1567 | (2008) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method) |
| ASTM C 171 | (2007) Standard Specification for Sheet Materials for Curing Concrete |
| ASTM C 172 | (2008) Standard Practice for Sampling Freshly Mixed Concrete |
| ASTM C 173/C 173M | (2008) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method |
| ASTM C 192/C 192M | (2007) Standard Practice for Making and |

| | |
|---|---|
| | Curing Concrete Test Specimens in the Laboratory |
| ASTM C 231 | (2008c) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method |
| ASTM C 260 | (2006) Standard Specification for Air-Entraining Admixtures for Concrete |
| ASTM C 309 | (2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete |
| ASTM C 31/C 31M | (2008a) Standard Practice for Making and Curing Concrete Test Specimens in the Field |
| ASTM C 33 | (2007) Standard Specification for Concrete Aggregates |
| ASTM C 330 | (2005) Standard Specification for Lightweight Aggregates for Structural Concrete |
| ASTM C 39/C 39M | (2005e1e2) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens |
| ASTM C 42/C 42M | (2004) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete |
| ASTM C 494/C 494M | (2008a) Standard Specification for Chemical Admixtures for Concrete |
| ASTM C 496/C 496M | (2004e1) Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens |
| ASTM C 552 | (2007) Standard Specification for Cellular Glass Thermal Insulation |
| ASTM C 567 | (2005a) Determining Density of Structural Lightweight Concrete |
| ASTM C 578 | (2008b) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation |
| ASTM C 591 | (2008) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation |
| ASTM C 595 | (2008) Standard Specification for Blended Hydraulic Cements |
| ASTM C 618 | (2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete |

| | |
|---|---|
| ASTM C 685/C 685M | (2007) Concrete Made by Volumetric Batching and Continuous Mixing |
| ASTM C 78 | (2008) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading) |
| ASTM C 881/C 881M | (2002) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete |
| ASTM C 937 | (2002) Grout Fluidifier for Preplaced-Aggregate Concrete |
| ASTM C 94/C 94M | (2007) Standard Specification for Ready-Mixed Concrete |
| ASTM C 940 | (1998a; R 2003) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory |
| ASTM C 989 | (2006) Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars |
| ASTM D 1751 | (2004; R 2008) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) |
| ASTM D 1752 | (2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion |
| ASTM D 75 | (2003) Standard Practice for Sampling Aggregates |
| ASTM E 1155 | (1996; R 2008) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers |
| ASTM E 96/E 96M | (2005) Standard Test Methods for Water Vapor Transmission of Materials |

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

| | |
|---|---|
| NIST HB 44 | (2007) NIST Handbook 44: Specifications, Tolerances, and other Technical Requirements for Weighing and Measuring Devices |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| COE CRD-C 104 | (1980) Method of Calculation of the Fineness Modulus of Aggregate |
| COE CRD-C 400 | (1963) Requirements for Water for Use in |

| | |
|---|---|
| | Mixing or Curing Concrete |
| COE CRD-C 521 | (1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete |
| COE CRD-C 540 | (2001) Standard Specification for Nonbituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type |
| COE CRD-C 572 | (1974) Specifications for Polyvinylchloride Waterstops |
| COE CRD-C 94 | (1995) Specification for Surface Retarders |

NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)

| | |
|---|---|
| NRMCA CPMB 100 | (2000) Concrete Plant Standards |
| NRMCA QC 3 | (2002) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities |
| NRMCA TMMB 100 | (2001) Truck Mixer, Agitator and Front Discharge Concrete Carrier Standards |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mixture Proportions; G

The results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength or class of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

SD-04 Samples

Surface Retarder

Sample of surface retarder material with manufacturer's

instructions for application in conjunction with air-water cutting.

SD-06 Test Reports

Testing and Inspection for Contractor Quality Control; G

Certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

SD-07 Certificates

Qualifications

Written documentation for Contractor Quality Control personnel.

## 1.3 QUALIFICATIONS

Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) Certified Workmen in one of the following grades or shall have written evidence of having completed similar qualification programs:

Concrete Field Testing Technician, Grade I
Concrete Laboratory Testing Technician, Grade I or II
Concrete Construction Inspector, Level II
Concrete Transportation Construction Inspector or
Reinforced Concrete Special Inspector, Jointly certified by American Concrete Institute (ACI), Building Official and Code Administrators International (BOCA), International Code Council (ICC), and Southern Building Code Congress International (SBCCI).

The foreman or lead journeyman of the flatwork finishing crew shall have similar qualification for ACI Concrete Flatwork Technician/Finisher or equal, with written documentation.

## 1.4 FIELD TEST PANELS

Field test panels shall be constructed prior to beginning of work using the materials and procedures proposed for use on the job, to demonstrate the results to be attained. The quality and appearance of each panel shall be subject to the approval of the Contracting Officer, and, if not judged satisfactory, additional panels shall be constructed until approval is attained. Formed or finished surfaces in the completed structure shall match the quality and appearance of the approved field example.

### 1.4.1 Slab Panels

A slab panel at least 4 feet by 5 feet and 4 inches thick shall be constructed to demonstrate exposed aggregate slab finish and a similar panel for extra high class slab finish. Panels shall be located in an inconspicuous location. Each panel shall have a full length joint line.

## 1.5 SPECIAL REQUIREMENTS

A pre-installation meeting with the Contracting Officer will be required at

least 10 days prior to start of construction. The Contractor shall be responsible for calling the meeting; the Project Superintendent and active installation personnel shall be present.

## 1.6 GENERAL REQUIREMENTS

### 1.6.1 1.6.1 Tolerances

Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices shall be in accordance with ACI 117/117R. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing; when forms or shoring are used, the measurements shall be made prior to removal.

#### 1.6.1.1 Floors

For the purpose of this Section the following terminology correlation between ACI 117/117R and this Section shall apply:

| Floor Profile Quality Classification From ACI 117/117R | This Section |
|---|---|
| Conventional Bullfloated | Same |
| Good | Float Finish or Trowel Finish |
| Flat | Float Finish or Trowel Finish |

Levelness tolerance shall not apply where design requires floors to be sloped to drains or sloped for other reasons.

#### 1.6.1.2 Floors by the F-Number System

The flatness and levelness of floors shall be carefully controlled and the tolerances shall be measured by the F-Number system of Paragraph 4.5.6 and 4.5.6.1 of ACI 117/117R. The Contractor shall furnish an approved floor profilograph or other equipment capable of measuring the floor flatness (FF) number and the floor levelness (FL) number in accordance with ASTM E 1155. The Contractor shall perform the tolerance measurements within 72 hours after floor slab construction while being observed by the Contracting Officer. The tolerances of surfaces beyond the limits of ASTM E 1155 (the areas within 24 inches of embedments and construction joints) shall be acceptable to the Contracting Officer. Tolerances of the following areas shall meet the requirements for the listed surfaces as specified in paragraphs 4.5.6 and 4.5.6.1 of ACI 117/117R.

| | |
|---|---|
| Bullfloated- | All exterior slabs - broom finish |
| Good | All floors receiving paint coat finishers or sealer FF38 FL25 (1/4" per 10') |
| Flat | All floors receiving applied floor finishes other than paint FF50 FL35 (1/8" per 10') |

### 1.6.2 Strength Requirements and w/c Ratio

#### 1.6.2.1 Strength Requirements

Specified compressive strength (f'c) shall be as follows:

| COMPRESSIVE STRENGTH | STRUCTURE OR PORTION OF STRUCTURE |
|---|---|
| 4000 psi at 28 days | Concrete Slab on Grade |
| 3500 psi at 28 days | Sidewalks |
| 3000 psi at 28 days | Elevated slabs |

Concrete made with high-early strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete made with Type I or II portland cement. Compressive strength shall be determined in accordance with ASTM C 39/C 39M. Flexural strength shall be determined in accordance with ASTM C 78.

a. Evaluation of Concrete Compressive Strength. Compressive strength specimens ( 6 by 12 inch cylinders) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength f'c and no individual test result falls below the specified strength f'c by more than 500 psi. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.

b. Investigation of Low-Strength Compressive Test Results. When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 500 psi or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42/C 42M. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the strength of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. Non-destructive tests (tests other than test cylinders or cores) shall not be used as a basis for acceptance or rejection. The Contractor shall perform the coring and repair the holes. Cores will be tested by the Government.

c. Load Tests. If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318. Concrete work evaluated by structural analysis or by results of a load test as being understrength shall be corrected in a manner satisfactory to the Contracting Officer. All investigations, testing, load tests, and correction of deficiencies shall be performed by and at the expense of the Contractor and must be approved by the

Contracting Officer, except that if all concrete is found to be in compliance with the drawings and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.

1.6.2.2 Water-Cement Ratio

Maximum water-cement ratio (w/c) for normal weight concrete shall be as follows:

| WATER-CEMENT RATIO, BY WEIGHT | STRUCTURE OR PORTION OF STRUCTURE |
|---|---|
| 0.45 | Slabs on grade |
| 0.50 | Elevated slabs, unexposed areas, footings |

These w/c's may cause higher strengths than that required above for compressive or flexural strength. The maximum w/c required will be the equivalent w/c as determined by conversion from the weight ratio of water to cement plus pozzolan, silica fume, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where silica fume or GGBF slag is used, the weight of the silica fume and GGBF slag shall be included in the equations of ACI 211.1 for the term P which is used to denote the weight of pozzolan.

1.6.3 Air Entrainment

Except as otherwise specified for lightweight concrete, all normal weight concrete shall be air entrained to contain between 4 and 7 percent total air, except that when the nominal maximum size coarse aggregate is 3/4 inch or smaller it shall be between 4.5 and 7.5 percent. Concrete with specified strength over 5000 psi may have 1.0 percent less air than specified above. Specified air content shall be attained at point of placement into the forms. Air content for normal weight concrete shall be determined in accordance with ASTM C 231.

1.6.4 Slump

Slump of the concrete, as delivered to the point of placement into the forms, shall be within the following limits. Slump shall be determined in accordance with ASTM C 143/C 143M.

| Structural Element | Slump Minimum | Slump Maximum |
|---|---|---|
| Foundation walls, substructure walls, footings, slabs | 1 in. | 3 in. |
| Any structural concrete approved for placement by pumping: | | |
| At pump | 2 in. | 6 in. |
| At discharge of line | 1 in. | 4 in. |

When use of a plasticizing admixture conforming to ASTM C 1017/C 1017M or when a Type F or G high range water reducing admixture conforming to ASTM C 494/C 494M is permitted to increase the slump of concrete, concrete shall have a slump of 2 to 4 inches before the admixture is added and a

maximum slump of 8 inches at the point of delivery after the admixture is added.

1.6.5 Concrete Temperature

The temperature of the concrete as delivered shall not exceed 90 degrees F. When the ambient temperature during placing is 40 degrees F or less, or is expected to be at any time within 6 hours after placing, the temperature of the concrete as delivered shall be between 55 and 75 degrees F.

1.6.6 Size of Coarse Aggregate

The largest feasible nominal maximum size aggregate (NMSA) specified in paragraph AGGREGATES shall be used in each placement. However, nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

1.6.7 Special Properties and Products

Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Any of these materials to be used on the project shall be used in the mix design studies.

1.7 MIXTURE PROPORTIONS

Concrete shall be composed of portland cement, other cementitious and pozzolanic materials as specified, aggregates, water and admixtures as specified.

1.7.1 Proportioning Studies for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Contractor. Except as specified for flexural strength concrete, mixture proportions shall be based on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's test reports indicating compliance with these specifications. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratios required in subparagraph Water-Cement Ratio will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus pozzolan, silica fume, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where silica fume or GGBF slag is used, the weight of the silica fume and GGBF slag shall be included in the equations in ACI 211.1 for the term P, which is used to denote the weight of pozzolan. If pozzolan is used in the concrete mixture, the minimum pozzolan content shall be 15 percent by weight of the total cementitious material, and the maximum shall be 35

percent. Laboratory trial mixtures shall be designed for maximum permitted slump and air content. Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for any conveying or placing method proposed which requires special properties and for concrete to be placed in unusually difficult placing locations. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192/C 192M. They shall be tested at 7 and 28 days in accordance with ASTM C 39/C 39M. From these test results, a curve shall be plotted showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, a curve shall be plotted showing the relationship between 7 day and 28 day strengths. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

### 1.7.2 Average Compressive Strength Required for Mixtures

The mixture proportions selected during mixture design studies shall produce a required average compressive strength (f'cr) exceeding the specified compressive strength (f'c) by the amount indicated below. This required average compressive strength, f'cr, will not be a required acceptance criteria during concrete production. However, whenever the daily average compressive strength at 28 days drops below f'cr during concrete production, or daily average 7-day strength drops below a strength correlated with the 28-day f'cr, the mixture shall be adjusted, as approved, to bring the daily average back up to f'cr. During production, the required f'cr shall be adjusted, as appropriate, based on the standard deviation being attained on the job.

#### 1.7.2.1 Computations from Test Records

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths (f'c) within 1,000 psi of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Required average compressive strength f'cr used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

f'cr = f'c + 1.34S where units are in psi

f'cr = f'c + 2.33S - 500 where units are in psi

Where S = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following

table:

| NUMBER OF TESTS | MODIFICATION FACTOR FOR STANDARD DEVIATION |
|---|---|
| 15 | 1.16 |
| 20 | 1.08 |
| 25 | 1.03 |
| 30 or more | 1.00 |

1.7.2.2 Computations without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength f'cr shall be determined as follows:

a. If the specified compressive strength f'c is less than 3,000 psi,

f'cr = f'c + 1000 psi

b. If the specified compressive strength f'c is 3,000 to 5,000 psi,

f'cr = f'c + 1,200 psi

c. If the specified compressive strength f'c is over 5,000 psi,

f'cr = f'c + 1,400 psi

1.8 STORAGE OF MATERIALS

Cement and other cementitious materials shall be stored in weathertight buildings, bins, or silos which will exclude moisture and contaminants and keep each material completely separated. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Aggregate shall not be stored directly on ground unless a sacrificial layer is left undisturbed. Reinforcing bars and accessories shall be stored above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Materials shall be capable of being accurately identified after bundles or containers are opened.

1.9 GOVERNMENT ASSURANCE INSPECTION AND TESTING

Day-to day inspection and testing shall be the responsibility of the Contractor Quality Control (CQC) staff. However, representatives of the Contracting Officer can and will inspect construction as considered appropriate and will monitor operations of the Contractor's CQC staff. Government inspection or testing will not relieve the Contractor of any of his CQC responsibilities.

1.9.1 Materials

The Government will sample and test aggregates, cementitious materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. The Contractor shall provide

facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

1.9.2 Fresh Concrete

Fresh concrete will be sampled as delivered in accordance with ASTM C 172 and tested in accordance with these specifications, as considered necessary.

1.9.3 Hardened Concrete

Tests on hardened concrete will be performed by the Government when such tests are considered necessary.

1.9.4 Inspection

Concrete operations may be tested and inspected by the Government as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the Government for final acceptance.

PART 2 PRODUCTS

2.1 2.1 CEMENTITIOUS MATERIALS

Cementitious Materials shall be portland cement, or portland cement in combination with pozzolan or ground granulated blast furnace slag or silica fume and shall conform to appropriate specifications listed below. Use of cementitious materials in concrete which will have surfaces exposed in the completed structure shall be restricted so there is no change in color, source, or type of cementitious material.

2.1.1 Portland Cement

ASTM C 150, Type I with a maximum 15 percent amount of tricalcium aluminate, or Type II.

2.1.2 Pozzolan (Fly Ash)

Pozzolan shall conform to ASTM C 618, Class C or F, including low alkali multiple factor, drying shrinkage, and uniformity, requirements in Table 3 of ASTM C 618. Requirement for maximum alkalies from Table 1A of ASTM C 618 shall apply. If pozzolan is used, it shall never be less than 15 percent nor more than 35 percent by weight of the total cementitious material. The Contractor shall comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS.

2.1.3 Silica Fume

Silica fume shall conform to ASTM C 1240. Available alkalies shall conform to the optimal limit given in Table 2 of ASTM C 1240. Silica fume may be furnished as a dry, densified material or as a slurry. In accordance with paragraph Technical Service for Specialized Concrete, the Contractor shall provide at no cost to the Government the services of a manufacturer's technical representative experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume.

## 2.2 AGGREGATES

Fine and coarse aggregates shall conform to the following.

### 2.2.1 Fine Aggregate

Fine aggregate shall conform to the quality and gradation requirements of ASTM C 33.

### 2.2.2 Coarse Aggregate

Coarse aggregate shall conform to ASTM C 33, Class 5S.

## 2.3 CHEMICAL ADMIXTURES

Chemical admixtures, when required or permitted, shall conform to the appropriate specification listed. Admixtures shall be furnished in liquid form and of suitable concentration for easy, accurate control of dispensing.

### 2.3.1 Air-Entraining Admixture

ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.

### 2.3.2 Accelerating Admixture

ASTM C 494/C 494M, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

### 2.3.3 Water-Reducing or Retarding Admixture

ASTM C 494/C 494M, Type A, B, or D, except that the 6-month and 1-year compressive and flexural strength tests are waived.

### 2.3.4 High-Range Water Reducer

A
STM C 494/C 494M, Type F or G, except that the 6-month and 1-year strength requirements are waived. The admixture shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

### 2.3.5 Other Chemical Admixtures

Chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017/C 1017M, Type I or II. These admixtures shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

## 2.4 CURING MATERIALS

### 2.4.1 Impervious-Sheet

Impervious-sheet materials shall conform to ASTM C 171, type optional, except, that polyethylene sheet shall not be used.

2.4.2 Membrane-Forming Compound

Membrane-Forming curing compound shall conform to ASTM C 309, Type 1-D or 2, except that only a styrene acrylate or chlorinated rubber compound meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing, or flooring specified. Nonpigmented compound shall contain a fugitive dye, and shall have the reflective requirements in ASTM C 309 waived.

2.4.3 Burlap and Cotton Mat

Burlap and cotton mat used for curing shall conform to AASHTO M 182.

2.5 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of COE CRD-C 400.

2.6 NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107, Grade A, and shall be a commercial formulation suitable for the proposed application.

2.7 NONSLIP SURFACING MATERIAL

Nonslip surfacing material shall consist of 55 percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded together to form a homogeneous material sufficiently porous to provide a good bond with portland cement paste; or factory-graded emery aggregate consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. The aggregate shall be well graded from particles retained on the No. 30 sieve to particles passing the No. 8 sieve.

2.8 LATEX BONDING AGENT

Latex agents for bonding fresh to hardened concrete shall conform to ASTM C 1059.

2.9 EPOXY RESIN

Epoxy resins for use in repairs shall conform to ASTM C 881/C 881M, Type V, Grade 2. Class as appropriate to the existing ambient and surface temperatures.

2.10 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application. Dovetail slots shall be galvanized steel. Inserts for shelf angles and bolt hangers shall be of malleable iron or cast or wrought steel.

2.11 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 6 mils or other equivalent material having a vapor permeance rating not exceeding 0.5 perms as determined in accordance with ASTM E 96/E 96M.

## 2.12 JOINT MATERIALS

### 2.12.1 Joint Fillers, Sealers, and Waterstops

Expansion joint fillers shall be preformed materials conforming to ASTM D 1751. Materials for and sealing of joints shall conform to the requirements of Section 07 92 00 JOINT SEALANTS.

### 2.12.2 Contraction Joints in Slabs

Sawable type contraction joint inserts shall conform to COE CRD-C 540. Nonsawable joint inserts shall have sufficient stiffness to permit placement in plastic concrete without undue deviation from a straight line and shall conform to the physical requirements of COE CRD-C 540, with the exception of Section 3.4 "Resistance to Sawing". Plastic inserts shall be polyvinyl chloride conforming to the materials requirements of COE CRD-C 572.

# PART 3 EXECUTION

## 3.1 PREPARATION FOR PLACING

Before commencing concrete placement, the following shall be performed. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Forms shall be in place, cleaned, coated, and adequately supported. Reinforcing steel shall be in place, cleaned, tied, and adequately supported, in accordance with Section 03 20 01.00 10 CONCRETE REINFORCEMENT. Transporting and conveying equipment shall be in-place, ready for use, clean, and free of hardened concrete and foreign material. Equipment for consolidating concrete shall be at the placing site and in proper working order. Equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the placing site, in proper working condition and in sufficient amount for the entire placement. When hot, windy conditions during concreting appear probable, equipment and material shall be at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

### 3.1.1 Foundations

#### 3.1.1.1 Concrete on Earth Foundations

Earth (subgrade, base, or subbase courses) surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the foundation shall be well drained and shall be satisfactorily graded and uniformly compacted.

#### 3.1.1.2 Excavated Surfaces in Lieu of Forms

Concrete for footings may be placed directly against the soil provided the earth or rock has been carefully trimmed, is uniform and stable, and meets the compaction requirements of Section 31 23 00.00 20 EXCAVATION AND FILL. The concrete shall be placed without becoming contaminated by loose material, and the outline of the concrete shall be within the specified tolerances.

3.1.2 Previously Placed Concrete

Concrete surfaces to which additional concrete is to be bonded shall be prepared for receiving the next horizontal lift by cleaning the construction joint surface with either air-water cutting, sandblasting, high-pressure water jet, or other approved method. Concrete at the side of vertical construction joints shall be prepared as approved by the Contracting Officer. Air-water cutting shall not be used on formed surfaces or surfaces congested with reinforcing steel. Regardless of the method used, the resulting surfaces shall be free from all laitance and inferior concrete so that clean surfaces of well bonded coarse aggregate are exposed and make up at least 10-percent of the surface area, distributed uniformly throughout the surface. The edges of the coarse aggregate shall not be undercut. The surface of horizontal construction joints shall be kept continuously wet for the first 12 hours during the 24-hour period prior to placing fresh concrete. The surface shall be washed completely clean as the last operation prior to placing the next lift.

3.1.2.1 Air-Water Cutting

Air-water cutting of a fresh concrete surface shall be performed at the proper time and only on horizontal construction joints. The air pressure used in the jet shall be 100 psi plus or minus, 10 psi, and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. When approved by the Contracting Officer, a surface retarder complying with the requirements of COE CRD-C 94 may be applied to the surface of the lift in order to prolong the period of time during which air-water cutting is effective. After cutting, the surface shall be washed and rinsed as long as there is any trace of cloudiness of the wash water. Where necessary to remove accumulated laitance, coatings, stains, debris, and other foreign material, high-pressure waterjet or sandblasting shall be used as the last operation before placing the next lift.

3.1.2.2 High-Pressure Water Jet

A stream of water under a pressure of not less than 3,000 psi shall be used for cutting and cleaning. Its use shall be delayed until the concrete is sufficiently hard so that only the surface skin or mortar is removed and there is no undercutting of coarse-aggregate particles. If the waterjet is incapable of a satisfactory cleaning, the surface shall be cleaned by sandblasting.

3.1.2.3 Wet Sandblasting

Wet sandblasting shall be used after the concrete has reached sufficient strength to prevent undercutting of the coarse aggregate particles. After wet sandblasting, the surface of the concrete shall then be washed thoroughly to remove all loose materials.

3.1.2.4 Waste Disposal

The method used in disposing of waste water employed in cutting, washing, and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal shall be subject to approval.

3.1.3 Vapor Barrier

Vapor barrier shall be provided beneath the interior on-grade concrete floor slabs. The greatest widths and lengths practicable shall be used to eliminate joints wherever possible. Joints shall be lapped a minimum of 12 inches. Torn, punctured, or damaged vapor barrier material shall be removed and new vapor barrier shall be provided prior to placing concrete. For minor repairs, patches may be made using laps of at least 12 inches. Lapped joints shall be sealed and edges patched with pressure-sensitive adhesive or tape not less than 2 inches wide and compatible with the membrane. Vapor barrier shall be placed directly on underlying subgrade, base course, or capillary water barrier, unless it consists of crushed material or large granular material which could puncture the vapor barrier. In this case, a thin layer of approximately 1/2 inch of fine graded material should be rolled or compacted over the fill before installation of the vapor barrier to reduce the possibility of puncture. Concrete placement shall be controlled so as to prevent damage to the vapor barrier.

3.1.4 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Conduit and other embedded items shall be clean and free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding shall not be performed on embedded metals within 12 inches of the surface of the concrete. Tack welding shall not be performed on or to embedded items.

3.2 CONCRETE PRODUCTION
3.2.1 3.2.1 General Requirements

Concrete shall either be batched and mixed onsite and shall conform to the following subparagraphs.

3.2.2 Batching Plant

The batching plant shall be located off site close to the project. The batching plant shall conform to the requirements of NRMCA CPMB 100 and as specified; however, rating plates attached to batch plant equipment are not required.

3.2.3 Batching Equipment

The batching controls shall be semiautomatic or automatic, as defined in NRMCA CPMB 100. A semiautomatic batching system shall be provided with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance. The batching system shall be equipped with accurate recorder or recorders that meet the requirements of NRMCA CPMB 100. The weight of water and admixtures shall be recorded if batched by weight. Separate bins or compartments shall be provided for each size group of aggregate and type of cementitious material, to prevent intermingling at any time. Aggregates shall be weighed either in separate weigh batchers with individual scales or, provided the smallest size is batched first, cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher

with cementitious material. If both portland cement and other cementitious material are used, they may be batched cumulatively, provided that the portland cement is batched first, except that silica fume shall always be batched separately. Water may be measured by weight or volume. Water shall not be weighed or measured cumulatively with another ingredient. Filling and discharging valves for the water metering or batching system shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. Piping for water and for admixtures shall be free from leaks and shall be properly valved to prevent backflow or siphoning. Admixtures shall be furnished as a liquid of suitable concentration for easy control of dispensing. An adjustable, accurate, mechanical device for measuring and dispensing each admixture shall be provided. Each admixture dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and individually discharged automatically in a manner to obtain uniform distribution throughout the water as it is added to the batch in the specified mixing period. When use of truck mixers makes this requirement impractical, the admixture dispensers shall be interlocked with the sand batchers. Different admixtures shall not be combined prior to introduction in water and shall not be allowed to intermingle until in contact with the cement. Admixture dispensers shall have suitable devices to detect and indicate flow during dispensing or have a means for visual observation. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment, and for sampling and calibrating the dispensing of cementitious material, water, and admixtures. Filling ports for cementitious materials bins or silos shall be clearly marked with a permanent sign stating the contents.

3.2.4 Scales

The weighing equipment shall conform to the applicable requirements of CPMB Concrete Plant Standard, and of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. The tests shall be made at the specified frequency in the presence of a Government inspector. The weighing equipment shall be arranged so that the plant operator can conveniently observe all dials or indicators.

3.2.5 Batching Tolerances

(A) Tolerances with Weighing Equipment

| MATERIAL | PERCENT OF REQUIRED WEIGHT |
|---|---|
| Cementitious materials | 0 to plus 2 |
| Aggregate | plus or minus 2 |
| Water | plus or minus 1 |
| Chemical admixture | 0 to plus 6 |

(B) Tolerances with Volumetric Equipment

For volumetric batching equipment used for water and admixtures, the following tolerances shall apply to the required volume of material being batched:

| MATERIAL | PERCENT OF REQUIRED MATERIAL |
|---|---|
| Water: | plus or minus 1 percent |
| Chemical admixtures: | 0 to plus 6 percent |

3.2.6 Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the weights of the materials being batched.

3.2.7 Concrete Mixers

Mixers shall be stationary mixers or truck mixers. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

3.2.8 Stationary Mixers

Concrete plant mixers shall be drum-type mixers of tilting, nontilting, horizontal-shaft, or vertical-shaft type, or shall be pug mill type and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C 94/C 94M applicable to central-mixed concrete.

3.3 TRANSPORTING CONCRETE TO PROJECT SITE

Concrete shall be transported to the placing site in truck mixers, or by approved pumping equipment. Nonagitating equipment, other than pumps, shall not be used for transporting lightweight aggregate concrete.

3.4 CONVEYING CONCRETE ON SITE

Concrete shall be conveyed from mixer or transporting unit to forms as rapidly as possible and within the time interval specified by methods which will prevent segregation or loss of ingredients using following equipment. Conveying equipment shall be cleaned before each placement.

3.4.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 2 square feet. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 2 cubic yards shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and

rate of deposit of concrete in each dumping position.

3.4.2 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes normally attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

3.4.3 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure type; pneumatic placing equipment shall not be used. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least 3 times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 4 inches. Aluminum pipe shall not be used.

3.5 PLACING CONCRETE

Mixed concrete shall be discharged within 1-1/2 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds 85 degrees F, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the transporting unit. Concrete shall be handled from mixer or transporting unit to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Sufficient placing capacity shall be provided so that concrete can be kept free of cold joints.

3.5.1 Depositing Concrete

Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in a single lift. Concrete to receive other construction shall be screeded to the proper level. Concrete shall be deposited continuously in one layer or in layers so that fresh concrete is deposited on in-place concrete that is still plastic. Fresh concrete shall not be deposited on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete that has surface dried, partially hardened, or contains foreign material shall not be used. When temporary spreaders are used in the forms, the spreaders shall be removed as their service becomes unnecessary. Concrete shall not be placed in slabs over columns and walls until concrete in columns and walls has been in-place at least two hours or until the concrete begins to lose its plasticity. Concrete for beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as concrete for adjoining slabs.

### 3.5.2 Consolidation

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 4 inches thick or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 10,000 vibrations per minute, an amplitude of at least 0.025 inch, and the head diameter shall be appropriate for the structural member and the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a reasonable amount. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then vertically withdrawn slowly while operating. Form vibrators shall not be used unless specifically approved and unless forms are constructed to withstand their use. Vibrators shall not be used to move concrete within the forms. Slabs 4 inches and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique. Excessive vibration of lightweight concrete resulting in segration or flotation of coarse aggregate shall be prevented. Frequency and amplitude of vibrators shall be determined in accordance with COE CRD-C 521. Grate tampers ("jitterbugs") shall not be used.

### 3.5.3 Cold Weather Requirements

Special protection measures, approved by the Contracting Officer, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 40 degrees F. The temperature of the concrete when placed shall be not less than 50 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, an accelerating admixture conforming to ASTM C 494/C 494M, Type C or E may be used, provided it contains no calcium chloride. Calcium chloride shall not be used.

### 3.5.4 Hot Weather Requirements

When the ambient temperature during concrete placing is expected to exceed 85 degrees F, the concrete shall be placed and finished with procedures previously submitted and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C 1064/C 1064M. Cooling of the mixing water or aggregates or placing concrete in the cooler part of the day may be required to obtain an adequate placing temperature. A retarder may be used, as approved, to facilitate placing and finishing. Steel forms and reinforcements shall be cooled as approved prior to concrete placement when steel temperatures are greater than 120 degrees F. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.

Maximum Allowable Concrete Placing Temperature

| Relative Humidity, Percent, During Time of Concrete Placement | Maximum Allowable Concrete Temperature Degrees |
|---|---|
| Greater than 60 | 90 F |
| 40-60 | 85 F |
| Less than 40 | 80 F |

3.5.5 Prevention of Plastic Shrinkage Cracking

During hot weather with low humidity, and particularly with appreciable wind, as well as interior placements when space heaters produce low humidity, the Contractor shall be alert to the tendency for plastic shrinkage cracks to develop and shall institute measures to prevent this. Particular care shall be taken if plastic shrinkage cracking is potentially imminent and especially if it has developed during a previous placement. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 2.1.5 of ACI 305R. In addition the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, sprinkling, ponding or wet covering. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin as directed, after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

3.5.6 Placing Concrete in Congested Areas

Special care shall be used to ensure complete filling of the forms, elimination of all voids, and complete consolidation of the concrete when placing concrete in areas congested with reinforcing bars, embedded items, waterstops and other tight spacing. An appropriate concrete mixture shall be used, and the nominal maximum size of aggregate (NMSA) shall meet the specified criteria when evaluated for the congested area. Vibrators with heads of a size appropriate for the clearances available shall be used, and the consolidation operation shall be closely supervised to ensure complete and thorough consolidation at all points. Where necessary, splices of reinforcing bars shall be alternated to reduce congestion. Where two mats of closely spaced reinforcing are required, the bars in each mat shall be placed in matching alignment to reduce congestion. Reinforcing bars may be temporarily crowded to one side during concrete placement provided they are returned to exact required location before concrete placement and consolidation are completed.

3.5.7 Placing Flowable Concrete

If a plasticizing admixture conforming to ASTM C 1017/C 1017M is used or if a Type F or G high range water reducing admixture is permitted to increase the slump, the concrete shall meet all requirements of paragraph GENERAL REQUIREMENTS in PART 1. Extreme care shall be used in conveying and placing the concrete to avoid segregation. Consolidation and finishing shall meet all requirements of paragraphs Placing Concrete, Finishing Formed Surfaces, and Finishing Unformed Surfaces. No relaxation of requirements to accommodate flowable concrete will be permitted.

3.6 JOINTS

Joints shall be located and constructed as indicated or approved. Joints

not indicated on the drawings shall be located and constructed to minimize the impact on the strength of the structure. In general, such joints shall be located near the middle of the spans of supported slabs, beams, and girders unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs, unless otherwise approved. Joints shall be perpendicular to the main reinforcement. All reinforcement shall be continued across joints; except that reinforcement or other fixed metal items shall not be continuous through expansion joints, or through construction or contraction joints in slabs on grade. Reinforcement shall be 2 inches clear from each joint. Except where otherwise indicated, construction joints between interior slabs on grade and vertical surfaces shall consist of 30 pound asphalt-saturated felt, extending for the full depth of the slab. The perimeters of the slabs shall be free of fins, rough edges, spalling, or other unsightly appearance. Reservoir for sealant for construction and contraction joints in slabs shall be formed to the dimensions shown on the drawings by removing snap-out joint-forming inserts, by sawing sawable inserts, or by sawing to widen the top portion of sawed joints. Joints to be sealed shall be cleaned and sealed as indicated and in accordance with Section 07 92 00 JOINT SEALANTS.

### 3.6.1 Construction Joints

For concrete other than slabs on grade, construction joints shall be located so that the unit of operation does not exceed that indicated or approved. Concrete shall be placed continuously so that each unit is monolithic in construction. Fresh concrete shall not be placed against adjacent hardened concrete until it is at least 24 hours old. Construction joints shall be located as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of the Contracting Officer. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete columns, walls, or piers shall be in place at least 2 hours, or until the concrete begins to lose its plasticity, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints in walls or columns are required, a strip of 1 inch square-edge lumber, bevelled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 1 inch above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph Previously Placed Concrete.

### 3.6.2 Contraction Joints in Slabs on Grade

Contraction joints shall be located and detailed as shown on the drawings. Contraction Joints shall be produced by forming a weakened plane in the concrete slab by use of rigid inserts impressed in the concrete during placing operations, use of snap-out plastic joint forming inserts or sawing a continuous slot with a concrete saw. Regardless of method used to

produce the weakened plane, it shall be 1/4 the depth of the slab thickness and between 1/8 and 3/16 inch wide. For saw-cut joints, cutting shall be timed properly with the set of the concrete. Cutting shall be started as soon as the concrete has hardened sufficiently to prevent ravelling of the edges of the saw cut. Cutting shall be completed before shrinkage stresses become sufficient to produce cracking. Reservoir for joint sealant shall be formed as previously specified.

### 3.6.3 Expansion Joints

Installation of expansion joints and sealing of these joints shall conform to the requirements and Section 07 92 00 JOINT SEALANTS.

### 3.6.4 Waterstops

Waterstops shall be installed in conformance with the locations and details shown on the drawings using materials and procedures specified.

### 3.6.5 Dowels and Tie Bars

Dowels and tie bars shall be installed at the locations shown on the drawings and to the details shown, using materials and procedures specified in Section 03 20 01.00 10 CONCRETE REINFORCEMENT and herein. Conventional smooth "paving" dowels shall be installed in slabs using approved methods to hold the dowel in place during concreting within a maximum alignment tolerance of 1/8 inch in 12 inches. "Structural" type deformed bar dowels, or tie bars, shall be installed to meet the specified tolerances. Care shall be taken during placing adjacent to and around dowels and tie bars to ensure there is no displacement of the dowel or tie bar and that the concrete completely embeds the dowel or tie bar and is thoroughly consolidated.

## 3.7 FINISHING FORMED SURFACES

Forms, form materials, and form construction as specified. Finishing of formed surfaces shall be as specified herein. Unless another type of architectural or special finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired. Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that requires a Class A or B finish. Except for major defects, as defined hereinafter, surface defects shall be repaired as specified herein within 24 hours after forms are removed. Repairs of the so-called "plaster-type" will not be permitted in any location. Tolerances of formed surfaces shall conform to the requirements of ACI 117. These tolerances apply to the finished concrete surface, not to the forms themselves; forms shall be set true to line and grade. Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter shall be repaired as specified in paragraph Damp-Pack Mortar Repair. Defects whose surface diameter is greater than their depth shall be repaired as specified in paragraph Repair of Major Defects. Repairs shall be finished flush with adjacent surfaces and with the same surface texture. The cement used for all repairs shall be a blend of job cement with white cement proportioned so that the final color after curing and aging will be the same as the adjacent concrete. Concrete with excessive honeycomb, or other defects which affect the strength of the member, will be rejected. Repairs shall be demonstrated to be acceptable and free from cracks or loose or drummy areas at the completion of the contract and, for Class A and B Finishes,

shall be inconspicuous. Repairs not meeting these requirements will be rejected and shall be replaced.

3.7.1 Class A Finish and Class B Finish

Class A finish is required where indicated on the drawings. Class B finish is required where indicated on the drawings. Fins, ravelings, and loose material shall be removed, all surface defects over 1/2 inch in diameter or more than 1/2 inch deep, shall be repaired and, except as otherwise indicated or as specified, holes left by removal of form ties shall be reamed and filled. Defects more than 1/2 inch in diameter shall be cut back to sound concrete, but in all cases at least 1 inch deep. The Contractor shall prepare a sample panel for approval (as specified in PART 1) before commencing repair, showing that the surface texture and color match will be attained. Metal tools shall not be used to finish repairs in Class A surfaces.

3.7.2 Class C and Class D Finish

Class C finish is required where indicated on the drawings. Class D finish is required where indicated on the drawings. Fins, ravelings, and loose material shall be removed, and, except as otherwise indicated or as specified, holes left by removal of form ties shall be reamed and filled. Honeycomb and other defects more than 1/2 inch deep or more than 2 inches in diameter shall be repaired. Defects more than 2 inches in diameter shall be cut back to sound concrete, but in all cases at least 1 inch deep.

3.7.3 [Enter Appropriate Subpart Title Here]3.7.3.1 Smooth Finish

After other concrete construction is complete in each overall separate contiguous area of the structure, smooth finish shall be applied to the areas indicated on the drawings. A mortar mix consisting of one part portland cement and two parts well-graded sand passing a No. 30 sieve, with water added to give the consistency of thick paint, shall be used. Where the finished surface will not receive other applied surface, white cement shall be used to replace part of the job cement to produce an approved color, which shall be uniform throughout the surfaces of the structure. After the surface has been thoroughly wetted and allowed to approach surface dryness, the mortar shall be vigorously applied to the area by clean burlap pads or by cork or wood-floating, to completely fill all surface voids. Excess grout shall be scraped off with a trowel. As soon as it can be accomplished without pulling the mortar from the voids, the area shall be rubbed with burlap pads having on their surface the same sand-cement mix specified above but without any mixing water, until all of the visible grout film is removed. The burlap pads used for this operation shall be stretched tightly around a board to prevent dishing the mortar in the voids. The finish of any area shall be completed in the same day, and the limits of a finished area shall be made at natural breaks in the surface. The surface shall be continuously moist cured for 48 hours commencing immediately after finishing operations in each area. The temperature of the air adjacent to the surface shall be not less than 50 degrees F for 24 hours prior to, and 48 hours after, the application. In hot, dry weather the smooth finish shall be applied in shaded areas or at night, and shall never be applied when there is significant hot, dry wind.

## 3.8 REPAIRS

### 3.8.1 Damp-Pack Mortar Repair

Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter but not over 4 inchesshall be repaired by the damp-pack mortar method. Form tie holes shall be reamed and other similar defects shall be cut out to sound concrete. The void shall then be thoroughly cleaned, thoroughly wetted, brush-coated with a thin coat of neat cement grout and filled with mortar. Mortar shall be a stiff mix of 1 part portland cement to 2 parts fine aggregate passing the No. 16 mesh sieve, and minimum amount of water. Only sufficient water shall be used to produce a mortar which, when used, will stick together on being molded into a ball by a slight pressure of the hands and will not exude water but will leave the hands damp. Mortar shall be mixed and allowed to stand for 30 to 45 minutes before use with remixing performed immediately prior to use. Mortar shall be thoroughly tamped in place in thin layers using a hammer and hardwood block. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through to the outside face. All holes shall be packed full. Damp-pack repairs shall be moist cured for at least 48 hours.

### 3.8.2 Repair of Major Defects

Major defects will be considered to be those more than 1/2 inch deep or, for Class A and B finishes, more than 1/2 inch in diameter and, for Class C and D finishes, more than 2 inches in diameter. Also included are any defects of any kind whose depth is over 4 inches or whose surface diameter is greater than their depth. Major defects shall be repaired as specified below.

#### 3.8.2.1 Surface Application of Mortar Repair

Defective concrete shall be removed, and removal shall extend into completely sound concrete. Approved equipment and procedures which will not cause cracking or microcracking of the sound concrete shall be used. If reinforcement is encountered, concrete shall be removed so as to expose the reinforcement for at least 2 inches on all sides. All such defective areas greater than 12 square inches shall be outlined by saw cuts at least 1 inch deep. Defective areas less than 12 square inches shall be outlined by a 1 inch deep cut with a core drill in lieu of sawing. All saw cuts shall be straight lines in a rectangular pattern in line with the formwork panels. After concrete removal, the surface shall be thoroughly cleaned by high pressure washing to remove all loose material. Surfaces shall be kept continually saturated for the first 12 of the 24 hours immediately before placing mortar and shall be damp but not wet at the time of commencing mortar placement. The Contractor, at his option, may use either hand-placed mortar or mortar placed with a mortar gun. If hand-placed mortar is used, the edges of the cut shall be perpendicular to the surface of the concrete. The prepared area shall be brush-coated with a thin coat of neat cement grout. The repair shall then be made using a stiff mortar, preshrunk by allowing the mixed mortar to stand for 30 to 45 minutes and then remixed, thoroughly tamped into place in thin layers. If hand-placed mortar is used, the Contractor shall test each repair area for drumminess by firm tapping with a hammer and shall inspect for cracks, both in the presence of the Contracting Officer's representative, immediately before completion of the contract, and shall replace any showing drumminess or cracking. If mortar placed with a mortar gun is used, the gun shall be a small compressed air-operated gun to which the mortar is slowly hand fed

and which applies the mortar to the surface as a high-pressure stream, as approved. Repairs made using shotcrete equipment will not be accepted. The mortar used shall be the same mortar as specified for damp-pack mortar repair. If gun-placed mortar is used, the edges of the cut shall be beveled toward the center at a slope of 1:1. All surface applied mortar repairs shall be continuously moist cured for at least 7 days. Moist curing shall consist of several layers of saturated burlap applied to the surface immediately after placement is complete and covered with polyethylene sheeting, all held closely in place by a sheet of plywood or similar material rigidly braced against it. Burlap shall be kept continually wet.

3.8.2.2 Repair of Deep and Large Defects

Deep and large defects will be those that are more than 6 inches deep and also have an average diameter at the surface more than 18 inches or that are otherwise so identified by the Project Office. Such defects shall be repaired as specified herein or directed, except that defects which affect the strength of the structure shall not be repaired and that portion of the structure shall be completely removed and replaced. Deep and large defects shall be repaired by procedures approved in advance including forming and placing special concrete using applied pressure during hardening. Preparation of the repair area shall be as specified for surface application of mortar. In addition, the top edge (surface) of the repair area shall be sloped at approximately 20 degrees from the horizontal, upward toward the side from which concrete will be placed. The special concrete shall be a concrete mixture with low water content and low slump, and shall be allowed to age 30 to 60 minutes before use. Concrete containing a specified expanding admixture may be used in lieu of the above mixture; the paste portion of such concrete mixture shall be designed to have an expansion between 2.0 and 4.0 percent when tested in accordance with ASTM C 940. A full width "chimney" shall be provided at the top of the form on the placing side to ensure filling to the top of the opening. A pressure cap shall be used on the concrete in the chimney with simultaneous tightening and revibrating the form during hardening to ensure a tight fit for the repair. The form shall be removed after 24 hours and immediately the chimney shall be carefully chipped away to avoid breaking concrete out of the repair; the surface of the repair concrete shall be dressed as required.

3.8.3 Resinous and Latex Material Repair

In lieu of the portland cement bonding coats specified above, an epoxy resin or a latex bonding agent may be used.

3.9 FINISHING UNFORMED SURFACES

The finish of all unformed surfaces shall meet the requirements of paragraph Tolerances in PART 1, when tested as specified herein.

3.9.1 General

The ambient temperature of spaces adjacent to unformed surfaces being finished and of the base on which concrete will be placed shall be not less than 50 degrees F. In hot weather all requirements of paragraphs Hot Weather Requirements and Prevention of Plastic Shrinkage Cracking shall be met. Unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, with additional finishing as specified below, and shall be true to the elevation shown on the drawings.

Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings, properly consolidated, and left true and regular. Unless otherwise shown on the drawings, exterior surfaces shall be sloped for drainage, as directed. Where drains are provided, interior floors shall be evenly sloped to the drains. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or "jitterbugs" shall not be used for any surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing shall not be permitted. If bleedwater is present prior to finishing, the excess water shall be carefully dragged off or removed by absorption with porous materials such as burlap. During finishing operations, extreme care shall be taken to prevent over finishing or working water into the surface; this can cause "crazing" (surface shrinkage cracks which appear after hardening) of the surface. Any slabs with surfaces which exhibit significant crazing shall be removed and replaced. During finishing operations, surfaces shall be checked with a 10 foot straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

3.9.2 Troweled Finish

Areas as indicated on the drawings shall be given a trowel finish. After floating is complete and after the surface moisture has disappeared, unformed surfaces shall be steel-troweled to a smooth, even, dense finish, free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. Additional trowelings shall be performed, either by hand or machine until the surface has been troweled 3 times, with waiting period between each. Care shall be taken to prevent blistering and if such occurs, troweling shall immediately be stopped and operations and surfaces corrected. A final hard steel troweling shall be done by hand, with the trowel tipped, and using hard pressure, when the surface is at a point that the trowel will produce a ringing sound. The finished surface shall be thoroughly consolidated and shall be essentially free of trowel marks and be uniform in texture and appearance. The concrete mixture used for troweled finished areas shall be adjusted, if necessary, in order to provide sufficient fines (cementitious material and fine sand) to finish properly.

3.9.3 Non-Slip Finish

Non-slip floors shall be constructed in accordance with the following subparagraphs.

3.9.3.1 Broomed

Areas as indicated on the drawings shall be given a broomed finish. After floating, the surface shall be lightly steel troweled, and then carefully scored by pulling a coarse fiber push-type broom across the surface. Brooming shall be transverse to traffic. After the end of the curing period, the surface shall be vigorously broomed with a coarse fiber broom to remove all loose or semi-detached particles.

3.10 EXTERIOR SLAB AND RELATED ITEMS

3.10.1 Sidewalks

Concrete shall be 5 inches minimum thickness. Contraction joints shall be

provided at 5 feet spaces unless otherwise indicated. Contraction joints shall be cut 1 inch deep with a jointing tool after the surface has been finished. Transverse expansion joints 1/2 inch thick shall be provided at changes in direction and where sidewalk abuts curbs, steps, rigid pavement, or other similar structures. Sidewalks shall be given a lightly broomed finish. A transverse slope of 1/4 inch per foot shall be provided, unless otherwise indicated. Variations in cross section shall be limited to 1/4 inch in 5 feet.

3.10.2 Curbs and Gutters

Concrete shall be formed, placed, and finished by hand using a properly shaped "mule" or constructed using a slipform machine specially designed for this work. Contraction joints shall be cut 3 inches deep with a jointing tool after the surface has been finished. Expansion joints ( 1/2 inch wide) shall be provided at 100 feet maximum spacing unless otherwise indicated. Exposed surfaces shall be finished using a stiff bristled brush.

3.11 CURING AND PROTECTION

3.11.1 General

Concrete shall be cured by an approved method for the period of time given below:

| | |
|---|---|
| All concrete | 7 days |

Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, mechanical injury and damage from rain and flowing water for the duration of the curing period. Air and forms in contact with concrete shall be maintained at a temperature above 50 degrees F for the first 3 days and at a temperature above 32 degrees F for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure, and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. Materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat, including welding, shall be permitted near or in direct contact with the concrete at any time. Except as otherwise permitted by paragraph Membrane Forming Curing Compounds, moist curing shall be provided for any areas to receive floor hardener, any paint or other applied coating, or to which other concrete is to be bonded. Concrete containing silica fume shall be initially cured by fog misting during finishing, followed immediately by continuous moist curing. Except for plastic coated burlap, impervious sheeting alone shall not be used for curing.

3.11.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, commencing immediately after finishing. If water or curing materials used stain or discolor concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned as approved. When wooden forms are left in place during curing, they shall be kept wet at all times. If steel forms are used in hot weather, nonsupporting vertical forms shall be broken loose from the concrete soon after the concrete hardens and curing water continually applied in this void. If the forms are removed before the end of the curing period, curing shall be

carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. The Contractor shall have an approved work system to ensure that moist curing is continuous 24 hours per day.

3.11.3 Cold Weather Curing and Protection

When the daily ambient low temperature is less than 32 degrees F the temperature of the concrete shall be maintained above 40 degrees F for the first seven days after placing. During the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 25 degrees F as determined by suitable temperature measuring devices furnished by the Government, as required, and installed adjacent to the concrete surface and 2 inches inside the surface of the concrete. The installation of the thermometers shall be made by the Contractor as directed.

3.12 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

The Contractor shall perform the inspection and tests described below and, based upon the results of these inspections and tests, shall take the action required and shall submit specified reports. When, in the opinion of the Contracting Officer, the concreting operation is out of control, concrete placement shall cease and the operation shall be corrected. The laboratory performing the tests shall be onsite and shall conform with ASTM C 1077. Materials may be subjected to check testing by the Government from samples obtained at the manufacturer, at transfer points, or at the project site. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per 30 days thereafter for conformance with ASTM C 1077.

3.12.1 Grading and Corrective Action

3.12.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately reported to the Contracting Officer, concreting shall be stopped, and immediate steps taken to correct the grading.

3.12.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the

aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of 5 tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

3.12.2 Quality of Aggregates

Thirty days prior to the start of concrete placement, the Contractor shall perform all tests for aggregate quality required by ASTM C 33. In addition, after the start of concrete placement, the Contractor shall perform tests for aggregate quality at least every three months, and when the source of aggregate or aggregate quality changes. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

3.12.3 Scales, Batching and Recording

The accuracy of the scales shall be checked by test weights prior to start of concrete operations and at least once every three months. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors. Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. At the same time, the Contractor shall test and ensure that the devices for dispensing admixtures are operating properly and accurately. When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

3.12.4 Batch-Plant Control

The measurement of concrete materials including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic yard amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic yard for each class of concrete batched during each day's plant operation.

3.12.5 Concrete Mixture

a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each

separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with ASTM C 231 for normal weight concrete and ASTM C 173/C 173M for lightweight concrete. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph Air Entrainment. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line, respectively. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a secondary control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the air content at the mixer controlled as directed.

b. Air Content Corrective Action. Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted.

c. Slump Testing. In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C 143/C 143M for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current

control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control charts for slump and the chart for range, and for determining need for any remedial action. Limits shall be set on separate control charts for slump for each type of mixture. The upper warning limit shall be set at 1/2 inch below the maximum allowable slump specified in paragraph Slump in PART 1 for each type of concrete and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 2 inches. Samples for slump shall be taken at the mixer. However, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the slump at the mixer controlled as directed.

d. Slump Corrective Action. Whenever points on the control charts for slump reach the upper warning limit, an adjustment shall immediately be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum w/c ratio specified, based on aggregates which are in a saturated surface dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, the concreting operation shall immediately be halted, and the Contractor shall take appropriate steps to bring the slump under control. Additional slump tests shall be made as directed.

e. Temperature. The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall be in accordance with ASTM C 1064/C 1064M. The temperature shall be reported along with the compressive strength data.

f. Strength Specimens. At least one set of test specimens shall be made, for compressive or flexural strength as appropriate, on each different concrete mixture placed during the day for each 500 cubic yards or portion thereof of that concrete mixture placed each day. Additional sets of test specimens shall be made, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. A truly random (not haphazard) sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength in

accordance with paragraph Strength Requirements in PART 1 shall consist of four specimens, two to be tested at 7 days and two at 28 days. A set of test specimens for concrete with a 90-day strength in accordance with the same paragraph shall consist of six specimens, two tested at 7 days, two at 28 days, and two at 90 days. Test specimens shall be molded and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M for test cylinders and ASTM C 78 for test beams. Results of all strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength "tests", ("test" as defined in paragraph Strength Requirements in PART 1) moving average of last 3 "tests" for strength, and moving average for range for the last 3 "tests" for each mixture. The charts shall be similar to those found in ACI 214R.

3.12.6 Inspection Before Placing

Foundations, construction joints, forms, and embedded items shall be inspected by the Contractor in sufficient time prior to each concrete placement in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

3.12.7 Placing

The placing foreman shall supervise placing operations, shall determine that the correct quality of concrete or grout is placed in each location as specified and as directed by the Contracting Officer, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume placed, and method of placement. The placing foreman shall not permit batching and placing to begin until it has been verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

3.12.8 Curing Inspection

a. Moist Curing Inspections. At least once each shift, and not less than twice per day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

b. Moist Curing Corrective Action. When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by 1 day.

3.12.9 Cold-Weather Protection

At least once each shift and once per day on non-work days, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

3.12.10 Mixer Uniformity

a. Stationary Mixers. Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 75,000 cubic yards of concrete placed, whichever results in the shortest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M.

b. Truck Mixers. Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.

c. Mixer Uniformity Corrective Action. When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

3.12.11 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

-- End of Section --

Dawson #5

HSI & Concrete Specialty Supply
READY MIX
A Division of Huey Stockstill, Inc.
P.O. Box 758
Picayune, MS 39466
Phone: 601.798.2981 Fax: 601.798.3072

PICAYUNE PLANT
130 Huey Stockstill Rd.
Picayune, MS 39466
(601) 798-1665

POPLARVILLE PLANT
778 Hwy 26 E
Poplarville, MS 39470
(601) 795-8699

## PORTLAND CEMENT CONCRETE MIX DESIGN

DATE: 4-May-09
PROJECT: NEW RAVINE AND COMBAT CRAFT OPERATIONS FACILITY
MIX TYPE: 40110-13 DESCRIPTION: 4000 P.S.I.

| PORTLAND CEMENT | | OTHER ADMIXTURE | AIR-ENT MIXTURE |
|---|---|---|---|
| TYPE: | Type I/II | TYPE: "C" Fly Ash | TYPE: D1000 |
| PRODUCER: | Holcim (Theodore) | SOURCE: HEAD WATER RESOURCES | AMOUNT: |
| FINE AGGREGATE | | COARSE AGGREGATE | |
| TYPE: | Fine Aggregate | TYPE: #67 Coarse Aggregate | |
| SOURCE: | Huey Stockstill, Inc. (12 Oaks) | SOURCE: Huey Stockstill, Inc. (12 Oaks) | |

### MATERIALS

| MATERIALS | SIZE RANGE | BULK SP. GR. | ABSORPTION % |
|---|---|---|---|
| CEMENT | — | 3.15 | — |
| FINE AGGREGATE | 3/8" - #100 | 2.62 | 0.63 |
| COARSE AGGREGATE | 1" - #8 | 2.47 | 3.01 |
| FLY ASH | — | 2.64 | — |
| | | | |

### MIX DATA

| SAMPLE NUMBER | 40110-13 | | |
|---|---|---|---|
| | MIXTURE BY WEIGHT | NET WEIGHTS 1 CUBIC YARD | ABSOLUTE VOLUME MIX CUBIC YARD |
| FLY ASH (ASTM C618) | 113 | 113 | 0.69 |
| CEMENT (ASTM C150) | 451 | 451 | 2.29 |
| FINE AGGREGATE (ASTM C33) | 1489 | 1489 | 9.11 |
| COARSE AGGREGATE (ASTM C33) | 1700 | 1700 | 11.03 |
| WATER | 242 | 242 | 3.88 |
| WATER REDUCER D-65 (ASTM C494) | 17 oz./CY | — | — |
| ADVA FLOW (SUPER) | 22 oz/CY | ------ | — |
| TOTAL | | 3995 | 27.00 |
| WATER/CEMENT RATIO 0.43 | | THEO. UNIT WEIGHT (LB. PER CUBIC FOOT) 147.96 | |
| SLUMP (IN.): 4" | | | |

CONTRACTOR: COAST CONCRETE Q.C. BRUCE C. EZELL 601-273-0540
PRODUCER: H S I Ready Mix a division of Huey Stockstill, Inc.

**DAMMON ENGINEERING INC**

**Date:** 5.4.09 **Project:** Stennis ROF

**Reviewed:** X

**Reviewed as Noted:** _____

**Revise and Resubmit:** _____

**Rejected:** _____

**Other:** _____

**Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. This contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his or her work with that at all other trades and performing all in a safe and satisfactory manner.**

**Submittal Item:** Conc. Mix Design

**Comments**

## BROADMOOR, L.L.C.

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

Robert [illegible] 5.4.09

DQC Manager Date

[illegible] 5/4/09

QC Officer Date

SECTION 04 20 00

MASONRY
**02/09**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

| | |
|---|---|
| ACI 530/530.1 | (2008) Building Code Requirements and Specification for Masonry Structures; Containing Building Code Requirements for Masonry Structures, Specification for Masonry Structures and Companion Commentaries |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 153/A 153M | (2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| ASTM A 167 | (1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |
| ASTM A 615/A 615M | (2008b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM A 641/A 641M | (2003) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire |
| ASTM A 82/A 82M | (2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement |
| ASTM B 370 | (2003) Standard Specification for Copper Sheet and Strip for Building Construction |
| ASTM C 1019 | (2008a) Standard Test Method for Sampling and Testing Grout |
| ASTM C 1072 | (2006) Standard Test Method for Measurement of Masonry Flexural Bond Strength |
| ASTM C 1142 | (1995; R 2007) Standard Specification for Extended Life Mortar for Unit Masonry |
| ASTM C 129 | (2006) Standard Specification for |

| | |
|---|---|
| | Nonloadbearing Concrete Masonry Units |
| ASTM C 140 | (2008a) Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units |
| ASTM C 144 | (2004) Standard Specification for Aggregate for Masonry Mortar |
| ASTM C 150 | (2007) Standard Specification for Portland Cement |
| ASTM C 207 | (2006) Standard Specification for Hydrated Lime for Masonry Purposes |
| ASTM C 270 | (2008a) Standard Specification for Mortar for Unit Masonry |
| ASTM C 476 | (2008) Standard Specification for Grout for Masonry |
| ASTM C 494/C 494M | (2008a) Standard Specification for Chemical Admixtures for Concrete |
| ASTM C 55 | (2006e1) Concrete Brick |
| ASTM C 593 | (2006) Fly Ash and Other Pozzolans for Use with Lime |
| ASTM C 641 | (2007) Staining Materials in Lightweight Concrete Aggregates |
| ASTM C 744 | (2008) Prefaced Concrete and Calcium Silicate Masonry Units |
| ASTM C 780 | (2008) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry |
| ASTM C 90 | (2008) Loadbearing Concrete Masonry Units |
| ASTM C 91 | (2005) Masonry Cement |
| ASTM C 94/C 94M | (2007) Standard Specification for Ready-Mixed Concrete |
| ASTM D 2240 | (2005) Standard Test Method for Rubber Property - Durometer Hardness |
| ASTM D 2287 | (1996; R 2001) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds |
| ASTM E 119 | (2008a) Standard Test Methods for Fire Tests of Building Construction and Materials |
| ASTM E 514 | (2008) Water Penetration and Leakage Through Masonry |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|---|---|
| ICC IBC | (2006; Errata 2006; Errata 2007; Supplement 2007; Errata 2007) International Building Code |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| UFC 3-310-04 | (2007) Seismic Design for Buildings |

1.2 SYSTEM DESCRIPTION

1.1.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. Masonry materials may be locally available.

1.2 [Enter Appropriate Subpart Title Here]1.2.1 Design Requirements

1.2.1.1 Unit Strength Method

Compute compressive strength of masonry system "Unit Strength Method," ACI 530/530.1. Submit calculations and certifications of unit and mortar strength.

1.2.1.2 Seismic Requirement

In addition to design requirements of ICC IBC, provide additional seismic reinforcement in accordance with UFC 3-310-04. The total minimum reinforcing percentage for structural walls shall be 0.20 percent and non-structural walls shall be 0.15 percent. The maximum spacing of reinforcing bars shall be as follows:

| Wall Type | Vertical | Horizontal |
|---|---|---|
| Structural | 24 inches | 48 inches |
| Non-structural | 48 inches | 80 inches |

Bond beams are required at the top of footings, at the bottom and top of openings at roof and floor levels, and at the top of parapet walls.

1.2.1.3 Special Inspection

Perform special inspections and testing for seismic-resisting systems and components in accordance with UFC 3-310-04 SEISMIC DESIGN FOR BUILDINGS.

1.2.1.4 Masonry Strength

Determine masonry strength in accordance with ACI 530/530.1; submit test reports on three prisms as specified in ACI 530/530.1. The cost of testing shall be paid by the Contractor.

1.2.2 Additional Requirements

a. Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.1.2.3 [Enter Appropriate Subpart Title Here]

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings G

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings.

SD-03 Product Data

Concrete Brick G
Concrete Masonry Units (CMU) G
Cement G
Insulation G
Flashing G
Anchors, Ties, and Bar Positioners G

SD-04 Samples

Concrete Masonry Units (CMU) G
Concrete Brick G

Color samples of three stretcher units and one unit for each type of special shape. Units shall show the full range of color and texture. Submit sample of colored mortar with applicable masonry unit.

Anchors, Ties, and Bar Positioners G

Two of each type used.

Expansion-Joint Materials G

One piece of each type used.

Joint Reinforcement G

One piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

Insulation G

One piece of board type insulation, not less than 16 by 24 inches

in size, containing the label indicating the rated permeance and R-values.

Portable Panel; G

One panel of broken face CMU, containing approximately 24 brick facings to establish range of color and texture.

SD-05 Design Data

Pre-mixed Mortar G
Unit Strength Method G

Pre-mixed mortar composition. Calculations and certifications of masonry unit and mortar strength.

SD-06 Test Reports

Field Testing of Mortar G
Field Testing of Grout G
Prism tests G
Masonry Cement G
Efflorescence Test G

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

SD-07 Certificates

Clay or Shale Brick
Concrete Brick
Concrete Masonry Units (CMU)
Control Joint Keys
Anchors, Ties, and Bar Positioners
Expansion-Joint Materials
Joint Reinforcement
Reinforcing Steel Bars and Rods
Masonry Cement
Mortar Coloring
Insulation
Precast Concrete Items
Admixtures for Masonry Mortar
Admixtures for Grout

Certificates of compliance stating that the materials meet the specified requirements.

Insulation

Certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

Contamination

SD-08 Manufacturer's Instructions

Masonry Cement

When masonry cement is used, submit the manufacturer's printed instructions on proportions of water and aggregates and on mixing to obtain the type of mortar required.

SD-10 Operation and Maintenance Data

Take-Back Program

Documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

## 1.4 QUALITY ASSURANCE

### 1.4.1 Appearance

Blend all broken face CMU to produce a uniform appearance when installed. An observable "banding" or "layering" of colors or textures caused by improperly mixed brick is unacceptable.

### 1.4.2 Contamination

When using bricks containing contaminated soil, supplier shall certify that the hazardous waste is neutralized by the manufacturing process and that no additional pollutants will be released, or that the product is free from hazardous contaminants.

### 1.4.3 Sample Masonry Panels

After material samples are approved and prior to starting masonry work, construct a portable panel of clay or shale brick and sample masonry panels for each type and color of masonry required. At least 48 hours prior to constructing the sample panel or panels, submit written notification to the Contracting Officer. Sample panels shall not be built in, or as part of the structure, but shall be located where directed.

#### 1.4.3.1 Configuration

Panels shall be L-shaped or otherwise configured to represent all of the wall elements. Panels shall be of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project.

#### 1.4.3.2 Composition

Panels shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work shall be demonstrated during the construction of the panels. Installation or application procedures for anchors, wall ties, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weep holes shall be shown in the sample panels. Panels shall show installation of electrical boxes and conduit. Panels that represent reinforced masonry shall contain a 2 by 2 foot opening placed at least 2 feet above the panel base and 2 feet away from

all free edges, corners, and control joints. Required reinforcing shall be provided around this opening as well as at wall corners and control joints.

1.4.3.3 Construction Method

Where anchored veneer walls are required, demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Temporary provisions shall be demonstrated to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. If sealer is specified to be applied to the masonry units, sealer shall be applied to the sample panels. Panels shall be built on a properly designed concrete foundation.

1.4.3.4 Usage

The completed panels shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel for that type of masonry construction has been completed and approved. Panels shall be protected from the weather and construction operations until the masonry work has been completed and approved. After completion of the work, the sample panels, including all foundation concrete, shall become the property of the Contractor and shall be removed from the construction site.

1.5 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

1.5.1 Masonry Units

Cover and protect moisture-controlled concrete masonry units and cementitious materials from precipitation. Conform to all handling and storage requirements of ASTM C 90. Prefabricated lintels shall be marked on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.5.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.5.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

1.6 PROJECT/SITE CONDITIONS

Conform to ACI 530/530.1 for hot and cold weather masonry erection.

1.6.1 Hot Weather Installtion

Take the following precautions if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent or the ambient air temperature exceeds 90 degrees F and the wind velocity is more than 8 mph. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

1.6.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F or temperature of masonry units is below 40 degrees F, submit a written statement of proposed cold weather construction procedures for approval.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval.

2.2 CONCRETE BRICK

Concrete brick shall conform to ASTM C 55, Grade N. Concrete brick may be used where necessary for filling out in concrete masonry unit construction.

2.3 CONCRETE MASONRY UNITS (CMU)

Cement shall have a low alkali content and be of one brand. Units shall contain a minimum of 10 percent post-consumer recycled content. Units shall be of modular dimensions and air, water, or steam cured. Surfaces of units shall be smooth and of uniform texture.

a. Hollow Load-Bearing Units: ASTM C 90, made with lightweight or normal weight aggregate. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.

b. Hollow Non-Load-Bearing Units: ASTM C 129, made with lightweight or normal weight aggregate. Load-bearing units may be provided in lieu of non-load-bearing units.

2.3.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.

2.3.2 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be 1 inch. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.3.2.1 Architectural Units

Units shall have patterned split face. Split face pattern shall be similar to existing. Units shall be integrally colored during manufacture. Color shall be selected by User.

2.3.3 Fire-Rated CMU

Concrete masonry units used in fire-rated construction shown on the drawings shall be of minimum equivalent thickness for the fire rating indicated and the corresponding type of aggregates indicated in TABLE I. Units containing more than one of the aggregates listed in TABLE I will be rated on the aggregate requiring the greater minimum equivalent thickness to produce the required fire rating. Construction shall conform to ASTM E 119.

TABLE I

FIRE-RATED CONCRETE MASONRY UNITS

See note (a) below

| Aggregate Type | Minimum equivalent thickness inches for fire rating of: 4 hours | 3 hours | 2 hours |
|---|---|---|---|
| Pumice | 4.7 | 4.0 | 3.0 |
| Expanded slag | 5.0 | 4.2 | 3.3 |
| Expanded clay, shale, or slate | 5.7 | 4.8 | 3.7 |
| Limestone, scoria, cinders or unexpanded slag | 5.9 | 5.0 | 4.0 |
| Calcareous gravel | 6.2 | 5.3 | 4.2 |
| Siliceous gravel | 6.7 | 5.7 | 4.5 |

Minimum equivalent thickness shall equal net volume as determined in conformance with ASTM C 140 divided by the product of the actual length and height of the face shell of the unit in inches. Where walls are to receive plaster or be faced with brick, or otherwise form an assembly; the thickness of plaster or brick or other material in the assembly will be

included in determining the equivalent thickness.2.4 [Enter Appropriate Subpart Title Here]

2.4.1 Splash Blocks

Splash blocks shall be as detailed. Reinforcement shall be the manufacturer's standard.

2.5 STONE ITEMS

Stone for trim, sills, lintels, and copings shall be limestone, sandstone, or granite, and shall be cut to the design shown. Sandstone shall be standard grade, buff, gray, or buff brown, with a smooth finish free from clay pits and tool marks. Granite shall be a good commercial grade building granite of medium or moderately coarse grain, and a light or medium gray or light pink color, with a smooth machine finish on washes, 4-cut finish on treads, and 6-cut or equivalent machine finish on other exposed surfaces. Limestone shall be standard buff limestone with a smooth machine finish free from tool marks. Lintels, except when supported by a steel member, shall be 4 inches or more thick from face to back edge and of the depth required to support the masonry over the opening. Stone shall have beds and joints at right angles to the face, with sharp, true arises. Copings and sills shall be provided with washes, and where overhanging the walls, shall have drips cut on the underside.

2.6 MORTAR FOR STRUCTURAL MASONRY

ASTM C 270, Type N. Strength (f'm) as indicated. Test in accordance with ASTM C 780. Use Type I, II, or III portland cement. Do not use admixtures containing chlorides. When structural reinforcement is incorporated, maximum air-content shall be 12 percent in cement-lime mortar and 18 percent in masonry cement mortar. Use up to 40 percent Class F fly ash with type IP cement in cement-lime mortar. Fly ash shall comply with ASTM C 593.

2.7 MASONRY MORTAR

Type M mortar shall conform to ASTM C 270 and shall be used for foundation walls. Mortar Type N shall conform to the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate; Type N cement-lime mortar proportions shall be 1 part cement, 1 part lime and 6 parts aggregate. Type N or S mortar shall be used for non-load-bearing, non-shear-wall interior masonry; and Type S for remaining masonry work; except where higher compressive strength is indicated on structural drawings. When masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C 1072. Pointing mortar in showers and kitchens shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.7.1 Admixtures for Masonry Mortar

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to

ASTM C 494/C 494M, Type C.

2.7.2 Colored Mortar

Mortar coloring shall be added to the mortar used for exposed masonry surfaces to produce a uniform color. Mortar coloring shall be chemically inert, of finely ground limeproof pigment, and furnished in accurately pre-measured and packaged units that can be added to a measured amount of cement.

2.7.3 Hydrated Lime and Alternates

Hydrated lime shall conform to ASTM C 207.

2.7.4 Cement

Portland cement shall conform to ASTM C 150, Type I, II, or III,. Masonry cement shall conform to ASTM C 91, Type N orS. Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar. Incorporate to the maximum extent, without conflicting with other requirements of this section, up to 40 percent fly ash, up to 70 percent slag, up to 10 percent cenospheres, and up to 10 percent silica fume.

2.7.5 Pre-Mixed Mortar

Pre-mixed mortar shall conform to ASTM C 1142.

2.7.6 Sand and Water

Sand shall conform to ASTM C 144. Water shall be clean, potable, and free from substances which could adversely affect the mortar.

2.8 WATER-REPELLANT ADMIXTURE

Polymeric type formulated to reduce porosity and water transmission. Construct panels of masonry units conforming to ASTM C 744 and mortar which contain the water-repellant admixture. When tested in accordance with ASTM C 1072, such panels shall have flexural strength not less than that specified or indicated. When tested in accordance with ASTM E 514, panels shall exhibit no water visible on back of test panel and no leaks through the panel after 24 hours, and not more than 25 percent of wall area shall be damp after 72 hours.

2.9 GROUT AND READY-MIXED GROUT

Grout shall conform to ASTM C 476, fine or coarse. Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 11 inches. Minimum grout strength shall be 2000 psi in 28 days, as tested by ASTM C 1019. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Ready-Mixed grout shall conform to ASTM C 94/C 94M.

2.9.1 Admixtures for Grout

In cold weather, a non-chloride based accelerating admixture may be used subject to approval; accelerating admixture shall be non-corrosive, shall

contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C. In general, air-entrainment, anti-freeze or chloride admixtures shall not be used except as approved by the Contracting Officer.

2.9.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

## 2.10 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153/A 153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82/A 82M. Wire ties or anchors in exterior walls shall conform to ASTM A 641/A 641M. Joint reinforcement in interior walls, and in exterior or interior walls exposed to moist environment shall conform to ASTM A 641/A 641M; coordinate with paragraph JOINT REINFORCEMENT below. Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face.

2.10.1 Wire Mesh Ties

Wire mesh for tying 4 inch thick concrete masonry unit partitions to other intersecting masonry partitions shall be 1/2 inch mesh of minimum 16 gauge steel wire. Minimum lengths shall be not less than 12 inches.

2.10.2 Wall Ties

Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 1/2 inch eccentricity between each element of the tie. Play between pintle and eye opening shall be not more than 1/16 inch. The pintle and eye elements shall be formed so that both can be in the same plane.

2.10.3 Dovetail Anchors

Dovetail anchors shall be of the flexible wire type, 3/16 inch diameter zinc-coated steel wire, triangular shaped, and attached to a 12 gauge or heavier steel dovetail section. These anchors shall be used for anchorage of veneer wythes or composite-wall facings extending over the face of concrete columns, beams, or walls. Cells within vertical planes of these anchors shall be filled solid with grout for full height of walls or partitions, or solid units may be used.

2.10.4 Adjustable Anchors

Adjustable anchors shall be 3/16 inch diameter steel wire, triangular-shaped. Anchors attached to steel shall be 5/16 inch diameter steel bars placed to provide 1/16 inch play between flexible anchors and structural steel members. Spacers shall be welded to rods and columns. Equivalent welded-on steel anchor rods or shapes standard with the flexible-anchor manufacturer may be furnished when approved. Welds shall be cleaned and given one coat of zinc-rich touch up paint.

2.10.5 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during

the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

## 2.11 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82/A 82M, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153/A 153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 5/8 inch cover from either face. The distance between crosswires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

## 2.12 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade 60.

## 2.13 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 30 degrees F after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

## 2.14 RIGID BOARD-TYPE INSULATION

Provide rigid board-type insulation as shown on plans.

## 2.15 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07 92 00 JOINT SEALANTS, and shall be penetrating with a maximum volatile organic compound (VOC) content of 600 grams/liter.

## 2.16 THROUGH WALL FLASHING

Flashing shall be as specified in Section 07 60 00 FLASHING AND SHEET METAL. Provide one of the following types shall be metal .

a. Stainless Steel Flashing: Copper, ASTM B 370, minimum 16 ounce weight; stainless steel, ASTM A 167, Type 301, 302, 304, or 316, 0.015 inch thick, No. 2D finish. Provide with factory-fabricated

deformations that mechanically bond flashing against horizontal movement in all directions. Deformations shall consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations.

## 2.17 WEEP HOLE VENTILATORS

Weep hole ventilators shall be prefabricated aluminum, plastic or wood blocking sized to form the proper size opening in head joints. Provide aluminum and plastic inserts with grill or screen-type openings designed to allow the passage of moisture from cavities and to prevent the entrance or insects. Ventilators shall be sized to match modular construction with a standard 3/8 inch mortar joint.

# PART 3 EXECUTION

## 3.1 PREPARATION

Prior to start of work, masonry inspector shall verify the applicable conditions as set forth in ACI 530/530.1, inspection. The Contracting Officer will serve as inspector or will select a masonry inspector.

### 3.1.1 Protection

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

a. Air Temperature 40 to 32 Degrees F. Sand or mixing water shall be heated to produce mortar temperatures between 40 and 120 degrees F

### 3.1.2 Completed Masonry and Masonry Not Being Worked On

a. Mean daily air temperature 40 to 32 degrees F. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

### 3.1.3 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

### 3.1.4 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

### 3.1.5 Surfaces

Surfaces on which masonry is to be placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 1/8 inch. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

## 3.2 LAYING MASONRY UNITS

a. Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic.

b. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb.

c. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below.

d. In double wythe construction, the inner wythe may be brought up not more than 16 inches ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 8 inches.

### 3.2.1 Forms and Shores

Provide bracing and scaffolding as required. Design bracing to resist wind pressure as required by local codes. Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

### 3.2.2 Reinforced Concrete Masonry Units Walls

Where vertical reinforcement occurs, fill cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Embed the adjacent webs in mortar to prevent leakage of grout. Remove mortar fins protruding from joints before placing grout. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at vertical intervals not to exceed 160 bar diameters. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be not less than 1/2 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together.

3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 [Enter Appropriate Subpart Title Here]

3.2.4.1 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 1 gram per minute per square inch of bed surface shall be in conformance with ASTM C 67. The method of wetting shall ensure that each unit is nearly saturated but surface dry when laid. Test clay or shale brick daily on the job, prior to laying, as follows: Using a wax pencil, draw a circle the size of a quarter on five randomly selected bricks. Apply 20 drops of water with a medicine dropper to the surface within the circle on each brick. If the average time that the water is completely absorbed in the five bricks is less than 1-1/2 minutes, wet bricks represented by the five bricks tested.

3.2.4.2 Solid Units

Bed, head, and collar joints shall be completely filled with mortar.

3.2.4.3 Hollow Units

Hollow units shall be laid as specified for concrete masonry units.

3.2.4.4 Cavity Walls

Provide a continuous cavity as indicated. Securely tie the two wythes together with horizontal joint reinforcement. Bevel mortar beds away from cavity to prevent projection into cavity when bricks are shoved in place. Keep cavities clear and clean of mortar droppings. At the bottom of cavity walls, in the course immediately above the through-wall flashing, temporarily omit one brick every 4 feet. With a hose and clean water, wash all mortar droppings and debris out of the cavity through the temporary openings at least twice each day masonry is laid, and more often when required to keep the cavities clean. Fill in the openings with bricks and mortar after the wall is complete and the cavity has been inspected and found clean. Provide weep holes of open head joints spaced 24 inches o.c. at base of wall and vertical obstructions (e.g. lintels).

3.2.4.5 Reinforced Brick Walls

Provide two wythes of brick separated by a continuous space and reinforced as indicated. Bevel mortar beds away from grout space to prevent projection into grout space when bricks are shoved in place. Deeply

furrowed bed joints will not be permitted. Lay exterior wythe of brick to the height of each grout pour in advance of interior wythe. Clean grout space and set reinforcing before laying interior wythe. Provide metal ties to prevent spreading of the wythes and to maintain vertical alignment of walls. Position reinforcing as indicated. Wire vertical reinforcing securely in position as the brickwork progresses. Use puddling rod or vibrator to consolidate the grout. The minimum clear distance between parallel bars shall be the nominal diameter of the bars; the minimum clear distance between masonry and reinforcing shall be 1/4 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together. Stagger splices in adjacent horizontal bars.

3.2.4.6 CMU Veneer

Provide a continuous cavity as indicated. Install brick veneer after sheathing, masonry anchors, and flashing have been installed to the cold-formed steel framing system. Care shall be provided to avoid damaging the moisture barrier. Damaged moisture barrier and flashing shall be repaired or replaced before brick veneer is installed. Means shall be provided to keep cavities clean and clear of mortar droppings.

3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

TOLERANCES

| | |
|---|---|
| Variation from the plumb in the lines and surfaces of columns, walls and arises | |
| In adjacent masonry units | 1/8 inch |
| In 10 feet | 1/4 inch |
| In 20 feet | 3/8 inch |
| In 40 feet or more | 1/2 inch |
| Variations from the plumb for external corners, expansion joints, and other conspicuous lines | |
| In 20 feet | 1/4 inch |
| In 40 feet or more | 1/2 inch |
| Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines | |
| In 20 feet | 1/4 inch |
| In 40 feet or more | 1/2 inch |
| Variation from level for bed joints and top | |

TOLERANCES

| surfaces of bearing walls | |
|---|---|
| In 10 feet | 1/4 inch |
| In 40 feet or more | 1/2 inch |
| **Variations from horizontal lines** | |
| In 10 feet | 1/4 inch |
| In 20 feet | 3/8 inch |
| In 40 feet or more | 1/2 inch |
| **Variations in cross sectional dimensions of columns and in thickness of walls** | |
| Minus | 1/4 inch |
| Plus | 1/2 inch |

3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.7.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall. Joints in unparged masonry walls below grade shall be pointed tight. Flush joints for architectural units, such as fluted units, shall completely fill both the head and bed joints.

3.2.7.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to

obtain a straight and true mortar joint.

3.2.7.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

3.2.8 Joint Widths

Joint widths shall be as follows:

3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 3/8 inch joints, except for prefaced concrete masonry units.

3.2.8.2 Prefaced Concrete Masonry Units

Prefaced concrete masonry units shall have a joint width of 3/8 inch wide on unfaced side and not less than 3/16 inch nor more than 1/4 inch wide on prefaced side.

3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.2.12 Partitions

Partitions shall be continuous from floor to underside of floor or roof deck where shown. Openings in firewalls around joists or other structural members shall be filled as indicated or approved. Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be continuous may be stopped approximately 4 inches above the ceiling level. An isolation joint shall be placed in the intersection between partitions and structural or exterior walls as shown. Interior partitions having 4 inch nominal thick units shall be tied to intersecting partitions of 4 inch units, 5 inches into partitions of 6 inch units, and

7 inches into partitions of 8 inch or thicker units. Cells within vertical plane of ties shall be filled solid with grout for full height of partition or solid masonry units may be used. Interior partitions having masonry walls over 4 inches thick shall be tied together with joint reinforcement. Partitions containing joint reinforcement shall be provided with prefabricated pieces at corners and intersections or partitions.

## 3.3 ANCHORED VENEER CONSTRUCTION

The inner and outer wythes shall be completely separated by a continuous airspace as shown on the drawings. Both the inner and the outer wythes shall be laid up together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, through-wall flashings shall be protected from damage until they are fully enclosed in the wall. The airspace between the wythes shall be kept clear and free of mortar droppings by temporary wood strips laid on the wall ties and carefully lifted out before placing the next row of ties. A coarse gravel or drainage material shall be placed behind the weep holes in the cavity to a minimum depth of 4 inches of coarse aggregate or 10 inches of drainage material to keep mortar droppings from plugging the weep holes.

## 3.4 WEEP HOLES

Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior at acceptable locations as indicated on drawings. Weep holes shall be open head joints. Weep holes shall be provided not more than 24 inches on centers in mortar joints of the exterior wythe above wall flashing, over foundations, bond beams, and any other horizontal interruptions of the cavity. Weep holes shall be perfectly horizontal or slightly canted downward to encourage water drainage outward and not inward. Weep holes shall be constructed using weep hole ventilators. Weep holes shall be kept free of mortar and other obstructions.

## 3.5 COMPOSITE WALLS

Masonry wythes shall be tied together with joint reinforcement or with unit wall ties. The facing wythe shall be anchored or tied to the backup at a maximum spacing of 16 inches on center vertically and 16 inches on center horizontally. Unit ties shall be spaced not over 16 inches on centers horizontally, in courses not over 16 inches apart vertically, staggered in alternate courses. Ties shall be laid not closer than 5/8 inch to either masonry face. Ties shall not extend through control joints. Collar joints between masonry facing and masonry backup shall be filled solidly with grout.

## 3.6 MORTAR MIX

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2.5 hours after mixing shall be discarded.

## 3.7 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

### 3.7.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

### 3.7.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

## 3.8 JOINT REINFORCEMENT INSTALLATION

Joint reinforcement shall be installed at 16 inches on center or as indicated. Reinforcement shall be lapped not less than 6 inches. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 5/8 inch cover to either face of the unit.

## 3.9 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

### 3.9.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

### 3.9.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units

receiving grout.

3.9.3 Grout Holes and Cleanouts

3.9.3.1 Grout Holes

Grouting holes shall be provided in slabs, spandrel beams, and other in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 16 inches on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

3.9.3.2 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 32 inches where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 3 by 4 inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.9.3.3 Cleanouts for Solid Unit Masonry Construction

Cleanouts for construction of walls consisting of a grout filled cavity between solid masonry wythes shall be provided at the bottom of every pour by omitting every other masonry unit from one wythe. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanout holes shall not be plugged until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.9.4 Grouting Equipment

3.9.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

3.9.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of

the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

3.9.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

3.9.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

3.9.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 1/4 inch into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 4 feet in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 12 to 18 inches into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall

be used subject to the limitations in Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

| Maximum Grout Pour Height (feet) (4) | Grout Type | Grouting Procedure | Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (in.) (1,2) Multiwythe Masonry (3) | Hollow-unit Masonry |
|---|---|---|---|---|
| 1 | Fine | Low Lift | 3/4 | 1-1/2 x 2 |
| 5 | Fine | Low Lift | 2 | 2 x 3 |
| 8 | Fine | High Lift | 2 | 2 x 3 |
| 12 | Fine | High Lift | 2-1/2 | 2-1/2 x 3 |
| 24 | Fine | High Lift | 3 | 3 x 3 |
| 1 | Coarse | Low Lift | 1-1/2 | 1-1/2 x 3 |
| 5 | Coarse | Low Lift | 2 | 2-1/2 x 3 |
| 8 | Coarse | High Lift | 2 | 3 x 3 |
| 12 | Coarse | High Lift | 2-1/2 | 3 x 3 |
| 24 | Coarse | High Lift | 3 | 3 x 4 |

Notes:

(1) The actual grout space or cell dimension shall be larger than the sum of the following items:

a) The required minimum dimensions of total clear areas given in the table above;

b) The width of any mortar projections within the space;

c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.

(2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 3/4 inch or greater in width.

(3) For grouting spaces between masonry wythes.

(4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

## 3.10 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

## 3.11 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using in accordance with the details shown on the drawings. Sash jamb

units shall have a 3/4 by 3/4 inch groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 3/4 inch; backer rod and sealant shall be installed in accordance with Section 07 92 00 JOINT SEALANTS. Exposed interior control joints shall be raked to a depth of 1/4 inch. Concealed control joints shall be flush cut.

## 3.12 JOINTS SHOWN ON THE DRAWINGS

a. Concrete masonry veneer joints

b. will be located, detailed, and constructed as shown on the drawings. Keep joints free of mortar and other debris.

## 3.13 SHELF ANGLES

Adjust shelf angles as required to keep the masonry level and at the proper elevation. Shelf angles shall be galvanized and provided in sections not longer than 10 feet and installed with a 1/4 inch gap between sections. Shelf angles shall be mitered and welded at building corners with each angle not shorter than 4 feet, unless limited by wall configuration.

## 3.14 LINTELS

### 3.14.1 Masonry Lintels

Construct masonry lintels with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 1/2 inch above the bottom inside surface of the lintel unit.

### 3.14.2 Precast Concrete and Steel Lintels

Construct steel lintels as shown on the drawings. Lintels shall be set in a full bed of mortar with faces plumb and true. Steel and precast lintels shall have a minimum bearing length of 8 inches unless otherwise indicated on the drawings.

## 3.15 SILLS AND COPINGS

Sills and copings shall be set in a full bed of mortar with faces plumb and true.

## 3.16 ANCHORAGE TO CONCRETE AND STRUCTURAL STEEL

### 3.16.1 Anchorage to Concrete

Anchorage of masonry to the face of concrete columns, beams, or walls shall be with dovetail anchors spaced not over 16 inches on centers vertically and 16 inches on center horizontally.

3.16.2 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 16 inches on centers vertically, and if applicable, not over 16 inches on centers horizontally.

3.17 PARGING

The outside face of below-grade exterior concrete-masonry unit walls enclosing usable rooms and spaces, except crawl spaces, shall be parged with type S mortar. Parging shall not be less than 1/2 inch thick troweled to a smooth dense surface so as to provide a continuous unbroken shield from top of footings to a line 6 inches below adjacent finish grade, unless otherwise indicated. Parging shall be coved at junction of wall and footing. Parging shall be damp-cured for 48 hours or more before backfilling. Parging shall be protected from freezing temperatures until hardened.

3.18 INSULATION

Anchored veneer walls shall be insulated, where shown, by installing board-type insulation on the cavity side of the inner wythe. Insulation shall be neatly fitted between obstructions without impaling of insulation on ties or anchors. The insulation shall be applied in parallel courses with vertical joints breaking midway over the course below and shall be applied in moderate contact with adjoining units without forcing, and shall be cut to fit neatly against adjoining surfaces.

3.19 SPLASH BLOCKS

Splash blocks shall be located as shown.

3.20 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, completely remove mortar and grout daubs or splashings from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.20.1 Dry-Brushing

a. Exposed concrete masonry unit

b. Exposed split faced masonry

c. shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

## 3.21 BEARING PLATES

Set bearing plates for beams, joists, joist girders and similar structural members to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE.

## 3.22 PROTECTION

Protect facing materials against staining. Cover top of walls with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

## 3.23 WASTE MANAGEMENT

Manage waste according to the Waste Management Plan and as follows. Minimize water used to wash mixing equipment. Use trigger operated spray nozzles for water hoses.

### 3.23.1 Separate and Recycle Waste

Place materials defined as hazardous or toxic waste in designated containers. Fold up metal banding, flatten, and place in designated area for recycling. Collect wood packing shims and pallets and place in designated area. Use leftover mixed mortar as where lower strength mortar meets the requirements for bulk fill. Separate masonry waste and place in designated area for use as structural fill. Separate selected masonry waste and excess for landscape uses, either whole or crushed as ground cover.

### 3.23.2 Take-Back Program

Collect information from manufacturer for take-back program options. Set aside masonry units, full and partial scrap, and packaging to be returned to manufacturer for recycling into new product. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

## 3.24 TEST REPORTS

### 3.24.1 Field Testing of Mortar

At least three specimens of mortar shall be taken each day. A layer of mortar 1/2 to 5/8 inch thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

### 3.24.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 2000 psi at 28 days.

### 3.24.3 Efflorescence Test

Test brick, which will be exposed to weathering, for efflorescence. Schedule tests far enough in advance of starting masonry work to permit retesting if necessary. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Units meeting the definition of "effloresced" will be subject to rejection.

### 3.24.4 Prism Tests

Perform at least one prism test sample for each 5,000 square feet of wall but not less than three such samples shall be made for any building. Three prisms will be used in each sample. Prisms shall be tested in accordance with ACI 530/530.1. Seven-day tests may be used provided the relationship between the 7- and 28-day strengths of the masonry is established by the tests of the materials used. If the compressive strength of any prism falls below the specified value by more than 500 psi, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. If the likelihood of low-strength masonry is confirmed and computations indicate that the load-carrying capacity may have been significantly reduced, tests of cores drilled, or prisms sawed, from the area in question may be required. In such case, three specimens shall be taken for each prism test more than 500 psi below the specified value. Masonry in the area in question shall be considered structurally adequate if the average compressive strength of three specimens is equal to at least 85 percent of the specified value, and if the compressive strength of no single specimen is less than 75 percent of the specified value. Additional testing of specimens extracted from locations represented by erratic core or prism strength test results will be permitted.

-- End of Section --

SECTION 05 40 00

COLD-FORMED METAL FRAMING
**04/06**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

| | |
|---|---|
| AISI SG02-1 | (2001) North American Specification for the Design of Cold-Formed Steel Structural Members |
| AISI SG03-3 | (2002) Cold-Formed Steel Design Manual Set |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.3/D1.3M | (2008; Errata 2008) Structural Welding Code - Sheet Steel |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 1008/A 1008M | (2008a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened |
| ASTM A 123/A 123M | (2008) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A 153/A 153M | (2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| ASTM A 370 | (2008b) Standard Test Methods and Definitions for Mechanical Testing of Steel Products |
| ASTM A 653/A 653M | (2008) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM B 633 | (2007) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel |
| ASTM C 955 | (2008a) Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application |

| | |
|---|---|
| | of Gypsum Panel Products and Metal Plaster Bases |
| ASTM E 329 | (2008) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction |

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

| | |
|---|---|
| SAE J78 | (1998) Steel Self Drilling Tapping Screws |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Framing Components; G

a. Cross sections, plans, and/or elevations showing component types and locations for each framing application; including shop coatings and material thicknesses for each framing component.

b. Connection details showing fastener type, quantity, location, and other information to assure proper installation.

c. Drawings depicting panel configuration, dimensions, components, locations, and construction sequence if the Contractor elects to install prefabricated/prefinished frames.

SD-03 Product Data

Steel studs,joists, tracks, bracing, bridging and accessories

SD-04 Certificates

Load-bearing cold-formed metal framing

Mill certificates or test reports from independent testing agency, qualified in accordance with ASTM E 329, showing that the steel sheet used in the manufacture of each cold-formed component complies with the minimum yield strengths and uncoated steel thickness specified. Test reports shall be based on the results of three coupon tests in accordance with ASTM A 370.

Welds

Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.3/D1.3M.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to job site and store in adequately ventilated, dry locations. Storage area shall permit easy access for inspection and handling. If necessary to store materials outside, stack off the ground,

support on a level platform, and protect from the weather as approved. Handle materials to prevent damage. Finish of the framing members shall be maintained at all times, using an approved high zinc dust content, galvanizing repair paint whenever necessary to prevent the formation of rust. Replace damaged items with new, as directed by the Contracting Officer.

1.4 LOAD-BEARING COLD-FORMED METAL FRAMING

Include top and bottom tracks, bracing, fastenings, and other accessories necessary for complete installation. Framing members shall have the structural properties indicated. Where physical structural properties are not indicated, they shall be as necessary to withstand all imposed loads. Design framing in accordance with AISI SG03-3.

1.5 MAXIMUM DEFLECTION

a. Exterior Studs:

| Deflection Criteria | Exterior Finish |
|---|---|
| L/240 or L/360 | Synthetic Plaster, Metal Panels |
| L/360 | Cement Plaster, Wood Veneer |
| L/600 | Brick Veneer, Stone Panels |

Wall deflections shall be computed on the basis that studs withstand all lateral forces independent of any composite action from sheathing materials. Studs abutting windows or louvers shall also be designed not to exceed 1/4 inch maximum deflection.

b. Floor Joists:

L/360 - Live load only
L/240 - Total load

c. Roof Rafters:

L/240 - Live load only

1.6 QUALITY ASSURANCE

1.6.1 Drawing Requirements

Submit framing components to show sizes, thicknesses, layout, material designations, methods of installation, and accessories.

PART 2 PRODUCTS

2.1 STEEL STUDS, JOISTS, TRACKS, BRACING, BRIDGING AND ACCESSORIES

Framing components shall comply with ASTM C 955 and the following.

2.1.1 Studs and Joists of 16 Gage (0.0598 Inch) and Heavier

Galvanized steel, ASTM A 653/A 653M, SS Grade 50, G60.

2.1.2 Studs and Joists of 18 Gage (0.0478 Inch) and Lighter

Studs and Joists of 18 Gage (0.0478 Inch) and Lighter, Track, and

Accessories (All Gages): Galvanized steel, ASTM A 653/A 653M, SS, Grade 50 33,000 psi G60; or carbon steel, ASTM A 1008/A 1008M, Grade C, painted.

2.1.3 Sizes, Gages, Section Modulus, and Other Structural Properties

Size and gage as indicated. Steel stud deflection shall be limited to L/600 for exterior wall brick veneer construction.

2.2 MARKINGS

Studs and track shall have product markings stamped on the web of the section. The markings shall be repeated throughout the length of the member at a maximum spacing of 4 feet on center and shall be legible and easily read. The product marking shall include the following:

a. An ICBO number.

b. Manufacturer's identification.

c. Minimum delivered uncoated steel thickness.

d. Protective coating designator.

e. Minimum yield strength.

2.3 CONNECTIONS

Screws for steel-to-steel connections shall be self-drilling tapping in compliance with SAE J78 of the type, size, and location as shown on the drawings. Electroplated screws shall have a Type II coating in accordance with ASTM B 633. Screws, bolts, and anchors shall be hot-dipped galvanized in accordance with ASTM A 123/A 123M or ASTM A 153/A 153M as appropriate. Screws bolts, and anchors shall be hot dipped galvanized in accordance with ASTM A 123/A 123M or ASTM A 153/A 153M as appropriate.

2.4 PLASTIC GROMMETS

Supply plastic grommets, recommended by stud manufacturer, to protect electrical wires. Prevent metal to metal contact for plumbing pipes.

PART 3 EXECUTION

3.1 FASTENING

Fasten framing members together by welding or by using self-drilling or self-tapping screws. Electrodes and screw connections shall be as required and indicated in the design calculations.

3.1.1 Welds

All welding shall be performed in accordance with AWS D1.3/D1.3M, as modified by AISI SG02-1. All welders, welding operations, and welding procedures shall be qualified according to AWS D1.3/D1.3M. All welds shall be cleaned and coated with rust inhibitive galvanizing paint. Do not field weld materials lighter than 18 gage.

3.1.2 Screws

Screws shall be of the self-drilling self-tapping type. Screw penetration

through joined materials shall not be less than three exposed threads. Minimum spacings and edge distances for screws shall be as specified in AISI SG02-1. Screws covered by sheathing materials shall have low profile heads.

3.1.3 Anchors

Anchors shall be of the type, size, and location shown on the drawings.

3.2 INSTALLATION

3.2.1 Tracks

Provide accurately aligned runners at top and bottom of partitions. Anchor tracks as indicated in design calculations. Butt weld joints in tracks or splice with stud inserts. Fasteners shall be at least 3 inches from the edge of concrete slabs.

3.2.2 Studs

Cut studs square and set with firm bearing against webs of top and bottom tracks. Position studs vertically in tracks and space as indicated in design. Do not splice studs. Provide at least two studs at jambs of doors and other openings 2 feet wide or larger. Provide jack studs over openings, as necessary, to maintain indicated stud spacing. Provide tripled studs at corners, positioned to receive interior and exterior finishes. Fasten studs to top and bottom tracks by welding or screwing both flanges to the tracks. Framed wall openings shall include headers and supporting components as shown on the drawings. Headers shall be installed in all openings that are larger than the stud spacing in a wall. In curtain wall construction, provide for vertical movement where studs connect to the structural frame. Provide horizontal bracing in accordance with the design calculations and AISI SG03-3, consisting of, as a minimum, runner channel cut to fit between and welded to the studs or hot- or cold-rolled steel channels inserted through cutouts in web of each stud and secured to studs with welded clip angles. Bracing shall be not less than the following:

| LOAD | HEIGHT | BRACING |
|---|---|---|
| Wind load only | Up to 10 feet | One row at mid-height |
| | Over 10 feet | Rows 5'-0" o.c. maximum |
| Axial load | Up to 10 feet | Two rows at 1/3 points |
| | Over 10 feet | Rows 3'-4" o.c. maximum |

3.2.3 Joists and Trusses

Locate each joist or truss directly above a stud. Provide doubled joists under parallel partitions wherever partition length exceeds 1/2 of joist span. Joists shall have at least 2.50 inches of bearing on steel, 4 inches on masonry, and shall be reinforced over bearings where required to prevent web crippling. Splice joists over bearings only. Lap and weld splices as indicated. Provide manufacturer's standard bridging which shall not be less than the following:

| CLEAR SPAN | BRIDGING |
|---|---|
| Up to 14 feet | One row near center |

| CLEAR SPAN | BRIDGING |
|---|---|
| 14 to 20 feet | Two rows at 1/3 points |
| 20 to 26 feet | Three rows at 1/4 points |
| 26 to 32 feet | Four rows at 1/5 points |

Temporary bracing shall be provided and remain in place until work is permanently stabilized.

3.2.4 Erection Tolerances

a. Framing members which will be covered by finishes such as wallboard, plaster, or ceramic tile set in a mortar setting bed, shall be within the following limits:

(1) Layout of walls and partitions: 1/4 inch from intended position;

(2) Plates and runners: 1/4 inch in 8 feet from a straight line;

(3) Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and

(4) Face of framing members: 1/4 inch in 8 feet from a true plane.

b. Framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive shall be within the following limits:

(1) Layout of walls and partitions: 1/4 inch from intended position;

(2) Plates and runners: 1/8 inch in 8 feet from a straight line;

(3) Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and

(4) Face of framing members: 1/8 inch in 8 feet from a true plane.

3.2.5 Special Inspection and Testing for Seismic-Resisting Systems

Special inspections and testing for seismic-resisting systems and components shall be done as specified.

-- End of Section --

SECTION 05 50 00

MISCELLANEOUS METAL FABRICATIONS
**08/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

| | |
|---|---|
| AA 46 | (1978) Standards for Anodized Architectural Aluminum |
| AA DAF-45 | (2003) Designation System for Aluminum Finishes |

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

| | |
|---|---|
| AISC 303 | (2005) Code of Standard Practice for Steel Buildings and Bridges |

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

| | |
|---|---|
| ASSE/SAFE A10.3 | (2006) Operations - Safety Requirements for Powder Actuated Fastening Systems |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.1/D1.1M | (2008) Structural Welding Code - Steel |

ASME INTERNATIONAL (ASME)

| | |
|---|---|
| ASME B18.2.1 | (1996; Addenda A 1999; Errata 2003; R 2005) Square and Hex Bolts and Screws (Inch Series) |
| ASME B18.2.2 | (1987; R 2005) Standard for Square and Hex Nuts |
| ASME B18.21.1 | (1999; R 2005) Lock Washers (Inch Series) |
| ASME B18.22.1 | (1965; R 2008) Plain Washers |
| ASME B18.6.2 | (1998; R 2005) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series |
| ASME B18.6.3 | (2003; R 2008) Machine Screws and Machine Screw Nuts |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 123/A 123M | (2008) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A 153/A 153M | (2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| ASTM A 307 | (2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength |
| ASTM A 36/A 36M | (2008) Standard Specification for Carbon Structural Steel |
| ASTM A 47/A 47M | (1999; R 2004) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process |
| ASTM A 48/A 48M | (2003; R 2008) Standard Specification for Gray Iron Castings |
| ASTM A 500/A 500M | (2007) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes |
| ASTM A 53/A 53M | (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A 653/A 653M | (2008) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A 687 | (1993) Standard Specification for High-Strength Nonheaded Steel Bolts and Studs |
| ASTM A 780 | (2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings |
| ASTM A 786/A 786M | (2005) Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates |
| ASTM A 924/A 924M | (2008a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| ASTM B 108/B 108M | (2008) Standard Specification for Aluminum-Alloy Permanent Mold Castings |
| ASTM B 209 | (2007) Standard Specification for Aluminum |

| | |
|---|---|
| | and Aluminum-Alloy Sheet and Plate |
| ASTM B 221 | (2008) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes |
| ASTM B 26/B 26M | (2005) Standard Specification for Aluminum-Alloy Sand Castings |
| ASTM D 1187 | (1997; R 2002e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal |
| ASTM E 488 | (1996; R 2003) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements |

MASTER PAINTERS INSTITUTE (MPI)

| | |
|---|---|
| MPI 79 | (Jan 2004) Alkyd Anti-Corrosive Metal Primer |

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

| | |
|---|---|
| NAAMM MBG 531 | (2000) Metal Bar Grating Manual |

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

| | |
|---|---|
| SSPC SP 3 | (2004; E 2004) Power Tool Cleaning |
| SSPC SP 6 | (7) Commercial Blast Cleaning |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Access doors and panels, installation drawings G

Cover plates and frames, installation drawings G

Control joint covers, installation drawings G

Floor gratings, installation drawings G

Embedded angles and plates, installation drawings G

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Access doors and panels

Cover plates and frames

Floor gratings and handrails

Structural steel door frames

SD-04 Samples

Control-joint covers

Provide full size samples , taken from manufacturer's stock, and be complete as required for installation in the structure. Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A 36/A 36M.

2.1.2 Structural Tubing

ASTM A 500/A 500M.

2.1.3 Steel Pipe

ASTM A 53/A 53M, Type E or S, Grade B.

2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A 47/A 47M.

2.1.5 Gratings

a. Gray cast iron ASTM A 48/A 48M, Class 40.

b. Metal plank grating, non-slip requirement, aluminum ASTM B 209, 6061-T6; steel ASTM A 653/A 653M, G90.

2.1.6 Floor Plates, Patterned

Floor plate ASTM A 786/A 786M. Steel plate shall not be less than 14 gage.

2.1.7 Anchor Bolts

ASTM A 307. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

2.1.7.1 Expansion Anchors, Sleeve Anchors, Adhesive Anchors

Design values listed shall be as tested according to ASTM E 488.

2.1.7.2 Lag Screws and Bolts

ASME B18.2.1, type and grade best suited for the purpose.

2.1.7.3 Toggle Bolts

ASME B18.2.1.

2.1.7.4 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 and ASTM A 687 or ASTM A 307.

2.1.7.5 Powder Driven Fasteners

Follow safety provisions of ASSE/SAFE A10.3.

2.1.7.6 Screws

ASME B18.2.1, ASME B18.6.2, and ASME B18.6.3.

2.1.7.7 Washers

Provide plain washers to conform to ASME B18.22.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME B18.21.1.

2.1.8 Aluminum Alloy Products

Conform to ASTM B 209 for sheet plate, ASTM B 221 for extrusions and ASTM B 26/B 26M or ASTM B 108/B 108M for castings, as applicable. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A 123/A 123M, ASTM A 153/A 153M, ASTM A 653/A 653M or ASTM A 924/A 924M, G90, as applicable.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A 780 or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints, but coat with rust preventative applied in the shop.

2.2.4.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.6 Aluminum Surfaces

2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.2.6.2 Aluminum Finishes

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA DAF-45, or AA 46. Unless otherwise specified, provide all other aluminum items with a anodized finish. Provide a coating thickness not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF-45. Provide a polished satin finish om items to be anodized.

2.3 ACCESS DOORS AND PANELS

Provide flush type access doors and panels unless otherwise indicated. Fabricate frames for access doors of steel not lighter than 14 gage with

welded joints and anchorage for securing into construction. Provide access doors with a minimum of 14 by 20 inches and of not lighter than 14 gage steel, with stiffened edges and welded attachments. Provide access doors hinged to frame and with a flush-face, turn-screw-operated latch. Provide exposed metal surface with a baked enamel finish.

## 2.4 CONTROL-JOINT COVERS

Provide control-joint covers to be located on wall surfaces of concrete, masonry and tile work. Provide protective coating on the surface in contact with concrete, masonry or tile.

## 2.5 COVER PLATES AND FRAMES

Fabricate cover plates of 1/4 inch thick rolled steel weighing not more than 100 pounds per plate with a selected raised pattern nonslip top surface. Plate shall be galvanized. Reinforce to sustain a live load of _____ pounds per square foot. Frames shall be structural steel shapes and plates, with bent steel bars or headed anchors welded to frame for anchoring to concrete securely fastened to the structure as indicated. Miter and weld all corners. Butt joint straight runs. Allow for expansion on straight runs over 15 feet. Provide holes for lifting tools. Provide flush drop handles for removal formed from 1/4 inch round stock where indicated. Provide holes and openings with 1/2 inch clearance for pipes and equipment. Remove sharp edges and burrs from cover plates and exposed edges of frames. Weld all connections and grind top surface smooth. Weld bar stops every six inches. Provide 1/8 inch clearance at edges and between cover plates.

## 2.6 Control JOINT COVERS

Provide control joint covers constructed of extruded aluminum with anodized satin aluminum finish for walls and ceilings and with standard mill finish for floor covers and exterior covers. Furnish plates, backup angles, expansion filler strip and anchors as indicated.

## 2.7 EXTRUDED FLOOR MAT FRAMES

Provide recess frames for roll-up floor mats of extruded 6063-T5 aluminum, in sizes shown. Miter corners to ensure accurate fitting. Determine depth of recess by the mat thickness. Anchor frames in concrete with anchor pins or bolts. Provide roll-up mats of aluminum construction with serrated surface. Provide roll-up mats for use in recessed area. Show construction details of recessed areas on the drawings.

## 2.8 FLOOR GRATINGS

Design steel grating in accordance with NAAMM MBG 531 for bar type grating or manufacturer's charts for plank grating. Galvanize steel floor gratings.

a. Design floor gratings to support a live load of 100 pounds per square foot for the spans indicated, with maximum deflection of L/240.

b. NAAMM MBG 531, band edges of grating with bars of the same size as the bearing bars. Weld banding in accordance with the manufacturer's standard for trim unless otherwise indicated. Design tops of bearing bars, cross or intermediate bars to be in the same plane and match grating finish.

## 2.9 MISCELLANEOUS PLATES AND SHAPES

Provide for items that do not form a part of the structural steel framework, such as lintels, sill angles, support framing for ceiling-mounted toilet partitions, miscellaneous mountings and frames. Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as indicated and as required to support wall loads over openings. Provide with connections and welds. Construct to have at least 8 inches bearing on masonry at each end.

Provide angles and plates, ASTM A 36/A 36M, for embedment as indicated. Galvanize embedded items exposed to the elements according to ASTM A 123/A 123M.

# PART 3 EXECUTION

## 3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners shall be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Form joints exposed to the weather shall be formed to exclude water. Items listed below require additional procedures.

## 3.2 WORKMANSHIP

Provide miscellaneous metalwork that is well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections of work in place and ground smooth. Provide a smooth finish on exposed surfaces of work in place and unless otherwise approved, flush exposed riveting. Mill joints where tight fits are required. Corner joints shall be coped or mitered, well formed, and in true alignment. Accurately set work to established lines and elevations and securely fastened in place. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

## 3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

## 3.4 BUILT-IN WORK

Form for anchorage metal work built-in with concrete or masonry, or provide with suitable anchoring devices as indicated or as required. Furnish metal work in ample time for securing in place as the work progresses.

## 3.5 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

## 3.6 FINISHES

### 3.6.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

### 3.6.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.

### 3.6.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer.

## 3.7 ACCESS PANELS

Install a removable access panel not less than 12 by 12 inches directly below each valve, flow indicator, damper, or air splitter that is located above the ceiling, other than an acoustical ceiling, and that would otherwise not be accessible.

## 3.8 CONTROL-JOINT COVERS

Provide covers over control-joints and fasten on one side only with fasteners spaced to give positive contact with wall surfaces on both sides of joint throughout the entire length of cover.

## 3.9 COVER PLATES AND FRAMES

Install the tops of cover plates and frames flush with floor.

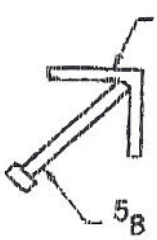
## 3.10 RECESSED FLOOR FRAMES & MATS

Verify field measurements prior to releasing materials for fabrication by the manufacturer. Use a mat frame to ensure recess accuracy in size, shape and depth. Form drain pit by blocking out concrete when frames are installed, dampproof after concrete has set. Assemble frames onsite and

install so that upper edge will be level with finished floor surface. Screeded the concrete base inside the mat recess frame area using the edge provided by the frame as a guide and anchor into the cement with anchor pins a minimum of 24 inches on centers.

-- End of Section --

Dawson # 27

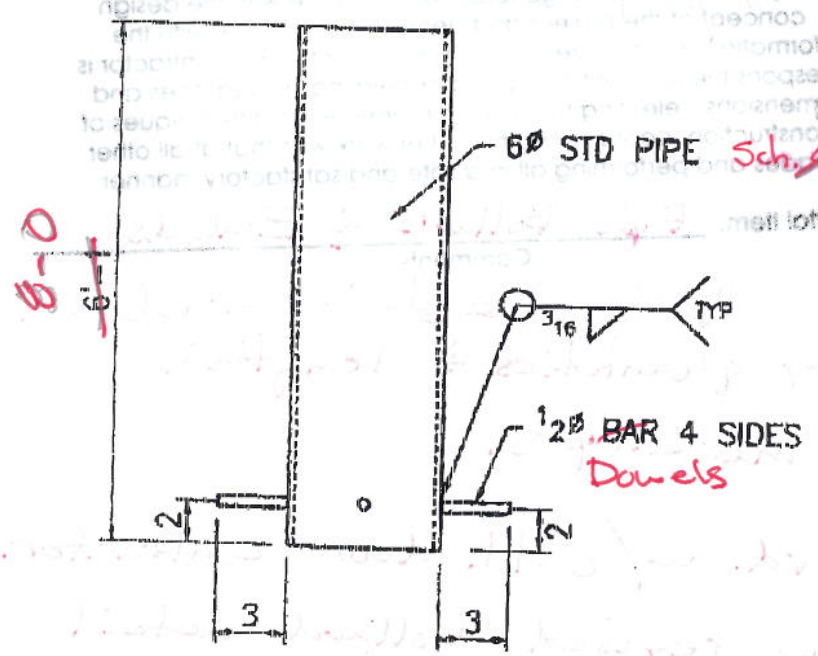


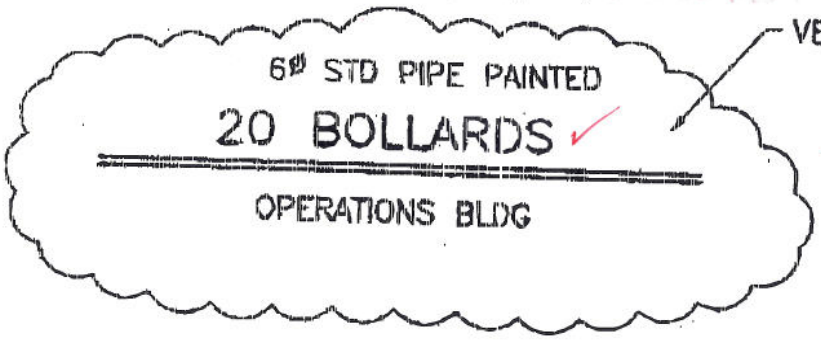

GALVANIZE

10 L'S 12'-0 LONG

## 10 ANGLE EMBEDS

OPERATIONS BLDG




Project Name: Stennis Riverine
Contract: N69450-05-D-0096
Bem Proj.: 3013-70
Submittal: 055000-01
Reviewer
Reviewed by: J. Collins
DATE: 3/2/09

| | |
|---|---|
| COMBAT CRAFT OPERATIONS FACILITY<br>NASA JOHN C. STENNIS SPACE CTR. MISS. | OPERATIONS BLDG |
| | 2/26/09 SHEET 1 |

**DAMMON ENGINEERING INC**

**Date:** 3.31.09 **Project:** Stennis ROE
**Reviewed:** _____
**Reviewed as Noted:** X
**Revise and Resubmit:** _____
**Rejected:** _____
**Other:** _____

Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. The contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction, coordinating his or her work with that of all other trades and performing all in a safe and satisfactory manner.

**Submittal Item:** Pipe Bollards & Embeds

Comments

Roland Trilli

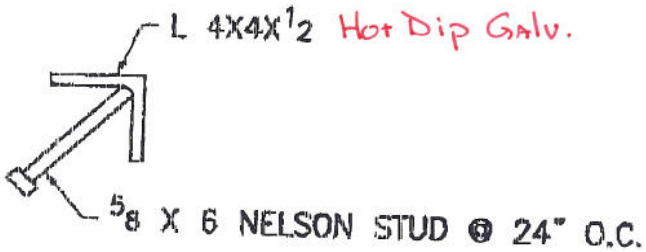
- Verify quantities & lengths.
- See mark-ups.
- Co-ord. w/ O.H. door contractor.
- Review revised bollard detail.

**BROADMOOR, L.L.C.**

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

Roland Trilli 3.31.09
DQC Manager Date

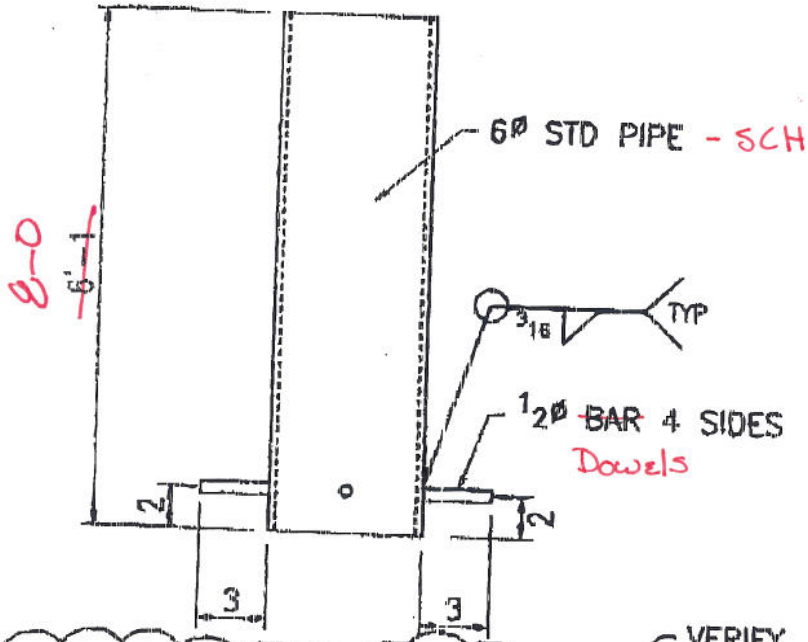
[signature] 3/31/09
QC Officer Date




GALVANIZE
6 L'S 26'-0 LONG ✓

# 6 ANGLE EMBEDS

BOAT STORAGE BLDG.




VERIFY

12 - Exterior
~~24 Interior~~ 6Ø STD PIPE PAINTED

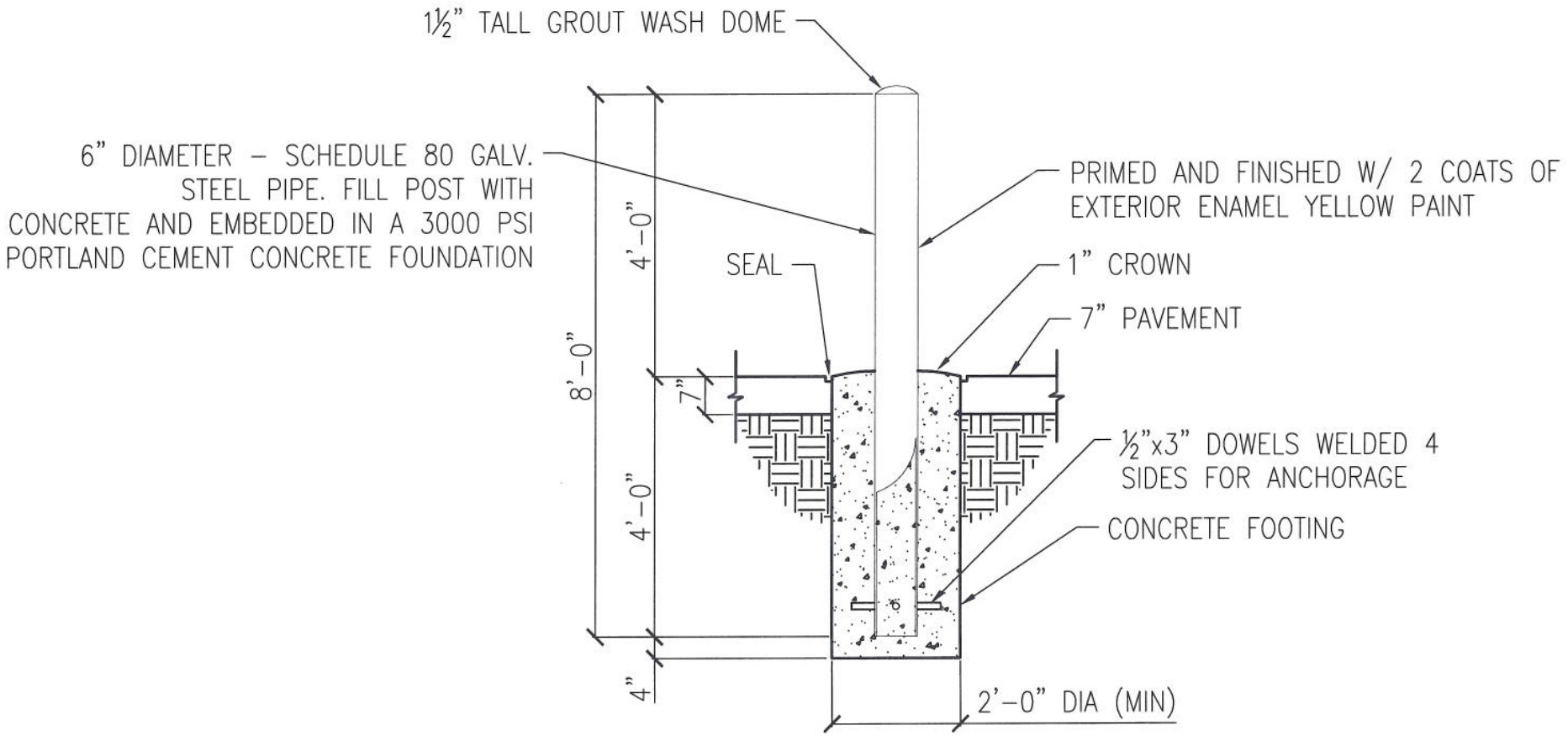
# 36 ~~12~~ BOLLARDS

BOAT STORAGE BLDG.

NOTE: Interior bollards are being reviewed weather or not they stay will verify with owner & Relay Info to you → Not Read.

Project Name: Stennis Riverine
Contract: N69450-05-D-0096
Item Proj.: 3013-70
Submittal: 055000-01
Reviewed
Reviewed by: J. Collins
DATE: 3/2/09

| | |
|---|---|
| COMBAT CRAFT OPERATIONS FACILITY<br>NASA JOHN C. STENNIS SPACE CTR. MISS. | BOAT STORAGE BLDG.<br>2/26/09 SHEET 2 |




**BOLLARD DETAIL** - C3.1

N.T.S.

SECTION 06 20 00

FINISH CARPENTRY
**08/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

| | |
|---|---|
| ALSC PS 20 | (1970) American Softwood Lumber Standard |

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

| | |
|---|---|
| AWPA M2 | (2001) Standard for Inspection of Treated Wood Products |
| AWPA M4 | (2002) Standard for the Care of Preservative-Treated Wood Products |
| AWPA P5 | (2005) Standard for Waterborne Preservatives |

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

| | |
|---|---|
| APA PS 1 | (1995) Voluntary Product Standard for Construction and Industrial Plywood |
| APA PS 2 | (2004) Voluntary Product Standard for Wood-Based Structural-Use Panels |

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

| | |
|---|---|
| AWI Qual Stds | (8th Edition) AWI Quality Standards |

ASME INTERNATIONAL (ASME)

| | |
|---|---|
| ASME B18.2.1 | (1996; Addenda A 1999; Errata 2003; R 2005) Square and Hex Bolts and Screws (Inch Series) |
| ASME B18.2.2 | (1987; R 2005) Standard for Square and Hex Nuts |
| ASME B18.6.1 | (1981; R 2008) Wood Screws (Inch Series) |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM F 547 | (2006) Nails for Use with Wood and Wood-Base Materials |

COMPOSITE PANEL ASSOCIATION (CPA)

| | |
|---|---|
| CPA A208.1 | (1999) Medium Density Fiberboard (MDF) For Interior Applications |

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

| | |
|---|---|
| NHLA Rules | (2003) Rules for the Measurement & Inspection of Hardwood & Cypress |

REDWOOD INSPECTION SERVICE (RIS) OF THE CALIFORNIA REDWOOD ASSOCIATION (CRA)

| | |
|---|---|
| RIS Grade Use | (1998) Redwood Lumber Grades and Uses |

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

| | |
|---|---|
| NELMA Grading Rules | (2003) Standard Grading Rules for Northeastern Lumber |

SOUTHERN PINE INSPECTION BUREAU (SPIB)

| | |
|---|---|
| SPIB 1003 | (2002) Standard Grading Rules for Southern Pine Lumber |

U.S. DEPARTMENT OF COMMERCE (DOC)

| | |
|---|---|
| DOC FED PS58 | (1974) Basic Hardboard |

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

| | |
|---|---|
| WCLIB 17 | (2000) Standard Grading Rules |

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

| | |
|---|---|
| WWPA G-5 | (1998) Western Lumber Grading Rules |

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

| | |
|---|---|
| WDMA I.S. 4 | (2000) Water-Repellent Preservative Non-Pressure Treatment for Millwork |

WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION (WMMPA)

| | |
|---|---|
| WMMPA WM 6 | (1987) Industry Standard for Non-Pressure Treating of Wood Millwork |

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

Manufacturer's printed data, showing texture, density, catalog

cuts, and installation instructions.

Wood Items

Manufacturer's printed data indicating the usage of engineered or recycled wood products, and environmentally safe preservatives.

SD-04 Samples

Moldings

Trim

Samples shall be of sufficient size to show patterns, color ranges, and types, as applicable, of the material proposed to be used.

SD-07 Certificates

Certificates of grade

Certificates of compliance

1.3 DETAIL DRAWINGS

The Contractor shall submit detail drawings showing fabricated items and special mill and woodwork items. Drawings shall indicate materials and details of construction, methods of fastening, erection, and installation.

1.4 CERTIFICATES

Provide certificates of grade from the grading agency on graded but unmarked lumber or plywood attesting that materials meet the grade requirements specified herein.

Provide certificates of compliance unless materials bear certification markings or statements.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver lumber, plywood, trim, and millwork to job site in an undamaged condition. Stack materials to ensure ventilation and drainage. Protect against dampness before and after delivery. Store materials under cover in a well-ventilated enclosure and protect against extreme changes in temperature and humidity. Do not store products in building until wet trade materials are dry.

1.6 QUALITY ASSURANCE

1.6.1 Lumber

Identify each piece or each bundle of lumber, millwork, and trim by the grade mark of a recognized association or independent inspection agency that is certified by the Board of Review, American Lumber Standards Committee, to grade the species.

1.6.2 Plywood

Each sheet of plywood shall bear the mark of a recognized association or

independent inspection agency that maintains continuing control over quality of the plywood. Mark shall identify plywood by species group or span rating, and shall show exposure durability classification, grade, and compliance with APA PS 1.

1.6.3 Hardboard and Particleboard

Materials shall bear a marking or statement identifying the producer and the applicable standard.

1.6.4 Pressure-Treated Lumber and Plywood

Each treated piece shall be inspected in accordance with AWPA M2.

1.6.5 Nonpressure-Treated Woodwork and Millwork

Mark, stamp, or label, indicating compliance with WDMA I.S. 4.

1.6.6 Fire-Retardant Treated Lumber

Each piece to bear Underwriters Laboratories label or the label of another nationally recognized independent testing laboratory.

PART 2 PRODUCTS

2.1 WOOD

2.1.1 Sizes and Patterns of Wood Products

Yard and board lumber sizes shall conform to ALSC PS 20. Provide shaped lumber and millwork in the patterns indicated and standard patterns of the association covering the species. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the applicable standard.

2.1.2 Trim, Finish, and Frames

Provide species and grades listed for materials to be paint finished. Provide materials that are to be stain, natural, or transparent finished one grade higher than that listed. Provide species indicated for materials to be transparent finished. Run trim, except window stools and aprons with hollow backs.

TABLE OF GRADES FOR WOOD TO RECEIVE PAINT FINISH

| Grading Rules | Species | Exterior and Interior Trim, Finish, and Frames |
|---|---|---|
| WWPA G-5 grading rules | Aspen<br>Douglas Fir-Larch<br>Douglas Fir-South<br>Engelmann Spruce<br>-Lodgepole Pine<br>Engelmann Spruce<br>Hem-Fir<br>Idaho White Pine<br>Lodgepole Pine<br>Mountain Hemlock<br>Mountain Hemlock | All Species: C & Btr. Select (Choice & Btr Idaho White Pine) or Superior Finish. Western Red Cedar may be graded C & Btr. Select or A & Btr. per Special Western Red Cedar Rules. |

TABLE OF GRADES FOR WOOD TO RECEIVE PAINT FINISH

| Grading Rules | Species | Exterior and Interior Trim, Finish, and Frames |
|---|---|---|
| | -Hem-Fir<br>Ponderosa Pine-<br>Sugar Pine<br>(Ponderosa Pine<br>-Lodgepole Pine)<br>White Woods<br>(Western Woods)<br>Western Cedars<br>Western Hemlock | |
| WCLIB 17<br>standard grading<br>rules | Douglas Fir-Larch<br>Hem-Fir<br>Mountain Hemlock<br>Sitka Spruce<br>Western Cedars<br>Western Hemlock | All Species: C & Btr<br>VG, except A for<br>Western Red Cedar |
| SPIB 1003<br>grading rules | Southern Pine | C & Btr |
| NHLA Rules | Cypress | C-Select |
| NELMA Grading Rules<br>standard<br>grading rules | Balsam Fir<br>Eastern Hemlock-<br>Tamarack<br>Eastern Spruce<br>Eastern White Pine<br>Norway Pine<br>Northern Pine<br>Northern White Cedar | All Species: C-<br>Select except C & Btr<br>for Eastern White<br>Pine and Norway Pine |
| RIS Grade Use<br>standard<br>specifications | Redwood | Clear<br>Clear All Heart |
| NHLA Rules<br>rules | Cypress | B Finish |
| | Red Gum<br>Soft Elm<br>Birch | Select or Btr<br>(for interior use only) |

2.1.3 Utility Shelving

Utility shelving shall be a suitable species equal to or exceeding requirements of No. 3 Common white fir under WWPA G-5, 1 inch thick; or plywood, interior type, Grade A-B, 1/2 inch thick, any species group.

2.1.4 Softwood Plywood

APA PS 1, thicknesses as indicated.

Plywood for Shelving: Interior type, A-B Grade, any species group.

b. Plywood for Countertops: Exterior type, A-C Grade.

2.1.5 Hardboard

DOC FED PS58, standard type.

2.1.6 Particleboard

CPA A208.1, Grade 1-M-2 or 2-M-2 or better.

2.1.7 Shoe Mold

Clear red or white oak, 1/2 by 5/8 inch unless otherwise indicated.

2.1.8 Wood Structural Panels

Wood Structural Panels shall conform to APA PS 2, exterior, exposure 1 single-faced, 4 feet wide, maximum practicable lengths, selected from manufacturer's standard patterns to satisfy the wind load for the specified span.

2.2 MOISTURE CONTENT OF WOOD PRODUCTS

Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products at time of delivery to the job site, and when installed, shall be as follows:

a. Interior Paneling: 12 percent.

b. Interior Finish Lumber, Trim, and Millwork 1 1/4 Inches Nominal or Less in Thickness: 12 percent.

c. Exterior Treated and Untreated Finish Lumber and Trim 4 Inches Nominal or Less in Thickness: 19 percent.

d. Moisture content of other materials shall be in accordance with the applicable standards.

2.3 PRESERVATIVE TREATMENT OF WOOD PRODUCTS

2.3.1 Nonpressure Treatment

Treat woodwork and millwork, such as exterior trim, door trim, and window trim, in accordance with WDMA I.S. 4, with either 2 percent copper napthenate, 3 percent zinc napthenate, or 1.8 percent copper-8-quinolinolate. Provide a liberal brushcoat of preservative treatment to field cuts and holes.

2.3.2 Pressure Treatment

Lumber and plywood used on the exterior of buildings or in contact with masonry or concrete shall be treated with water-borne preservative listed in AWPA P5 as applicable, and inspected in accordance with AWPA M2. Identify treatment on each piece of material by the quality mark of an agency accredited by the Board of Review of the American Lumber Standards Committee. Plywood shall be treated to a reflection level as follows:

Exterior wood molding and millwork within 18 inches of soil, in contact with water or concrete shall be preservative-treated in accordance with

WMMPA WM 6. Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWPA M4. Items of all-heart material of cedar, cypress, or redwood will not require preservative treatment, except when in direct contact with soil.

## 2.4 HARDWARE

Provide sizes, types, and spacings of manufactured building materials recommended by the product manufacturer except as otherwise indicated or specified.

### 2.4.1 Wood Screws

ASME B18.6.1.

### 2.4.2 Bolts, Nuts, Lag Screws, and Studs

ASME B18.2.1 and ASME B18.2.2.

### 2.4.3 Nails

Nails shall be the size and type best suited for the purpose and shall conform to ASTM F 547. Nails shall be hot-dip galvanized or aluminum when used on exterior work. For siding, length of nails shall be sufficient to extend 1-1/2 inches into supports, including wood sheathing over framing. Screws for use where nailing is impractical shall be size best suited for purpose.

## 2.5 FABRICATION

### 2.5.1 Quality Standards (QS)

The terms "Premium," "Custom," and "Economy" refer to the quality grades defined in AWI Qual Stds. Items not specified to be of a specific grade shall be Custom grade. The AWI QS is superseded by all contract document requirements indicated or stated herein.

# PART 3 EXECUTION

## 3.1 FINISH WORK

Provide sizes, materials, and designs as indicated and as specified. Apply primer to finish work before installing. Where practicable, shop assemble and finish items of built-up millwork. Joints shall be tight and constructed in a manner to conceal shrinkage. Miter trim and moldings at exterior angles and cope at interior angles and at returns. Material shall show no warp after installation. Install millwork and trim in maximum practical lengths. Fasten finish work with finish nails. Provide blind nailing where practicable. Set face nails for putty stopping.

### 3.1.1 Exterior Finish Work

Machine-sand exposed flat members and square edges. Machine-finish semi-exposed surfaces. Construct joints to exclude water. In addition to nailing, glue joints of built-up items with waterproof glue as necessary for weather-resistant construction. Provide well distributed end joints in built-up members. Provide shoulder joints in flat work. Hold backs of wide-faced miters together with metal rings and waterproof glue. Fascias and other flat members, unless otherwise indicated, shall be 3/4 inch

thick. Provide door and window trim in single lengths. Provide braced, blocked, and rigidly anchored cornices for support and protection of vertical joints. Install soffits in largest practical size. Joints of plywood shall occur over center lines of supports. Fasten soffits with aluminum or stainless steel nails. Back prime all concealed surfaces of exterior trim.

3.1.2 Interior Finish Work

After installation, sand exposed surfaces smooth. Provide window and door trim in single lengths.

3.1.3 Door Frames

Set plumb and square. Provide solid blocking at not more than 16 inches o.c. for each jamb. Position blocking to occur behind hinges and lock strikes. Double wedge frames and fasten with finishing nails. Set nails for putty stopping.

3.2 SHELVING

one inch nominal thick wood shelf material with end and intermediate supports and arranged to prevent buckling and sagging. Where adjustable shelving is indicated, provide standards and brackets or shelf rests for each shelf.

3.3 MISCELLANEOUS

3.3.1 Cabinets

Install level, plumb, and tight against adjacent walls. Secure cabinets to walls with concealed toggle bolts, and secure top to cabinet with concealed screws. Make cut-outs for fixtures to templates supplied by fixture manufacturer. Carefully locate cut-outs for pipes so that edges of holes will be covered by escutcheons.

3.4 MOLDING AND INTERIOR TRIM

Molding and interior trim shall be installed straight, plumb, level and with closely fitted joints. Exposed surfaces shall be machine sanded at the mill. Molded work shall be coped at returns and interior angles and mitered at external corners. Intersections of flatwork shall be shouldered to ease any inherent changes in plane. Window and door trim shall be provided in single lengths. Blind nailing shall be used to the extent practicable, and face nailing shall be set and stopped with a nonstaining putty to match the finish applied. Screws shall be used for attachment to metal; setting and stopping of screws shall be of the same quality as required where nails are used.

-- End of Section --

SECTION 06 61 16

SOLID POLYMER (SOLID SURFACING) FABRICATIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D 2583 | (2007) Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor |
| ASTM D 570 | (1998; R 2005) Standard Test Method for Water Absorption of Plastics |
| ASTM D 638 | (2008) Standard Test Method for Tensile Properties of Plastics |
| ASTM D 696 | (2003) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer |
| ASTM E 84 | (2008a) Standard Test Method for Surface Burning Characteristics of Building Materials |
| ASTM G 21 | (1996; R 2002) Determining Resistance of Synthetic Polymeric Materials to Fungi |

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

| | |
|---|---|
| IAPMO Z124.3 | (1995) Plastic Lavatories |
| IAPMO Z124.6 | (1997) Plastic Sinks |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA LD 3 | (2005) Standard for High-Pressure Decorative Laminates |

NSF INTERNATIONAL (NSF)

| | |
|---|---|
| NSF 51 | (2007) Food Equipment Materials |

TILE COUNCIL OF AMERICA (TCA)

| | |
|---|---|
| TCA Hdbk | (2007) Handbook for Ceramic Tile Installation |

## 1.2 GENERAL DESCRIPTION

Work in this section includes vanity top, countertops, lavatory bowls and other items utilizing solid polymer (solid surfacing) fabrication as shown on the drawings and as described in this specification. Do not change source of supply for materials after work has started, if the appearance of finished work would be affected. Variation in component size and location of openings to be plus or minus 1/8 inch.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Counter and Vanity Tops; G, AE
Installation; G, AE

Detail Drawings indicating locations, dimensions, component sizes, fabrication and joint details, attachment provisions, installation details, and coordination requirements with adjacent work.

SD-03 Product Data

Solid polymer material
Fabrications

Product data indicating product description, fabrication information, and compliance with specified performance requirements for solid polymer, joint adhesive, sealants, and heat reflective tape.

SD-04 Samples

Material; G, AE

A sample of each color and pattern for approval. Samples shall indicate full range of color and pattern variation. Approved samples shall be retained as a standard for this work.

SD-10 Operation and Maintenance Data

Clean-up

A minimum of six copies of maintenance data indicating manufacturer's care, repair and cleaning instructions. Maintenance video shall be provided,if available. Maintenance kit for matte finishes shall be submitted.

## 1.4 DELIVERY, STORAGE AND HANDLING

Materials shall not be delivered to project site until areas are ready for installation. Components and materials shall be delivered to the site undamaged, in containers clearly marked and labeled with manufacturer's name. Materials shall be stored indoors and adequate precautions taken to

prevent damage to finished surfaces. Protective coverings shall be provided to prevent physical damage or staining following installation, for duration of project.

1.5 WARRANTY

Manufacturer's warranty of ten years against defects in materials, excluding damages caused by physical or chemical abuse or excessive heat, shall be provided. Warranty shall provide for material and labor for replacement or repair of defective material for a period of ten years after component installation.

1.6 QUALIFICATIONS

To insure warranty coverage, solid polymer fabricators shall be certified to fabricate by the solid polymer material manufacturer being utilized. All fabrications shall be marked with the fabricator's certification label affixed in an inconspicuous location. Fabricators shall have a minimum of 5 years of experience working with solid polymer materials.

PART 2 PRODUCTS

2.1 MATERIAL

Solid polymer material shall be a homogeneous filled solid polymer; not coated, laminated or of a composite construction; meeting IAPMO Z124.3 and IAPMO Z124.6 requirements. Material shall have minimum physical and performance properties specified. Superficial damage to a depth of 0.01 inch shall be repairable by sanding or polishing. Material thickness shall be as indicated on the drawings. In no case shall material be less than indicated on the drawings.

2.1.1 Cast,100 Percent Acrylic Polymer Solid Surfacing Material

Cast, 100 percent acrylic solid polymer material shall be composed of acrylic polymer, mineral fillers, and pigments and shall meet the following minimum performance requirements:

| PROPERTY | REQUIREMENT (min. or max.) | TEST PROCEDURE |
|---|---|---|
| Tensile Strength | 5800 psi (min.) | ASTM D 638 |
| Hardness | 55-Barcol Impressor (min.) | ASTM D 2583 |
| Thermal Expansion | .000023 in/in/F (max.) | ASTM D 696 |
| Boiling water Surface Resistance | No Change | NEMA LD 3-3.05 |
| High Temperature Resistance | No Change | NEMA LD 3-3.06 |
| Impact Resistance (Ball drop) | | NEMA LD 3-303 |
| 1/4" sheet | 36", 1/2 lb ball, no failure | |

| PROPERTY | REQUIREMENT (min. or max.) | TEST PROCEDURE |
|---|---|---|
| 1/2" sheet | 140", 1/2 lb ball, no failure | |
| 3/4" sheet | 200", 1/2 lb ball, no failure | |
| Mold & Mildew Growth | No growth | ASTM G 21 |
| Bacteria Growth | No Growth | ASTM G 21 |
| Liquid Absorption (Weight in 24 hrs.) | 0.1% max. | ASTM D 570 |
| Flammability | | ASTM E 84 |
| Flame Spread | 25 max. | |
| Smoke Developed | 30 max | |
| Sanitation | "Food Contact" approval | NSF 51 |

2.1.2 Material Patterns and Colors

Patterns and colors for all solid polymer components and fabrications shall be those indicated on the project specification, Section 09 06 90 COLOR SCHEDULE. Pattern and color shall occur, and shall be consistent in appearance, throughout the entire depth (thickness) of the solid polymer material.

2.1.3 Surface Finish

Exposed finished surfaces and edges shall receive a uniform appearance. Exposed surface finish shall be polished; gloss rating of 55-80.

2.2 ACCESSORY PRODUCTS

Accessory products, as specified below, shall be manufactured by the solid polymer manufacturer or shall be products approved by the solid polymer manufacturer for use with the solid polymer materials being specified.

2.2.1 Seam Adhesive

Seam adhesive shall be a two-part adhesive kit to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid polymer materials and components to create a monolithic appearance of the fabrication. Adhesive shall be approved by the solid polymer manufacturer. Adhesive shall be color-matched to the surfaces being bonded where solid-colored, solid polymer materials are being bonded together. The seam adhesive shall be clear or color matched where particulate patterned, solid polymer materials are being bonded together.

2.2.2 Panel Adhesive

Panel adhesive shall be neoprene based panel adhesive meeting TCA Hdbk,

Underwriter's Laboratories (UL) listed. This adhesive shall be used to bond solid polymer components to adjacent and underlying substrates.

2.2.3 Silicone Sealant

Sealant shall be a mildew-resistant, FDA and UL listed silicone sealant or caulk in a clear formulation. The silicone sealant shall be approved for use by the solid polymer manufacturer. Sealant shall be used to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures.

2.2.4 Mounting Hardware

Provide mounting hardware, including sink/bowl clips, inserts and fasteners for attachment of under mount sinks and lavatories.

2.3 FABRICATIONS

Components shall be factory or shop fabricated to sizes and shapes indicated, to the greatest extent practical, in accordance with approved Shop Drawings and manufacturer's requirements. Factory cutouts shall be provided for sinks, lavatories, and plumbing fixtures where indicated on the drawings. Contours and radii shall be routed to template, with edges smooth. Defective and inaccurate work will be rejected.

2.3.1 Joints and Seams

Joints and seams shall be formed between solid polymer components using manufacturer's approved seam adhesive. Joints shall be inconspicuous in appearance and without voids to create a monolithic appearance.

2.3.2 Edge Finishing

Rout and finish component edges to a smooth, uniform appearance and finish. Edge shapes and treatments, including any inserts, shall be as detailed on the drawings. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.

2.3.3 Counter and Vanity Top Splashes

Backsplashes and end splashes shall be fabricated from 1/2 inch thick solid surfacing material and shall be provided to dimensions and shapes as indicated on the drawings. Backsplashes and end splashes shall be provided for all counter tops and vanity tops at locations indicated on the drawings. Backsplashes shall be shop fabricated and be loose, to be field attached.

2.3.3.1 End Splashes

End splashes shall be provided loose for installation at the jobsite after horizontal surfaces to which they are to be attached have been installed.

2.3.4 Counter and Vanity Tops

All solid surfacing, solid polymer counter top and vanity top components shall be fabricated from 1/2 inch thick material. Edge details, dimensions, locations, and quantities shall be as indicated on the Drawings. Counter tops shall be complete with loose backsplash and loose

end splashes at all locations as indicated on the drawings. Attach 2 inch wide reinforcing strip of polymer material under each horizontal counter top seam.

2.3.4.1 Counter Top With Sink

A. Stainless Steel or Vitreous China Sink.

Countertops with sinks shall include cutouts to template as furnished by the sink manufacturer. Manufacturer's standard sink mounting hardware for stainless steel installation shall be provided. Seam between sink and counter top shall be sealed with silicone sealant. Sink, faucet, and plumbing requirements shall be in accordance with Section 22 00 00 PLUMBING,GENERAL PURPOSE.

B. Solid Polymer Sink

Solid polymer sinks shall be a manufacturer's standard, pre-molded product specifically designed for attachment to solid polymer counter tops.

2.3.4.2 Vanity Tops With Bowls

A. Solid Polymer Bowl

Solid polymer bowls shall be a solid polymer manufacturer's standard, pre-molded product specifically designed for attachment to solid polymer counter tops.

B. One-Piece Vanity Top and Bowl

One-piece vanity top and bowl fabrications shall be a standard pre-fabricated product provided by the solid polymer manufacturer. Each unit shall include a vanity top with integral backsplash and sink bowl.

2.3.5 Solid Polymer Vanity Bowls

Solid polymer vanity bowls shall be a standard product of the solid polymer manufacturer, designed specifically to be installed in solid polymer vanity tops. Bowls shall be of the same polymer composition as the adjoining counter top. Bowl design shall support a seam adhesive undercount installation method. Bowl dimensions shall be as indicated on the drawings.

PART 3 EXECUTION

3.1 COORDINATION

In most instances, installation of solid polymer fabricated components and assemblies will require strong, correctly located structural support provided by other trades. To provide a stable, sound, secure installation, close coordination is required between the solid polymer fabricator/installer and other trades to insure that necessary structural cabinet counter top structural support, proper clearances, and other supporting components are provided for the installation of wall panels, countertops, to the degree and extent recommended by the solid polymer manufacturer. Contractor shall appropriate staging areas for solid polymer fabrications.

## 3.2 INSTALLATION

### 3.2.1 Components

All components and fabricated units shall be installed plumb, level, and rigid. Field joints between solid polymer components to provide a monolithic appearance shall be made using solid polymer manufacturer's approved seam adhesives, with joints inconspicuous in the finished work. Metal or vitreous china sinks and lavatory bowls shall be attached to counter tops using solid polymer manufacturer's recommended clear silicone sealant and mounting hardware. Solid polymer sinks and bowls shall be installed using a color-matched seam adhesive. Plumbing connections to sinks and lavatories shall be made in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

#### 3.2.1.1 Loose Counter Top Splashes

Loose splashes shall be mounted in locations as noted on the drawings. Loose splashes shall be adhered to the counter top with a color matched silicone sealant when the solid polymer components are solid colors. Adhesion of particulate patterned solid polymer splashes to counter tops shall utilize a clear silicone sealant.

### 3.2.2 Silicone Sealant

A clear, silicone sealant or caulk shall be used to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures. Sealant bead shall be smooth and uniform in appearance and shall be the minimum size necessary to bridge any gaps between the solid surfacing material and the adjacent surface. Bead shall be continuous and run the entire length of the joint being sealed.

### 3.2.3 Plumbing

Plumbing connections to sinks and lavatories shall be made in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

## 3.3 CLEAN-UP

Components shall be cleaned after installation and covered to protect against damage during completion of the remaining project items. Components damaged after installation by other trades will be repaired or replaced at the General Contractor's cost. Component supplier will provide a repair/replace cost estimate to the General Contractor who shall approve estimate before repairs are made. The Contractor shall submit maintenance data as specified in the Submittals paragraph, under SD-10.

-- End of Section --

SECTION 07 21 16

MINERAL FIBER BLANKET INSULATION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C 665 | (2006) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing |
| ASTM C 930 | (2005) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories |
| ASTM E 136 | (2004) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C |
| ASTM E 84 | (2008a) Standard Test Method for Surface Burning Characteristics of Building Materials |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 211 | (2006) Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances |
| NFPA 31 | (2006; Errata 2006; Errata 2007) Installation of Oil Burning Equipment |
| NFPA 54 | (2006) National Fuel Gas Code |
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1910.134 | Respiratory Protection |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Blanket insulation

Vapor retarder

Accessories

SD-08 Manufacturer's Instructions

Insulation

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials to site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.3.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.4 SAFETY PRECAUTIONS

1.4.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

1.4.2 Smoking

Do not smoke during installation of blanket thermal insulation.

1.4.3 Other Safety Concerns

Consider other safety concerns and measures as outlined in ASTM C 930.

PART 2 PRODUCTS

2.1 BLANKET INSULATION

2.1.1 Unfaced Batt Insulation

ASTM C 665, Type I, blankets without membrane coverings with a flame spread rating of 25 or less and a smoke developed rating of 150 or less when tested in accordance with ASTM E 84.

2.1.1 Poly-Encapsulated Batt Insulations (Floor Cavity Installation)

ASTM C 665 Type II, Class A, Category 1, with a flame spread rating of 25 or less and a smoke developed rating of 150 or less, per ASTM E 84.

2.1.3 Thermal Resistance Value (R-VALUE)

As indicated

2.1.2 Recycled Materials

Provide Thermal Insulation containing recycled materials to the extent practicable, provided the material meets all other requirements of this section. The minimum required recycled materials content by weight are:

Rock Wool: 75 percent slag
Fiberglass: 20 to 25 percent glass cullet

2.1.3 Prohibited Materials

Do not provide asbestos-containing materials.

2.2 BLOCKING

Wood, unfaced mineral fiber blankets in accordance with ASTM C 665, Type I, or other approved materials. Use only non-combustible materials meeting the requirements of ASTM E 136 for blocking around chimneys and heat producing devices.

2.3 VAPOR RETARDER

Vapor Retarder/Waterproofing Membrane is specified in Section 07 13 53 ELASOMERIC SHEET WATERPROOFING.
2.4 2.4 ACCESSORIES

2.4.1 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

2.4.2 Wire Mesh

Corrosion resistant and as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders.

3.2 PREPARATION

3.2.1 Wire Mesh Support

Install wire mesh to underside of roof truss rafters. Provide blocking to create adequate depth to support unfaced insulation with no compresssion.

3.2.2 Blocking Around Heat Producing Devices

Install non-combustible blocking around heat producing devices to provide the following clearances:

a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless these are certified by the manufacturer for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is to be placed above fixture or device, 24 inches above fixture.

b. Masonry chimneys or masonry enclosing a flue: 2 inches from outside face of masonry. Masonry chimneys for medium and high heat operating appliances: Minimum clearances required by NFPA 211.

c. Vents and vent connectors used for venting the products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances as required by NFPA 211.

d. Gas Fired Appliances: Clearances as required in NFPA 54.

e. Oil Fired Appliances: Clearances as required in NFPA 31.

Blocking around flues and chimneys is not required when insulation blanket, including any attached vapor retarder, passed ASTM E 136, in addition to meeting all other requirements stipulated in Part 2. Blocking is also not required if the chimneys are certified by the manufacturer for use in contact with insulating materials.

3.3 INSTALLATION

3.3.1 Insulation

Install and handle insulation in accordance with manufacturer's instructions. Keep material dry and free of extraneous materials. Ensure personal protective clothing and respiratory equipment is used as required. Observe safe work practices.

3.3.1.1 Electrical wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.3.1.2 Continuity of Insulation

Install blanket insulation to butt tightly against adjoining blankets and to studs, rafters, joists, sill plates, headers and any obstructions. Where insulation required is thicker than depth of associated structural components, provide full width blankets to cover across top of components. Provide continuity and integrity of insulation at corners, wall to ceiling joints, roof, and floor. Avoid creating thermal bridges.

3.3.1.3 Installation at Bridging and Cross Bracing

Insulate at bridging and cross bracing by splitting blanket vertically at center and packing one half into each opening. Butt insulation at bridging and cross bracing; fill in bridged area with loose or scrap insulation.

3.3.1.4 Installation around Liquid Filled Piping

Place insulation to the outside of pipes.

3.3.1.5 Insulation without Affixed Vapor Retarder

Provide snug friction fit to hold insulation in place. Stuff pieces of insulation into cracks between trusses, joists, studs and other framing, such as door and window heads, jambs, and sills, band joists, and headers.

3.3.1.6 Sizing of Blankets

Provide only full width blankets when insulating between trusses, joists, or studs. Size width of blankets for a snug fit where trusses, joists or studs are irregularly spaced.

3.3.1.7 Special Requirements for Floors and Roofs

Hold insulation in place with corrosion resistant wire mesh, wire fasteners, or wire lacing.

3.3.2 Installation of Separate Vapor Retarder

Apply continuous vapor retarder as indicated. Seal at sill, header, windows, doors and utility penetrations. Repair punctures or tears. See Specification Section 07 13 53 ELASTOMERIC SHEET WATERPROOFING.

-- End of Section --

SECTION 07 60 00

FLASHING AND SHEET METAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 167 | (1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

| | |
|---|---|
| SMACNA 1793 | (2006) Architectural Sheet Metal Manual, Sixth Edition, Second Printing |

1.2 GENERAL REQUIREMENTS

Finished sheet metalwork will form a weathertight construction without waves, warps, buckles, fastening stresses or distortion, which allows for expansion and contraction. Sheet metal mechanic is responsible for cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades. Coordinate installation of sheet metal items used in conjunction with roofing with roofing work to permit continuous roofing operations.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Base flashing; G, AE

Flashing at doors, windows, floor decking; G, AE

Miscellaneous wall/floor intersection; G,AE

Indicate thicknesses, dimensions, fastenings and anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

SD-11 Closeout Submittals

Quality Control Plan

Submit for sheet metal work in accordance with paragraph entitled "Field Quality Control."

1.4 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

Flashing material shall be stainless steel. No other material is allowed. Conform to the requirements specified and to the thicknesses and configurations established in SMACNA Arch. manual for the materials. Different items shall be of the same metal.

Furnish sheet metal items in 8 to 10 foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 12 inch legs. Provide accessories and other items essential to complete the sheet metal installation. Provide accessories made of the same or compatible materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this section. Provide sheet metal items with mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used except as follows:

2.1.1 Exposed Sheet Metal Items

Must be of the same material.

2.1.2 Stainless Steel

ASTM A 167, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

2.1.3 Fasteners

Use the same metal or a metal compatible with the item fastened. Use stainless steel fasteners to fasten dissimilar materials.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Workmanship

Make lines and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth,

dry, and free of defects and projections. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

3.1.2 Nailing

Confine nailing of sheet metal generally to sheet metal having a maximum width of 18 inch. Confine nailing of flashing to one edge only. Space nails evenly not over 3 inch on center and approximately 1/2 inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work.

3.1.3 Cleats

Provide cleats for all sheet metal which would otherwise require an exposed fastener. All cleats shall be continuous and of the same material and thickness as the sheet metal being installed. Pretin cleats for soldered seams.

3.1.4 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection.

3.1.5 Seams

Straight and uniform in width and height with no solder showing on the face.

3.1.5.1 Lap Seams

Finish soldered seams not less than one inch wide. Overlap seams not soldered, not less than 3 inch.

3.1.5.2 Loose-Lock Expansion Seams

Not less than 3 inch wide; provide minimum one inch movement within the joint. Completely fill the joints with the specified sealant, applied at not less than 1/8 inch thick bed.

3.1.5.3 Flat Seams

Make seams in the direction of the flow.

3.1.6 Soldering

Where soldering is specified, apply to stainless steel items. Pretin edges of sheet metal before soldering is begun.

3.1.7 Expansion and Contraction

Provide expansion and contraction joints at not more than40 foot intervals. Provide an additional joint where the distance between the last

expansion joint and the end of the continuous run is more than half the required interval. Space joints evenly.

### 3.1.8 Base Flashing

Extend up vertical surfaces of the flashing not less than 8 inch and not less than 4 inch under the roof covering. Where finish wall coverings form a counterflashing, extend the vertical leg of the flashing up behind the applied wall covering not less than 8 inches. Horizontal flashing at vertical surfaces must extend vertically above the roof surface and fastened at their upper edge to the deck a minimum of 6 inch on center with a minimum of 2-inch lap of any surface. Solder end laps and provide for expansion and contraction. Extend the metal flashing over crickets at the up-slope side of curbs, and similar vertical surfaces extending through sloping roofs, the metal flashings. Extend the metal flashings onto the roof covering not less than 4.5 inch at the lower side of vertical surfaces extending through the roof decks. Install and fit the flashings so as to be completely weathertight. Provide factory-fabricated base flashing for interior and exterior corners.

## 3.2 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

## 3.3 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

## 3.4 FIELD QUALITY CONTROL

Establish and maintain a Quality Control Plan for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Remove work that is not in compliance with the contract and replace or correct. Include quality control, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.

b. Verification that specified material is provided and installed.

c. Inspection of sheet metalwork, for proper size(s) and thickness(es), fastening and joining, and proper installation.

### 3.4.1 Procedure

Submit for approval prior to start of roofing work. Include a checklist of points to be observed. Document the actual quality control observations and inspections. Furnish a copy of the documentation to the Contracting Officer at the end of each day.

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

| Sheet Metal Items | Stainless Steel, Inch Gage] |
|---|---|
| Building Expansion Joints | |
| Cover | .015 |
| Covering on minor flat, pitched or curved surfaces | .018 |
| Flashings: | |
| Base | .018 |
| Cap (Counter-flashing) | .015 |
| Eave | .015 |
| Sheets, smooth | .018 |
| Edge strip | .025 |
| Continuous cleat | .015 |
| Joint Cover plates (See Table II) | .015 |

TABLE II. SHEET METAL JOINTS

| Item Designation | TYPE OF JOINT: Copper, Terne-Coated Steel, Zinc-Coated Steel and Stainless Steel | Remarks |
|---|---|---|
| Joint cap for building expansion seam, cleated joint at roof | 1.25 inch single lock, standing seam, cleated | |
| Flashings | | |
| Base | One inch 3 inch lap for expansion joint | Aluminum producer's recommended hard setting sealant for locked aluminum joints. Fill each metal expansion joint with a joint |

TABLE II. SHEET METAL JOINTS

| Item Designation | TYPE OF JOINT: Copper, Terne-Coated Steel, Zinc-Coated Steel and Stainless Steel | Remarks |
|---|---|---|
| | | sealing compound compound. |
| Eave | One inch flat locked, cleated<br>One inch loose locked, expansion joint cleated | Same as base flashing. |
| Edge strip | Butt | - - - |
| Sheet, smooth | Butt with 1/4 inch space | Use sheet flashing backup plate. |

-- End of Section --

SECTION 07 92 00

JOINT SEALANTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C 1311 | (2002) Standard Specification for Solvent Release Agents |
| ASTM C 509 | (2006) Elastomeric Cellular Preformed Gasket and Sealing Material |
| ASTM C 920 | (2008) Standard Specification for Elastomeric Joint Sealants |
| ASTM D 1056 | (2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber |
| ASTM D 1667 | (2005) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell) |
| ASTM D 2452 | (2003) Standard Test Method for Extrudability of Oil- and Resin-Base Caulking Compounds |
| ASTM D 2453 | (2003) Standard Test Method for Shrinkage and Tenacity of Oil- and Resin-Base Caulking Compounds |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sealants

Primers

Bond breakers

Backstops

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). Provide a copy of the Material

Safety Data Sheet for each solvent, primer or sealant material.

SD-07 Certificates

Sealant

Certificates of compliance stating that the materials conform to the specified requirements.

1.3 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 40 and 90 degrees F.

1.4 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, color, and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 90 degrees F or less than 0 degrees F.

1.5 QUALITY ASSURANCE

1.5.1 Compatibility with Substrate

Verify that each of the sealants are compatible for use with joint substrates.

1.5.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

1.6 SPECIAL WARRANTY

Guarantee sealant joint against failure of sealant and against water penetration through each sealed joint for five years.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

2.1.1 Interior Sealant

Provide ASTM C 920, Type S or M, Grade NS, Class 12.5, Use NT. Location(s) and color(s) of sealant for the following:

| LOCATION | COLOR |
|---|---|
| a. Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface-mounted equipment and fixtures, and similar items. | |
| b. Perimeter of frames at doors, windows, | |

| LOCATION | COLOR |
|---|---|
| and access panels which adjoin exposed interior concrete and masonry surfaces. | |
| c. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted. | |
| d. Joints between plumbing fixtures and ceramic tile; joints between shower receptors and ceramic tile; joints formed where nonplaner tile surfaces meet. | |
| e. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change. | |
| f. Behind escutcheon plates at valve pipe penetrations and showerheads in showers. | |
| g. Joints indicated on drawings | |

Color: All interior latex sealants shall be installed prior to final painting, and painted to match adjacent surface. Non-paintable sealant shall match color of adjacent surface.

2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C 920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows:

| LOCATION | COLOR |
|---|---|
| a. Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin concrete or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations. | |
| b. Expansion and control joints. | |
| c. Voids where items pass through exterior walls. | |
| d. Metal-to-metal joints where sealant is indicated or specified. | |
| e. Joints between ends of gravel stops, fascias, copings, and adjacent walls. | |
| f. Joints indicated on drawings | |

Color: Exterior sealant shall match color of darkest adjacent color.

Note: Exterior siding and trim are cementitious materials. Follow

| LOCATION | COLOR |
|---|---|

manufacturers written instruction for sealant products and installation.

2.1.3 Floor Joint Sealant

ASTM C 920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows:

| | LOCATION | COLOR |
|---|---|---|
| a. | Seats of metal thresholds for exterior doors. | Gray |
| b. | Control and expansion joints in floors, slabs, ceramic tile, and walkways. | Gray to match concrete. |

2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.3 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.4 BACKSTOPS

Provide neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Make backstop material compatible with sealant. Do not use oakum or other types of absorptive materials as backstops.

2.4.1 Rubber

Conform to ASTM D 1056, Type 2, closed cell, Class A or B, round cross section for cellular rubber sponge backing.

2.4.2 PVC

Conform to ASTM D 1667, Grade VO 12, open-cell foam, round cross section for Polyvinyl chloride (PVC) backing.

2.4.3 Synthetic Rubber

Conform to ASTM C 509, Option I, Type I preformed rods or tubes for Synthetic rubber backing.

2.4.4 Neoprene

Conform to ASTM D 1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2 for Neoprene backing.

2.4.5 Butyl Rubber Based

Provide Butyl Rubber Based Sealants of single component, solvent release,

color as indicated, conforming to ASTM C 1311.

2.4.6 Silicon Rubber Base

Provide Silicon Rubber Based Sealants of single component, solvent release, color as indicated, conforming to ASTM C 920, Non-sag, Type S, Grade NS, Class 25.

2.5 CAULKING

Conform to ASTM D 2452 and ASTM D 2453, Type 5, for Oil- and resin-based caulking.

2.6 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer except for aluminum and bronze surfaces that will be in contact with sealant.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean surfaces from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths. When resealing an existing joint, remove existing caulk or sealant prior to applying new sealant. For surface types not listed below, contact sealant manufacturer for specific recommendations.

3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

3.1.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For removing protective coatings and final cleaning, use nonstaining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.1.3 Concrete Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence and loose mortar from the joint cavity.

3.1.4 Wood Surfaces

Keep wood surfaces to be in contact with sealants free of splinters and sawdust or other loose particles.

3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix multicomponent elastomeric sealants in accordance with manufacturer's

instructions.

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

| JOINT WIDTH | JOINT DEPTH | |
|---|---|---|
| | Minimum | Maximum |
| For metal, glass, or other nonporous surfaces: | | |
| 1/4 inch (minimum) | 1/4 inch | 1/4 inch |
| over 1/4 inch | 1/2 of width | Equal to width |
| For wood, concrete, masonry, | | |
| 1/4 inch (minimum) | 1/4 inch | 1/4 inch |
| Over 1/4 inch to 1/2 inch | 1/4 inch | Equal to width |
| Over 1/2 inch to 2 inch | | |
| Over 2 inch. | (As recommended by sealant manufacturer) | |

b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is not required on metal surfaces.

3.3.2 Masking Tape

Place masking tape on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Remove masking tape within 10 minutes after joint has been filled and tooled.

3.3.3 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

a. Where indicated.

b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios".

3.3.4 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer

to exposed finish surfaces.

3.3.5 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

3.3.6 Sealants

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Make sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified. Apply sealer over the sealant when and as specified by the sealant manufacturer.

3.4 PROTECTION AND CLEANING

3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

3.4.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.

b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

-- End of Section --

SECTION 08 11 13

STEEL DOORS AND FRAMES
**08/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.1/D1.1M | (2008) Structural Welding Code - Steel |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 653/A 653M | (2008) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A 879/A 879M | (2006) Standard Specification for Steel Sheet, zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface |
| ASTM A 924/A 924M | (2008a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| ASTM C 578 | (2008b) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation |
| ASTM C 591 | (2008) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation |
| ASTM C 612 | (2004e1) Mineral Fiber Block and Board Thermal Insulation |
| ASTM D 2863 | (2008) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index) |
| ASTM E 1300 | (2007e1) Determining Load Resistance of Glass in Buildings |
| ASTM F 2248 | (2003) Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass |

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

| | |
|---|---|
| BHMA A115 | (2006)(Complete Set - Spec dates Vary) Specifications for Door and Frame Preparation for Hardware (Incl A115.1 (1990), A115.2 (1987), A115.4 (1994), A115.5 (1992), A115.6 (1993), A115.12 (1994), A115.13 (1991), A115.14 (1994), A115.15 (1994), A115.16 (1990), A115.17 (1994), A115.18 (1994) |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 105 | (2006; Errata 2007; Errata 2007) Installation of Smoke Door Assemblies |
| NFPA 252 | (2007) Standard Methods of Fire Tests of Door Assemblies |
| NFPA 80 | (2006; Errata 2008) Standard for Fire Doors and Other Opening Protectives |

STEEL DOOR INSTITUTE (SDI/DOOR)

| | |
|---|---|
| SDI/DOOR 111 | (2004) Recommended Selection and Usage Guide for Standard Steel Doors, Frames and Accessories |
| SDI/DOOR 113 | (2001) Determining the Steady State Thermal Transmittance of Steel Door and Frame Assemblies |
| SDI/DOOR A250.11 | (2001) Recommended Erection Instructions for Steel Frames |
| SDI/DOOR A250.4 | (2001) Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings |
| SDI/DOOR A250.6 | (2003) Hardware on Steel Doors (Reinforcement - Application) |
| SDI/DOOR A250.8 | (2003) Recommended Specification for Standard Steel Doors and Frames |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 10B | (2008) Fire Tests of Door Assemblies |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors G

Frame G

Accessories

Weatherstripping

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors G

Schedule of frames G

Submit door and frame locations.

SD-03 Product Data

Doors G

Frames G

Accessories

Weatherstripping

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to SDI/DOOR A250.8 requirements.

SD-04 Samples

Where colors are not indicated, submit manufacturer's standard colors and patterns for selection.

## 1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Strap knock-down frames in bundles. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

# PART 2 PRODUCTS

## 2.1 STANDARD STEEL DOORS

SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive door hardware as specified in Section 08 71 00. Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 1-3/4 inch thick, unless otherwise indicated. Provide exterior glazing in accordance with ASTM F 2248 and ASTM E 1300.

2.1.1 Classification - Level, Performance, Model

2.1.1.1 Heavy Duty Doors

SDI/DOOR A250.8, Level 2, physical performance Level B with core construction as required by the manufacturer for interior doors and for exterior doors, of size(s) and design(s) indicated.

2.2 INSULATED STEEL DOOR SYSTEMS

Insulated steel doors shall have a core of polyurethane foam and an R factor of 10.0 or more (based on a k value of 0.16); face sheets, edges, and frames of galvanized steel not lighter than 23 gage, 16 gage, and 16 gage respectively; magnetic weatherstripping; nonremovable-pin hinges; thermal-break aluminum threshold; and vinyl door bottom. Doors and frames shall receive phosphate treatment, rust-inhibitive primer, and baked acrylic enamel finish. Doors shall have been tested in accordance with SDI/DOOR A250.4 and shall have met the requirements for Level C. Prepare doors to receive specified hardware.Doors shall be 1-3/4 inch thick.

2.3 SOUND RATED STEEL DOORS

Doors shall have a Sound Transmission Class STC as indicated on the drawings.

2.4 ACCESSORIES

2.4.1 Louvers

2.4.1.1 Interior Louvers

SDI/DOOR 111, Louvers shall be stationary sightproof and lightproof type. Detachable moldings on room or non security side of door; on security side of door, moldings to be integral part of louver. Form louver frames of 20 gage steel and louver blades of a minimum 24 gage. Louvers for lightproof doors shall have minimum of 20 percent net-free opening. Sightproof louvers to be inverted "V" blade design with minimum 55 and inverted "Y" blade design with minimum 40] percent net-free opening.

2.4.1.2 Exterior Louvers

Louvers shall be inverted "Y" or "V" type with minimum of 55 percent net-free opening. Weld or tenon louver blades to continuous channel frame and weld assembly to door to form watertight assembly. Form louvers of hot-dip galvanized steel of same gage as door facings. Louvers shall have steel-framed insect and bird screens secured to room side and readily removable. Provide aluminum wire cloth, 18 by 18 or 18 by 16 inch mesh, for insect screens and galvanized steel, 1/2 by 1/2 inch mesh hardware cloth, for bird screens. Net-free louver area to be before screening.

2.4.2 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08 71 00 DOOR HARDWARE provide overlapping steel astragals with the doors.

2.4.3 Moldings

Provide moldings around glass of interior and exterior doors and louvers of

interior doors. Provide nonremovable moldings on outside of exterior doors and on corridor side of interior doors. Other moldings may be stationary or removable. Secure inside moldings to stationary moldings, or provide snap-on moldings. Muntins shall interlock at intersections and shall be fitted and welded to stationary moldings.

## 2.5 INSULATION CORES

Insulated cores shall be of type specified, and provide an apparent U-factor of .48 in accordance with SDI/DOOR 113 and shall conform to:

a. Rigid Cellular Polyisocyanurate Foam: ASTM C 591, Type I or II, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D 2863; or

b. Rigid Polystyrene Foam Board: ASTM C 578, Type I or II; or

c. Mineral board: ASTM C 612, Type I.

## 2.6 STANDARD STEEL FRAMES

Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors, cased openings, and interior glazed panels, unless otherwise indicated.

### 2.6.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

Weld frames in accordance with the recommended practice of the Structural Welding Code Sections 1 through 6, AWS D1.1/D1.1M and in accordance with the practice specified by the producer of the metal being welded.

### 2.6.2 Mullions and Transom Bars

Mullions and transom bars shall be closed or tubular construction and be a member with heads and jambs butt-welded thereto or knock-down for field assembly. Bottom of door mullions shall have adjustable floor anchors and spreader connections.

### 2.6.3 Stops and Beads

Form stops and beads from 20 gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inch on center. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

### 2.6.4 Cased Openings

Fabricate frames for cased openings of same material, gage, and assembly as specified for metal door frames, except omit door stops and preparation for hardware.

### 2.6.5 Anchors

Provide anchors to secure the frame to adjoining construction. Provide

steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 18 gage.

2.6.5.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;

b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding.

2.6.5.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member.

2.7 FIRE DOORS AND FRAMES

NFPA 80 and NFPA 105 and this specification. The requirements of NFPA 80 and NFPA 105 shall take precedence over details indicated or specified.

2.7.1 Labels

Fire doors and frames shall bear the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing shall be in accordance with NFPA 252 or UL 10B. Labels shall be metal with raised letters, and shall bear the name or file number of the door and frame manufacturer. Labels shall be permanently affixed at the factory to frames and to the hinge edge of the door. Door labels shall not be painted.

2.7.2 Oversized Doors

For fire doors and frames which exceed the size for which testing and labeling are available, furnish certificates stating that the doors and frames are identical in design, materials, and construction to a door which has been tested and meets the requirements for the class indicated.

2.7.3 Astragal on Fire Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements.

2.8 WEATHERSTRIPPING

As specified in Section 08 71 00 DOOR HARDWARE.

2.9 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in SDI/DOOR A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI/DOOR A250.8 and SDI/DOOR A250.6. For additional requirements refer to BHMA A115. Drill and tap for surface-applied hardware at the project site.

Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI/DOOR A250.8, as applicable. Punch door frames , with the exception of frames that will have weatherstripping or lightproof or soundproof gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

## 2.10 FINISHES

### 2.10.1 Factory-Primed Finish

All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in SDI/DOOR A250.8. Where coating is removed by welding, apply touchup of factory primer.

### 2.10.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A 924/A 924Mand ASTM A 653/A 653M. The coating weight shall meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot, total both sides, i.e., A40. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in SDI/DOOR A250.8.

### 2.10.3 Electrolytic Zinc-Coated Anchors and Accessories

Provide electrolytically deposited zinc-coated steel in accordance with ASTM A 879/A 879M, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in SDI/DOOR A250.8.

## 2.11 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. Design other frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive calking compound.

### 2.11.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

## 2.12 PROVISIONS FOR GLAZING

Materials as specified.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Frames

Set frames in accordance with SDI/DOOR A250.11. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Backfill frames with mortar. Coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

#### 3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

#### 3.1.3 Fire Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80.

### 3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

### 3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

-- End of Section --

SECTION 08 36 13

SECTIONAL OVERHEAD DOORS
**07/06**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 123/A 123M | (2008) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A 227/A 227M | (2006) Standard Specification for Steel Wire, Cold-Drawn for Mechanical Springs |
| ASTM A 229/A 229M | (1999; R 2005) Standard Specification for Steel Wire, Oil-Tempered for Mechanical Springs |
| ASTM A 36/A 36M | (2008) Standard Specification for Carbon Structural Steel |
| ASTM A 653/A 653M | (2008) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM B 209 | (2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate |
| ASTM B 221 | (2008) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes |
| ASTM E 330 | (2002) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference |

DOOR AND ACCESS SYSTEM MANUFACTURERS ASSOCIATION (DASMA)

| | |
|---|---|
| DASMA 102 | (2003) Sectional Overhead Type Doors |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA ICS 1 | (2000; R 2005; R 2008) Standard for Industrial Control and Systems General Requirements |
| NEMA ICS 2 | (2000; Errata 2002; R 2005; Errata 2006) |

| | |
|---|---|
| | Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment |
| NEMA ICS 6 | (1993; R 2006) Standard for Industrial Controls and Systems Enclosures |
| NEMA MG 1 | (2007; Errata 2008) Standard for Motors and Generators |
| NEMA ST 20 | (1992; R 1997) Standard for Dry-Type Transformers for General Applications |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-02 Shop Drawings

Doors G

Show types, sizes, locations, metal gages including minimum metal decimal thickness, hardware provisions, installation details, and other details of construction. For electrically-operated doors, include supporting brackets for motors, location, type, and ratings of motors, switches, and safety devices.

SD-03 Product Data

Doors G

Electric operators G

For electrically motor-operated doors, submit manufacturer's wiring diagrams for motor and controls.

SD-08 Manufacturer's Instructions

Doors

SD-10 Operation and Maintenance Data

Doors G

Submit Data Package 2 as specified.

1.3 DELIVERY, STORAGE, AND HANDLING

Protect doors and accessories from damage during delivery, storage, and handling. Clearly mark manufacturer's brand name. Store doors in dry

locations with adequate ventilation, free from dust and water. Remove damaged items and provide new. Provide easy access for inspection and handling of overhead doors prior to installation.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Hard-Drawn Springwire

ASTM A 227/A 227M.

#### 2.1.2 Oil-Tempered Springwire

ASTM A 229/A 229M.

#### 2.1.3 Steel Sheet

ASTM A 653/A 653M.

#### 2.1.4 Steel Shapes

ASTM A 36/A 36M.

#### 2.1.5 Aluminum Extrusions

ASTM B 221, Alloy 6063-T5.

#### 2.1.6 Aluminum Sheets and Strips

ASTM B 209, alloy and temper best suited for the purpose.

### 2.2 DOORS

DASMA 102. Industrial doors. Metal doors to have horizontal sections hinged together which operate in a system of tracks to completely close the door opening in the closed position and make the full width and height of the door opening available for use in the open position. Provide a permanent label on the door indicating the name and address of the manufacturer. Provide doors with standard lift type designed to slide up and back into a horizontal overhead position and requiring a maximum of 16 inch of headroom for 2 inch tracks and 21 inch of headroom for 3 inch tracks. Doors operate by electric power with auxiliary hand chain operation.

### 2.3 DESIGN REQUIREMENTS

Conform to DASMA 102 and design wind load 43.3 pounds per square foot. Provide doors to remain operable and undamaged after conclusion of tests conducted in accordance with ASTM E 330 using the design wind load.

### 2.4 FABRICATION

#### 2.4.1 Steel Overhead Doors

Form door sections of hot-dipped galvanized steel not lighter than 22 gage with flush surface without ribs or grooves. Install sections not less than 2 inch in thickness. Meeting rails to have interlocking joints to ensure a weathertight closure and alignment for full width of the door. Provide

sections of the height indicated or the manufacturer's standard. Do not exceed thick 24 inch height for intermediate sections. Bottom sections may be varied to suit door height. Do not exceed 30 inch height for bottom section.

2.4.1.1 Insulated Sections

Insulate door sections with fibrous glass or plastic foam to provide a "U" factor of 0.14 or less when tested in accordance with ASTM C 1363. Cover interior of door sections with steel sheets of not lighter than24 gage to completely enclose the insulating material.

2.4.2 Tracks

Provide galvanized steel tracks not lighter than 14 gage for 2 inch tracks and not lighter than 12 gage for 3 inch tracks. Provide vertical tracks with continuous steel angle not lighter than 13 gage for installation to walls. Incline vertical track through use of adjustable brackets to obtain a weathertight closure at jambs. Reinforce horizontal track with galvanized steel angle; support from track ceiling construction with galvanized steel angle and cross bracing to provide a rigid installation.

2.4.3 Hardware

Provide hinges, brackets, rollers, locking devices, and other hardware required for complete installation. Install roller brackets and hinges with14 gage galvanized steel. Provide rollers with ball bearings and case-hardened races. Provide reinforcing on doors where roller hinges are connected. Provide a positive locking device and cylinder lock with two keys on manually operated doors.

2.4.4 Counterbalancing

Counterbalance doors with an oil-tempered, helical-wound torsional spring mounted on a steel shaft. Provide adjustable spring tension, connect spring to doors with cable through cable drums. Provide cable safety factor of at least 7 to 1.

2.5 MANUAL OPERATORS

2.5.1 Chain Hoist Operators

Provide a galvanized, endless chain operating over a sprocket. Extend chain to within 4 feet of the floor and mount on inside of building. Obtain reduction by use of roller chain and sprocket drive or gearing. Provide chain cleat and pin for securing operator chain. Do not exceed the maximum lifting force of 35 pounds required to operate the door.

2.6 ELECTRIC OPERATORS

2.6.1 Operator Features

Provide operators of the drawbar type type as recommended by the manufacturer. Include operators with electric motor, machine-cut reduction gears, steel chain and sprockets, magnetic brake, brackets, pushbutton controls, limit switches, magnetic reversing contactor, a manual chain hoist operator for emergency use, and other accessories necessary for operation. Design electric operator so motor may be removed without disturbing the limit switch timing and without affecting the manual

operator. Provide the operator with slipping clutch coupling to prevent stalling the motor. Provide a clutch controlled emergency manual operator so that it may be engaged and disengaged from the floor; do not affect limit switch timing by operation. The manual operator is not required if door can be manual-pushup operated with a force not to exceed 25 pounds. Provide an electrical or mechanical device that disconnects the motor from the operating mechanism when the manual operator is engaged.

2.6.2 Motors

NEMA MG 1, high-starting torque, reversible type with sufficient horsepower and torque output to move the door in either direction from any position. Provide a motor to produce a door travel speed of not less than 8 inch or more than one foot per second without exceeding the rated capacity. Motors shall be operate on current of the characteristics indicated at not more than 3600 rpm. Single-phase motors shall not have commutation or more than one starting contact. Provide motor enclosures with drip-proof type or NEMA TENV type.

2.6.3 Controls

Provide a motor for each door with an enclosed, across-the-line type, magnetic reversing contactor, thermal overload and undervoltage protection, solenoid-operated brake, limit switches, and control switches. Locate control switches at least 5 feet above the floor so the operator will have complete visibility of the door at all times. Provide control equipment to conform to NEMA ICS 1 and NEMA ICS 2. Provide control enclosures with NEMA ICS 6, Type 12 or Type 4, except that contactor enclosures may be Type 1. Provide a three-button type control switch stations with buttons marked "OPEN," "CLOSE," and "STOP." The "OPEN" and "STOP" buttons shall require only momentary pressure to operate. The "CLOSE" button shall require constant pressure to maintain the closing motion of the door. If the door is in motion and the "STOP" button is pressed or the "CLOSE" button released, the door shall stop instantly and remain in the stop position; from the stop position, the door may be operated in either direction by the "OPEN" or "CLOSE" button. Pushbuttons shall be full-guarded to prevent accidental operation. Provide limit switches to automatically stop doors at the fully open and closed positions. Limit switch positions shall be readily adjustable.

2.6.4 Safety Device

Provide a pneumatic or electric type safety device on the bottom edge of electrically-operated doors. The device shall immediately stop and reverse the door movement during the closing travel upon contact with an obstruction in the door opening or upon failure of any component of the control system. Provide for an automatic lock-out on the door closing circuit and a manually operable door until the failure or damage has been corrected.

2.6.5 Control Transformers

NEMA ST 20. Provide transformers in power circuits as necessary to reduce the voltage on the control circuits to 120 volts or less.

2.6.6 Electrical Components

NFPA 70. Furnish manual or automatic control and safety devices, including extra flexible Type SO cable and spring-loaded automatic takeup reel or

equivalent device, for operation of the doors. Conduit wiring and mounting of controls are specified in the corresponding electrical specification section.

## 2.7 WEATHER SEALS AND SAFETY DEVICE

Provide exterior doors with weatherproof joints between sections by means of tongue-and-groove joints, rabbetted joints, shiplap joints, or wool pile, vinyl or rubber weatherstripping; a rubber, wool pile, or vinyl, adjustable weatherstrip at the top and jambs; and a compressible neoprene, rubber, wool pile, or vinyl weather seal attached to the bottom of the door. On exterior doors that are electrically operated, the bottom seal shall be combination compressible weather seal and safety device for stopping and reversing door movement.

## 2.8 FINISHES

Hot-dip galvanize concealed metal surfaces and tracks in accordance with ASTM A 123/A 123M. Hot-dip galvanized and other ferrous metal surfaces, except rollers and lock components, which are shop primed.

### 2.8.1 Galvanized and Shop Primed

Provide a zinc coating on specified surfaces, a phosphate treatment, and a shop prime coat of rust-inhibitive paint. Conform to ASTM A 653/A 653M for galvanized coating, coating designation G60, for steel sheets, and ASTM A 123/A 123M for assembled steel products. The weight of coatings for assembled products shall be as designated in Table I of ASTM A 123/A 123M for the class of material to be coated. Provide a prime coat especially developed for materials treated by phosphates and adapted to application by dipping or spraying. Repair damaged zinc-coated surfaces with galvanizing repair paint and spot prime. At the Contractor's option, a two-part system including bonderizing, baked-on epoxy primer, and baked-on enamel topcoat may be applied in lieu of prime coat specified.

# PART 3 EXECUTION

## 3.1 INSTALLATION

NFPA 70. Install doors in accordance with approved shop drawings and manufacturer's written installation instructions. Lubricate and adjust doors to operate freely.

Provide a weathertight installation and free from warp, twist, or distortion. Adjust and lubricate doors to operate freely.

Provide all items and accessories for a complete installation in every respect.

## 3.2 ELECTRICAL WORK

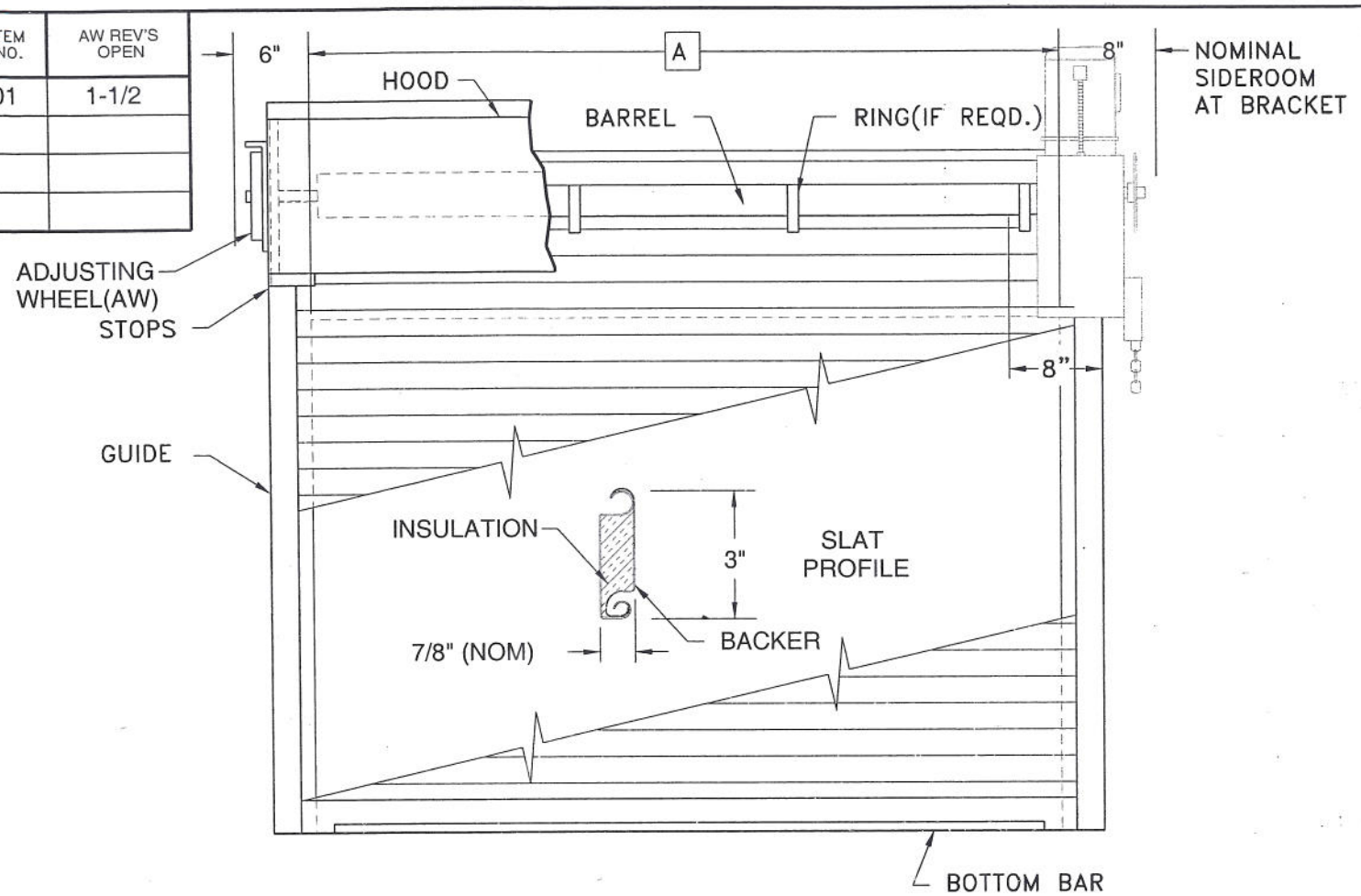
NFPA 70. Conduit, wiring, and mounting of controls.

## 3.3 TESTING

After installation is complete, operate doors to demonstrate installation and function of operators, safety features, and controls. Correct deficiencies.

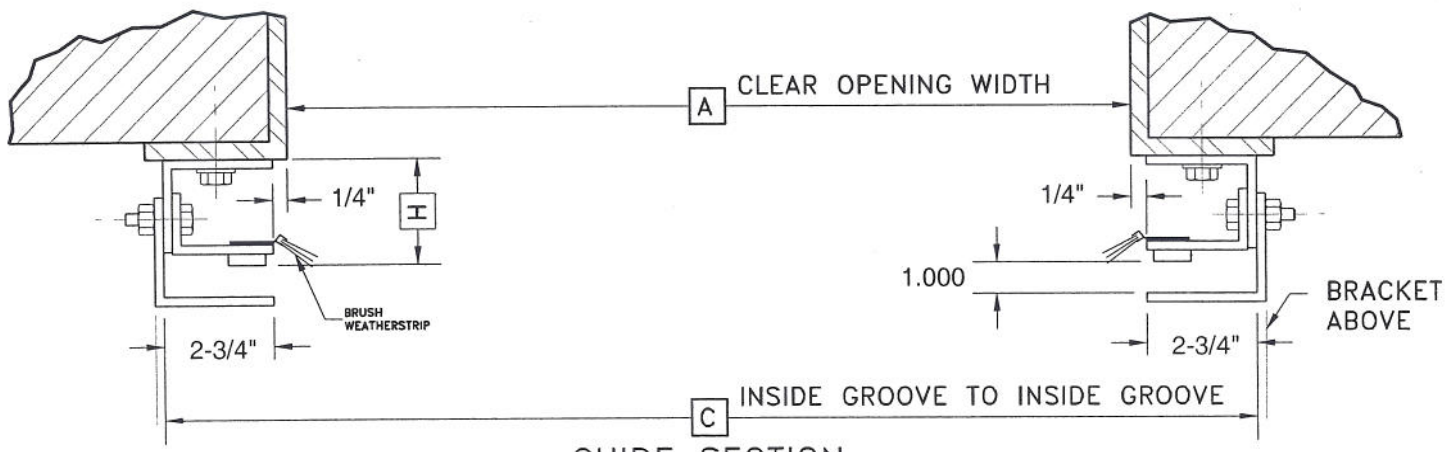
-- End of Section --

| ITEM NO. | AW REV'S OPEN |
|---|---|
| 01 | 1-1/2 |
| | |
| | |
| | |




## COILSIDE ELEVATION

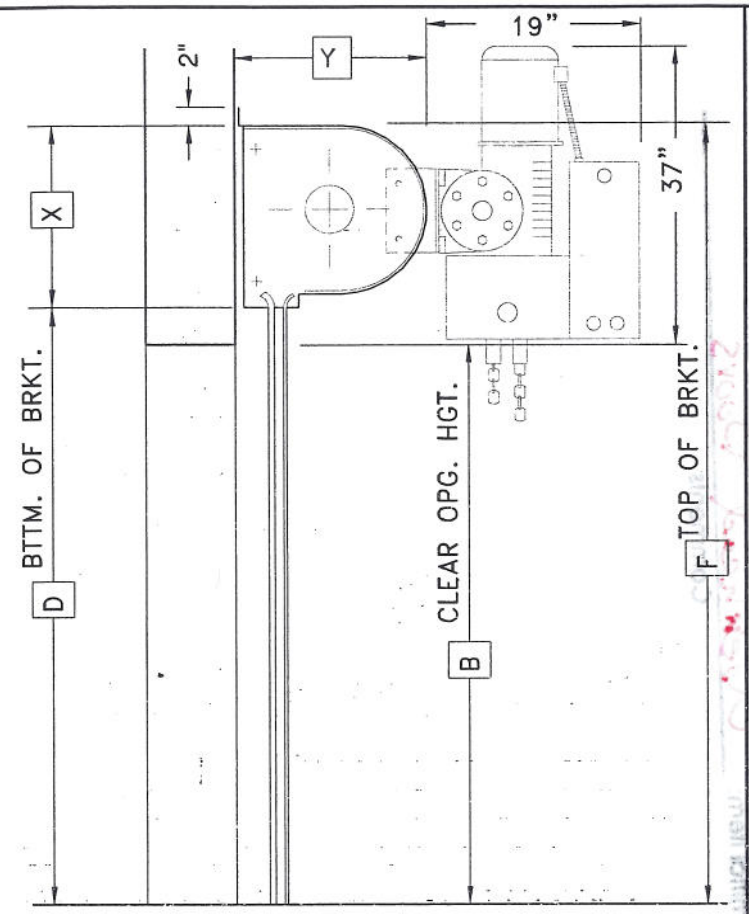
RIGHT HAND OPERATED DOOR SHOWN
LEFT HAND OPERATED DOOR OPPOSITE




## GUIDE SECTION

AS SHOWN

NOTE : WIDTH [C] IS IMPORTANT AND MUST BE HELD




## VERTICAL SECTION

| DOOR QTY. | ITEM NO. | HAND OF OPER. | WIDTHS | | | HEIGHTS | | | GUIDE | FOR BRACKET | | | SLAT LENGTH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | A | C | E | B | D | F | H | X | Y | Z | |
| 2 | 01 | RH | 12'0" | 12'6" | | 16'0" | 16'2" | 18'0" | 3-3/8" | 22" | 20-3/4" | | 12'2-3/4" |
| | | | | | | | | | | | | | |

CUSTOMER OPENING IDENTIFICATION

## GENERAL NOTES

SDF7

DESIGNED TO WITHSTAND ~~37#/SqFt~~ 43.3 #min. WINDLOAD.
CURTAIN IS 22GA STEEL INSULATED .
WINDLOCKS ON EACH END OF EVERY OTHER SLAT.
BOTTOM BAR IS GALVANIZED STEEL.
DOUBLE ANGLE WITH ASTRAGAL STANDARD.
GUIDES ARE STRUCTURAL THREE ANGLE.
HOODS ARE 24GA GALVANIZED STEEL .
SHOP COAT OF RUST INHIBITIVE PRIMER ON NONGALVANIZED STEEL SURFACES.
ALL GALVANIZING PER ASTM A 653 STANDARDS.
MOTOR OPERATOR IS GEAR REDUCTION TYPE EQUIPPED WITH EMERGENCY RELEASE CHAIN, FURNISHED WITH DOOR SPROCKET, ROLLER CHAIN, MOUNTING SUPPORT, PADLOCKABLE HAND CHAIN KEEPER, AND ONE PUSH BUTTON STATION (SAME NEMA RATING AS OPERATOR).

CIRCUIT: 1/2 HP 460 VAC 3 PH 60 HZ NEMA 1

## NOTES

CURTAIN FINISH: GALV STEEL PAINTED GRAY
BACKER FINISH: GALV STEEL PAINTED GRAY
BOTTOM BAR FINISH: GALVANIZED STEEL
GUIDE FINISH: STEEL SHOP PRIMED BLACK
HOOD FINISH: GALV STEEL PAINTED GRAY

OPTIONS ON THIS/THESE DOORS:
NEOPRENE BAFFEL INSIDE HOOD

- Door to be hot dip galv. with Painted Finish
- Switch to be 3 button

Wayne Dalton® Rolling Door Division
Kinnear® North American

THERMOTITE DOOR MODEL : 823C

PROJECT : STENNIS MAINT.BLDG
3-16-09 REVISED

ARCH :

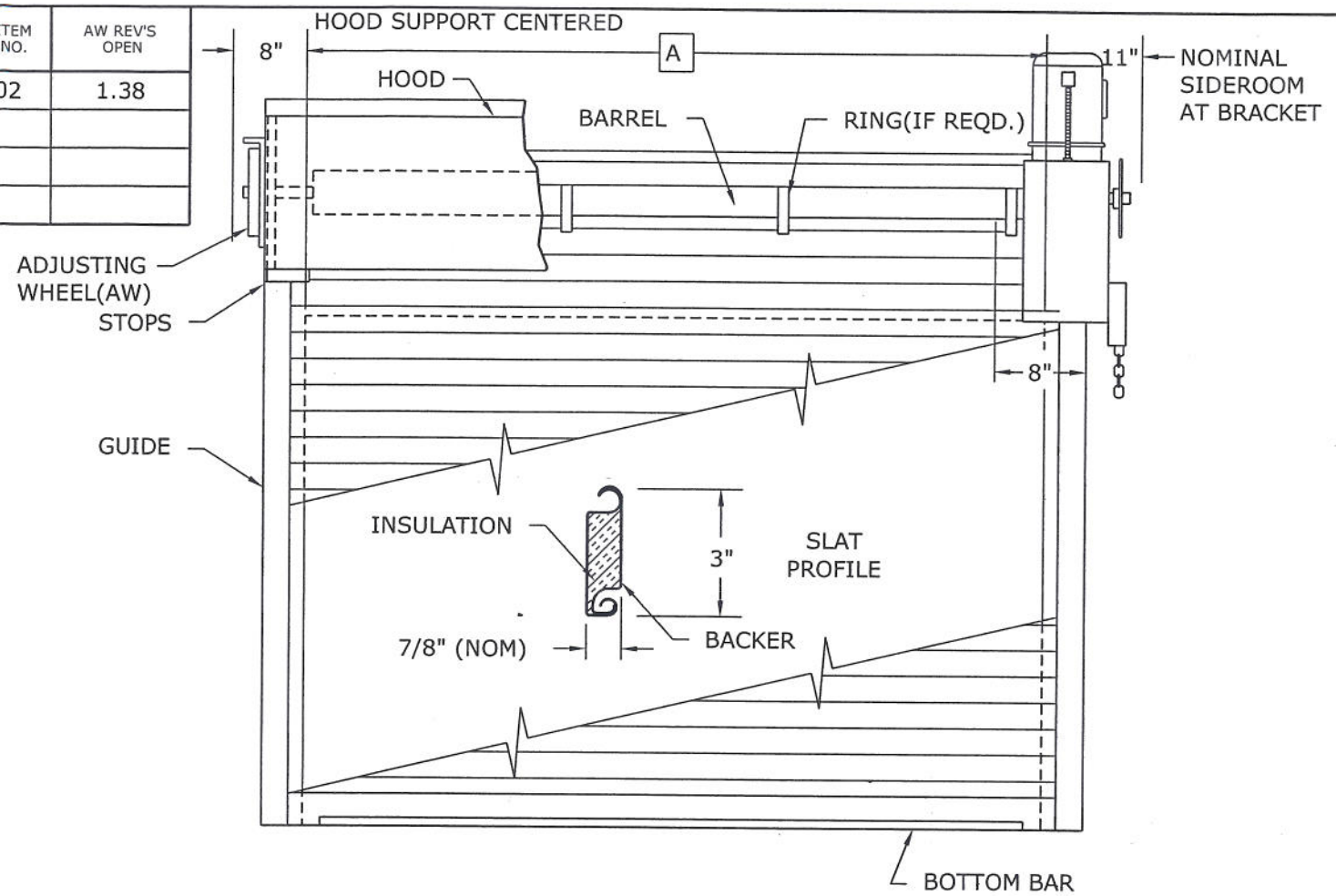
G.C. :

DISTR : PARTITIONS OF GULFPORT CORP.

DISTR P.O. NO. : | PREPARED BY : BGRAHAM | DATE : 03/11/2009

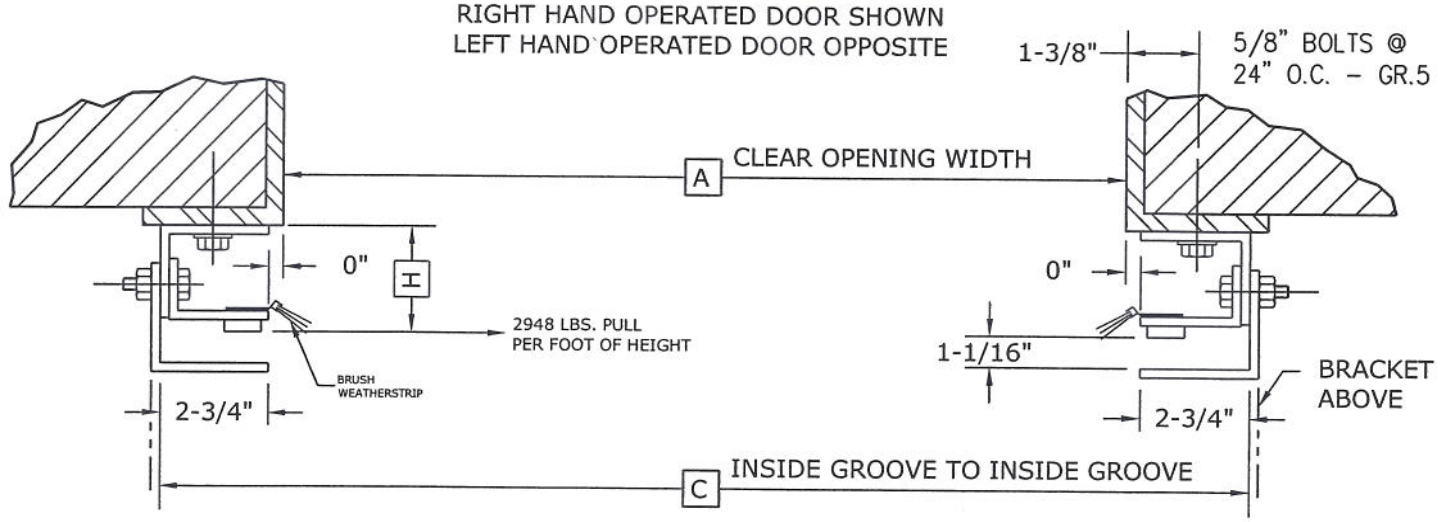
| REVISION | QUOTE NO. | DWG. NO. |
|---|---|---|
| 1 | 766778 | OF |

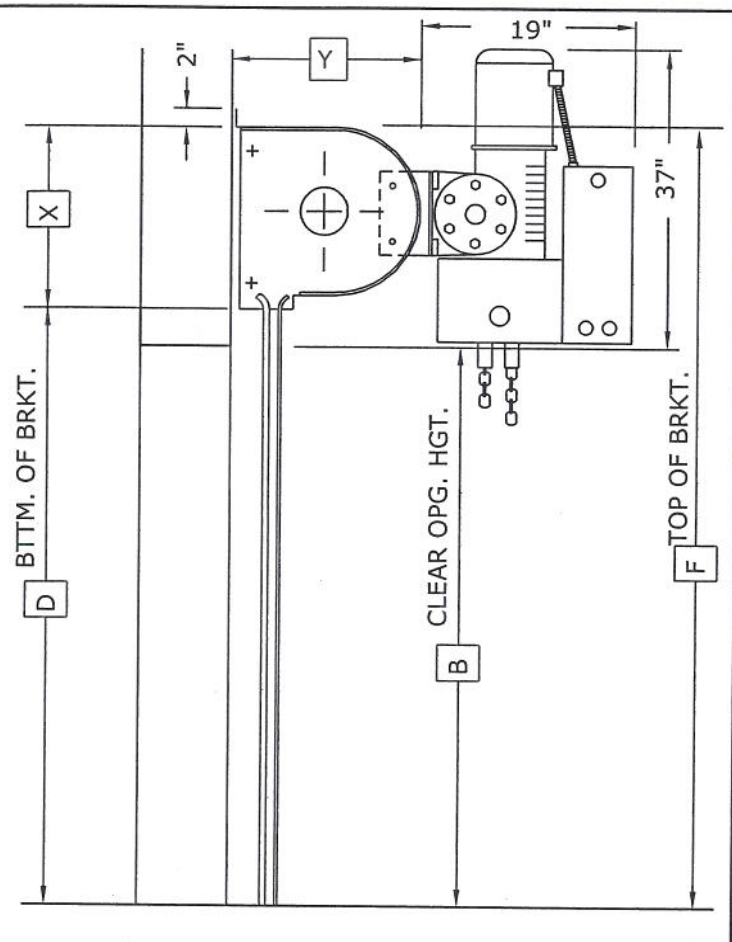
| ITEM NO. | AW REV'S OPEN |
|---|---|
| 02 | 1.38 |
| | |
| | |
| | |




## COILSIDE ELEVATION

RIGHT HAND OPERATED DOOR SHOWN
LEFT HAND OPERATED DOOR OPPOSITE




## VERTICAL SECTION

## GUIDE SECTION

NOTE : WIDTH C IS IMPORTANT AND MUST BE HELD

| DOOR QTY. | ITEM NO. | HAND OF OPER. | CUST. OPG. NO. | WIDTHS | | | HEIGHTS | | | GUIDE | FOR BRACKET | | | SLAT LENGTH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | A | C | E | B | D | F | H | X | Y | | |
| 4 | 02 | RH | | 26' 0" | 26' 6" | | 16' 0" | 16' 2" | 18' 2" | 3-3/4" | 24" | 22-3/4" | | 26' 3-3/8" |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

SDF7

## GENERAL NOTES

DESIGNED TO WITHSTAND ~~37 #/SqFt~~ WINDLOAD. 43.3# Min.
CURTAIN IS 20 GA STEEL INSULATED.
WINDLOCKS ON EACH END OF EVERY SLAT.
BOTTOM BAR IS STRUCTURAL STEEL - DOUBLE ANGLE WITH ASTRAGAL STANDARD.
GUIDES ARE STRUCTURAL THREE ANGLE.
HOODS ARE 24 GA GALVANIZED STEEL.
SHOP COAT OF RUST INHIBITIVE PRIMER ON NONGALVANIZED STEEL SURFACES. ALL GALVANIZING PER ASTM A-653 STANDARDS.
MOTOR OPERATOR IS GEAR REDUCTION TYPE EQUIPPED WITH DOOR SPROCKET, ROLLER CHAIN, MOUNTING SUPPORT, PADLOCKABLE HAND CHAIN KEEPER, AND ONE PUSH BUTTON STATION (SAME NEMA RATING AS OPERATOR).

CIRCUIT : 2.0 HP 460 VAC 3 PH 60 HZ

## NOTES

CURTAIN FINISH : GALV STEEL PAINTED GRAY
BACKER FINISH : GALV STEEL PAINTED GRAY
BOTTOM BAR FINISH : STEEL SHOP PRIMED BLACK
GUIDE FINISH : STEEL SHOP PRIMED BLACK
HOOD(S) FINISH : GALV STEEL PAINTED GRAY

OPTIONS ON THIS/THESE DOORS :
NEOPRENE BAFFLE INSIDE HOOD
37 PSF. DESIGN WINDLOAD
STANDARD 20,000 CYCLE BARREL

- Door to be Hot Dip galv. with Painted Finish
- Switch to be 3 button

Wayne Dalton — Rolling Door Division — Kinnear — North American

THERMOTITE DOOR MODEL : 821C

PROJECT : STENNIS MAINT. BLDG.

ARCH :

G.C. :

DISTR : PARTITIONS OF GULFPORT CORP.

DISTR P.O. NO. : PREPARED BY : DR DATE : 03/16/2009

| REVISION | ORDER NO. | DWG. NO. |
|---|---|---|
| | 766778 | 2 OF 2 |

**BROADMOOR, L.L.C.**

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

Robert [illegible] 4.29.09

DQC Manager Date

[illegible] 4/28/09

QC Officer Date

**DAMMON ENGINEERING INC**

Date: 4.28.09 Project: Stennis ROF

Reviewed: _____

Reviewed as Noted: X

Revise and Resubmit: _____

Rejected: _____

Other: _____

Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. This contractor is responsible for confirming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating his or her work with that of all other trades and performing all in a safe and satisfactory manner.

Submittal Item: Overhead Doors

Comments

SECTION 08 51 13

ALUMINUM WINDOWS
**01/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

| | |
|---|---|
| AA DAF-45 | (2003) Designation System for Aluminum Finishes |

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

| | |
|---|---|
| AAMA 101 | (2005) Standard Specification for Windows, Doors, and Unit Skylights |
| AAMA 611 | (1998) Voluntary Specification for Anodized Architectural Aluminum |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 1011/A 1011M | (2008) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability |
| ASTM A 36/A 36M | (2008) Standard Specification for Carbon Structural Steel |
| ASTM A 501 | (2007) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing |
| ASTM B 117 | (2007a) Standing Practice for Operating Salt Spray (Fog) Apparatus |
| ASTM B 221 | (2008) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes |
| ASTM B 244 | (1997; R 2002) Standard Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments |
| ASTM C 920 | (2008) Standard Specification for Elastomeric Joint Sealants |

| | |
|---|---|
| ASTM D 1972 | (1997; R 2005) Standard Practice for Generic Marking of Plastic Products |
| ASTM E 283 | (2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen |
| ASTM E 330 | (2002) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference |
| ASTM E 331 | (2000) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference |

GREEN SEAL (GS)

| | |
|---|---|
| GS-36 | (2000) Commercial Adhesives |

NATIONAL WOOD WINDOW AND DOOR ASSOCIATION (NWWDA)

| | |
|---|---|
| AAMA/NWWDA 101/I.S.2 | (1997) Voluntary Guide Specifications for Aluminum, Poly(Vinyl Chloride)(PVC) and Wood Windows and Glass Doors |

SCREEN MANUFACTURERS ASSOCIATION (SMA)

| | |
|---|---|
| SMA 1004 | (1987; R 1998) Aluminum Tubular Frame Screens for Windows |

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

| | |
|---|---|
| SCAQMD Rule 1168 | (1989; R 2005) Adhesive and Sealant Applications |

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

| | |
|---|---|
| SSPC Paint 101 | (1982) Paint Specification No. 101 Aluminum Alkyd Paint Leafing (Type I) and Non-Leafing (Type II) |
| SSPC Paint 12 | (1982; E 2000) Paint Specification No. 12 Cold-Applied Asphalt Mastic (Extra Thick Film) |

1.3 SUBMITTALS

1.2 [Enter Appropriate Subpart Title Here]

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Windows; G

SD-03 Product Data

Windows; G

Fasteners; G

Frames; G

Aluminum Sills; G

MULLIONS; G

Weatherstripping; G

Accessories; G

Windows

SD-04 Samples

Finish Sample

SD-05 Design Data

Structural calculations for deflection; G

Design Analysis; G

SD-06 Test Reports

Impact Resistance: G

Submit certification that glazed units of the types and sizes indicated passed ASTM E 1886 impact testing.

SD-10 Operation and Maintenance Data

Windows, Data Package 1; G

Submit as specified.

Plastic Identification

When not labeled, identify types in Operation and Maintenance Manual.

1.3 QUALITY ASSURANCE

1.4.1 Shop Drawing Requirements

Provide drawings that indicate elevations of windows, full-size sections, thickness and gages of metal, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, method of glazing, details of operating hardware, mullion details, method and materials for weatherstripping, material and method of attaching subframes, sills, trim, installation details, and other related items.

1.3.1 Sample Requirements

1.3.1.1 Finish Sample Requirements

Submit color chart of standard factory color coatings when factory-finish color coating is to be provided.

1.3.2 Design Data Requirements

Submit calculations to substantiate compliance with deflection requirements. A Professional Engineer must provide calculations.

Submit design analysis with calculations showing that the design of each different size and type of aluminum window unit and its anchorage to the structure meets the requirements of paragraph 1.9.1 "Minimum Antiterrorism Performance Criteria". Calculations verifying the structural performance of each window proposed for use, under the given loads, must be prepared and signed by a registered professional engineer. Reflect the window components and anchorage devices to the structure, as determined by the design analysis, in the shop drawings.

1.3.3 Test Report Requirements

Submit test reports for each type of window attesting that identical windows have been tested and meet the requirements specified herein.

1.4 DELIVERY AND STORAGE

Deliver windows to project site in an undamaged condition. Use care in handling and hoisting windows during transportation and at the jobsite. Store windows and components out of contact with the ground, under a weathertight covering, so as to prevent bending, warping, or otherwise damaging the windows. Repair damaged windows to an "as new" condition as approved. If windows can not be repaired, provide a new unit.

1.5 PROTECTION

Protect finished surfaces during shipping and handling using the manufacturer's standard method. Do not apply coatings or lacquers to surfaces to which calking and glazing compounds must adhere.

1.6 Plastic Identification

Verify that plastic products to be incorporated into the project are labeled in accordance with ASTM D 1972. Where products are not labeled, provide product data indicating polymeric information in the Operation and Maintenance Manual.

a. Type 1: Polyethylene Terephthalate (PET, PETE).

b. Type 2: High Density Polyethylene (HDPE).

c. Type 3: Vinyl (Polyvinyl Chloride or PVC).

d. Type 4: Low Density Polyethylene (LDPE).

e. Type 5: Polypropylene (PP).

f. Type 6: Polystyrene (PS).

g. Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

## 1.7 FIELD MEASUREMENTS

Take field measurements prior to preparation of the drawings and fabrication.

## 1.8 PERFORMANCE REQUIREMENTS

### 1.8.1 Minimum Antiterrorism Performance Criteria

Windows must meet the minimum antiterrorism performance criteria as specified in the paragraphs below.

#### 1.8.1.1 Aluminum Window Frames

Restrict aluminum framing members deflections of edges of glazing they support to L/160 under an equivalent 3-second duration loading of 43.3 pounds per square foot (psf), where L denotes the length of the glazing supported edge. (L is to be based on edge length of glazing in frame and not on the distance between anchors that fasten frame to the structure.)

The glazing frame bite for the window frames must be adequate to accept the width of structural silicone sealant or glazing tape as specified in paragraph "Provisions for Glazing" below.

#### 1.8.1.2 Window Frame Anchors

Fasten window frames to the supporting structure with anchors designed to resist forces generated by a 3-second duration load of 43.3 pounds per square foot (psf) acting on the entire window unit.

### 1.8.2 Wind Loading Design Pressure

Design window components, including mullions, hardware, and anchors, to withstand a wind-loading design pressure of at least 43.3 pounds per square foot (psf).

## 1.9 DRAWINGS

Submit the Fabrication Drawings for aluminum window units showing complete window assembly including weatherstripping, and subframe assembly details.

## 1.10 WINDOW PERFORMANCE

Aluminum windows must meet the following performance requirements. Perform testing requirements by an independent testing laboratory or agency.

### 1.10.1 Structural Performance

Structural test pressures on window units must be for positive load (inward) and negative load (outward) in accordance with ASTM E 330. After testing, there will be no glass breakage, permanent damage to fasteners. There must be no permanent deformation of any main frame, sash or ventilator member in excess of the requirements established for the window types and classification specified in this section.

1.10.2 Air Infiltration

Air infiltration must not exceed the amount established for each window type when tested in accordance with ASTM E 283.

1.10.3 Water Penetration

Water penetration must not exceed the amount established for each window type when tested in accordance with ASTM E 331. Minimum performance to be 8.0 psf.

1.10.4 Windborne Debris-Impact Resistance

Provide aluminum framed systems that pass large missile-impact tests and cyclic pressure tests for High Velocity Hurricane Zone requirements, per ICC IBC 2006. (Level D)

1.11 QUALIFICATION

Window manufacturer must specialize in designing and manufacturing the type of aluminum windows specified in this section, and have a minimum of 5 years of documented successful experience. Manufacturer must have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

1.12 WARRANTY

Provide Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 Window Materials

Window Frames and sash members, mullions, mullion covers, screen frames, and glazing beads must be extruded aluminum shapes fabricated from aluminum conforming to ASTM B 221 and SMA 1004, 6063-T5 aluminum alloy.

Joint-sealing compound must be a gun grade, nonsag, single-component butyl or acrylic sealant conforming to ASTM C 920.

2.1.1 Subframes

Where applicable, form subframe members from steel sheets conforming to ASTM A 1011/A 1011M, Grade 36, steel shapes conforming to ASTM A 36/A 36M, or steel tubing conforming to ASTM A 501.

2.1.2 Window Construction

Frames, sash, and head members must have a minimum thickness of 0.062 inch. Sills must have a minimum thickness of 0.093 inch, fabricated with an integral stiffening rib, and have weep holes not more than 2 feet on center.

Fabricate horizontal sash members, muntins, and meeting rails of extruded tubular-aluminum sections. Minimum depth of horizontal sash members and meeting rails must be 1-1/16 inches. Provide sash lift that is the full width of the window, extruded as an integral part of the sash.

Frames must have a minimum depth of 3 inches and will be provided with integral stiffening ribs, fins, drip at head, and weatherstripping grooves.

Mechanically join or weld frame and sash members to form rigid flush joints. Joints must not exceed manufacturer tolerances and will be sealed with factory-applied joint compound where required to provide a watertight joint.

2.1.3 Glazing Requirements

Design windows for field-applied glazing, using snap-on, screwless extruded-aluminum beads. Width of the stop bead must be as required for the glass thickness.

2.1.4 Materials

Frames, ventilators, mullions, mullion covers, glazing beads, and fittings must be extruded aluminum shapes fabricated from aluminum conforming to ASTM B 221, 6063-T5 alloy, AAMA/NWWDA 101/I.S.2. Aluminum sheet and plate will be 5005 alloy, temper as required.

Joint sealing compound must be a gun grade, nonsag, single-component butyl or acrylic sealant conforming to ASTM C 920 or silicone.

2.1.4.1 Steel Subframes

Where applicable, subframe members must be the size and weight indicated, formed from steel sheets conforming to ASTM A 1011/A 1011M, steel shapes conforming to ASTM A 36/A 36M, or steel tubing conforming to ASTM A 501. Coat members as specified under "Dissimilar Materials" herein.

2.1.4.2 Construction

Provide allowance for expansion between component parts for window assemblies.

Provide integral drip holes or weepholes or subsill flashing,for exterior in-sill sections at not more than 2 feet on center.

Use tubular sections in horizontal meeting rails longer than 48-7/8 inches.

Corner joints must be accurately fitted, flush, joints not exceeding manufacturer's tolerances. Apply joint-sealing compound to the unexposed surface of all mortise and tenon joints.

2.1.4.3 Glazing Provisions

Design windows for glazing, using snap-on, screwless, extruded or roll-formed aluminum, or AISI series-300 corrosion-resistant steel beads.

2.1.4.4 Aluminum Sills

Sills will be the profiles and dimensions indicated, the same alloy and finish as windows and furnished the full width of the window opening.

Securely anchor sills in place with concealed anchors not more than 18 inches on center.

2.1.5 Calking and Sealing

Are specified in Section 07 92 00 JOINT SEALANTS.

2.2 FABRICATION

Fabrication of window units must comply with manufacturer's instructions.

2.2.1 Provisions for Glazing

Design windows and rabbets suitable for glass thickness shown. For minimum antiterrorism windows, adhere glazing to its supporting frame using structural silicone sealant or adhesive glazing tape or previously tested method supported by test reports. The width of the structural silicone sealant bead must be at least equal to, but not larger than two times the thickness designation of the glass to which it adheres. The width of the adhesive glazing tape will be at least equal to two times, but not more than four times the thickness designation of the glass to which it adheres.

2.2.2 Fasteners

Use fasteners as standard with the window manufacturer for windows, trim, and accessories. Self-tapping sheet-metal screws are not acceptable for material more than 1/16 inch thick. Dril-Flex fasteners are acceptable.

2.2.3 Adhesives

Comply with applicable regulations regarding toxic and hazardous materials, GS-36, SCAQMD Rule 1168, and as specified in Section 07 92 00 JOINT SEALANTS.

2.2.4 Mullions and Transom Bars

Provide mullions between multiple window units which meet the design pressure of 43.3 psf. Secure mullions and transom bars to adjoining construction and window units in such a manner as to permit expansion and contraction and to form a weathertight joint.

2.2.5 Accessories

Provide windows complete with necessary hardware, fastenings, clips, fins, anchors, glazing beads, and other appurtenances necessary for complete installation and proper operation.

2.2.5.1 Fasteners

Provide concealed anchors of the type recommended by the window manufacturer for the specific type of construction. Anchors and fasteners must be compatible with the window and the adjoining construction.

2.2.5.2 Window Anchors

Anchoring devices for installing windows must be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel.

2.2.6 Finishes

Exposed aluminum surfaces must be factory finished with an anodic coating. Color must be as selected. All windows for each building will have the

same finish.

2.2.6.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF-45 and AAMA 611. Finish must be:

a. Architectural Class I ( 0.7 mil or thicker), designation AA-M10-C22-A42, integral color anodized.

## 2.3 MULLIONS - WHERE APPLICABLE

Provide mullions between multiple-window units where indicated.

Mullions and mullion covers must be the profile indicated, reinforced as required for the specified wind loading, and securely anchored to the adjoining construction. Mullion extrusion will include serrations or pockets to receive weatherstripping, sealant, or tape at the point of contact with each window flange.

Mullion assembly must include aluminum window clamps or brackets screwed or bolted to the mullion and the mullion cover.

Mullion cover must be screw-fastened to the mullion unless otherwise indicated.

Mullion reinforcing members must be steel or aluminum shapes provided by the window manufacturer to meet the specified design loading.

## 2.4 FINISH

Aluminum window, mullions, glazing beadings, trim, and accessory fittings must be thoroughly cleaned and will receive an Architectural Class I natural anodic coating (designation AA-M-12C22A41) in accordance with AA DAF-45. Anodic-coating thickness must be not less than 0.7 mil.

Test the thickness of the anodic coating in accordance with ASTM B 244.

Anodic coating must be continuous and, without being lacquered, will be capable of withstanding 500 hours of salt-spray exposure for Class A anodic coatings and 250 hours of salt-spray exposure for Class B anodic coatings when tested in accordance with ASTM B 117.

### 2.4.1 Color

Color must be selected from manufacturers standard colors.

# PART 3 EXECUTION

## 3.1 INSTALLATION

### 3.1.1 Method of Installation

Install in accordance with the window manufacturer's printed instructions and details. Build in windows as the work progresses or install without forcing into prepared window openings. Set windows at proper elevation, location, and reveal; plumb, square, level, and in alignment; and brace, strut, and stay properly to prevent distortion and misalignment. Protect ventilators and operating parts against accumulation of dirt and building

materials by keeping ventilators tightly closed and locked to frame. Bed screws or bolts in sill members, joints at mullions, contacts of windows with sills, built-in fins, and subframes in mastic sealant of a type recommended by the window manufacturer. Install and caulk windows in a manner that will deter entrance of water and wind.

3.1.2 Dissimilar Materials

Where aluminum surfaces are in contact with, or fastened to masonry, concrete, wood, or dissimilar metals, except stainless steel or zinc, protect the aluminum surface from dissimilar materials as recommended in the Appendix to AAMA 101. Do not coat surfaces in contact with sealants after installation with any type of protective material.

3.1.3 Anchors and Fastenings

Make provision for securing units to each other, to masonry, and to other adjoining construction.

3.2.1 Cleaning

Clean aluminum window finish and glass on exterior and interior sides in accordance with window manufacturer's recommendations. Do not use alkaline or abrasive agents. Take precautions to avoid scratching or marring window finish and glass surfaces.

3.2 DISSIMILAR MATERIALS

Aluminum must be kept from direct contact with steel or other dissimilar materials by painting, nonabsorptive tape, gasket, or other approved system as recommended by the manufacturer and as specified.

Give aluminum surfaces in contact with steel one coat of zinc-chromate primer applied to a dry-film thickness of not less than 1.5 mils, or one coat of a suitable nonhardening joint compound capable of excluding moisture from the joint during prolonged service.

Give steel surfaces in contact with aluminum one coat of zinc-chromate paint applied to a dry-coat thickness of 1.5 mils, and two or more coats of aluminum paint conforming to SSPC Paint 101, aluminum alkyd, Type II, applied to a dry-film thickness of 1.5 mils for each coat and a total dry-film thickness of 3.0 mils.

Corrosion-resistant, aluminized, or hot-dip galvanized steel placed in contact with aluminum need not be painted.

Give aluminum surfaces placed in contact with wood, concrete, or masonry construction one coat of bituminous paint conforming to SSPC Paint 12, applied to a thickness of at least 1/16 inch.

3.3 CLEANING

Clean interior and exterior surfaces of window units of mortar, plaster, paint spattering spots, and other foreign matter to present a neat appearance, to prevent fouling of weathering surfaces and weather-stripping, and to prevent interference with the operation of hardware. Replace all stained, discolored, or abraded windows that cannot be restored to their original condition with new windows.

-- End of Section --

# Aluminum Storefront - Kawneer IR501 Product Details

**BROADMOOR, L.L.C.**

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

Robert Wilson 5.12.09

DQC Manager Date

Matthew M Cable 5/12/09

QC Officer Date

**DAMMON ENGINEERING INC**

**Date:** 5.12.09 **Project:** Stennis ROF

**Reviewed:** X

**Reviewed as Noted:** _____

**Revise and Resubmit:** _____

**Rejected:** _____

**Other:** _____

Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. This contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his or her work with that at all other trades and performing all in a safe and satisfactory manner.

**Submittal Item:** Alum. Windows

Comments

APPLICABLE TO FIXED ALUMINUM STOREFRONT WINDOWS AND ENTRANCE FRAMING – RIVERINE



To be used at all typical window openings with exception of Window "C" at Bldg 2440 which will require "1600 Wall" Framing

KAWNEER IR 501 SYSTEM

## Features

2½" x 5" PROFILE DIM.

- IR 500/501 is 5" deep and has a 2-1/2" sightline (Expansion mullions have a 2-3/4" sightline)
- Screw Spline fabrication
- Center glazed
- Outside glazed with internal silicone seal
- IR 500 glazing options are 9/16", 5/8" and 1/4" (non-impact)
- IR 501 glazing options are 1-5/16" and 1" (non-impact)
- Permanodic® anodized finishes in 7 choices
- Painted finishes in standard and custom choices

## Optional Features

- Integrated entrance framing
- 350 IR Medium Stile - single or pairs of entrances
- IR 500 - shop or field glazed

## Product Applications

- Impact resistant
- Storefront, ribbom window or punched opening
- Low to mid-rise
- Single span

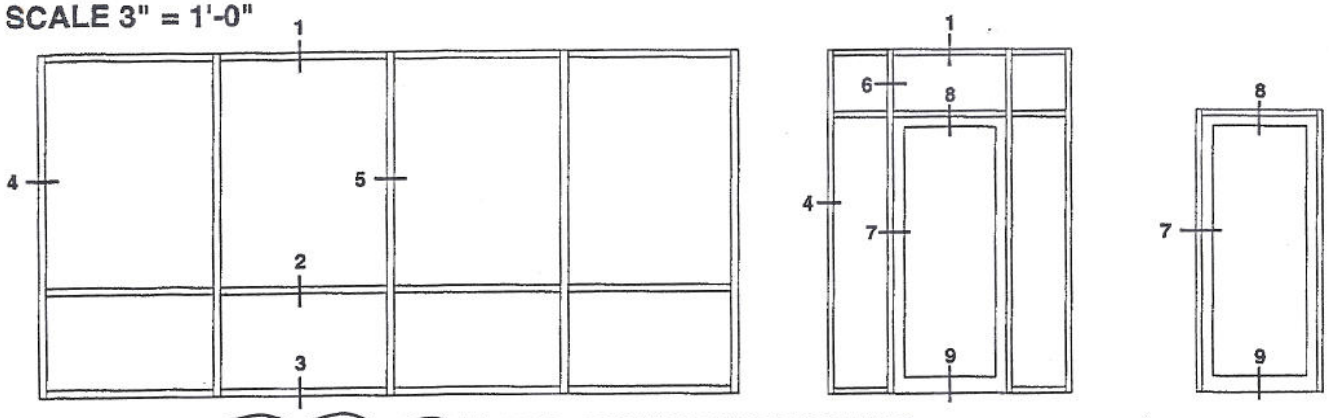
For specific product applications,
Consult your Kawneer representative.

Laws and building and safety codes governing the design and use of glazed entrance, window, and curtain wall products vary widely. Kawneer does not control the selection of product configurations, operating hardware, or glazing materials, and assumes no responsibility therefor.

Kawneer reserves the right to change configuration without prior notice when deemed necessary for product improvement.

© Kawneer Company, Inc., 2006

SCALE 3" = 1'-0"




ELEVATIONS ARE NUMBER KEYED TO DETAILS

APPLICABLE TO RIVERINE PROJECT

## 1-5/16" INFILL

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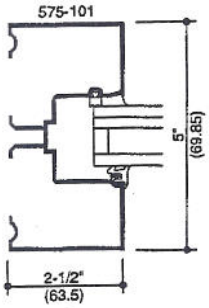


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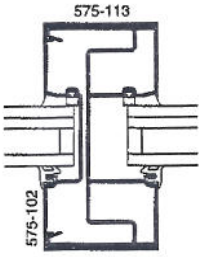
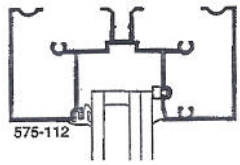
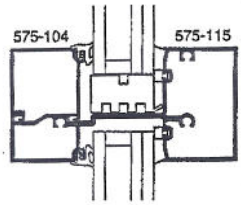


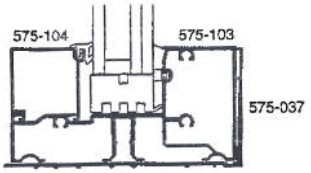

5 VERTICAL




1 HEAD




2 HORIZONTAL




3 SILL

## 1" INFILL (NON-IMPACT)

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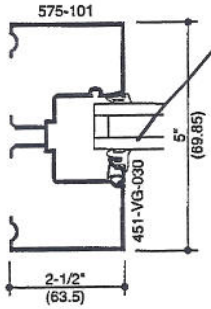
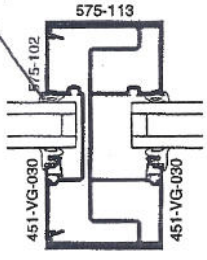
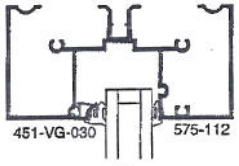


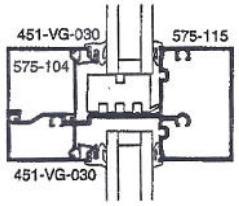

4 JAMB



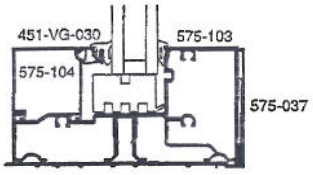

5 VERTICAL




1 HEAD




2 HORIZONTAL




3 SILL

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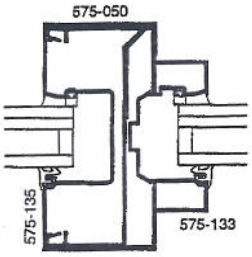
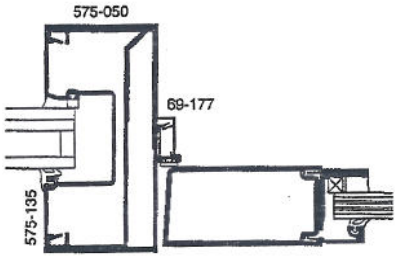
## SCALE 3" = 1'-0"

### 1-5/16" INFILL

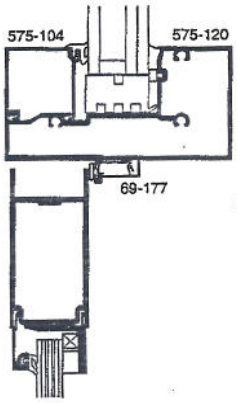
CAD DETAIL = IR501_1-516_pg02.dwg




6
DOOR JAMB AT TRAMSOM




7
DOOR JAMB

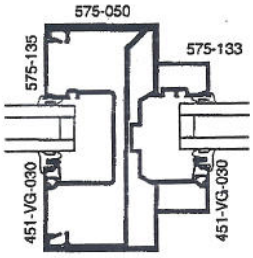



8
DOOR WITH TRANSOM

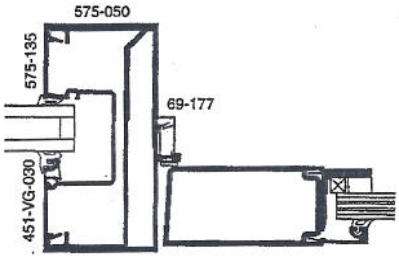
9
BOTTOM RAIL

### 1" INFILL (NON-IMPACT)

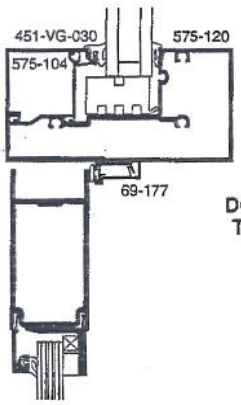
CAD DETAIL = IR501_1_pg02.dwg



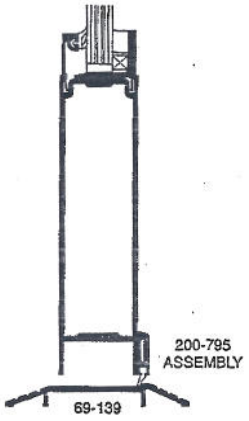

6
DOOR JAMB AT TRAMSOM




7
DOOR JAMB




8
DOOR WITH TRANSOM




9
BOTTOM RAIL

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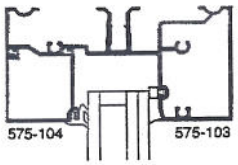
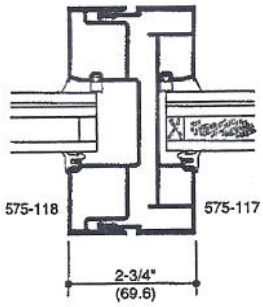
## SCALE 3" = 1'-0"

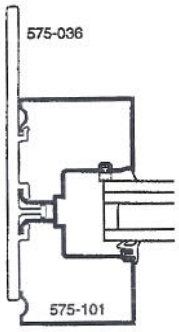
CAD DETAIL (1-5/16) = IR501_1-516_pg03.dwg
CAD DETAIL (1") = IR501_1_pg03.dwg

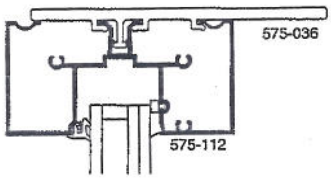



**OPTIONAL HEAD WITH STOP**




**EXPANSION MULLION**




**STRAP ANCHORS**

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Aluminum Storefront - Kawneer 1600 Wall Product Details (Window C - Bldg 2440)

**BROADMOOR, L.L.C.**

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

5.12.09

DQC Manager Date

5/12/09

QC Officer Date

**DAMMON ENGINEERING INC**

Date: 5.12.09 Project: Stennis ROF

Reviewed: X

Reviewed as Noted:

Revise and Resubmit:

Rejected:

Other:

Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. This contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction, coordinating his or her work with that of all other trades and performing all in a safe and satisfactory manner.

Submittal Item: Kawneer Vision C

Comments

APPLICABLE TO WINDOW TYPE "C" ON BLDG 2440 / RIVERINE



KAWNEER 1600 WALL SYSTEM

## Features

PROFILE DIMENSIONS
$2\frac{1}{2}$" x $7\frac{13}{16}$" @ RIVERINE PROJECT

- 1600 Wall System®1 is an outside glazed captured curtain wall
- 1600 Wall System®1 has a 2-1/2" (63.5) sight line
- Standard ~~6~~" (152.4) or 7~~4~~/2" (190.5) depth systems
- Infill options up to 1-1/8" (28.6)
- Concealed fastener joinery creates smooth, monolithic appearance
- Open-back horizontals and perimeters are available for cost savings
- Shear block fabrication method
- Corners and splayed mullions available
- Offers integrated entrance framing systems
- Silicone compatible glazing materials for long-lasting seals
- 1600 Wall System®1 has been small and large missile impact and cycle tested
- Two color option
- Permanodic® anodized finishes in 7 choices
- Painted finishes in standard and custom choices

## Optional Features

- Steel reinforcing available
- Rain screen and backpans
- Optional deep profile and bull nose covers available
- Deep and heavy-weight mullions available
- Veneer system available
- Integrates with standard Kawneer windows and concealed GLASSvent™
- Integrates with 1600 SUNSHADE™ and 1600 POWERSHADE®

## Product Applications

- Ideal for low to mid-rise applications where high performance is desired
- It also is the right choice for high span applications

For specific product applications,
Consult your Kawneer representative.

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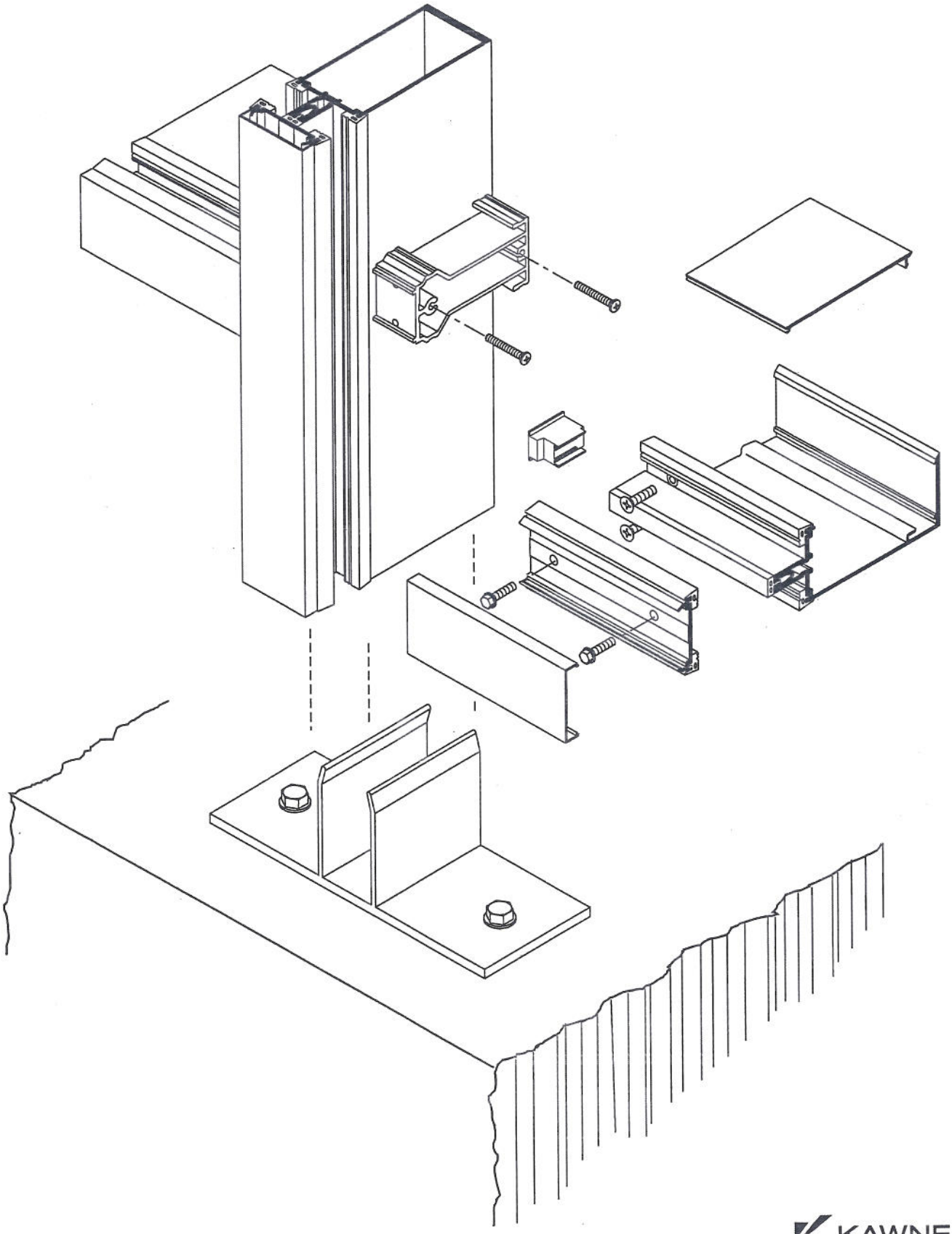
KAWNEER
AN ALCOA COMPANY

# 1600 WALL SYSTEM®1



## PICTORIAL VIEW



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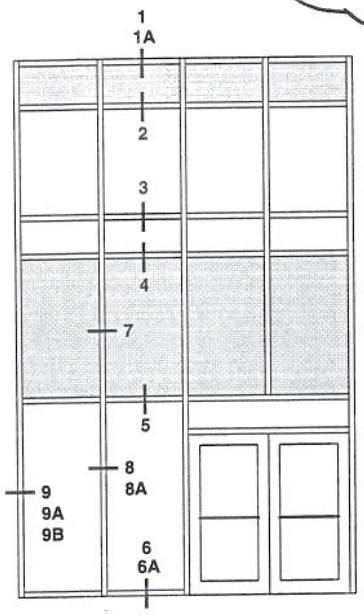
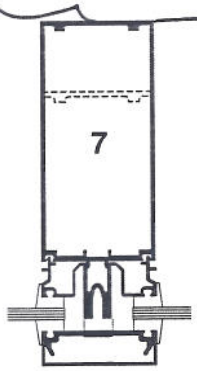
KAWNEER
AN ALCOA COMPANY

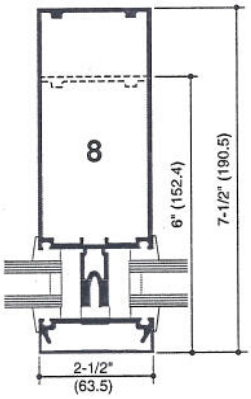
RIVERINE PROJECT WILL UTILIZE 1 5/16" INSULATED-LAMINATED GLASS INFILL IN LIEU OF 1" SHOWN

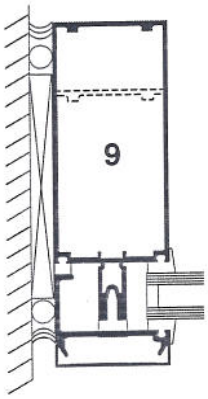
**SCALE 3" = 1'-0"**

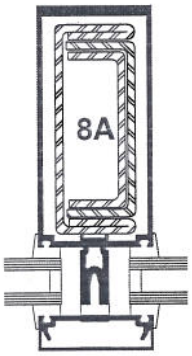



ELEVATION IS NUMBER KEYED TO DETAILS

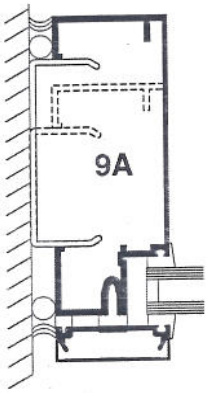


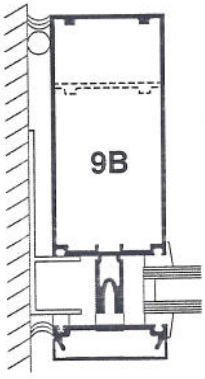



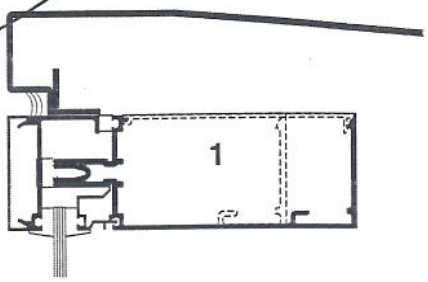



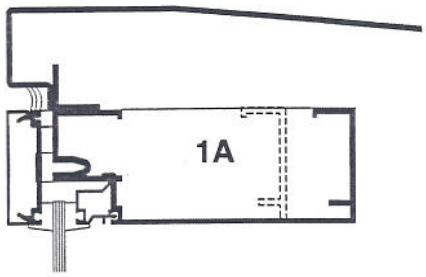



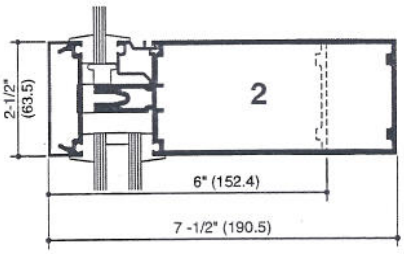

OPTIONAL STEEL REINFORCING AS REQUIRED

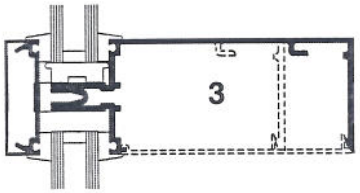


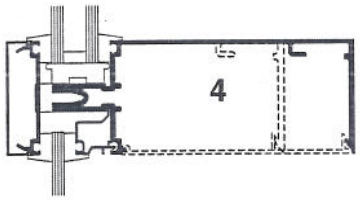



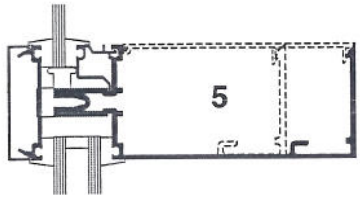



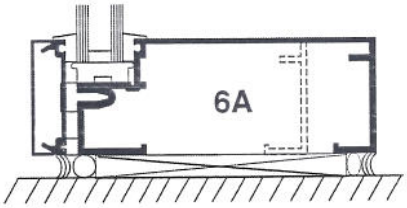



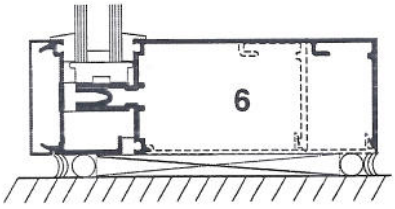

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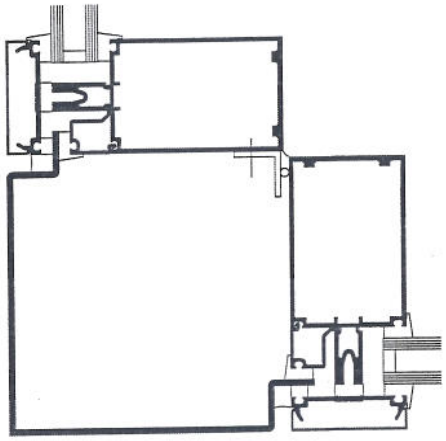
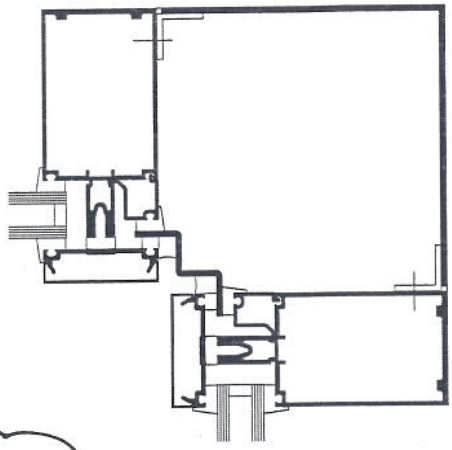
**SCALE 3" = 1'-0"**

NOTE: 1" SYSTEM SHOWN, 1/4" SYSTEM SIMILAR.

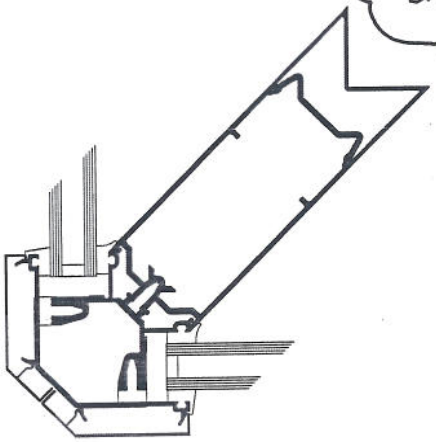


90° OUTSIDE CORNER

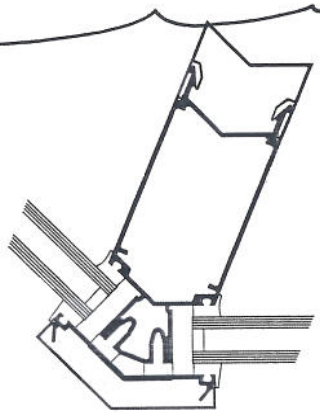


90° INSIDE CORNER

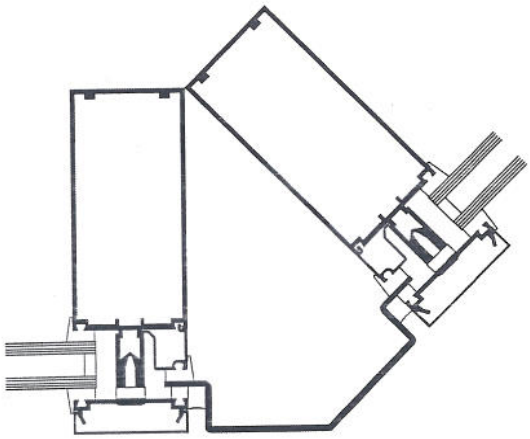
RIVERINE PROJECT LEAN-OUT WINDOW TYPE "C" ON BLDG 2440 WILL USE SIMILAR CORNER DETAIL



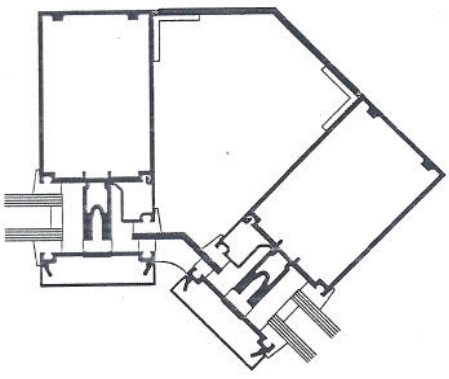
90° OUTSIDE CORNER



135° OUTSIDE CORNER



135° OUTSIDE CORNER



135° INSIDE CORNER

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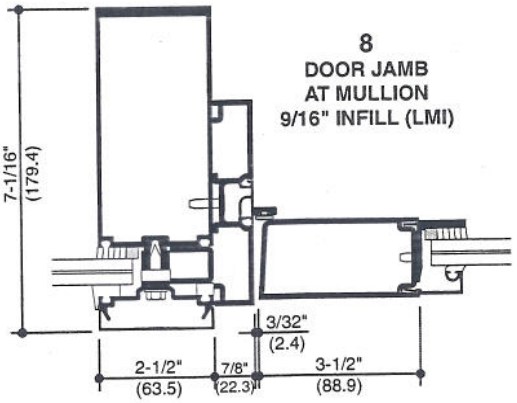
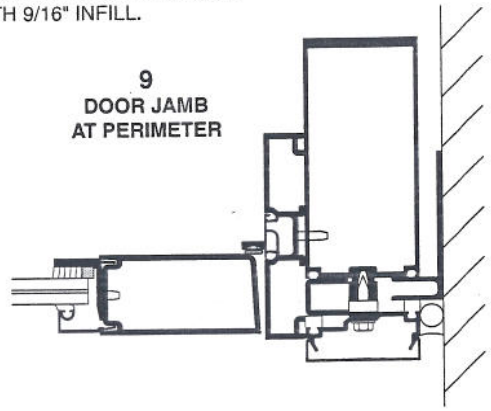
## SCALE 3" = 1'-0"

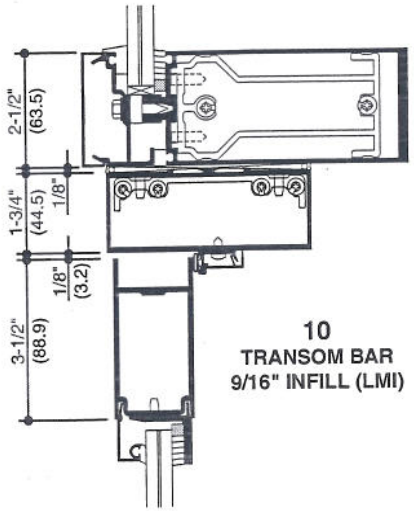
**NOTE:** 350 IR DOORS ARE USED WITH IMPACT FRAMING. DOORS ARE GLAZED WITH 9/16" INFILL.




**8**
**DOOR JAMB AT MULLION 9/16" INFILL (LMI)**

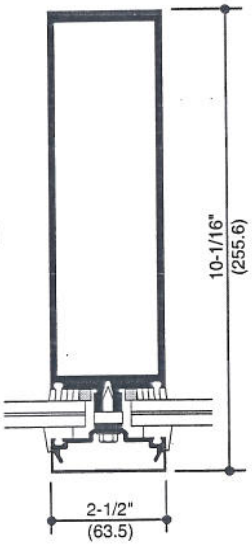


**9**
**DOOR JAMB AT PERIMETER**



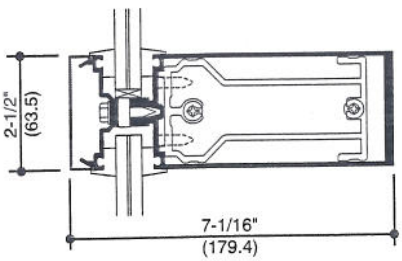

**10**
**TRANSOM BAR 9/16" INFILL (LMI)**

**OPTIONAL 10" DEEP SYSTEM 9/16" INFILL (LMI)**

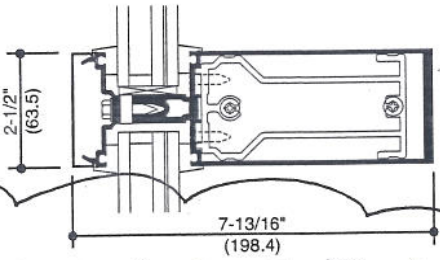



## GLAZING OPTIONS

**9/16" INFILL (SMI) SMALL MISSILE IMPACT**

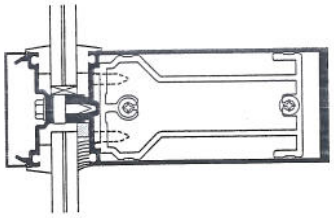



**1-5/16" INFILL (SMI) SMALL MISSILE IMPACT**

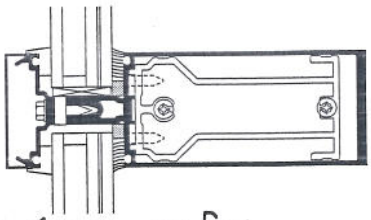



APPLICABLE TO RIVERINE PROJECT

**9/16" INFILL (SMI) OVER 9/16" INFILL (LMI)**



**1-5/16" INFILL (LMI) *LARGE MISSILE IMPACT**



Insulated-Laminated Glass Infill

KAWNEER
AN ALCOA COMPANY

Laws and building and safety codes governing the design and use of glazed entrance, window, and curtain wall products vary widely. Kawneer does not control the selection of product configurations, operating hardware, or glazing materials, and assumes no responsibility therefor.

Kawneer reserves the right to change configuration without prior notice when deemed necessary for product improvement.

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# Kawneer 1600 Wall UFC Performance Test Report

**BROADMOOR, L.L.C.**

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

5.12.09

DQC Manager Date

5/12/09

QC Officer Date

**DAMMON ENGINEERING INC**

Date: 5.12.09 Project: Stevens ROF

Reviewed: X

Reviewed as Noted:

Revise and Resubmit:

Rejected:

Other:

Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. This contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his or her work with that of all other trades and performing all in a safe and satisfactory manner.

Submittal Item: Kawneer Test Reports

Comments

BLAST TEST REPORT (UFC)

APPLICABLE TO WINDOW "C" BLDG 2440 – RIVERINE

1225
95438-63

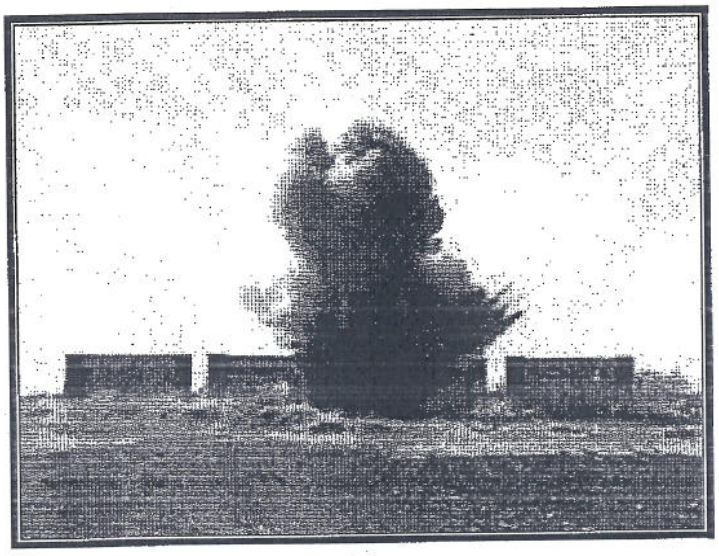
# Kawneer Company, Inc. - Blast Resistant Windows

**Test Report T049-0112-06**


**Hurricane Test Laboratory, LLC**
*Testing and Evaluation Solutions*
3417 73rd Street, Suite D
Lubbock, Texas 79423
www.htltest.com


## Full Scale Arena Blast Test per ASTM F 1642-04
## Kawneer Company, Inc., Norcross, Georgia

**Test Site:**
Hurricane Test Laboratory, LLC, Field Site
Lynn County, Texas
February 1, 2006



**Test Summary:**

**Hurricane Test Laboratories, LLC, conducted a single full scale arena blast test with three (3) identical test specimens of the 350HW Door with 1600 System 1 Framing with Project-Out Glassvent and three (3) identical test specimens of the 8325TL Fixed over Project-Out Window for Kawneer Company, Inc. The test specimens were manufactured, fabricated and installed per Kawneer Company's drawings TUD162-100B (Sheets 1-16). Each test specimen underwent the specified test pressure 6 psi peak air blast pressure and 42 psi-ms positive phase impulse.**

*Testing & Evaluation Solutions*

www.htltest.com

March 08, 2006

Attn: Mr. Donnie Hunter
Kawneer Company
555 Guthridge Ct.
Technology Park/Atlanta
Norcross, Georgia 30092

Subject: Full Scale Area Blast Test on Feb 1, 2006

Dear Mr. Donnie Hunter:

I have attached the independent test report for the full scale arena blast test we performed on the "350HW Door with 1600 System 1 Framing with Project-Out Glassvent" storefront and the "8325TL Fixed over Project-Out Windows." We performed this test per the specifications set forth by ASTM F1642-04.

Hurricane Test Laboratory performed this test using 300 pounds of ANFO with a standoff distance of 125 feet. This charge produced a peak air blast pressure and positive phase impulse above the required pressure of 6 psi and 42 psi-msec respectively.

Please feel free to contact me if you have any questions or require further assistance.

Sincerely,

Steven R. Samuels
Operations Manager
Hurricane Test Laboratory, LLC

Hurricane Test Laboratory, LLC
3417 73rd Street, Suite D
Lubbock, Texas 79423
806-797-2208

# Kawneer Company, Inc. - Blast Resistant Windows

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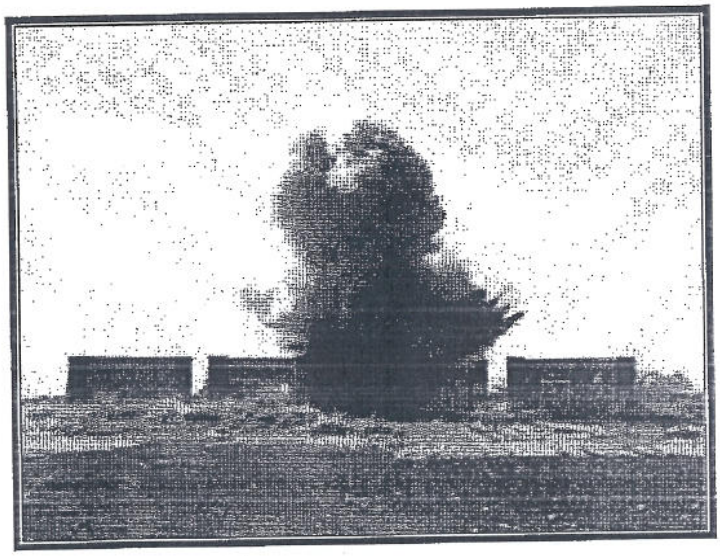

**Test Summary:**
**Hurricane Test Laboratories, LLC, conducted a single full scale arena blast test with three (3) identical test specimens of the 350HW Door with 1600 System 1 Framing with Project-Out Glassvent and three (3) identical test specimens of the 8325TL Fixed over Project-Out Window for Kawneer Company, Inc. The test specimens were manufactured, fabricated and installed per Kawneer Company's drawings TUD162-100B (Sheets 1-16). Each test specimen underwent the specified test pressure 6 psi peak air blast pressure and 42 psi-ms positive phase impulse.**

## PREFACE

Hurricane Test Laboratory, LLC (HTL) conducted a single full scale arena blast test for Kawneer Company, Inc. in Norcross, Georgia on February 01, 2006, at the HTL remote blast site located in Lynn County, Texas. HTL evaluated three (3) identical "350HW Door with 1600 System 1 Framing with Project-Out Glassvent" and three (3) identical "8325TL Fixed over Project-Out Windows" to evaluate the hazard rating per ASTM F 1642-04: Glazing and Glazing Systems Subject to Airblast Loadings (ASTM F1642-04). This report documents the test results for the specified windows.

HTL provided the blast reaction chambers, test planning, data acquisition system, test execution, and report documentation. Mr. Steven R. Samuels acted as the test director for HTL and Mr. Vinu Abraham, also from HTL, witnessed the test. Kawneer Company designed, manufactured, and installed their test specimen at an offsite location and shipped the preassembled windows to HTL's test site. Mr. Donnie Hunter served as the product manager and as a witness for Kawneer Company.

## ABSTRACT

Kawneer Company in Norcross, Georgia commissioned HTL to perform a single full scale arena blast test with three (3) identical storefront systems and three (3) identical window specimens in accordance with ASTM F 1642-04. Kawneer Company designed, manufactured, and preassembled their single span test specimens offsite per Kawneer Company's drawings TUD162-100B (Sheets 1-16), provided in Appendix A, and shipped the completed systems to our remote test facility in Lynn County, Texas. HTL installed their preassembled window buck into the HTL blast reaction chambers. HTL instrumented the blast reaction chambers with pressure transducers to record the reflected air blast pressure acting on the windows and a free field pressure transducer to measure the incident air blast pressure. The test charge size consisted of 300 lbs (136 kg) of Ammonium Nitrate Fuel Oil (ANFO) at a standoff distance of 124 ft (37.8 m). This created a peak overpressures within ten (10) percent of 6 psi (41.37 kPa) and a positive phase impulse of 42 psi-ms (289.7 kPa-ms) acting on the reflecting surface.

Two (2) of Kawneer Company's "350HW Door with 1600 System 1 Framing with Project-Out Glassvent" provided protection consistent with a "***Low Hazard***" in accordance with ASTM F 1642-04. Some glass fragments flew into the opening with a sum total united dimension of greater than 10 in. (25 cm) for each specimen. One (1) of Kawneer Company's "350HW Door with 1600 System 1 Framing with Project-Out Glassvent" provided protection consistent with a "***High Hazard***" in accordance with ASTM F 1642-04. It should be noted Kawneer Company mistakenly installed one of the glass lites inside-out. If this was prevented, HTL strongly feels the third wall system would have also provided protection consistent with a "***Low Hazard***" rating per ASTM F1642-04. In all three (3) storefront systems the glazing fractured with no tears in the glazing interlayer and HTL observed zero length of pull out from the glass pocket.

Kawneer Company also tested their "8325TL Fixed over Project-Out Window." This window provided protection consistent with a "***Minimal Hazard***" per ASTM F1642-04. The glazing fractured with no tears in the glazing interlayer and HTL observed zero length pullout from the glass pocket. There were zero perforations caused by glazing slivers and zero fragment indents anywhere in the vertical witness panel.

## BACKGROUND

Accidental and intentional explosions have heightened the need for blast resistance glazing. Glass shards historically cause many injuries as a result of air blast pressure loadings. Eliminating or reducing flying or falling glass shards greatly reduces or eliminates glass related injuries during an airblast pressure event.

### American Standard for Testing and Materials (ASTM F 1642-04)

ASTM published a standard test method titled "F 1642-04: Glazing and Glazing Systems Subject to Airblast Loadings" (ASTM F 1642-04) that provides a protocol for conducting and assessing blast tests on glazing. This test method provides a means to evaluate the hazards of glazing or glazing systems subject to airblast loadings. Table 1 provides a summary of the different hazard ratings specified in ASTM F 1642-04, and Figure 1 provides a graphical presentation of the hazard ratings.

**Table 1: Summary of the ASTM F1642-04: Glazing and Glazing Systems Subject to Airblast Loadings Hazard Rating for Glazings under Full Scale Blast Loading.**

| Hazard Rating | Description | Fragments | |
|---|---|---|---|
| | | 1 m to 3m | Witness Panel |
| No Break | The glazing is allowed to break and there is no visible damage to the framing system. | None | None |
| No Hazard | The glazing fractures but is fully retained in the facility test frame or glazing system frame and the rear surface is unbroken | None | None |
| Minimal Hazard | Glazing fractures and the total length of tears in the glazing plus the total length of pullout from the edge of the frame is less than 20% of the glazing sight perimeter. | < 10" unified dimension | 3 or less perforations from glazing slivers and no fragment indents. |
| Very Low Hazard | Glazing fractures and is located within 1 meter of the original location | < 10" unified dimension | 3 or less perforations from glazing slivers and no fragment indents. |
| Low Hazard | Glazing Fractures | Glazing fragments generally fall between 1 meter and 3 meters. | <10 perforations 50 cm below the bottom of the specimen and none of the perforations penetrate through the full thickness of the witness panel |
| High Hazard | Glazing Fractures | 1 meter and 3 meters. | > 10 perforations in the area of the witness panel and one or more fragments penetrate fully through the witness panel |

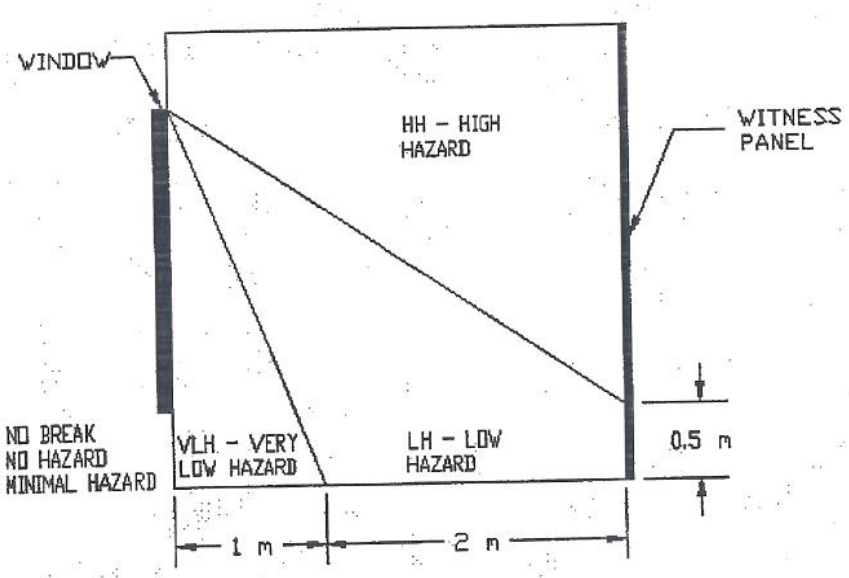


**Figure 1: Cross-Section through Witness Area per ASTM F1642-04: Glazing and Glazing Systems Subject to Airblast Loadings.**

## US General Service Administration (GSA)

US General Service Administration published a standard titled "US General Service Administration Standard Test Method for Glazing and Window Systems Subject to Dynamic Overpressure Loading" (GSA) that provides a protocol for conducting and assessing blast tests on glazing. This test method provides a means to evaluate the hazards of glazing or glazing systems subject to airblast loadings. Table 2 provides a summary of the different hazard ratings specified in GSA and Figure 2 provides a graphical presentation of the hazard ratings.

**Table 2: GSA Performance Condition for Window System Response**

| Performance Condition | Protection Level | Hazard Level | Description of Window Glazing Response |
|---|---|---|---|
| 1 | Safe | None | Glazing does not break. No visible damage to glazing or frame. |
| 2 | Very High | None | Glazing cracks but is retained by the frame. Dusting or very small fragments near sill or on the floor acceptable. |
| 3a | High | Very Low | Glazing cracks. Fragments enter space and land on floor no further than 3.3 ft from the window. |
| 3b | Medium | Medium | Glazing cracks. Fragments enter space and land on floor no further than 10 ft from the window. |
| 4 | Low | High | Glazing cracks. Fragments enter space and land on floor and impact a vertical witness panel at a distance of no more than 10 ft. from the window at a height no greater than 2 ft. above the floor. |
| 5 | Low | High | Glazing cracks and window system fails catastrophically. Fragments enter space impacting a vertical witness panel at a distance of no more than 10 ft. from the window at a height greater than 2 ft above the floor |

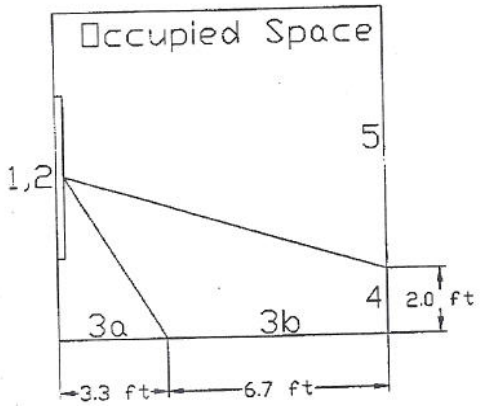


**Figure 2: Cross-Section through Occupied Space per US General Service Administration Standard Test Method for Glazing and Window Systems Subject to Dynamic Overpressure Loading**

## Unified Facilities Criteria (UFC)

The Unified Facilities Criteria (UFC): *DoD Minimum Antiterrorism Standards for Building* published a document to "minimize the likelihood of mass casualties from terrorist attacks." This document describes levels of protection for building occupants. These protection levels are described in Table 3.

**Table 3: Levels of Protection per UFC 4-010-01 – New and Existing Buildings**

| Level of Protection | Potential Structural Damage | Potential Door and Glazing Hazard | Potential Injury |
|---|---|---|---|
| Below AT standards | Severely damaged. Frame collapse/massive destruction. Little left standing | Doors and windows fail and result in lethal hazard | Majority of personnel suffer fatalities. |
| Very Low | Heavily damaged-onset of structural collapse: Major deformation of primary and secondary structural members, but progressive collapse is unlikely. Collapse of non-structural elements. | Glazing will break and is likely to be propelled into the building, resulting in serious glazing fragment injuries, but fragments will be reduced. Doors may be propelled into rooms, presenting serious hazards. | Majority of personnel suffer serious injuries. There are likely to be a limited number (10% to 25%) of fatalities. |
| Low | Damaged – unrepairable. Major deformations of non-structural elements and secondary structural members and minor deformation of primary structural members, but progressive collapse is unlikely. | Glazing will break, but fall within 1 meter of the wall or otherwise not present a significant fragment hazard. Doors may fail, but they will rebound out and their frames, presenting minimal hazards. | Majority of personnel suffer significant injuries. There may be a few (<10%) fatalities. |
| Medium | Damaged – repairable. Minor deformations of non-structural elements and secondary structural members and no permanent deformations in primary structural members. | Glazing will break, but will remain in the window frame. Doors will stay in frames, but will not be reusable. | Some minor injuries, but fatalities are unlikely. |
| High | Superficially damaged. No permanent deformation of primary and secondary structural members or non-structural elements. | Glazing will not break. Doors will be reusable. | Only superficial injuries are likely. |

## Test Site

The HTL remote blast site, located in Lynn County, Texas, and 40 miles south of Lubbock, Texas, creates an ideal location for blast testing. Located amidst cotton fields, this site offers an area with flat terrain secluded from any houses or populated areas. This minimizes any possible problems that may arise with the public's concern with noise and general concerns of an explosion. Although secluded, the blast site offers electrical power which runs critical systems for blast testing.

## Blast Reaction Chambers

HTL's blast reaction chambers construction consist of wide flange steel beams, steel tubes, and a 3/16" steel skin which encloses the blast reaction chambers as shown in Figure 3. HTL also placed 48" wide wing walls on the blast reaction chamber to reduce clearing effects on the reflecting surface as shown in Figure 3. The overall dimensions of the blast reaction chambers are twenty-eight (28) feet wide, including the wing wall, twelve (12) feet tall, and ten (10) feet deep. This depth encloses the blast reaction chambers to facilitate the housing of witness panels, structural members, and prevents air blast pressures from wrapping around the test specimen.

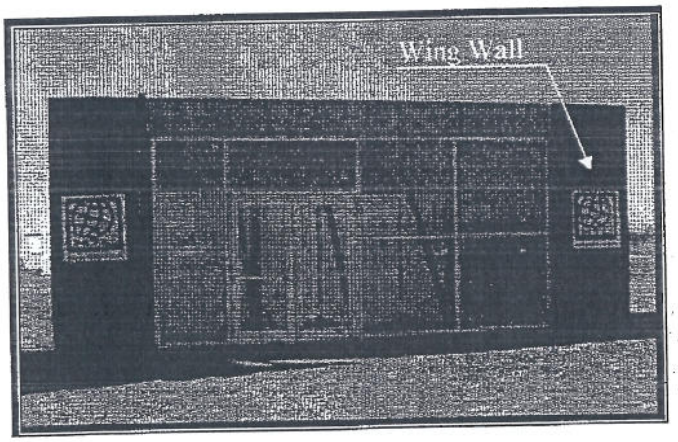


Figure 3: Blast Reaction Chamber

**Test Specimens**

HTL tested two glazing systems under a single air blast loading; the Kawneer "350HW Door with 1600 System 1 Framing with Project-Out Glassvent" (Figure 4), and the "8325TL Fixed over Project-Out Window" (Figure 5). Figure 4 shows a label schematic of the storefront test specimen. This label schematic is used as a reference for this report.

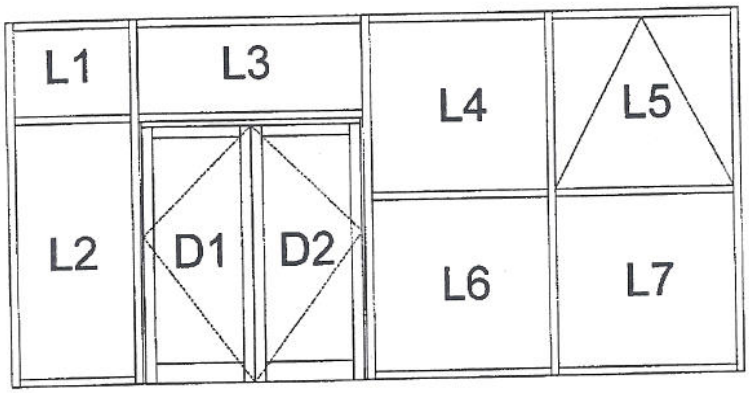


**Figure 4: "350HW Door with 1600 System 1 Framing with Project-Out Glassvent" Wall System Label Schematic**

Lites L2, L6, L7 and doors D1, D2 in the "350HW Door with 1600 System 1 Framing with Project-Out Glassvent" consisted of insulating units with an inboard lite constructed of two (2) 3.0 mm (1/8 in) laminated annealed plies with a 2.29 mm (0.090 in) Solutia Saflex interlayer, and the outboard lite consisted of a 6.0 mm (1/4 in) fully tempered lite sealing a 12.7 mm (0.5 in) airspace. Lites L1, L3, L4, and L5 consisted of insulating units with the inboard lite constructed with two (2) 3.0 mm (1/8 in) laminated annealed plies with a 0.090 in (2.29 mm) Solutia Saflex interlayer and an outboard lite of 6.0 mm (1/4 in) annealed sealing a 0.5 in (12.7 mm) airspace. Kawneer company wet glazed each lite with Tremco Proglaze SSG. A detailed set of drawings for the glazing and framing is provided in Appendix A.

Lite L5 served as an operable vent. Doors D1, and D2 served as functional doors at the time of the full scale arena blast test. Appendix A provides a detailed set of drawings of the door hardware and construction.

Kawneer Company also tested three (3) identical specimens of their "8325TL Fixed over Project-Out Window" in a single blast reaction chamber. Each window comprised of two lites, both insulating units. The inboard lite construction consisted of a laminated lite with two (1/8 in) annealed plies with a (0.060 in) Solutia Safelex interlayer and an outboard lite comprised of a 3.0 mm (1/4 in) annealed ply sealing a 1/2 in (12.7 mm) air space. Kawneer Company wet glazed each lite with Tremco Trimsil 600 for the weather seals and perimeter sills and all structure sealant consisted of Tremco Proglaze SSG. A detailed set of drawings for the glazing and framing is provided in Appendix A.

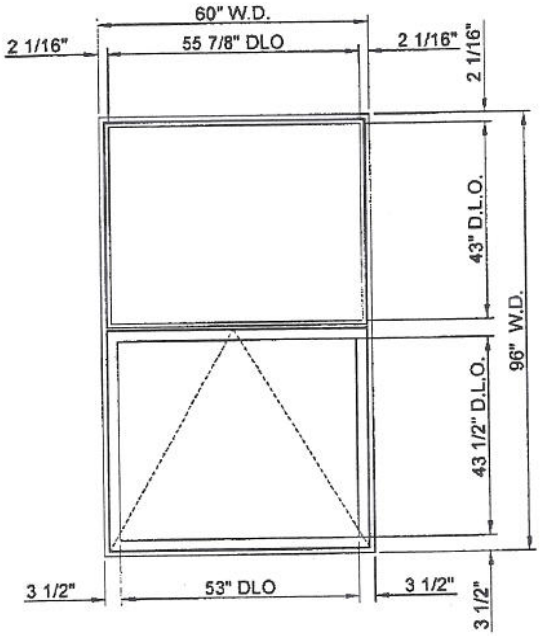


Figure 5: 8325TL Fixed over Project-Out Window

**Witness Panels**

HTL installed witness panels 121.5" from the interior face of the test specimen. Each panel consisted of two layers of material. The outer layer consisted of one-half (1/2) in. (12.7 mm) thick rigid foam plastic thermal insulation board composed of polyisocyanurate foam bonded to a durable white-matte non-glare aluminum facer and a reflective reinforced aluminum facer with a density of two (2) pounds per cubic foot.

The inside layer consisted of 1" extruded polystyrene insulation with a density of 1.8 pounds per cubic foot.

**Data Acquisition System**

HTL used a high speed data acquisition system with twelve (12) PCB reflected pressure transducers and one (1) PCB free-field pressure transducer. HTL mounted the reflected pressure transducers on the blast reaction chamber to determine the peak air blast pressure and positive phase impulse acting on the test specimen. The data acquisition system recorded seventy-five thousand (75,000) samples per second during the air blast pressure event.

HTL mounted reflected pressure transducers on each of the blast reaction chambers. For blast reaction chamber 1 through 3, HTL mounted two reflected pressure transducer on the wing wall located six (6) feet from the ground and thirty-four (34) inches from the outside of the wing wall. Also on these chambers, HTL mounted one (1) reflected pressure transducer on the midpoint twenty (20) inches from the top of the blast reaction chamber. For blast reaction chamber 4, HTL mounted two (2) pressure transducers at the midpoint between the middle and side windows and one (1) pressure transducer at the midpoint twenty-five (25) inches from the top of the blast reaction chamber.

**Weather Conditions**

On February 1, 2006, the test site's weather was clear and warm. No precipitation had fallen on the test date. HTL measured the ambient air temperature as 64°F (18°C) and the average temperature of the glazing as 43°F (6°C) less than five (5) minutes prior to the blast test.

**Chamber Location**

HTL utilized all four of their blast reaction chambers. Each chamber was placed tangent to a one hundred twenty-four (124) foot arc providing the required standoff distance for this specific test. Test Chamber 1, 2, and 3 (Figure 6) enclosed the "350HW Door with 1600 System 1 Framing with Project-Out Glassvent." Test Chamber 4

enclosed three (3) identical test specimens of the "8325TL Fixed over Project-Out Window." Figure 6 shows and labels the orientation of each blast reaction chamber.

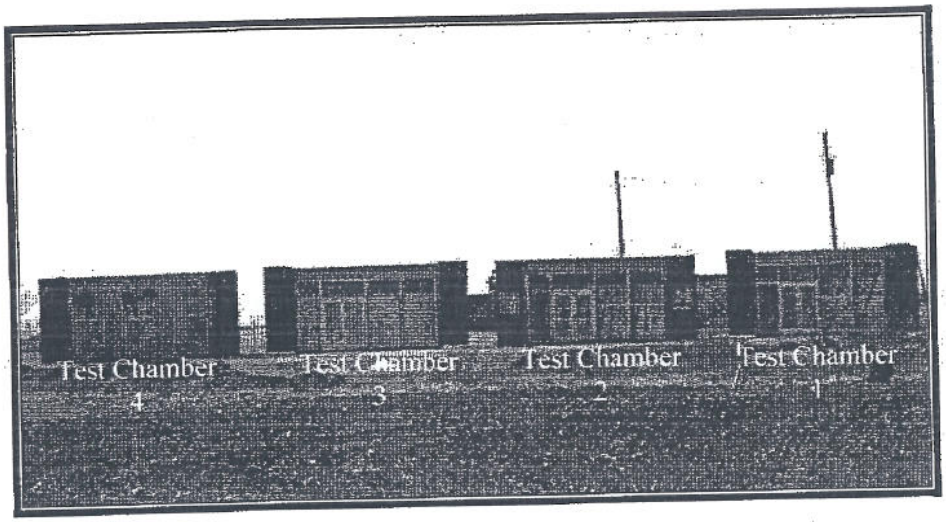


Figure 6: Blast Reaction Chamber Location

## TEST RESULTS AND MAJOR FINDINGS

HTL performed a full scale arena blast test for Kawneer Company on February 1, 2006. This section presents the test results and major findings from the full scale arena blast test.

### Peak Air Blast Pressure

HTL used a data acquisition system to record the pressure time history for each chamber in the blast. HTL then used this data to determine the peak air blast pressure. The data system recorded consistent peak air blast pressures on the reflecting surface. Theoretically, the peak air blast pressure acts equally over the reflecting surface at the time air blast event. Figure 7 shows the pressure time history for the full scale arena blast test.

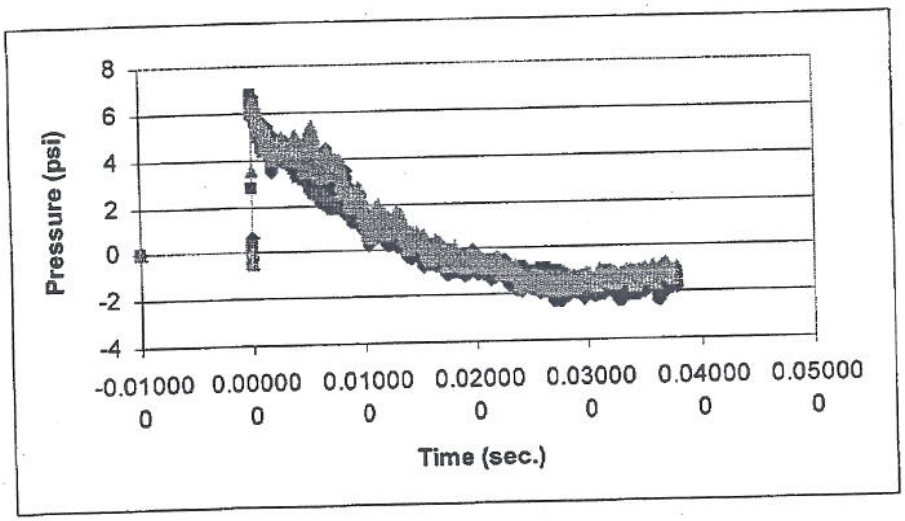


Figure 7: Airblast Pressure vs. Time Raw Data

**Positive Phase Impulse**

The positive phase impulse varies over the reflecting surface due to clearing effects. Higher pressures on the reflecting surface move toward the lower air pressure surrounding the blast reaction chamber causing a rarefaction wave on this surface. This creates lower impulses towards the edge of the reflecting surface and higher impulses towards the middle of the reflecting surface. HTL mounted two (2) pressure transducers on the wing walls and one (1) pressure transducer above the specimen in the centerline. These locations read the same peak positive phase air blast pressure but lower positive phase impulses due to their location. The positive phase impulse measured on the pressure transducers is slightly lower than what actually occurred on the test specimen.

**Blast Reaction Chamber 1**

Blast reaction chamber 1 housed a single storefront specimen of Kawneer, Company's "350HW Door with 1600 System 1 Framing with Project-Out Glassvent." This specimen underwent a peak overpressure of 6.62 psi (45.7 kpa) and a positive phase impulse of approximately 41.0 psi-ms (282.8 kpa-ms). Blast Reaction Chamber 1 is pictured in Figure 8 prior to the arena test and Figure 9 shows the test specimen post blast testing.

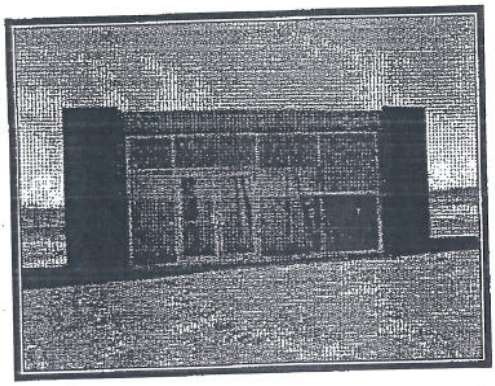

**Figure 8: Blast Reaction Chamber 1, Pre-Blast Test**

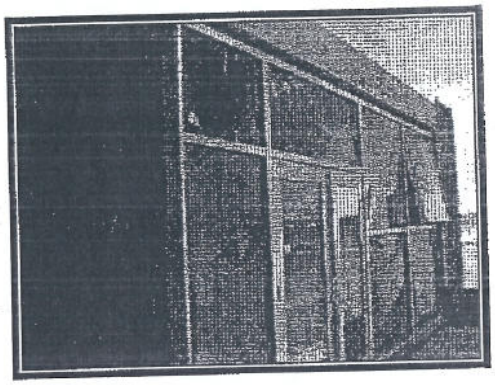

**Figure 9: Blast Reaction Chamber 1, Post-Blast Test**

The specimen placed in blast reaction chamber 1 received a "***High Hazard***" rating per ASTM F1642-04, a "***Performance Condition 5***" per GSA, and a "***Very Low Level of Protection***" per UFC 4-010-01. Kawneer Company mistakenly glazed lite L4 inside-out thus placing the sacrificial lite, i.e. 1/4" (6.0 mm) annealed, toward the inside of the building. This caused glass shards from this lite to enter the occupied as shown in Figure 10. Kawneer Company glazed identical lites for L1, L3, L4, and L5. These identical lites performed similarly for all storefront specimens except the incorrect glazed lite L4 projected glass shards into the occupied space instead of outside the occupied space. This leads HTL to believe correct installation of Lite L4 in the storefront specimen placed in Blast Reaction Chamber 1 would have produced a "***Low Hazard***" per ASTM F1642-04 and a "***Performance Condition 3b***" per GSA since glass fragments would have been projected away from the occupied space. All other lites in this system behaved similarly to the other two (2) storefronts systems placed in the blast reaction chambers two (2) and three (3). Table 4 summarizes the "350HW Door with 1600 System 1 Framing with Project-Out Glassvent" individual lite sizes and the fractured lites in the system. The storefront system glazing fractured with no tears in the glazing interlayer and no pull out from the glass pocket. Also, the doors and operable vent rebounded outward from the frames but remained attached to the frame.

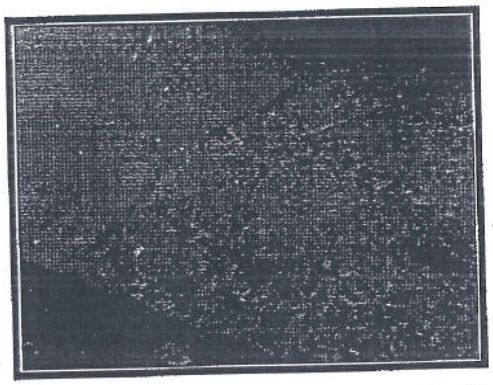

**Figure 10: Glass Fragments from Incorrectly Glazed Lite.**

**Table 4: Storefront System Installed in Blast Reaction Chamber 1, Dimension and Fracture Summary**

| Label | Dimensions | | Inboard Fractured? | Outboard Fractured? | Length of Tear Out |
|---|---|---|---|---|---|
| | Width* | Height* | | | |
| | in. (mm) | in. (mm) | | | in. (mm) |
| L1 | 37.5 (952.5) | 28.4 (720.7 ) | No | Yes | None |
| L2 | 28.4 (720.7 ) | 82.6 (2098.7) | Yes | Yes | None |
| L3 | 73.5 (1866.9) | 28.4 (720.7 ) | Yes | Yes | None |
| L4* | 57.5 (1460.5) | 55.5 (1409.7) | Yes | Yes | None |
| L5 | 57.5 (1460.5) | 55.5 (1409.7) | Yes | Yes | None |
| L6 | 57.5 (1460.5) | 55.5 (1409.7) | Yes | Yes | None |
| L7 | 57.5 (1460.5) | 55.5 (1409.7) | Yes | Yes | None |
| D1 | 28.8 (732.6) | 73.2 (1859.0) | Yes | No | None |
| D2 | 28.8 (732.6) | 73.2 (1859.0) | Yes | No | None |

*Lite was installed backwards, i.e. laminated lite was installed as outboard lite.
*All dimensions are DLO.

**Blast Reaction Chamber 2**

Blast reaction chamber 2 housed a single specimen of Kawneer, Company's "350HW Door with 1600 System 1 Framing with Project-Out Glassvent". This specimen underwent a peak overpressure of 6.70 psi (46.2 kpa) and a positive phase impulse of 40.0 psi-ms (275.8 kpa-ms). Figure 11 shows the pre-test specimen and Figure 12 shows the post-test specimen.

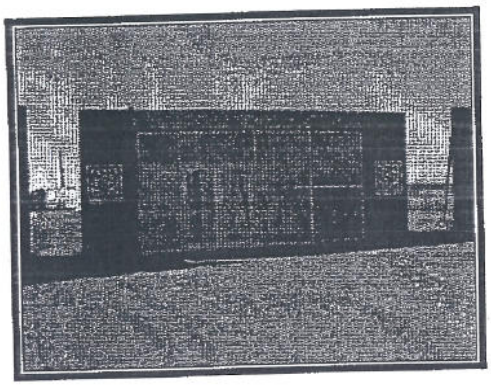

Figure 11: Blast Reaction Chamber 2, Pre-Blast Test and Post-Blast Test

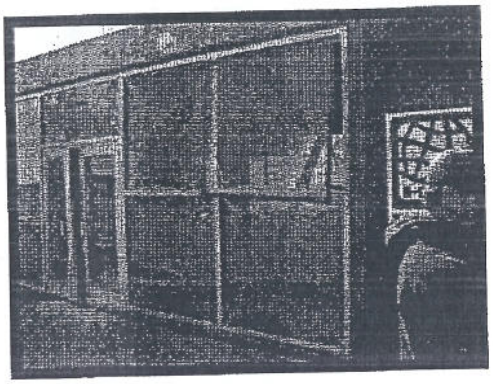

Figure 12: Blast Reaction Chamber 2, Pre-Blast Test and Post-Blast Test

The storefront system placed in Blast Reaction Chamber 2 received a "***Low Hazard***" rating per ASTM F1642-04, a "***Performance Condition 3b***" per GSA, and far exceeded a "***Low Level of Protection***" per UFC 4-010-01. HTL collected fragments with a sum total united dimension greater than 10 in. (25 cm) on the floor between 40 in. (1 m) and 120 in. (3 m). There were zero perforations or fragment indents found in the witness panels. The storefront system glazing fractured with no tears in the glazing interlayer and HTL observed zero pull out from the glass pocket. The doors and operable vent rebounded outward from the frames but remained attached to the frame. Table 5 provides a summary of each individual lite in the storefront system.

**Table 5: Storefront System Installed in Blast Reaction Chamber 2, Dimension and Fracture Summary**

| Label | Dimensions | | Inboard Fractured? | Outboard Fractured? | Length of Tear Out in. (mm) |
|---|---|---|---|---|---|
| | Width* in. (mm) | Height* in. (mm) | | | |
| L1 | 37.5 (952.5) | 28.4 (720.7 ) | No | No | None |
| L2 | 28.4 (720.7 ) | 82.6 (2098.7) | Yes | No | None |
| L3 | 73.5 (1866.9) | 28.4 (720.7 ) | Yes | Yes | None |
| L4 | 57.5 (1460.5) | 55.5 (1409.7) | Yes | Yes | None |
| L5 | 57.5 (1460.5) | 55.5 (1409.7) | Yes | Yes | None |
| L6 | 57.5 (1460.5) | 55.5 (1409.7) | Yes | No | None |
| L7 | 57.5 (1460.5) | 55.5 (1409.7) | Yes | Yes | None |
| D1 | 28.8 (732.6) | 73.2 (1859.0) | Yes | Yes | None |
| D2 | 28.8 (732.6) | 73.2 (1859.0) | Yes | Yes | None |

*All dimensions are DLO.

**Blast Reaction Chamber 3**

Blast reaction chamber 3 housed a single storefront system of Kawneer Company's "350HW Door with 1600 System 1 Framing with Project-Out Glassvent". This specimen underwent a peak overpressure of 6.62 psi (45.7 kpa) and a positive phase impulse of 38.4 psi-ms (264.8 kpa-ms). Figure 13 shows the pre-test specimen and Figure 14 shows the post test specimen.

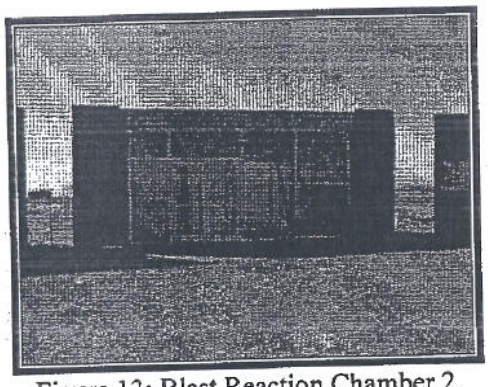

Figure 13: Blast Reaction Chamber 2, Pre-Blast Test

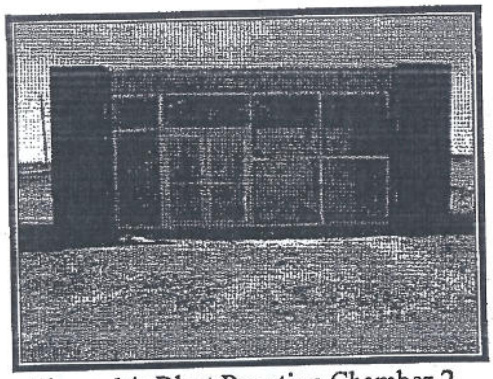

Figure 14: Blast Reaction Chamber 2, Post-Blast Test

The specimen placed in blast reaction chamber 3 received a "***Low Hazard***" rating per ASTM F1642-04, a "***Performance Condition 3b***" per GSA, and far exceeded a "***Low Level of Protection***" per UFC 4-010-01. HTL collected fragments with a sum total united dimension greater than 10 in. (25 cm) on the floor between 40 in. (1 m) and 120 in. (3 m). There were zero perforations or fragment indents found in the witness panels. The storefront system glazing fractured with no tears in the glazing interlayer and no pull out from the glass pocket. The doors and operable vent rebounded outward from the frames but remained attached to the frame. Table 6 provides a summary of each individual lite in the storefront system.

**Table 6: Storefront System Installed in Blast Reaction Chamber 3: Dimension and Fracture Summary**

| Label | Dimensions | | Inboard Fractured? | Outboard Fractured? | Length of Tear Out |
|---|---|---|---|---|---|
| | Width* | Height* | | | |
| | in. (mm) | in. (mm) | | | in. (mm) |
| L1 | 37.5 (952.5) | 28.4 (720.7 ) | Yes | No | None |
| L2 | 28.4 (720.7 ) | 82.6 (2098.7) | Yes | No | None |
| L3 | 73.5 (1866.9) | 28.4 (720.7 ) | Yes | Yes | None |
| L4 | 57.5 (1460.5) | 55.5 (1409.7) | No | No | None |
| L5 | 57.5 (1460.5) | 55.5 (1409.7) | Yes | Yes | None |
| L6 | 57.5 (1460.5) | 55.5 (1409.7) | Yes | Yes | None |
| L7 | 57.5 (1460.5) | 55.5 (1409.7) | Yes | Yes | None |
| D1 | 28.8 (732.6) | 73.2 (1859.0) | Yes | Yes | None |
| D2 | 28.8 (732.6) | 73.2 (1859.0) | Yes | Yes | None |

*All dimensions are DLO.

**Blast Reaction Chamber 4**

Blast reaction chamber 4 housed three (3) identical specimens of Kawneer Company's "8325TL Fixed over Project-Out Windows." These specimens underwent a peak overpressure of 6.63 psi (45.7 kpa) and a positive phase impulse of 38.7 psi-ms (266.9 kpa-ms). Figure 15 shows the window prior to blast testing and Figure 16 shows the Kawneer Company's specimens after the blast test.

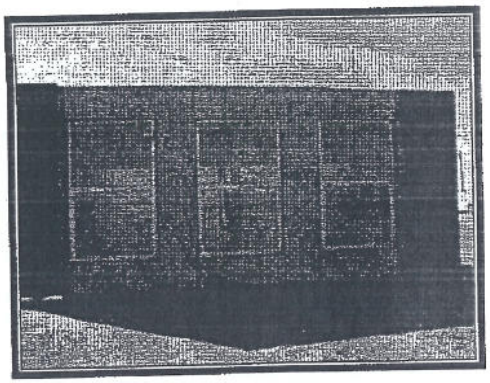

Figure 15: Blast Reaction Chamber 4, Pre-Blast Test

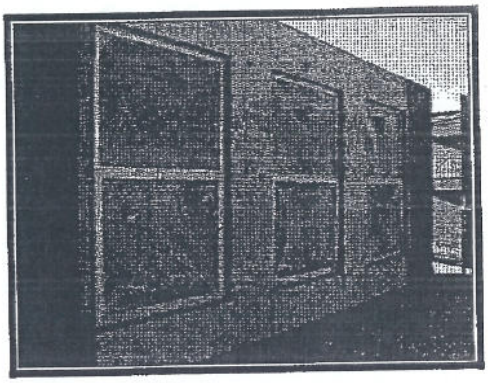

Figure 16: Blast Reaction Chamber 4, Pre-Blast Test

The specimen placed in blast reaction chamber 4 received a "***Minimal Hazard***" rating per ASTM F1642-04 a "***Performance Condition 2***" per GSA, and a "***Medium Level of Protection***" per UFC 4-010-01. HTL collected zero fragments on the floor behind each specimen. Each lite fractured under blast loading but only produced glazing dust on the floor. There were zero perforations or fragment indents found in the witness panels. The window system glazing fractured with no tears in the glazing interlayer and HTL observed zero pull out from the glass pocket.

## SUMMARY

The main objective of blast resistant glazing is to reduce or eliminate glass related injuries from an air blast pressure loading. In order to accomplish this objective, the glazing and frame must perform to its specifications. Kawneer, Company's "350HW Door with 1600 System 1 Framing with Project-Out Glassvent" performed well under air blast pressure loading. Incorrect installation of the lite L4 in the storefront system installed in Blast Reaction Chamber 1 created a "***High Hazard***" rating. HTL believes correct installation would have produced a "***Low Hazard***" rating, the same as the other two (2) identical storefront systems for this blast test.

Kawneer Company's "8325TL Fixed over Project-Out Windows" performed very well under air blast pressure loading. All the lites fractured but only produced glass dust and glazing slivers. Each lite's interlayer remained untorn and remained fully retained in the glass pocket.

ASTM F1642 is in the process of "loosing" their standard in regards to the sum total dimension of fragments. HTL believes under the new standard, the "350HW Door with 1600 System 1 Framing with Project-Out Glassvent" would receive a higher rating than under the ASTM F1642-04. At that time, HTL feels the hazard rating for the storefront system needs reevaluation after the release of the new ASTM F1642 standard.

**Table 3: Summary of Test Results**

| | |
|---|---|
| Date: | February 1, 2006 |
| Location: | Lynn County, Texas |
| Ambient Temperature: | 64°F (18°C) |
| Specimen Temperature: | 43°F (6°C) |
| Weather: | Clear |
| Charge Type: | Ammonium Nitrate Fuel Oil |
| Charge Weight: | 300 lbs (136 kg) |
| Standoff Distance: | 124 feet (37.8 m) |
| Peak Air Blast Pressure: | 6.62 psi (45.7 kPa) |
| Measured Positive Phase Impulse: | Chamber 1: 41 psi-ms (282.8 kPa-ms)<br>Chamber 2: 40 psi-ms (275.8 kPa-ms)<br>Chamber 3: 38.4 psi-ms (275.8 kPa-ms)<br>Chamber 4: 38.7 psi-ms (268.9 kPa-ms) |

# APPENDIX B

# AIR BLAST PRESSURE-TIME HISTORIES

Air blast pressure time histories have not been included in the document per the request of Kawneer Company. To obtain this information, please submit a written statement requesting this information and proof of permission from Kawneer Company to Hurricane Test Laboratory, LLC. Hurricane Test Laboratory, LLC will then provide a copy of this information to the requesting party.

# Kawneer IR501 & 350IR UFC Performance Test Report

**BROADMOOR, L.L.C.**

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

Robert White 5.12.09

DQC Manager Date

Timothy M Cull 5/12/09

QC Officer Date

**DAMMON ENGINEERING INC**

Date: 5.12.09 Project: Stennis ROF

Reviewed: X

Reviewed as Noted:

Revise and Resubmit:

Rejected:

Other:

Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. This contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his or her work with that at all other trades and performing all in a safe and satisfactory manner.

Submittal Item: Kawneer Test Report

Comments

BLAST TEST REPORT (UFC 4-010-02) — RIVERINE
ALUMINUM ENTRANCE, FRAME & WINDOW PRODUCTS

1463
95438-76

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Lubbock, Texas 79404
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Kawneer Company, Inc.
350IR Door in an IR501 Frame
Test Report #: T049-1201-07-IR501

## 1.0 MANUFACTURER'S IDENTIFICATION

| | | |
|---|---|---|
| 1.1 | Name of Applicant: | Kawneer Company, Inc.<br>555 Guthridge Court<br>Norcross, GA 30092<br>Voice: 770.449.5555<br>Fax: 770.734.1560 |
| 1.2 | Contact Person: | Donnie Hunter |

## 2.0 SCOPE OF WORK

Kawneer Company, Inc. retained HTL, LLC to conduct a full scale arena blast test per the requirements of ASTM F1642 and GSA-TS01-2003 on their 350IR Door in an IR501 Frame. HTL tested three (3) alike mock-ups exceeding the required minimum peak positive pressure of 5.8 psi and positive phase impulse of 41 psi-msec.

## 3.0 TESTING INFORMATION

| | | |
|---|---|---|
| 3.1 | Location: | Lynn County, Texas |
| 3.2 | Test Date: | June 24th, 2008 |
| 3.3 | Test Time: | 2:55 P.M. CST |
| 3.4 | Ambient Temperature: | 93.0 °F |
| 3.5 | Relative Humidity | 24% |
| 3.6 | Weather Conditions | Clear |

## 4.0 EXPLOSIVE CHARGE

| | | |
|---|---|---|
| 4.1 | Charge Type: | Dyno Nobel Unimax® |
| 4.2 | Charge Weight: | 420 lbs |
| 4.3 | Standoff Distance | 143 feet. |

## 5.0 TEST SETUP

5.1 Data Acquisition System
HTL used a high speed data acquisition system with a system record time of one-hundred thousand (100,000) samples per second.

5.2 Reflected Pressure Transducers
HTL used seven (7) pressure transducers to measure the blast pressure time histories acting on the surface of the 350IR Door in an IR501 Frame.

5.3 Internal Pressure Transducers
HTL used one (1) pressure transducers to measure the internal blast pressure time history in each of the three (3) blast reaction chamber. These sensors were installed parallel to charge.

ENGINEER OF RECORD
Steven R. Samuels
9/15/08
Steven R. Samuels, P.E.
TX Reg. #101259
9/15/2008

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Lubbock, Texas 79404
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5.4 Free Field Pressure Transducers
HTL used two (2) free field pressure transducers to measure the free field air blast pressure time history. HTL placed these transducers at a distance greater than twenty-five (25) feet from any blast reaction chamber with a standoff distance of 143 ft.

5.5 Witness Panels
HTL used witness panels defined in ASTM F1642-04 Section 8.7.5. These witness panels also qualify for GSA-TS01-2003 Section 6.4.1. The witness panel makeup consisted of two layers of material. The outer layer consisted of one-half (1/2) inch thick rigid foam plastic thermal insulation board composed of polyisocyanurate foam bonded to a durable white-matte non-glare aluminum facer and a reflective reinforced aluminum facer with a density of two (2) pounds per cubic foot. The inside layer consisted of one (1) inch extruded polystyrene insulation with a density of 1.8 pounds per cubic foot.

## 6.0 PRODUCT IDENTIFICATION

| | | |
|---|---|---|
| 6.1 | Product Type: | Storefront |
| 6.2 | Model Designation: | 350IR Door in a IR501 Frame |
| 6.3 | Overall Size: | 239 1/4" (w) x 119-5/8" (h) |
| 6.4 | Drawing: | This test report is incomplete if not accompanied by Kawneer Company, Inc.'s drawing labeled "TUD575001B" (Sheets 1 through 8) bearing the digital stamp of Hurricane Test Laboratory, LLC with an original signature located in Appendix E. |
| 6.5 | Sample Source: | Kawneer Company, Inc. |

## 7.0 PRODUCT DESCRIPTION

7.1 Frame Construction
The framing members were fabricated using the aluminum extrusions defined in Table 7.1.

Table 7.1: Aluminum Extrusion Details

| Description | Part # | Overall Cross-Section | Alloy |
|---|---|---|---|
| Door Jamb with Fin | 575-051 | 2.500" x 5.000" x 0.125" | 6063-T6 |
| HW Mullion | 575-101 | 2.500" x 5.000" x 0.172" | |
| Pocket Filler | 575-102 | 0.855" x 4.656" x 0.090" | |
| Standard Head/Sill | 575-103 | 2.500" x 4.952" x 0.090" | |
| Glass Stop | 575-104 | 1.523" x 1.628" x 0.075" | |
| Tubular Horizontal | 575-115 | 2.500" x 4.952" x 0.090" | |
| HW Mullion | 575-116 | 2.500" x 5.000" x 0.172" | |
| Pocket Insert | 575-133 | 1.748" x 3.320" x 0.090" | |
| Deep Pocket Filler | 575-135 | 1.575" x 4.656" x 0.090" | |
| HP Sill Flashing | 575-157 | 1.500" x 5.188" x 0.090" | |
| HP Sill | 575-158 | 2.500" x 4.952" x 0.090" | |
| HP Sill Cover | 575-159 | 1.438" x 1.492" x 0.063" | |
| IR500/501 C.O.C. Transom Bar | 575-059 | 2.500" x 4.952" x 0.090" | |
| IR501 Transom Bar Stop – Exterior | 575-160 | 0.843" x 1.650" x 0.070" | |
| IR501 Transom Bar Stop – Interior | 575-161 | 1.588" x 1.650" x 0.090" | |
| SAM II Door Stop | 041-045 | 1.062" x 2.000" x 0.062" | |
| S/A Transom Bar Clip | 450-103 | 1.250" x 4.150" x 0.125" | |

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7.1.1 Typical Frame Corner Construction
At each frame corner, the verticals ran through while the horizontal members were square cut, butted, and mechanically fastened to the verticals using #12 x 1" PHTF "AB" 300 series stainless steel screws.

7.1.2 Mullion Assembly
The mullions consisted of a single extrusion (Part# 575-116) and the pocket filler (Part# 575-102) snap fit into HW mullion extrusion.

7.1.3 Door Mullion Assembly
The door mullion consisted of a single extrusion (Part# 575-051) and the deep pocket filler (Part# 575-135) snap fit into the door jamb with fin extrusion.

7.1.4 Door Transom Jamb Assembly
The door mullion consisted of a single extrusion (Part# 575-051) with the deep pocket filler (Part# 575-135) and the pocket insert (Part# 575-133) snap fit into the door jamb with fin extrusion with the fin removed.

7.1.5 Head Assembly
The head consisted of a single extrusion (Part# 575-103) and the glass stop (Part# 575-104) snap fit into the head extrusion.

7.1.6 Sill Assembly
The sill consisted of a single extrusion (Part# 575-158) that was mechanically fastened to the HP sill flashing (Part#575-157) using #12 x 7/16" PHTFS 400 series SS screws. The glass stop (Part# 575-104) and HP sill cover (Part# 575-159) were then snap fit into the HP sill extrusion.

7.1.7 Horizontal Assembly
The horizontal consisted of a single extrusion (Part# 575-115) and the glass stop (Part# 575-104) snap fit into the tubular horizontal extrusion.

7.1.8 Door Header Assembly
The head consisted of a single extrusion (Part# 575-059) that was mechanically fastened to the interior transom bar stop (Part# 575-161) using #10 x 1/2" FHTFS 300 series SS screws, the S/A transom bar clip (Part# 450-103) using 1/4-20 self drilling Grade 2 steel screws, and the SAM II door stop using #10 x 1-5/8" FHTF "B" 300 series SS screws. The exterior transom bar stop (Part# 575-160) snap fit into the C.O.C. transom bar.

7.1.9 Door Header Corner Construction
At each side of the door header, the verticals ran through while the horizontals members were square cut, butted, and mechanically fastened to the verticals using four (4) #10 x 1-19/32" PHTF 430 series SS screws and two(2) #12 x 1" PHTF "AB" 300 series SS screws.

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7.1.10 Intermediate Mullion Reinforcement
Each interior mullion was reinforced with two (2) pieces of 1/2" x 1/2" x 8' A36 steel angle. The steel bar was attached to the mullion using two (2) #12 x 5/8" "B" fasteners on each side. The fasteners were located 4" from the top and bottom of the steel.

7.1.11 Interior Door Mullion and Transom Reinforcement
The interior door mullion and the door transom was reinforced with 1.096" x 4.494" x 0.134" Grade 50 steel. The steel was attached to the mullion and transom using two (2) #12 x 5/8" "B" fasteners on each side. The fasteners were located 4" from the top and bottom of the steel.

7.2 Door Construction
The framing members were fabricated using the aluminum extrusions defined in Table 7.2.

Table 7.2: Aluminum Extrusion Details

| Description | Part # | Overall Cross-Section | Alloy |
|---|---|---|---|
| Door Stile | 200-005 | 3.500" x 1.750" x 0.125" | 6063-T6 |
| Active Door Meeting Stile | 200-006 | 3.500" x 1.750" x 0.125" | |
| Inactive Door Meeting Stile | 200-007 | 3.562" x 1.750" x 0.125" | |
| Door Top Rail | 200-023 | 3.500" x 1.724" x 0.125" | |
| Door Bottom Rail | 200-032 | 6.500" x 1.724" x 0.125" | |
| Door Cross Rail | 200-058 | 3.000" x 1.724" x 0.125" | |
| Exterior Door Glass Stop | 575-043 | 1.356" x 0.351" x 0.070" | |
| Interior Door Glass Stop | 575-045 | 1.354" x 1.359" x 0.188" | |
| Threshold | 069-139 | 0.500" x 4.000" x 0.125" | |
| S/A T-Bar/Header w/ Weathering | 450-502 | 1.750" x 4.452" x 0.125" | |
| Door Jamb Anchor Block | 575-297 | 0.497" x 1.646" x 8.000" | |

7.2.1 Typical Door Frame Corner Construction
Frame members were all square cut. The vertical jambs ran through while the horizontal members were square cut, butted and mechanically fastened to each vertical. The IR 501 horizontal members have internal extruded screw splines and were attached to the jambs with (3) # 12 x 1" SS PHTFS at each connection. The door jamb consisted of a tubular open back section with an extruded fin (part # 575-051). At each bottom corner, the vertical jamb ran through while the threshold was square cut, butted and mechanically fastened to each vertical jamb using one (1), jamb pivot assembly (Part #035-523 LH and 035-524 RH). Each pivot assembly was secured to the vertical jamb using three (3), #12-24" x 5/8" FHMS (part #028-350). The threshold (Part #069-139) was then placed over the pivot assembly and secured to the pivot assembly using two (2), #12-24 X 3/8" FHMS (Part # 028-845). In addition the threshold was secured directly to the opening as described in the installation section of this test report.

7.2.2 Door Panel Cross Rail Corner Construction
At each cross rail, the cross rail end is square cut, butted, and attached to the vertical stile and welded in place using one (1) ¼" x 1-1/8" filet weld that are applied to both webs of the cross rail.

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7.2.3 Exterior Glass Stop
Each exterior glass stop (Part #575-043) is cut to the desired length and snap-fit to the adjacent door panel member. No sealant required.

7.2.4 Interior Fixed & Removable Glass Stop
Each interior glass stop (Part #575-045) is cut to the desired length and attached to the adjacent door panel member using a single row of #10 x 1/2" FHTFS (Part # 128-910). At the top and bottom rail four (4) fasteners, spaced 3" away from each end and two (2) equally spaced in between. At the vertical stiles nine (9) fasteners, spaced 3" away from each end and seven (7) equally spaced in between.

7.2.5 Miscellaneous Construction
A continuous aluminum sweep is applied along the bottom edge of each door panel (Part #200-795). Each sweep is secured to the bottom rail of the door panel using six (6), #6 x 3/4" PHTFS. A continuous adjustable astragal (Part #200-496) is applied to the lock stile of the active door panel using a single row of #6 x 11/16" FHSMS (part # 128-439) spaced 3.984, (4) at 9.562, 10.750, (4) at 8.750" on center thereafter. One flat spring was included at each fastener location.

7.3 Glazing Details

7.3.1 Glazing Materials

7.3.1.1 Type 1
This glazing consisted of an annealed glass lite with an overall thickness of 9/16" (nominal) constructed using the following components.
- 1/4" Annealed (Outboard)
- 0.090" Solutia Saflex® PVB Inner Layer
- 1/4" Annealed (Inboard)

7.3.1.2 Type 3
This glazing consisted of an annealed glass lite with an overall thickness of 1-5/16" (nominal) constructed using the following components.
- 1/4" Annealed (Outboard)
- 1/2" Air Space
- 1/4" Annealed
- 0.060" Solutia Saflex® PVB Inner Layer
- 1/4" Annealed (Inboard)

7.3.1.3 Type 4
This glazing consisted of an aluminum composite panel with an overall thickness of 1-5/16" (nominal) constructed using the following components.
- 4 mm Reynobond® with KEVLAR® Aluminum Composite Panel
- 1" x 1" Aluminum Bar Support

7.3.2 350IR Glazing Method
Lites L1, L2, and L3 were placed on a setting block, (Part # 027-342), and glazed from the exterior using a Tremco® Proglaze® SSG on the interior and a fixed gasket (Part# 027-563) on the exterior.

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7.3.3 IR501 Dry Glazing Method
Lites L6 and L8 were placed on a setting block, (Part # 127-070), and glazed from the exterior using a fixed gasket (Part# 127-121) on the interior and a fixed gasket (Part# 127-126) on the exterior.

7.3.4 IR501 Wet Glazing Method
Lites L4, L5 ,and L7 were placed on a setting block, (Part # 127-070), and glazed from the exterior using Tremco® Proglaze® SSG on the interior and a fixed gasket (Part# 027-074) on the exterior.

7.3.5 Reynobond® with KEVLAR® Glazing Method
Panels RB1 and RB2 were glazed from the exterior using Tremco® Proglaze® SSG on the interior and a fixed gasket (Part# 027-074) on the exterior.

7.3.6 Door Daylight Opening and Glass Bite
Each lite of glass had a glass bite of 3/4" on all four sides. Reference Kawneer Company, Inc. drawing #TUD575001B for daylight openings located in Appendix B. HTL verified all daylight opening dimensions.

7.3.7 Frame Daylight Opening and Glass Bite
Each lite of glass had a glass bite of 5/8" on all four sides. Reference Kawneer Company, Inc. drawing #TUD575001B for daylight openings located in Appendix B. HTL verified all daylight opening dimensions.

7.4 Frame Gaskets and Weather Stripping
Table 7.3 provides a summary of the gaskets and weather stripping used in the test specimen.

Table 7.3: Gasket and Weather Stripping Details

| Location | Part # | Material |
|---|---|---|
| Standard Push In Gasket | 027-074 | EPDM |
| Setting Block | 127-070 | |
| C.O.C. Transom Bar Setting Block | 127-138 | |
| Exterior Fixed Gasket | 127-126 | |
| Interior Fixed Gasket | 127-121 | |
| Slide In Spacer | 127-011 | Santropene |
| Sill to Sill Flashing Foam Tape | 127-120 | CCN Sponge |
| Water Deflector | 451-105 | Rigid PVC |

7.5 Sealants Used
Table 7.4 describes the location and sealant used in the test specimen.

Table 7.4: Sealants

| Location | Sealant |
|---|---|
| Perimeter Sealant | Tremco Proglaze SSG |
| Door Frame Sealant | Tremco Tremsil 600 |
| Door Panel Corner Sealant | None |

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7.6 Anchorage

Kawneer Company, Inc. secured the frame to the C12 x 25 A36 steel channel and 12" x 4" x 3/8" steel tube buck using #12 x 7/16" PHTFS aluminum anchors, 1/4-20 x 2" HH DrilFlex®, 1/4-20 x 2-1/2" DrilFlex®, 1/4-20 x 4" DrilFlex®, and 1/4"-20 x 2" FH Dril-flex® screws. Kawneer Company, Inc.'s drawing #TUD575001B shows anchorage locations and spacing for each anchor location. HTL verified the location, spacing, and type of anchor for each system tested to the drawing located in Appendix B.

## 8.0 AIR BLAST PRESSURE

8.1 Reflected Pressure Transducer Location

Figure 8.1 shows the locations of the reflected pressure transducers for the full scale arena blast test. HTL instrumented the test buck containing the three 8400TL windows. This buck was used as a transducer panel and accurately provided a means to measure the air blast pressure. This structure was same size, orientation, and standoff distance to the charge.

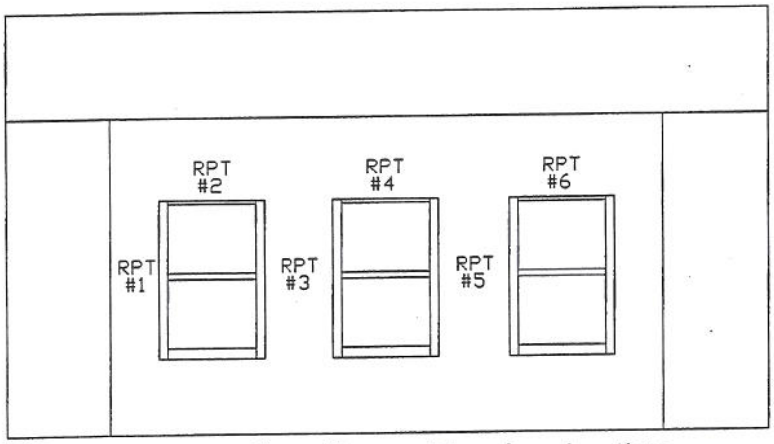


Figure 8.1: Reflected Pressure Transducer Locations.

8.2 Reflected Air Blast Pressure Results

The reflected pressure transducers were located on the test buck containing three 8400TL window specimens. This allowed HTL to observe the reflected blast pressure in areas where clearing effects have little influence;, thus allowing a more accurate positive phase impulse data acquisition on the test specimen. RPT #1 was located in a region where the positive phase impulse begins to drop off due to clearing effects. The transducers located towards the middle of the reflecting surface showed consistent results, as predicted. Table 8.1 summarizes the reflected blast pressure results and Figure 8.2 shows the air blast pressure time histories.

Table 8.1: Reflected Air Blast Pressure Results

| | RFP 1 | RFP 2 | RFP 3 | RFP 4 | RFP 5 | RFP 6 | Average |
|---|---|---|---|---|---|---|---|
| Peak Air Blast Pressure (psi) | 7.56 | 7.77 | 7.93 | 7.82 | 7.87 | 7.39 | 7.72 |
| Peak Positive Phase Impulse (psi–msec) | 38.11 | 41.19 | 42.07 | 42.12 | 42.67 | 42.72 | 42.15 |
| Positive Phase Duration (msec) | 11.81 | 10.94 | 12.39 | 14.17 | 12.59 | 14.63 | 12.75 |

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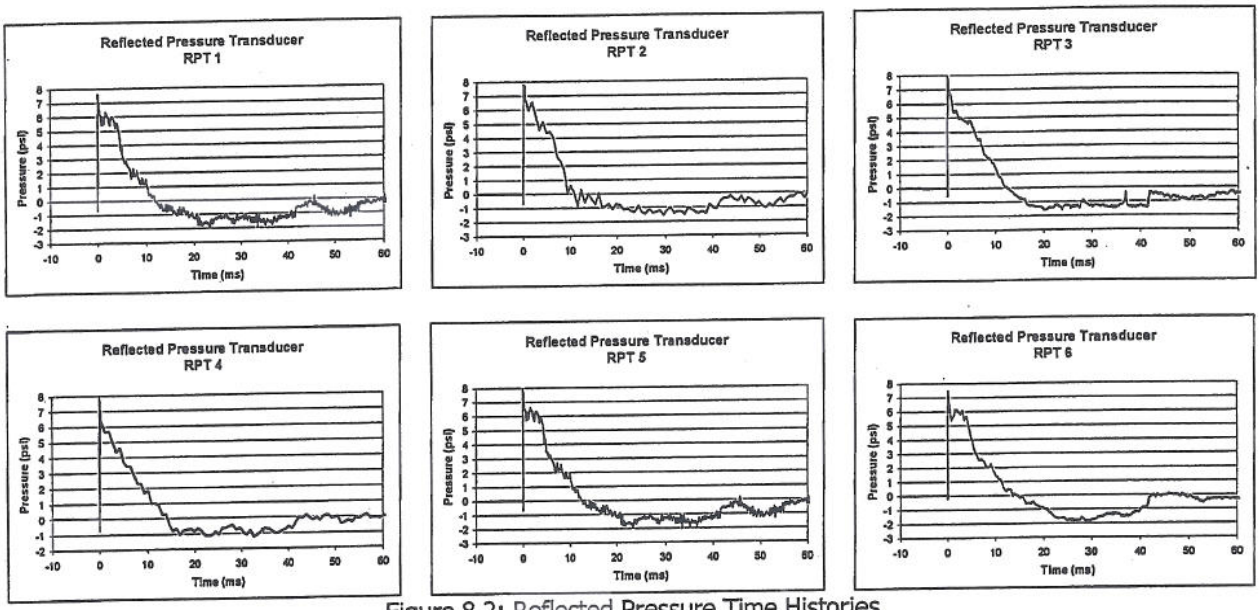


Figure 8.2: Reflected Pressure Time Histories

8.3 Free Field Air Blast Pressure Results

The free field pressure transducer produced consistent results between the two transducers. Table 8.2 provides the results obtained from the free field pressure transducers, and Figure 8.3 provides the free field air blast pressure time histories.

Table 8.2: Free Field Airblast Pressure Results

| | FF 1 | FF 2 | Average |
|---|---|---|---|
| Peak Air Blast Pressure (psi) | 3.6 | 3.4 | 3.5 |
| Peak Positive Phase Impulse (psi–msec) | 24.3 | 24.5 | 24.4 |
| Positive Phase Duration (msec) | 19.31 | 17.23 | 12.04 |

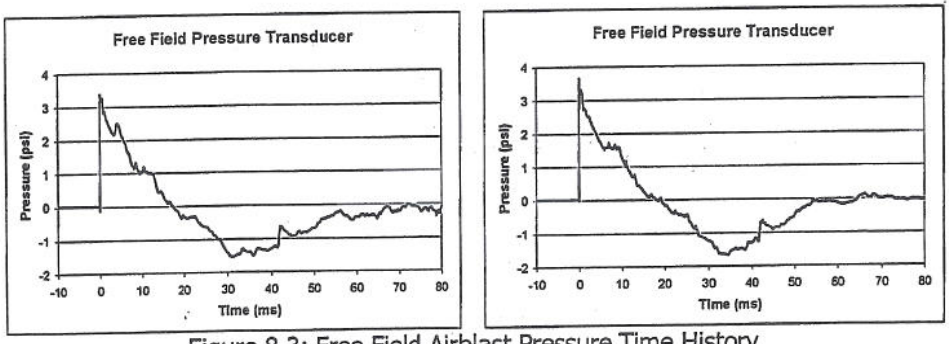


Figure 8.3: Free Field Airblast Pressure Time History

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8.4 Internal Blast Pressure

HTL measured the internal blast pressure of blast reaction chamber. HTL obtained a maximum peak internal pressure for Specimens 1, 2, and 3 of 0.99 psi, 0.71 psi, and 0.56 psi respectively.

## 9.0 TEST RESULTS

9.1 350IR Door in IR501 Frame Test Specimen

Figure 9.1 shows a 350IR Door in an IR501 Frame. This figure also provides labels for each lite and Reynobond® with KEVLAR® Sheet. The prefix "L" indicates a lite of glass while "RB" indicates a Reynobond® with KEVLAR® panel. These labels are used as a reference in this test report for all three (3) test specimens.

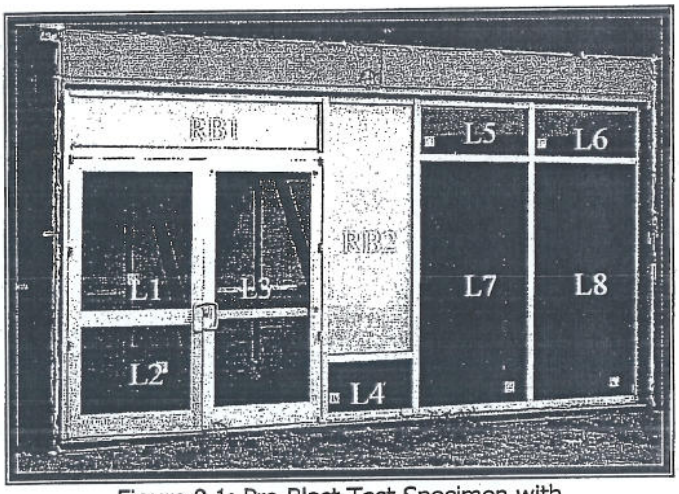


Figure 9.1: Pre-Blast Test Specimen with Lite and Framing Labels

9.2 Test Specimen #1 - Test Results

Tables 9.1 through 9.3 outline the response of the IR501 Storefront, 350IR Storefront Entrance Doors, and the Reynobond® with KEVLAR® panels under air blast pressure loading for Specimen #1. The tables also provide a glazing rating per the requirements of ASTM F1642-04 and GSA-TS01-2003. A complete photographic record of Specimen #1 is located in Appendix B.

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Table 9.1: Specimen #1:
IR501 Storefront Test Results

| | | | |
|---|---|---|---|
| IR501 Storefront | Response | Frame | The IR501 Storefront frame remained in the opening; however, most of the header anchors sheared. HTL observed a partial separation of the mullions between lites L4, RB2 and L5, L7. The mullion between lites L7 and L8 showed yielding at the midspan from the air blast pressure loading. The glass stops located above L6, below L7, and above RB2 detached from the frame and landed on the exterior of the blast reaction chamber. |
| | | Glazing | None of the glazing fractured under air blast pressure loading and remained fully retained in the framing. HTL observed zero glazing dust, slivers, and fragments inside the occupied space. Since the glazing did not fracture, zero perforation or fragment indents were observed in the witness panel. |
| | | Anchors | All of the top anchors sheared except for the two (2) end anchors for a total of twenty-eight (28) anchors that failed. The side and bottoms anchors so no sign of failure. |
| | Hazard Level | ASTM F1642-04 | Minimal Hazard |
| | | GSA-TS01-2003 | Performance Condition 2 |
| | | UFC 4-010-02 | Medium Level of Protection |

Table 9.2: Specimen #1
305IR Entrance Door Test Results

| | | | |
|---|---|---|---|
| 350IR Entrance Door | Response | Frame | The left door detached from the mullion and landed on the exterior of the occupied space, the right door remained attached to the mullion. The bottom and two (2) middle hinges completely sheared from the frame on the left door. The right door hinges showed signs of stress but remained attached to the mullion. Both doors opened to the exterior. The door frames suffered minor permanent deformations. The panic devices and door closers remained attached to the doors. |
| | | Glazing | The glazing L1 and L2 did not fracture. The glazing L3 fractured under air blast pressure loading. HTL observed a sum total united dimension of 2.75" inches past 40" from the interior face of the glazing which originated from Lite L3. HTL observed zero perforation or fragment indents in the witness panel. |
| | | Anchors | The hinge anchors remained attached to the frame; however, three hinges failed during the air blast pressure loading. |
| | Hazard Level | ASTM F1642-04 | Minimal Hazard |
| | | GSA-TS01-2003 | Performance Condition 2 |
| | | UFC 4-010-02 | Medium Level of Protection |

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Table 9.3: Specimen #1
Reynobond® with KEVLAR® Test Results

| | | | |
|---|---|---|---|
| Reynobond® with KEVLAR® | Response | | The Reynobond® with KEVLAR® panels remained in the glazing pocket. The glass stop located at the head of RB2 detached from the frame and landed on the exterior of the blast reaction chamber. The corners of RB2 shows stress lines and permanent deformations in the panel. RB1 showed only minimal signs of damage. |
| | Hazard Level | ASTM F1642-04 | No Hazard |
| | | GSA-TS01-2003 | No Hazard |
| | | UFC 4-010-02 | High Level of Protection |

9.3 Test Specimen #2 - Test Results

Tables 9.4 through 9.6 outline the response of the IR501 Storefront, 350IR Storefront Entrance Doors, and the Reynobond® with KEVLAR® panels under air blast pressure loading for Specimen #2. The tables also provide a glazing rating per the requirements of ASTM F1642-04 and GSA-TS01-2003. A complete photographic record of Specimen #2 is located in Appendix C.

Table 9.4: Specimen #2:
IR501 Storefront Test Results

| | | | |
|---|---|---|---|
| IR501 Storefront | Response | Frame | The IR501 Storefront frame remained in the opening; however, most of the header anchors sheared. HTL observed a partial separation of the mullion between lites L4, RB2 and L5, L7. The mullions located between lites L7 and L8 showed yielded at the midspan. The glass stop located above RB2 detached from the frame. |
| | | Glazing | None of the glazing fractured under air blast pressure loading except the outboard lite L7. All glazing remained fully retained in the framing. Since none of the inboard lites fractured, HTL observed zero glazing dust, slivers, and fragments inside the occupied space. Zero perforation or fragment indents were observed in the witness panel. |
| | | Anchors | All of the top anchors sheared except for the two (2) end anchors for a total of twenty-eight (28) anchors that failed. The side and bottoms anchors showed minimal damage. |
| | Hazard Level | ASTM F1642-04 | Minimal Hazard |
| | | GSA-TS01-2003 | Performance Condition 2 |
| | | UFC 4-010-02 | Medium Level of Protection |

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Table 9.5: Specimen #2
305IR Entrance Door Test Results

| | | | |
|---|---|---|---|
| 350IR Entrance Door | Response | Frame | The left door detached from the mullion and landed on the exterior of the occupied space, the right door remained attached to the mullion. The bottom and two (2) middle hinges completely sheared from the frame on the left door. The right door hinges showed signs of stress but remained attached to the mullion. Both doors opened to the exterior. The door frames suffered minor permanent deformations. The panic devices and door closers remained attached to the doors. |
| | | Glazing | The glazing L3 fractured under air blast pressure loading and remained fully retained in the framing. The remaining lites did not fracture. HTL observed minor glazing dust, slivers, and fragments inside the occupied space with a sum total united dimension of .75 inches. Zero perforation or fragment indents were observed in the witness panel. |
| | | Anchors | The hinge anchors remained attached to the frame; however, three hinges fail during the air blast pressure loading. |
| | Hazard Level | ASTM F1642-04 | Minimal Hazard |
| | | GSA-TS01-2003 | Performance Condition 3b |
| | | UFC 4-010-02 | Medium Level of Protection |

Table 9.6: Specimen #2
Reynobond® with KEVLAR® Test Results

| | | | |
|---|---|---|---|
| Reynobond® with KEVLAR® | Response | | The Reynobond® with KEVLAR® panels remained in the glazing pocket. The glass stop located at the head of RB2 detached from the frame and landed on the exterior of the blast reaction chamber. The corners of RB2 shows stress lines in the panel and panel had permanent deformation and "crinkling" in the panel. RB1 showed only minimal signs of stress. |
| | Hazard Level | ASTM F1642-04 | No Hazard |
| | | GSA-TS01-2003 | Performance Condition 2 |
| | | UFC 4-010-02 | High Level of Protection |

9.4 Test Specimen #3 - Test Results

Tables 9.7 through 9.9 outline the response of the IR501 Storefront, 350IR Storefront Entrance Doors, and the Reynobond® with KEVLAR® panels under air blast pressure loading for Specimen #2. The tables also provide a glazing rating per the requirements of ASTM F1642-04 and GSA-TS01-2003. A complete photographic record of Specimen #2 is located in Appendix C.

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Table 9.7: Specimen #3:
IR501 Storefront Test Results

| | | | |
|---|---|---|---|
| IR501 Storefront | Response | Frame | The IR501 Storefront frame remained in the opening; however, many of the anchors sheared in the header. HTL observed a partial separation of the mullion between lites L4, RB2 and L5, L7. The mullions located between lites L6 and L7 showed damage and yielding at the midspan. The glass stop located above RB2, and below L4 and L8 detached from the frame. |
| | | Glazing | None of the glazing fractured under air blast pressure loading except for L4 and glazing remained fully retained in the framing. HTL observed zero glazing dust, slivers, and fragments inside the occupied space. Since none of the inboard lites fractures, zero perforation or fragment indents were observed in the witness panel. |
| | | Anchors | The first anchor on the top left of the header appeared to have minimal damage, the twenty (20) subsequent anchors located to the right of the first anchors completely sheared. The following nine (9) anchors showed only minimal damage. The side and bottom anchors showed only minimal damage. |
| | Hazard Level | ASTM F1642-04 | Minimal Hazard |
| | | GSA-TS01-2003 | Performance Condition 2 |
| | | UFC 4-010-02 | Medium Level of Protection |

Table 9.8: Specimen #3
305IR Entrance Door Test Results

| | | | |
|---|---|---|---|
| 350IR Entrance Door | Response | Frame | Both doors remained attached to the mullion and opened toward the exterior of the occupied space. The top left hinge pin completely disengaged from the hinge. The middle hinges showed considerable damage but remained attached to the frame. The hinges on the right mullions showed minimal damage. The doors frame suffered minor permanent deformations. The panic device on the left door detached and landed inside the occupied with a maximum distance of 56.5 inches away from the interior side of the glazing. The left door panic device remained attached to the door. |
| | | Glazing | None of the glazing fractured under air blast pressure loading and the glazing remained fully retained in the framing. HTL observed zero glazing dust, slivers, and fragments inside the occupied space. Since none of the lites fractured, zero perforation or fragment indents were observed in the witness panel. |
| | | Anchors | The hinge anchors remained attached to the frame. |
| | Hazard Level | ASTM F1642-04 | Minimal Hazard |
| | | GSA-TS01-2003 | Performance Condition 3b |
| | | UFC 4-010-02 | Medium Level of Protection |

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Table 9.9: Specimen #3
Reynobond® with KEVLAR® Test Results

| | | | |
|---|---|---|---|
| Reynobond® with KEVLAR® | Response | | The Reynobond® with KEVLAR® panels remained in the glazing pocket. The glass stop located at the head of RB2 detached from the frame and landed on the exterior of the blast reaction chamber. The corners of RB2 shows stress lines in the panel and panel had permanent deformation and "crinkling" in the panel. RB1 showed only minimal signs of stress. |
| | Hazard Level | ASTM F1642-04 | No Hazard |
| | | GSA-TS01-2003 | Performance Condition 2 |
| | | UFC 4-010-02 | High Level of Protection |

## 10.0 SUMMARY

Table 10.1 provides a summary of the test results for Kawneer Company, Inc.'s 350IR Door in a IR501 Frame.

Table 10.1: Summary of Test Results

| Specimen # | Description | Hazard Rating | | | Internal Peak Air Blast Pressure | Average Peak Air Blast Pressure | Average Positive Phase Impulse |
|---|---|---|---|---|---|---|---|
| | | ASTM 1642 | GSA | UFC | (psi) | (psi-msec) | (psi-msec) |
| Specimen #1 | IR501 Frame | Minimal Hazard | 2 | Medium Level of Protection | 0.99 | 7.72 | 42.15 |
| | 350 IR Door | Minimal Hazard | 3b | Medium Level of Protection | | | |
| | Reynobond® with KEVLAR® | No Hazard | 2 | High Level of Protection | | | |
| Specimen #2 | IR501 Frame | Minimal Hazard | 2 | Medium Level of Protection | 0.71 | | |
| | 350 IR Door | Minimal Hazard | 3b | Medium Level of Protection | | | |
| | Reynobond® with KEVLAR® | No Hazard | 2 | High Level of Protection | | | |
| Specimen #3 | IR501 Frame | Minimal Hazard | 2 | Medium Level of Protection | 0.56 | | |
| | 350 IR Door | Minimal Hazard | 2 | Medium Level of Protection | | | |
| | Reynobond® with KEVLAR® | No Hazard | 2 | High Level of Protection | | | |

## 11.0 CERTIFICATION AND DISCLAIMER STATEMENT

All tests performed on this test specimen were conducted in accordance with the specifications of the applicable codes, standards and test methods listed below by HTL, LLC. HTL, LLC does not have, nor does it intend to acquire or will it acquire, a financial interest in any company manufacturing or

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distributing products tested at HTL. HTL is not owned, operated or controlled by any company manufacturing or distributing products it tests. This report is only intended for the use of the entity named in Section 1.0 of this report. Detailed assembly drawings showing wall thickness of all members, corner construction and hardware applications are on file and have been compared to the test specimen submitted. A copy of this test report along with representative sections of the test specimen will be retained at HTL for a period of three (3) years. All results obtained apply only to the specimen tested and they do indicate compliance with the performance requirements of the test methods and specifications listed in the following section.

## 12.0 APPLICABLE CODES, STANDARDS, AND TEST METHODS

**ASTM F-1642-04:** *Glazing and Glazing Systems subject to Airblast Loading*
**GSA-TS01-2003:** *US General Services Administration Standard Test Method for Glazing and Window Systems Subject to Dynamic Overpressure Loadings.*
* **UFC 4-010-02:** *DoD Minimum Anitterrosim Standards for Buildings*

## 13.0 WITNESSES (~~ALL OR PARTIAL~~)

| | | |
|---|---|---|
| Steven Samuels, P.E. | Operations Manager | HTL, LLC |
| Kyle Turner | Test Technician | HTL, LLC |
| Bart Master | Test Technician | HTL, LLC |
| Donnie Hunter | Product Manager | Kawneer Company, Inc. |
| Tanya Dolby, P.E. | Product Engineer | Kawneer Company, Inc. |
| Bill Hooper | Manager R&D | Kawneer Company, Inc. |
| Stephen Turano | Research Engineer | Kawneer Company, Inc. |
| Stan Steingold, P.E. | Application Engineer | Alcoa Architectural Products |
| Steve Austin | Technical Services Specialist | 3M |

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# APPENDIX A:
# PHOTOGRAPHIC RECORD

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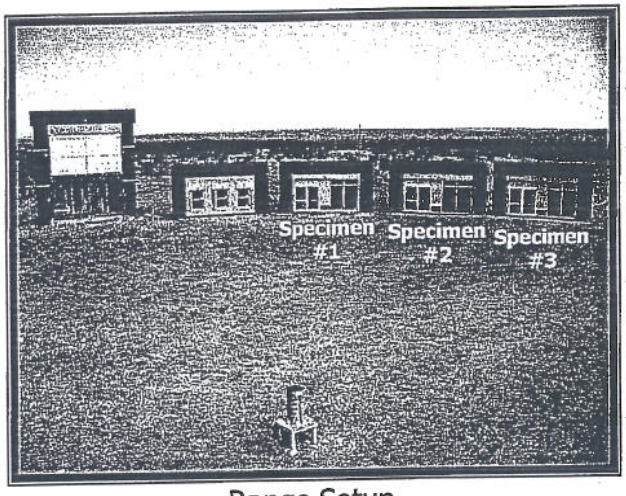
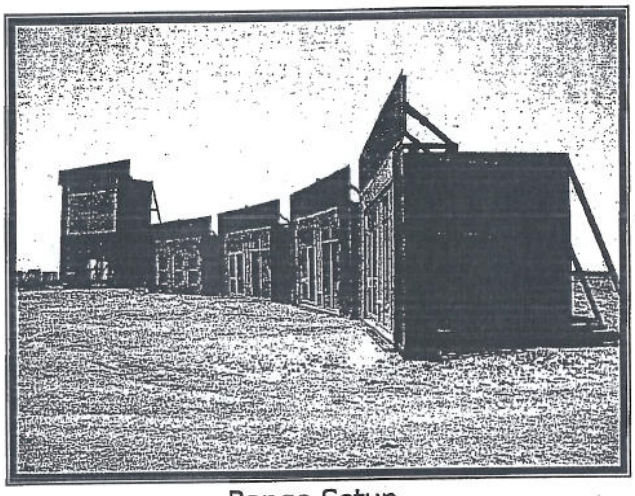
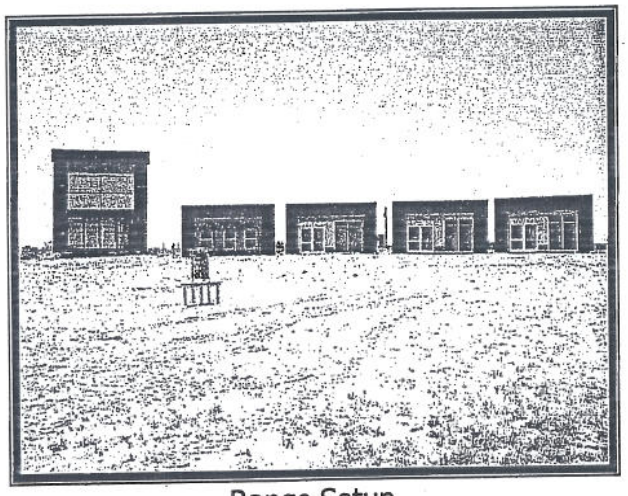



Range Setup



Range Setup



Range Setup

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# Glass Load Resistance Report 2/26/2009

## Glazing Information

| | |
|---|---|
| **Edge Support:** | 4 Sides |
| **Glazing Angle:** | 90.0° |
| **Lite Dimensions:** | |
| **Width:** | 27.0 in. |
| **Height:** | 72.0 in. |

## Project Details

| | |
|---|---|
| **Project Name:** | Riverine & Combatant Craft Oper Faci |
| **Project Location:** | Stennis Space Center, MS |
| **Comments:** | Bldg 2440 Door1, Requested by Rob Haidler, DeGeorg |

DOOR #1 BLDG 2440

## Glass Construction

**Single Glazed Lite [ Annealed ]**

| | |
|---|---|
| **Outboard Ply Thickness:** | 1/4 in. |
| **Interlayer Thickness:** | 0.090 in. |
| **Inboard Ply Thickness:** | 1/4 in. |
| **Nominal Lite Thickness:** | 1/2 in. |

## Short Load Duration, Resistance, and Deflection Data

| | | |
|---|---|---|
| **Load (~ 3 sec.)** | 50.0 | psf |
| **Load Resistance:** | 172 | psf |
| **Approximate center of glass deflection:** | 0.1 | in. |

## Conclusion

**Based on your design information, the load resistance is greater than or equal to the specified loading.**

## Statement of Compliance

Procedures followed in determining the resistance of this window glass are in accordance with ASTM E1300-02.

**Disclaimer:**

This software can be used to determine the load resistance of specified glass types exposed to uniform lateral loads of short or long duration subject to the following conditions:

- The glass is free of edge and surface damage and has been properly glazed in the opening in conformance with the manufacturer's recommendations.
- Procedures exist to determine load resistance for rectangular glass assemblies that are:
  Continuously supported along (1) all four edges, (2) all three edges, (3) two parallel edges, and (4) one edge.
- The software user has the responsibility of selecting the correct procedures for the required application from the software.
- The stiffness of members supporting any glass edge shall be sufficient that under design load, edge deflections shall not exceed L/175, where L denotes that length of the supported edge.
- The non-factored load values for laminated glass are representative of test data and calculations performed for polyvinyl butyral interlayer at a temperature of 50°C (122°F).

For other limiting conditions that may apply, refer to Section 5 of ASTM E1300 and local building codes.

Neither SDG nor PGMC guarantees and each disclaims any responsibility for any particular results relating to the use of the Window Glass Design-2002 Software Program. SDG and PGMC disclaim any liability for any personal injury or any loss or damage of any kind, including all indirect, special, or consequential damages and lost profits, arising out of or relating to the use of the Window Glass Design-2002 Software Program.

Prepared by: _____ on 2/26/2009

**Steve Marino, PPG Ind**

## BROADMOOR, L.L.C.

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

5.12.09

DQC Manager Date

5/12/09

QC Officer Date

## DAMMON ENGINEERING INC

**Date:** 5.12.09 **Project:** Stennis ROF

**Reviewed:** X

**Reviewed as Noted:**

**Revise and Resubmit:**

**Rejected:**

**Other:**

**Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. This contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his or her work with that of all other trades and performing all in a safe and satisfactory manner.**

**Submittal Item:** Glass Load Report

**Comments**

# Glass Load Resistance Report 2/26/2009

## Glazing Information

| | |
|---|---|
| **Edge Support:** | 4 Sides |
| **Glazing Angle:** | 90.0° |
| **Lite Dimensions:** | |
| **Width:** | 30.0 in. |
| **Height:** | 42.0 in. |

## Project Details

| | |
|---|---|
| **Project Name:** | Riverine & Combatant Craft Oper Faci |
| **Project Location:** | Stennis Space Center, MS |
| **Comments:** | Bldg 2440 Wnd A, Requested by Rob Haidler, DeGeorg |

## Glass Construction

WINDOW "A" BLDG 2440

**Double Glazed Insulating Unit**

**Outboard Lite [ Heat Strengthened ]**
**Nominal Lite Thickness:** 1/4 in.

**Inboard Lite [ Annealed ]**

| | |
|---|---|
| **Outboard Ply Thickness:** | 1/4 in. |
| **Interlayer Thickness:** | 0.090 in. |
| **Inboard Ply Thickness:** | 1/4 in. |
| **Nominal Lite Thickness:** | 1/2 in. |

## Short Load Duration, Resistance, and Deflection Data

| | | |
|---|---|---|
| **Load (~ 3 sec.)** | 50.0 | psf |
| **Load Resistance:** | > 210 | psf |
| **Approximate center of glass deflection:** | 0.08 | in. |

use 210 psf since this is the maximum value that falls w/in scope of ASTM E1300

## Conclusion

Based on your design information, the load resistance is greater than or equal to the specified loading.

## Statement of Compliance

Procedures followed in determining the resistance of this window glass are in accordance with ASTM E1300-02.
**Disclaimer:**
This software can be used to determine the load resistance of specified glass types exposed to uniform lateral loads of short or long duration subject to the following conditions:
- The glass is free of edge and surface damage and has been properly glazed in the opening in conformance with the manufacturer's recommendations.
- Procedures exist to determine load resistance for rectangular glass assemblies that are:
  Continuously supported along (1) all four edges, (2) all three edges, (3) two parallel edges, and (4) one edge.
- The software user has the responsibility of selecting the correct procedures for the required application from the software.
- The stiffness of members supporting any glass edge shall be sufficient that under design load, edge deflections shall not exceed L/175, where L denotes that length of the supported edge.
- The non-factored load values for laminated glass are representative of test data and calculations performed for polyvinyl butyral interlayer at a temperature of 50°C (122°F).

For other limiting conditions that may apply, refer to Section 5 of ASTM E1300 and local building codes.
Neither SDG nor PGMC guarantees and each disclaims any responsibility for any particular results relating to the use of the Window Glass Design-2002 Software Program. SDG and PGMC disclaim any liability for any personal injury or any loss or damage of any kind, including all indirect, special, or consequential damages and lost profits, arising out of or relating to the use of the Window Glass Design-2002 Software Program.

Prepared by: _____ on 2/26/2009
**Steve Marino, PPG Ind**

# Glass Load Resistance Report 2/26/2009

## Glazing Information

| | |
|---|---|
| **Edge Support:** | 4 Sides |
| **Glazing Angle:** | 90.0° |
| **Lite Dimensions:** | |
| **Width:** | 33.0 in. |
| **Height:** | 84.0 in. |

## Project Details

| | |
|---|---|
| **Project Name:** | Riverine & Combatant Craft Oper Faci |
| **Project Location:** | Stennis Space Center, MS |
| **Comments:** | Bldg 2440 Wnd C, Requested by Rob Haidler, DeGeorg |

## Glass Construction

WINDOW "C" BLDG 2440 (Lean-out observation)

**Double Glazed Insulating Unit**

| | | | |
|---|---|---|---|
| **Outboard Lite { Heat Strengthened }** | | **Inboard Lite { Annealed }** | |
| **Nominal Lite Thickness:** | 1/4 in. | **Outboard Ply Thickness:** | 1/4 in. |
| | | **Interlayer Thickness:** | 0.090 in. |
| | | **Inboard Ply Thickness:** | 1/4 in. |
| | | **Nominal Lite Thickness:** | 1/2 in. |

## Short Load Duration, Resistance, and Deflection Data

| | | |
|---|---|---|
| **Load (~ 3 sec.)** | 50.0 | psf |
| **Load Resistance:** | 129 | psf |
| **Approximate center of glass deflection:** | 0.16 | in. |

## Conclusion

**Based on your design information, the load resistance is greater than or equal to the specified loading.**

## Statement of Compliance

Procedures followed in determining the resistance of this window glass are in accordance with ASTM E1300-02.

**Disclaimer:**

This software can be used to determine the load resistance of specified glass types exposed to uniform lateral loads of short or long duration subject to the following conditions:

- The glass is free of edge and surface damage and has been properly glazed in the opening in conformance with the manufacturer's recommendations.
- Procedures exist to determine load resistance for rectangular glass assemblies that are:
  Continuously supported along (1) all four edges, (2) all three edges, (3) two parallel edges, and (4) one edge.
- The software user has the responsibility of selecting the correct procedures for the required application from the software.
- The stiffness of members supporting any glass edge shall be sufficient that under design load, edge deflections shall not exceed L/175, where L denotes that length of the supported edge.
- The non-factored load values for laminated glass are representative of test data and calculations performed for polyvinyl butyral interlayer at a temperature of 50°C (122°F).

For other limiting conditions that may apply, refer to Section 5 of ASTM E1300 and local building codes.

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Prepared by: _____ on 2/26/2009

**Steve Marino, PPG Ind**

# Glass Load Resistance Report 2/26/2009

## Glazing Information

| | |
|---|---|
| **Edge Support:** | 4 Sides |
| **Glazing Angle:** | 90.0° |
| **Lite Dimensions:** | |
| **Width:** | 48.0 in. |
| **Height:** | 37.0 in. |

## Project Details

| | |
|---|---|
| **Project Name:** | Riverine & Combatant Craft Oper Faci |
| **Project Location:** | Stennis Space Center, MS |
| **Comments:** | Bldg 2441 Wnd B, Requested by Rob Haidler, DeGeorg |

## Glass Construction

WINDOW "B" BLDG 2441

**Double Glazed Insulating Unit**

**Outboard Lite { Heat Strengthened }**

| | |
|---|---|
| **Nominal Lite Thickness:** | 1/4 in. |

**Inboard Lite { Annealed }**

| | |
|---|---|
| **Outboard Ply Thickness:** | 1/4 in. |
| **Interlayer Thickness:** | 0.090 in. |
| **Inboard Ply Thickness:** | 1/4 in. |
| **Nominal Lite Thickness:** | 1/2 in. |

## Short Load Duration, Resistance, and Deflection Data

| | | |
|---|---|---|
| **Load (~ 3 sec.)** | 50.0 | psf |
| **Load Resistance:** | 182 | psf |
| **Approximate center of glass deflection:** | 0.15 | in. |

## Conclusion

**Based on your design information, the load resistance is greater than or equal to the specified loading.**

## Statement of Compliance

Procedures followed in determining the resistance of this window glass are in accordance with ASTM E1300-02.

**Disclaimer:**

This software can be used to determine the load resistance of specified glass types exposed to uniform lateral loads of short or long duration subject to the following conditions:

- The glass is free of edge and surface damage and has been properly glazed in the opening in conformance with the manufacturer's recommendations.
- Procedures exist to determine load resistance for rectangular glass assemblies that are:
  Continuously supported along (1) all four edges, (2) all three edges, (3) two parallel edges, and (4) one edge.
- The software user has the responsibility of selecting the correct procedures for the required application from the software.
- The stiffness of members supporting any glass edge shall be sufficient that under design load, edge deflections shall not exceed L/175, where L denotes that length of the supported edge.
- The non-factored load values for laminated glass are representative of test data and calculations performed for polyvinyl butyral interlayer at a temperature of 50°C (122°F).

For other limiting conditions that may apply, refer to Section 5 of ASTM E1300 and local building codes.

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Prepared by: _____ on 2/26/2009

**Steve Marino, PPG Ind**

# Glass Load Resistance Report 2/26/2009

## Glazing Information

| | |
|---|---|
| **Edge Support:** | 4 Sides |
| **Glazing Angle:** | 90.0° |
| **Lite Dimensions:** | |
| **Width:** | 46.0 in. |
| **Height:** | 46.0 in. |

## Project Details

| | |
|---|---|
| **Project Name:** | Riverine & Combatant Craft Oper Faci |
| **Project Location:** | Stennis Space Center, MS |
| **Comments:** | Bldg 2442 Wnd A, Requested by Rob Haidler, DeGeorg |

## Glass Construction

WINDOW "A" BLDG 2442

**Double Glazed Insulating Unit**

**Outboard Lite [ Heat Strengthened ]**

| | |
|---|---|
| **Nominal Lite Thickness:** | 1/4 in. |

**Inboard Lite [ Annealed ]**

| | |
|---|---|
| **Outboard Ply Thickness:** | 1/4 in. |
| **Interlayer Thickness:** | 0.090 in. |
| **Inboard Ply Thickness:** | 1/4 in. |
| **Nominal Lite Thickness:** | 1/2 in. |

## Short Load Duration, Resistance, and Deflection Data

| | | |
|---|---|---|
| Load (~ 3 sec.) | 50.0 | psf |
| Load Resistance: | 164 | psf |
| Approximate center of glass deflection: | 0.2 | in. |

## Conclusion

Based on your design information, the load resistance is greater than or equal to the specified loading.

## Statement of Compliance

Procedures followed in determining the resistance of this window glass are in accordance with ASTM E1300-02.

Disclaimer:

This software can be used to determine the load resistance of specified glass types exposed to uniform lateral loads of short or long duration subject to the following conditions:

- The glass is free of edge and surface damage and has been properly glazed in the opening in conformance with the manufacturer's recommendations.
- Procedures exist to determine load resistance for rectangular glass assemblies that are:
  Continuously supported along (1) all four edges, (2) all three edges, (3) two parallel edges, and (4) one edge.
- The software user has the responsibility of selecting the correct procedures for the required application from the software.
- The stiffness of members supporting any glass edge shall be sufficient that under design load, edge deflections shall not exceed L/175, where L denotes that length of the supported edge.
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Prepared by: _____ on 2/26/2009

**Steve Marino, PPG Ind**

SECTION 08 71 00

DOOR HARDWARE
**08/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM E 283 | (2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen |
| ASTM F 883 | (2004) Padlocks |

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

| | |
|---|---|
| BHMA A156.1 | (2006) Butts and Hinges |
| BHMA A156.13 | (2005) Mortise Locks & Latches, Series 1000 |
| BHMA A156.15 | (2006) Closer Holder Release Devices |
| BHMA A156.16 | (2008) Auxiliary Hardware |
| BHMA A156.18 | (2006) Materials and Finishes |
| BHMA A156.2 | (2003) Bored and Preassembled Locks and Latches |
| BHMA A156.21 | (2006) Thresholds |
| BHMA A156.22 | (2005) Door Gasketing and Edge Seal Systems |
| BHMA A156.3 | (2008) Exit Devices |
| BHMA A156.4 | (2008) Door Controls - Closers |
| BHMA A156.5 | (2001) Auxiliary Locks & Associated Products |
| BHMA A156.6 | (2005) Architectural Door Trim |
| BHMA A156.7 | (2003) Template Hinge Dimensions |
| BHMA A156.8 | (2005) Door Controls - Overhead Stops and Holders |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 101 | (2008) Life Safety Code, 2006 Edition |
| NFPA 80 | (2006; Errata 2008) Standard for Fire Doors and Other Opening Protectives |

STEEL DOOR INSTITUTE (SDI/DOOR)

| | |
|---|---|
| SDI/DOOR A250.8 | (2003) Recommended Specification for Standard Steel Doors and Frames |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL Bld Mat Dir | (2008) Building Materials Directory |

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-02 Shop Drawings

Hardware schedule G

Keying system

SD-03 Product Data

Hardware items G

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package G

Submit as specified.

SD-11 Closeout Submittals

Key Bitting

1.3 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

| Hardware Item | Quantity | Size | Reference Publication Type No. | Finish | Mfr. Name and Catalog No. | Key Control Symbols | UL Mark (If fire rated and listed) | BHMA Finish Designation |
|---|---|---|---|---|---|---|---|---|
| --- | --- | --- | --- | --- | --- | --- | --- | --- |

1.4 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the Contracting Officer prior to completion of

the work. Include:

a. Complete listing of all keys (AA1, AA2, etc.).

b. Complete listing of all key cuts (AA1-123456, AA2-123458).

c. Tabulation showing which key fits which door.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.

## 1.5 QUALITY ASSURANCE

### 1.5.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, pivots, and closers of one lock, hinge, pivot, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

### 1.5.1 Key Shop Drawings Coordination Meeting

Prior to the submission of the key shop drawing, the Contracting Officer, Contractor, Door Hardware subcontractor, using Activity and Base Locksmith shall meet to discuss key requirements for the facility.

## 1.6 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.

# PART 2 PRODUCTS

## 2.1 TEMPLATE HARDWARE

Provide hardware to be applied to metal or to prefinished doors manufactured to template. Promptly furnish template information or templates to door and frame manufacturers. Conform to BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

## 2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for exit doors, as well as to other requirements indicated, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule." Provide the label of Underwriters Laboratories, Inc. for such hardware listed in UL Bld Mat Dir or labeled and listed by another testing laboratory acceptable to the Contracting Officer.

## 2.3 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, pivots, locks, latches, exit devices, bolts and closers where the identifying mark will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

### 2.3.1 Hinges

BHMA A156.1, 4-1/2 by 4-1/2 inch unless otherwise indicated. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed. Other antifriction bearing hinges may be provided in lieu of ball-bearing hinges.

### 2.3.2 Locks and Latches

#### 2.3.2.1 Mortise Locks and Latches

BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Install knobs and roses of mortise locks with screwless shanks and no exposed screws.2.3.2.2 [Enter Appropriate Subpart Title Here]

#### 2.3.2.3 Combination Locks

Pharmacy door locks shall be keyed separately from building master key system. Heavy-duty, mechanical combination lockset with five pushbuttons, standard-sized knobs, 3/4 inch deadlocking latch, 2-3/4 inch backset. Operate the locks by pressing two or more of the buttons in unison or individually in the proper sequence. Inside knob will operate the latch. Provide a keyed cylinder on the interior to permit setting the combination. Provide a keyed removable-core cylinder on the exterior to permit bypassing the combination. Provide a thumb turn on the interior to activate passage set function, so that outside knob operates latch without using the combination.

### 2.3.3 Exit Devices

BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices.

### 2.3.4 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Provide cylinders and cores with seven pin tumblers. Provide cylinders from products of one manufacturer, and provide cores from the products of one manufacturer. Locksets shall have interchangeable cores which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

### 2.3.5 Keying System

Provide a grand master keying system that is an extension of the existing base keying system. Provide construction interchangeable cores. Provide key cabinet as specified.

Key equipment spaces and mechanical rooms separately from the building systems, and keyed alike to the existing master and grand master systems

for these doors.

2.3.6 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.3.6.1 Knobs and Roses

Conform to the minimum test requirements of BHMA A156.2 and BHMA A156.13 for knobs, roses, and escutcheons. For unreinforced knobs, roses, and escutcheons, provide 0.050 inch thickness. For reinforced knobs, roses, and escutcheons, provide outer shell of 0.035 inch thickness, and combined thickness of 0.070 inch, except for knob shanks, which are 0.060 inch thick.

2.3.6.2 Lever Handles

Provide lever handles in lieu of knobs. Conform to the minimum requirements of BHMA A156.13 for mortise locks of lever handles for exit devices. Provide lever handle locks with a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when force in excess of that specified in BHMA A156.13 is applied to the lever handle. Provide lever handles return to within 1/2 inch of the door face.

2.3.7 Keys

Furnish one file key, one duplicate key, and one working key for each key change and for each master and grand master keying system. Furnish construction master keys, and control keys for removable cores. Furnish a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room number on keys.

2.3.8 Door Bolts

BHMA A156.16. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts: BHMA A156.3, Type 25.

2.3.9 Closers

BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, full size covers, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

2.3.9.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

2.3.10 Overhead Holders

BHMA A156.8.

2.3.11 Closer Holder-Release Devices

BHMA A156.15.

2.3.12 Door Protection Plates

BHMA A156.6.

2.3.12.1 Sizes of Mop and Kick Plates

2 inch less than door width for single doors; one inch less than door width for pairs of doors. Provide 10 inch kick plates for flush doors. Provide 6 inch mop plates.

2.3.13 Door Stops and Silencers

BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.3.14 Padlocks

ASTM F 883.

2.3.15 Thresholds

BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.3.16 Weather Stripping Gasketing

BHMA A156.22. Provide the type and function designation where specified in paragraph entitled "Hardware Schedule". Provide a set to include head and jamb seals, and, for pairs of doors, astragals. Air leakage of weather stripped doors not to exceed 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283.

2.3.17 Rain Drips

Extruded aluminum, not less than 0.08 inch thick, anodized. Set drips in sealant and fasten with stainless steel screws.

2.3.17.1 Door Rain Drips

Approximately 1-1/2 inch high by 5/8 inch projection. Align bottom with bottom edge of door.

2.3.17.2 Overhead Rain Drips

Approximately 1-1/2 inch high by 2-1/2 inch projection, with length equal to overall width of door frame. Align bottom with door frame rabbet.

2.3.18 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.4 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with

hardware. Provide stainless steel or nonferrous metal fasteners that are exposed to weather. Provide fasteners of type necessary to accomplish a permanent installation.

2.5 FINISHES

BHMA A156.18. Provide hardware in BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze. Provide hinges for exterior doors in stainless steel with BHMA 630 finish or chromium plated brass or bronze with BHMA 626 finish. Furnish exit devices in BHMA 626 finish in lieu of BHMA 630 finish. Match exposed parts of concealed closers to lock and door trim.

2.6 KEY CABINET AND CONTROL SYSTEM

BHMA A156.5, Type E8331 (60 hooks).

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed installation instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weather Stripping Installation

Handle and install weather stripping to prevent damage. Provide full contact, weather-tight seals. Operate doors without binding.

3.1.2 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws.

3.2 FIRE DOORS AND EXIT DOORS

Install hardware in accordance with NFPA 80 for fire doors, NFPA 101 for exit doors.

3.3 HARDWARE LOCATIONS

SDI/DOOR A250.8, unless indicated or specified otherwise.

a. Kick and Armor Plates: Push side of single-acting doors. Both sides of double-acting doors.

b. Mop Plates: Bottom flush with bottom of door.

3.4 KEY CABINET AND CONTROL SYSTEM

Locate where directed. Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each

key. Furnish complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

## 3.5 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

-- End of Section --

SECTION 09 29 00

GYPSUM BOARD

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI A108.11 | (1992) Interior Installation of Cementitious Backer Units |
| ANSI/CTI A108/A118/A136.1 | (2005) Specification for the Installation of Ceramic Tile |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C 1002 | (2007) Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs |
| ASTM C 1047 | (2005) Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base |
| ASTM C 1396/C 1396M | (2006a) Standard Specification for Gypsum Board |
| ASTM C 36/C 36M | (2003e1) Gypsum Wallboard |
| ASTM C 475/C 475M | (2002; R 2007) Joint Compound and Joint Tape for Finishing Gypsum Board |
| ASTM C 514 | (2004) Standard Specification for Nails for the Application of Gypsum Board |
| ASTM C 630/C 630M | (2003e1) Water-Resistant Gypsum Backing Board |
| ASTM C 840 | (2007) Application and Finishing of Gypsum Board |
| ASTM C 954 | (2007) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness |

GYPSUM ASSOCIATION (GA)

| | |
|---|---|
| GA 214 | (1996) Recommended Levels of Gypsum Board Finish |
| GA 216 | (2004) Application and Finishing of Gypsum Board |
| GA 600 | (2003) Fire Resistance Design Manual |

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Cementitious backer units

Water-Resistant Gypsum Backing Board

Gypsum Wallboard

Accessories

Submit for each type of gypsum board and for cementitious backer units.

Gypsum Board

Adhesives;
Joint Treatment Materials

Submit manufacturer's product data, indicating VOC content.]

SD-07 Certificates

Asbestos Free Materials; G, AE

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

SD-08 Manufacturer's Instructions

Material Safety Data Sheets

## 1.3 DELIVERY, STORAGE, AND HANDLING

### 1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation. Store per manufacturer's recommendations for allowable temperature and humidity range. Gypsum wallboard shall not be stored with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants. Do not store panels near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.3.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Temperature

Maintain a uniform temperature of not less than 50 degrees F in the structure for at least 48 hours prior to, during, and following the application of gypsum board, cementitious backer units, and joint treatment materials, or the bonding of adhesives.

1.4.2 Exposure to Weather

Protect gypsum board and cementitious backer unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

1.4.3 Temporary Ventilation

Provide temporary ventilation for work of this section.

1.5 QUALIFICATIONS

Furnish type of gypsum board work specialized by the installer with a minimum of 3 years of documented successful experience.

1.6 SCHEDULING

The gypsum wall board shall be taped, spackled and primed before the installation of the highly-emitting materials, including but not limited to oil based coatings, solvents or adhesives. The gypsum wallboard shall be installed after the installation and ventilation period of the highly-emitting materials.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only.

Submit Material Safety Data Sheets and manufacturer maintenance instructions for gypsum materials including adhesives.

2.1.1 Gypsum Board

ASTM C 36/C 36M and ASTM C 1396/C 1396M. Gypsum board shall contain a minimum of 5 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content. Paper facings shall contain 100 percent post-consumer recycled paper content.

2.1.1.1 Regular

48 inch wide, 5/8 inch thick, tapered edges.

2.1.1.2 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, tapered edges.

2.1.2 Regular Water-Resistant Gypsum Backing Board

ASTM C 630/C 630M

2.1.2.1 Regular

48 inch wide, 5/8 inch thick, tapered edges.

2.1.2.2 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, tapered edges.

2.1.3 Cementitious Backer Units

ANSI/CTI A108/A118/A136.1. (48 inches) wide, (5/8 inches) thick; use as a substrate for porcelain tile in wet areas that are exposed to direct moisture contact or condensation accumulation such as tubs, shower enclosures, saunas, steam rooms, gang shower rooms, and shower drying rooms, etc. (ANSI A118.9).

2.1.4 [Enter Appropriate Subpart Title Here]2.1.4 Impact Resistant Gypsum Board

(48 inches( wide, (5/8 inch) thick, tapered edges. Reinforced moisture-resistant, fire-resistant gypsum panel with imbedded fiber mesh or lexan backing tested in accordance with the following tests.

Provide metal framing of 20 gauge minimum. Provide fasteners that meet manufacturer requirements and specifications. Impact resistant gypsum board, when tested in accordancw tih ASTM E 84, shall have a flame spread rating of 25 or less an da smoke developed rating of 50 or less. Board shall be formulated for use on the interior side of exterior walls in hot, humid climates. Use board that supports the use of standard cutting tools. Finish wiht a high strength plaster veneer.

Structural Failure Test; ASTM E 695 or ASTM D 2394
Indentation Test; ASTM D 5420 or ASTM D 1037
Test for Resistance to Mold Growth; ASTM 3273

2.1.4 Joint Treatment Materials

ASTM C 475/C 475M. Use all purpose joint and texturing compound containing inert fillers and natural binders, including lime compound. Pre-mixed compounds shall be free of antifreeze, vinyl adhesives, preservatives,

biocides and other slow releasing compounds.

2.1.4.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.4.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.4.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.4.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.4.5 Joint Tape

Use cross-laminated or tapered edge tape recommended by the manufacturer. Paper and fiberglass joint tape are not permitted.

2.1.5 Fasteners

2.1.5.1 Nails

ASTM C 514.

2.1.5.2 Screws

ASTM C 1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.033 inch thick. ASTM C 954 steel drill screws for fastening gypsum board to steel framing members 0.033 to 0.112 inch thick. Provide cementitious backer unit screws with a polymer coating.

2.1.6 Accessories

ASTM C 1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges shall be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials.

2.1.7 Water

Provide clean, fresh, and potable water.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and

cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of board and cementitious backer units.

## 3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C 840 or GA 216 and the requirements specified. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length; select panel sizes to minimize waste. Cut out gypsum board to make neat, close, and tight joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Lay out panels to minimize waste; reuse cutoffs whenever feasible. Surfaces of gypsum board and substrate members may not be bonded together with an adhesive. Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Minimize framing by floating corners with single studs and drywall clips. Install gypsum board over framing at 16 inches on center. Provide type of gypsum board for use in each system specified herein as indicated.

### 3.2.1 Application of Single-Ply Gypsum Board to Wood Framing

Apply in accordance with ASTM C 840, System I or GA 216.

### 3.2.2 Floating Interior Angles

Minimize framing by floating corners with single studs and drywall clips. Locate the attachment fasteners adjacent to ceiling and wall intersections in accordance with ASTM C 840, System XII or GA 216, for single-ply applications of gypsum board to wood framing.

### 3.2.3 Control Joints

Install expansion and contraction joints in ceilings and walls in accordance with ASTM C 840, System XIII or GA 216. Fill control joints between studs in fire-rated construction with firesafing insulation to match the fire-rating of construction.

## 3.3 APPLICATION OF CEMENTITIOUS BACKER UNITS

### 3.3.1 Application

In wet areas (tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply cementitious backer units in accordance with ANSI A108.11. Place a 15 lb asphalt impregnated, continuous felt paper membrane behind cementitious backer units, between backer units and studs or base layer of gypsum board. Place membrane with a minimum 6 inch overlap of sheets laid shingle style.

### 3.3.2 Joint Treatment

ANSI A108.11.

## 3.4 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C 840, GA 214 and GA 216. Finish walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings to Level 4 in accordance with GA 214. Finish all gypsum board walls, partitions and ceilings to Level 5 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Tool joints as smoothly as possible to minimize sanding and dust. Do not use fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer. Protect workers, building occupants, and HVAC systems from gypsum dust.

### 3.4.1 Uniform Surface

Wherever gypsum board is to receive eggshell, semigloss or gloss paint finish, or where severe, up or down lighting conditions occur, finish gypsum wall surface in accordance to GA 214 Level 5. In accordance with GA 214 Level 5, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.

## 3.5 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07 92 00 JOINT SEALANTS Apply material with exposed surface flush with gypsum board or cementitious backer units.

## 3.6 FIRE-RESISTANT ASSEMBLIES

Wherever fire-rated construction is indicated, provide materials and application methods, including types and spacing of fasteners, wall and ceiling framing in accordance with the specifications contained in UL Fire Resistance for the Design Number(s) indicated, or GA 600 for the File Number(s) indicated. Joints of fire-rated gypsum board enclosures shall be closed and sealed in accordance with UL test requirements or GA requirements. Seal penetrations through rated partitions and ceilings tight in accordance with tested systems.

## 3.7 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

## 3.8 WASTE MANAGEMENT

Identify manufacturer's policy for collection or return of remaining construction scrap, unused material, and packaging material. Institute demolition and construction recycling to take advantage of manufacturer's programs. When such a service is not available, seek local recyclers to reclaim the materials.

-- End of Section --

SECTION 09 30 00

CERAMIC AND PORCELAIN TILE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI A108.13 | Installation of Load Bearing, Bonded Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone. |
| ANSI A118.13 | Specifications for Load Bearing, Bonded Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installations. |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 185/A 185M | (2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete |
| ASTM C 1028 | (2007) Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method |
| ASTM C 144 | (2004) Standard Specification for Aggregate for Masonry Mortar |
| ASTM C 150 | (2007) Standard Specification for Portland Cement |
| ASTM C 206 | (2003) Standard Specification for Finishing Hydrated Lime |
| ASTM C 207 | (2006) Standard Specification for Hydrated Lime for Masonry Purposes |
| ASTM C 241 | (1990; R 2005) Standard Specification for Abrasion Resistance of Stone Subjected to Foot Traffic |
| ASTM C 33 | (2007) Standard Specification for Concrete Aggregates |
| ASTM C 373 | (1988; R 2006) Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products |

| | |
|---|---|
| ASTM C 482 | (2002) Bond Strength of Ceramic Tile to Portland Cement |
| ASTM C 501 | (1984; R 2002) Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser |
| ASTM C 648 | (2004) Breaking Strength of Ceramic Tile |
| ASTM F 446 | (1985; R 2004e1) Grab Bars and Accessories Installed in the Bathing Area |

MARBLE INSTITUTE OF AMERICA (MIA)

| | |
|---|---|
| MIA Design Manual | (2003) Dimension Stone Design Manual |

TILE COUNCIL OF AMERICA (TCA)

| | |
|---|---|
| TCA Hdbk | (2007) Handbook for Ceramic Tile Installation |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 36 CFR 1191 | Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G, AE

Drawings showing ceramic tile pattern in elevations and floor plans.

SD-03 Product Data

Tile; G, AE
Setting-Bed
Mortar, Grout, and Adhesive

Manufacturer's catalog data and preprinted installation and cleaning instructions. Indicate VOC content.

SD-04 Samples

Tile; G, AE
Accessories; G, AE
Marble Thresholds; G, AE
Grout; G, AE

Samples of sufficient size to show color range, pattern, type

and joints.

1.3 DELIVERY AND STORAGE

Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Protect materials from weather, and stored under cover in accordance with manufacturer's printed instructions.

1.4 ENVIRONMENTAL REQUIREMENTS

a. Close space in which tile is being set to traffic and other work. Keep closed until tile is firmly set. Do not walk or work on newly tiled floors without using kneeling boards or equivalent protection of the tiled surface. Keep traffic off horizontal portland cement mortar installations for at least 72 hours. Keep all traffic off epoxy installed floors for at least 40 hours after grouting, and heavy traffic off for at least 7 days, unless otherwise specifically authorized by manufacturer.

b. Do not perform ceramic tile work unless the substrate and ambient temperature is at least 50 degrees F and rising. Maintain temperature above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used, ventilate the area to the outside to avoid carbon dioxide damage to new tilework.

1.5 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period.

1.6 EXTRA STOCK

Supply an extra two percent of each type tile used in clean and marked cartons.

1.7 DETAIL DRAWINGS

Dimension and draw detail drawings at a minimum scale of 1/4 inch = 1 foot. Include drawings of pattern at inside corners, outside corners, termination points and location of all equipment items such as thermostats, switch plates, mirrors and toilet accessories mounted on surface.

PART 2 PRODUCTS

2.1 TILE

Conform to TCA Hdbk for standard grade tile. Provide grade sealed containers. Mark seals with the marks on the signed master grade certificate. Provide an impact resistant tile with a minimum floor breaking strength for wall tile of 100 pound and for floor tile of 300 pound in accordance with ASTM C 648. Provide a 0.20 maximum percent water absorption in accordance with ASTM C 373. Provide a minimum coefficient of friction of 0.60 wet and dry in accordance with ASTM C 1028. Coordinate the color as specified. Tile may contain post-consumer or post-industrial recycled content.

2.1.1 Mosaic Tile

Furnish ceramic mosaic tile and trim shall be unglazed natural clay with

cushion edges. Provide tile size 3 inch by 3 inch or as specified.

2.1.2 Porcelain Tile

Furnish an unglazed porcelain tile and trim for floor applications, and a glazed porcelain tile for wall applications with teh color extending uniformly through the body of the tile. Provide a nominal size of 8 by 8 or 12 by 12 by 5/16 inch thick or as indicated in the drawings. Criteria for tile to meet or exceed is as follows: Abrasive wear in accordance with ASTM C 501 and bonding strength in accordance with ASTM C 482. Comply with 36 CFR 1191 for coefficient of friction for interior tiled floors. Coordinate color as specified.

2.1.3 Accessories

Provide built-in type accessories of the same materials and finish as the wall tile. Provide accessories as follows:

| | Quantity | Location |
|---|---|---|
| a. Recessed soap holder and hand hold combination: support static load in compliance with ASTM F 446 | 1 | shower |

2.2 SETTING-BED

Compose the setting-bed of the following materials:

2.2.1 Aggregate for Concrete Fill

Conform to ASTM C 33 for aggregate fill. Do not exceed one-half the thickness of concrete fill for maximum size of coarse aggregate.

2.2.2 Portland Cement

Conform to ASTM C 150 for cement, Type I, white for wall mortar and gray for other uses.

2.2.3 Sand

Conform to ASTM C 144 for sand.

2.2.4 Hydrated Lime

Conform to ASTM C 206 for hydrated lime, Type S or ASTM C 207, Type S.

2.2.5 Reinforcing Wire Fabric

Conform to ASTM A 185/A 185M for wire fabric. Provide 2 by 2 inch mesh, 16/16 wire or 1-1/2 by 2 inch mesh, 16/13 wire. Wire fabric may contain post-consumer or post-industrial recycled content.]

2.3 WATER

Provide potable water.

## 2.4 MORTAR, GROUT, AND ADHESIVE

### 2.4.1 Dry-Set Portland Cement Mortar

TCA Hdbk. Zero-volatile organic compound (VOC) content.

### 2.4.2 Conductive Dry-Set Mortar

TCA Hdbk. Zero-VOC content.

### 2.4.3 Latex-Portland Cement Mortar

TCA Hdbk. Zero-VOC content.

### 2.4.4 Ceramic Tile Grout

TCA Hdbk; petroleum-free and plastic-free sand portland cement grout dry-set grout latex-portland cement grout per TCA Hdbk. Maximum VOC content of 150 grams/liter.

### 2.4.5 Sealants

Comply with applicable regulations regarding toxic and hazardous materials and as specified. Single-component polyurethane sealant shall have a zero-VOC content. Two-component polyurethane sealant shall have a maximum VOC content of 45 grams/liter.

### 2.4.6 Cementitious Backer Board

Provide cementitious backer units, for use as tile substrate over wood sub-floors, in accordance with TCA Hdbk. Furnish 1/2 or 5/8 inch thick cementitious backer units.

## 2.5 MARBLE THRESHOLDS

Provide marble thresholds of size required by drawings or conditions. Categorize marble Group A as classified by MIA Design Manual. Provide a fine sand-rubbed finish marble with white in color. Provide minimum 12.0 marble abrasion when tested in accordance with ASTM C 241.

## 2.6 MEMBRANE MATERIALS

Conform to ANSI 118.10 and ANSI 108.13.

# PART 3 EXECUTION

## 3.1 PREPARATORY WORK AND WORKMANSHIP

Inspect surface to receive tile in conformance to the requirements of TCA Hdbk for surface conditions for the type setting bed specified and for workmanship. Provide variations of tiled surfaces that fall within maximum values shown below:

| TYPE | WALLS | FLOORS |
|---|---|---|
| Dry-Set Mortar | 1/8 inch in 8 ft. | 1/8 inch in 10 ft. |
| Organic Adhesives | 1/8 inch in 8 ft. | 1/16 inch in 3 ft. |
| Latex Portland Cement Mortar | 1/8 inch in 8 ft. | 1/8 inch in 10 ft. |
| Epoxy | 1/8 inch in 8 ft. | 1/8 inch in 10 ft. |

| TYPE | WALLS | FLOORS |
|---|---|---|

3.2 GENERAL INSTALLATION REQUIREMENTS

Do not start tile work until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Do not start floor tile installation in spaces requiring wall tile until after wall tile has been installed. Apply tile in colors and patterns indicated in the area shown on the drawings. Install tile with the respective surfaces in true even planes to the elevations and grades shown. Provide special shapes as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Solidly back tile bases and coves with mortar.

3.3 INSTALLATION OF WALL TILE

Install wall tile in accordance with the TCA Hdbk, method W244.

3.3.1 Workable or Cured Mortar Bed

Install tile over workable mortar bed or a cured mortar bed at the option of the Contractor. Install a 4 mil polyethylene membrane, metal lath, and scratch coat. Conform to TCA Hdbk for workable mortar bed, materials, and installation of tile. Conform to TCA Hdbk for cured mortar bed and materials.

3.3.2 Dry-Set Mortar and Latex-Portland Cement Mortar

Use Dry-set or Latex-Portland Cement to install tile in accordance with TCA Hdbk. Use Latex Portland Cement when installing porcelain ceramic tile.

3.4 INSTALLATION OF FLOOR TILE

Install floor tile in accordance with TCA Hdbk method F144. Install shower receptors in accordance with TCA Hdbk method B426.

3.4.1 Workable or Cured Mortar Bed

Install floor tile over a workable mortar bed or a cured mortar bed at the option of the Contractor. Conform to TCA Hdbk for workable mortar bed materials and installation. Conform to TCA Hdbk for cured mortar bed materials and installation. Provide minimum 1/4 inch to maximum 3/8 inch joints in uniformed width.

3.4.2 Dry-Set and Latex-Portland Cement

Use dry-set or Latex-Portland cement mortar to install tile directly over properly cured, plane, clean concrete slabs in accordance with TCA Hdbk. Use Latex Portland cement when installing porcelain ceramic tile.

3.4.3 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with TCA Hdbk.

3.4.4 Waterproofing Membrane

Install shower membrane per manufacturer's written instruction and TCA Hdbk.

### 3.4.5 Concrete Fill

Provide a 3500 psi concrete fill mix to dry as consistency as practicable. Compose concrete fill by volume of 1 part Portland cement to 3 parts fine aggregate to 4 parts coarse aggregate, and mix with water to as dry a consistency as practicable. Spread, tamp, and screed concrete fill to a true plane, and pitch to drains or levels as shown. Thoroughly damp concrete fill before applying setting-bed material. Reinforce concrete fill with one layer of reinforcement, with the uncut edges lapped the width of one mesh and the cut ends and edges lapped a minimum 2 inch. Tie laps together with 18 gauge wire every 10 inch along the finished edges and every 6 inch along the cut ends and edges. Provide reinforcement with support and secure in the centers of concrete fills. Provide a continuous mesh; except where expansion joints occur, cut mesh and discontinue across such joints. Provide reinforced concrete fill under the setting-bed where the distance between the under-floor surface and the finished tiles floor surface is a minimum2 inch, and of the same thickness that the mortar setting-bed over the concrete fill with the thickness required in the specified TCA Hdbk method.

## 3.5 INSTALLATION OF MARBLE THRESHOLDS

Install thresholds where indicated, in a manner similar to that of the ceramic tile floor. Provide thresholds full width of the opening. Install head joints at ends not exceeding 1/4 inch in width and grouted full.

## 3.6 EXPANSION JOINTS

Form and seal joints as specified in Section 07 92 00 JOINT SEALANTS.

### 3.6.1 Walls

Provide expansion joints at control joints in backing material. Wherever backing material changes, install an expansion joint to separate the different materials.

### 3.6.2 Floors

Provide expansion joints over construction joints, control joints, and expansion joints in concrete slabs. Provide expansion joints where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 24 to 36 feet each way in large interior floor areas and 12 to 16 feet each way in large exterior areas or areas exposed to direct sunlight or moisture. Extend expansion joints through setting-beds and fill.

## 3.7 CLEANING AND PROTECTING

Upon completion, thoroughly clean tile surfaces in accordance with manufacturer's approved cleaning instructions. Do not use acid for cleaning glazed tile. Clean floor tile with resinous grout or with factory mixed grout in accordance with printed instructions of the grout manufacturer. After the grout has set, provide a protective coat of a noncorrosive soap or other approved method of protection for tile wall surfaces. Cover tiled floor areas with building paper before foot traffic is permitted over the finished tile floors. Provide board walkways on tiled floors that are to be continuously used as passageways by workmen. Replace damaged or defective tiles.

-- End of Section --

SECTION 09 68 00

CARPET
**01/07**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

CARPET AND RUG INSTITUTE (CRI)

| | |
|---|---|
| CRI 104 | (2002) Standard for Installation Specification of Commercial Carpet |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation; GAE
Molding; G

Three copies of drawings indicating areas receiving carpet, carpet types, textures and patterns, direction of pile, location of seams, and locations of edge molding. Installation drawings for the following items diagramming the location of seams, edge moldings, and carpet direction for approval prior to installation.

1) Carpet Pads
2) Carpet Moldings
3) Base

SD-03 Product Data

Carpet; GAE
Carpet Pads; G
Carpet Moldings; G
Base; G, AE

Manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading, and flame resistance characteristics for each type of carpet material and installation accessory. Submit manufacturer's catalog data for the following items:

1) Carpet Pads
2) Carpet Moldings
3) Base

Surface Preparation; G, AE
Installation; G, AE

Three copies of the manufacturer's printed installation instructions for the carpet, including preparation of substrate, seaming techniques, and recommended adhesives and tapes.

SD-04 Samples

Carpet; G, AE
Molding; G, AE

a. Carpet: Two "Production Quality" samples 18 by 18 inches of each carpet proposed for use, showing quality, pattern, and color specified.

b. Vinyl or Aluminum Moldings: Two pieces of each type at least 12 inches long.

c. Special Treatment Materials: Two samples showing system and installation method.

SD-06 Test Reports

Moisture and Alkalinity Tests; G

Three copies of test reports of moisture and alkalinity content of concrete slab stating date of test, person conducting the test, and the area tested.

SD-07 Certificates

Carpet; G

Certificates of compliance from a laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards and Technology attesting that each type of carpet and carpet with cushion material conforms to the standards specified.

SD-10 Operation and Maintenance Data

Carpet; G; AE
Cleaning and Protection; G

Three copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles.

## 1.3 REGULATORY REQUIREMENTS

Provide the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) label for carpet, carpet cushion, and adhesives or demonstrate compliance with testing criteria and frequencies through independent laboratory test results. Carpet, carpet cushion, and adhesives bearing the label will indicate that the carpet has been tested and meets the criteria of the CRI IAQ Carpet Testing Program, and minimizes the impact on indoor air quality.

## 1.4 DELIVERY AND STORAGE

Deliver materials to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Remove materials from packaging and store them in a clean, dry, well ventilated area (100 percent outside air supply, minimum of 1.5 air changes per hour, and no recirculation), protected from damage, soiling, and moisture, and strong contaminant sources and residues,and maintain at a temperature above 60 degrees F for 2 days prior to installation. Carpet or carpet tiles shall not be stored with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants. Do not store carpet near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

## 1.5 ENVIRONMENTAL REQUIREMENTS

Maintain areas in which carpeting is to be installed at a temperature above 60 degrees F and below 90 degrees F for 2 days before installation, during installation, and for 2 days after installation. Provide temporary ventilation during work of this section. Maintain a minimum temperature of 55 degrees F thereafter for the duration of the contract. Do not permit traffic or movement of furniture or equipment in carpeted area for 24 hours after installation. Complete other work which would damage the carpet prior to installation of carpet.

## 1.6 SCHEDULING

Install carpet systems after the installation and ventilation period of materials or finishes which have high short-term emissions of VOCs, formaldehyde, particulates, or other air-borne compounds which may be adsorbed by or settle on the carpet tiles.

## 1.7 WARRANTY

Provide manufacturer's standard performance guarantees or warranties including minimum ten (10) year wear warranty, two (2) year material and workmanship and ten (10) year tuft bind and delamination.

## 1.8 OPERATIONAL SERVICE

Collect information from the manufacturer about maintenance agreement options, and submit to Contracting Officer. Service shall reclaim materials for recycling and/or reuse. Service shall not landfill or burn reclaimed materials. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

## 1.9 EXTRA MATERIAL

Provide extra material from same dye lot consisting of full width continuous broadloom and uncut carpet tiles for future maintenance. Provide a minimum of 15 percent of total square yards of each carpet type, pattern, and color.

PART 2 PRODUCTS

2.1 CARPET

Furnish first quality carpet; free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains, and other physical and manufacturing defects. Provide carpet materials and treatments as reasonably nonallergenic and free of other recognized health hazards. Provide a static control construction on all grade carpets which gives adequate durability and performance. Provide the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) Label. Carpet type bearing the label will indicate that carpet has been tested and meets the criteria of the CRI Green Label Requirements for Indoor Air Quality Test Criteria.

2.1.1 Modular Tile Carpet CPTT-1

Carpet shall comply with the following:

a. Carpet Construction: Provide a 24" x 24" modular, commercial quality, multi-colored, multi-level, textured, patterned loop carpet floor tile with factory-attached cushion. Carpet fiber shall be branded, 100% 6 or 6,6 nylon of Dupont Antron Lumina nylon, Mohawk Colorstrand SD nylon, Shaw Tile Eco Solution Q nylon, J&J Encore, or Solutia VIP and contian at lease 40% recycled nylon. Dye method shall be 100% solution dyed. Carpet tile shall have a non-woven synthetic primary backing and a secondary backing of fiberglass reinforced thermoplastic composition. Minimum Pile weight shall be 28 oz/sq. yd. Minimum yarn density shall be 6,500. Carpet must be treated with an anti-microbial agent. The attached cushion shall be suitable for severe traffic installation and shall not exceed 9 mm (3/8 inch) in thickness. Mohawk EcoFlex Modular System cushion, or equal, is acceptable.

   Carpet shall be Class I, meeting the minimum radiant flux requirements if NFPA 101 when tested in accordance with ASTM E 648. Carpet shall include a permanent static control system to control static build-up to less than 3.5 KV in accordance with AATCC-134. A lifetime warranty for colorfastness to light, static, staining, and wear is required. A 10-year warranty for colorfastness to atmospheric contaminants is required. CRI appearance retention rating shall be for severe traffic. Capret shall meet all CRI requirements for the IAQ Green Label Plus.

   Provide quick release glue down application. Adhesive(s) shall be recommended by the carpet manufacturer and in accordance with the warranty. Installer(s) shall be approved by the manufacturer, in writing. Carpet manufacturer shall be established and in good standing with industry. The manufacturer's technical representative shall review and approve each tuypical sample application or each room installation on-site prior to resuming the intallation and render on-site approval of the completed installation.

   A minimum of 2% total quantity for each color and pattern shall be provided, delivered, and stored within the on-base, designated storage facility for future replacement patching.

2.1.1.1 Cut and Loop Pile Carpet Tiles (CPTT-2)

Comply with the following carpet requirements:

a. Carpet Construction: Provide a 24" x 24" modular, commercial quality, multi-colored, textured, (upgraded appearance) patterned cut/loop carpet floor tile with factory-attached cushion. Carpet fiber shall be branded, 100% 6 or 6,6 nylon of Dupont Antron Lumina nylon, Mohawk Colorstrand SD nylon, Shaw Tile Eco Solution Q nylon, J&J Encore, or Solutia VIP and contian at lease 40% recycled nylon. Dye method shall be 100% solution dyed or a compbination of 80% solution dyed and 20% yarn dyed. Carpet tile shall have a non-woven synthetic primary backing and a secondary backing of fiberglass reinforced thermoplastic composition. Minimum Pile weight shall be 30 oz/sq. yd. Minimum yarn density shall be 6,500. Carpet must be treated with an anti-microbial agent. The attached cushion shall be suitable for severe traffic installation and shall not exceed 9 mm (3/8 inch) in thickness. Mohawk EcoFlex Modular System cushion, or equal, is acceptable.

   Carpet shall be Class I, meeting the minimum radiant flux requirements if NFPA 101 when tested in accordance with ASTM E 648. Carpet shall include a permanent static control system to control static build-up to less than 3.5 KV in accordance with AATCC-134. A lifetime warranty for colorfastness to light, static, staining, and wear is required. A 10-year warranty for colorfastness to atmospheric contaminants is required. CRI appearance retention rating shall be for severe traffic. Capret shall meet all CRI requirements for the IAQ Green Label Plus.

   Provide quick release glue down application. Adhesive(s) shall be recommended by the carpet manufacturer and in accordance with the warranty. Installer(s) shall be approved by the manufacturer, in writing. Carpet manufacturer shall be established and in good standing with industry. The manufacturer's technical representative shall review and approve each tuypical sample application or each room installation on-site prior to resuming the intallation and render on-site approval of the completed installation.

   A minimum of 2% total quantity for each color and pattern shall be provided, delivered, and stored within the on-base, designated storage facility for future replacement patching.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Do not install carpet on surfaces that are unsuitable and will prevent a proper installation. Repair holes, cracks, depressions, or rough areas using material recommended by the carpet or adhesive manufacturer. Free floor of any foreign materials and sweep clean. Before beginning work, test subfloor with glue and carpet to determine "open time" and bond.

3.2 MOISTURE AND ALKALINITY TESTS

Test concrete slab shall for moisture content and excessive alkalinity in accordance with CRI 104.

## 3.3 PREPARATION OF CONCRETE SUBFLOOR

Do not commence installation of the carpeting shall until concrete substrate is at least 90 days old. Prepare the concrete surfaces in accordance with instructions of the carpet manufacturer. Match carpet, when required, and adhesives to prevent off-gassing to a type of curing compounds, leveling agents, and concrete sealer.

## 3.4 INSTALLATION

Isolate area of installation from rest of building. Perform all work by installers who are CFI certified (International Certified Floorcovering Installer Association), or manufacturer's approved installers. Conduct installation in accordance with the manufacturer's printed instructions and CRI 104. Protect edges of carpet meeting hard surface flooring with molding and install in accordance with the molding manufacturer's printed instructions. Mothproofing for wool carpets shall use autofoam mothproofing system. Follow ventilation, personal protection, and other safety precautions recommended by the adhesive manufacturer. Continue ventilation during installation and for at least 72 hours following installation.

### 3.4.1 Modular Tile Installation

Install modular tiles with quick release adhesive, snugly jointed together. Lay tiles in the same direction with accessibility to the subfloor where required.

### 3.4.2 Entrance Carpet Installation

Install tiles with quick release adhesive, snugly jointed together. Lay tiles in the same direction. Prepare regular, unnoticeable, and treated seams with a seam adhesive. Install breadths parallel, with carpet pile in the same direction. Match patterns accurately. Neatly cut and fit, securely, cutouts at door jambs, columns, and ducts. Locate seams at doorways parallel to and centered directly under doors. Do not make seams perpendicular to doors or at pivot points.

## 3.5 CLEANING AND PROTECTION

### 3.5.1 Cleaning

As specified. After installation of the carpet, remove debris, scraps, and other foreign matter. Remove soiled spots and adhesive from the face of the carpet with appropriate spot remover. Cut off and remove protruding face yarn. Vacuum carpet clean with a high-efficiency particulate air (HEPA) filtration vacuum.

### 3.5.2 Protection

Protect the installed carpet from soiling and damage with heavy, reinforced, nonstaining kraft paper, plywood, or hardboard sheets. Lap and secure edges of kraft paper protection to provide a continuous cover. Restrict traffic for at least 48 hours. Remove protective covering when directed by the Contracting Officer.

## 3.6 REMNANTS

Manage waste as specified in the Waste Management Plan. Provide remnants

remaining from the installation, consisting of scrap pieces more than 2 feet in dimension with more than 6 square feet total to the Government. Remove non-retained scraps from site and recycle appropriately.

-- End of Section --

SECTION 09 90 00

PAINTS AND COATINGS
**08/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

| | |
|---|---|
| ACGIH 0100Doc | (2005) Documentation of the Threshold Limit Values and Biological Exposure Indices |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D 2092 | (1995; R 2001e1) Standard Guide for Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting |
| ASTM D 4263 | (1983; R 2005) Indicating Moisture in Concrete by the Plastic Sheet Method |
| ASTM D 4444 | (2008) Use and Calibration of Hand-Held Moisture Meters |
| ASTM D 523 | (2008) Standard Test Method for Specular Gloss |
| ASTM F 1869 | (2004) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride |

MASTER PAINTERS INSTITUTE (MPI)

| | |
|---|---|
| MPI 107 | (Jan 2004) Rust Inhibitive Primer (Water-Based) |
| MPI 77 | (Jan 2004) Epoxy Gloss |

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

| | |
|---|---|
| SCS SP-01 | (2000) Environmentally Preferable Product Specification for Architectural and Anti-Corrosive Paints |

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

| | |
|---|---|
| SSPC PA 1 | (2000; E 2004) Shop, Field, and Maintenance Painting |
| SSPC PA Guide 3 | (1982; E 1995) A Guide to Safety in Paint Application |

SSPC SP 1 (1982; E 2004) Solvent Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101 (Rev B) Color Code for Pipelines & for Compressed Gas Cylinders

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-313 (Rev D; Am 1) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000 Air Contaminants

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

In keeping with the intent of Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition", products certified by SCS as meeting SCS SP-01 shall be given preferential consideration over registered products. Products that are registered shall be given preferential consideration over products not carrying any EPP designation.

SD-02 Shop Drawings

Piping identification

Submit color stencil codes

SD-03 Product Data

Materials

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Coating G

Manufacturer's Technical Data Sheets

Indicate VOC content.

SD-08 Manufacturer's Instructions

Application instructions

Mixing

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-10 Operation and Maintenance Data

Coatings: G

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

## 1.3 REGULATORY REQUIREMENTS

### 1.3.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

### 1.3.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

### 1.3.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

### 1.3.4 Asbestos Content

Materials shall not contain asbestos.

### 1.3.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.3.6 Silica

Abrasive blast media shall not contain free crystalline silica.

1.3.7 Human Carcinogens

Materials shall not contain ACGIH 0100Doc and ACGIH 0100Doc confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.4 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F. Do not store paint, polyurethane, varnish, or wood stain products with materials that have a high capacity to adsorb VOC emissions. Do not store paint, polyurethane, varnish, or wood stain products in occupied spaces.

1.5 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations.

1.5.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA Guide 3.

1.5.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH 0100Doc, threshold limit values.

]1.6 ENVIRONMENTAL CONDITIONS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation.

1.6.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point;

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

1.6.2 Post-Application

Vacate space for as long as possible after application. Wait a minimum of 48 hours before occupying freshly painted rooms. Maintain one of the following ventilation conditions during the curing period, or for 72 hours after application:

a. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.7 SCHEDULING

Allow paint, polyurethane, varnish, and wood stain installations to cure prior to the installation of materials that adsorb VOCs, including furnishings.

1.8 COLOR SELECTION

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

1.9 LOCATION AND SURFACE TYPE TO BE PAINTED

1.9.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.9.1.1 Exterior Painting

Includes new surfaces and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

1.9.1.2 Interior Painting

Includes new surfaces and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

a. Exposed columns, girders, beams, joists, and metal deck; and

b. Other contiguous surfaces.

1.9.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

1.9.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

(1) Exposed piping, conduit, and ductwork;

(2) Supports, hangers, air grilles, and registers;

(3) Miscellaneous metalwork and insulation coverings.

b. Do not paint the following, unless indicated otherwise:

(1) New zinc-coated, aluminum, and copper surfaces under insulation.

(2) New aluminum jacket on piping.

(3) New interior ferrous piping under insulation.

1.9.4 Exterior Painting of Site Work Items

Field coat the following items:

New Surfaces

a. Steel Bollards

1.9.5 Definitions and Abbreviations

1.9.5.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.9.5.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

1.9.5.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendaring, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.9.5.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.9.5.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.9.5.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.9.5.7 EXT

MPI short term designation for an exterior coating system.

1.9.5.8 INT

MPI short term designation for an interior coating system.

1.9.5.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.9.5.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.9.5.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.9.5.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

| Gloss Level | Description | Units @ 60 degrees | Units @ 85 degrees |
|---|---|---|---|
| G1 | Matte or Flat | 0 to 5 | 10 max |
| G2 | Velvet | 0 to 10 | 10 to 35 |
| G3 | Eggshell | 10 to 25 | 10 to 35 |
| G4 | Satin | 20 to 35 | 35 min |
| G5 | Semi-Gloss | 35 to 70 | |
| G6 | Gloss | 70 to 85 | |
| G7 | High Gloss | | |

Gloss is tested in accordance with ASTM D 523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.9.5.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

1.9.5.14 Paint

See Coating definition.

1.9.5.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.9.5.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents. Comply with applicable regulations regarding toxic and hazardous materials.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 Surface Condition

Surfaces shall be clean, dry to the touch, and free from frost and moisture; remove grease, oil, wax, lacquer, paint, defective backstop, or other foreign matter that would prevent or impair adhesion. Where adequate grooves have not been provided, clean out to a depth of 1/2 inch and grind to a minimum width of 1/4 inch without damage to adjoining work. Grinding shall not be required on metal surfaces.

3.2.1 Backstops

In joints more than 1/2 inch deep, install glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free of oil or other staining elements as recommended by sealant manufacturer. Backstop material shall be compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

3.2.2 Primer and Bond Breaker

Install the type recommended by the sealant manufacturer.

3.2.3 Ambient Temperature

Between 38 degrees F and 95 degrees F when applying sealant.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Existing and New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: detergent wash in accordance with SSPC SP 1 to remove oil and grease. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

3.3.2 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 2092, Appendix X2, and remove by one of the methods described therein.

3.3.3 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

a. Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.3.4 Existing Surfaces with a Bituminous or Mastic-Type Coating

Remove chalk, mildew, and other loose material by washing with a solution of 1/2 cup trisodium phosphate, 1/4 cup household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, Chalking, Grease, and Oil: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cuphousehold detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water.

(2) Fungus and Mold: Wash new and existing uncoated] surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

(3) Paint and Loose Particles: Remove by wire brushing.

(4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in

accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D 4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F 1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board

a. Surface Cleaning: Plaster and stucco shall be clean and free from loose matter; gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.

b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263. New plaster to be coated shall have a maximum moisture content of 8 percent, when measured in accordance with ASTM D 4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.5 APPLICATION

3.5.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

e. Floors: For nonslip surfacing on level floors, as the intermediate coat is applied, cover wet surface completely with almandite garnet, Grit No. 36, with maximum passing U.S. Standard Sieve No. 40 less than 0.5 percent. When the coating is dry, use a soft bristle broom to sweep up excess grit, which may be reused, and vacuum up remaining residue before application of the topcoat. For nonslip surfacing on ramps, provide MPI 77 with non-skid additive, applied by roller in accordance with manufacturer's instructions.

### 3.5.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

### 3.5.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.5.4 Coating Systems

a. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.

b. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

c. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:

(1) One coat of primer.

(2) One coat of undercoat or intermediate coat.

(3) One topcoat to match adjacent surfaces.

3.6 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 1.5 mils DFT immediately prior to application of epoxy or urethane coatings.

e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.7 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

3.8 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in

accordance with MIL-STD-101. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

## 3.9 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

## 3.10 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows. Do not use kerosene or any such organic solvents to clean up water based paints. Properly dispose of paints or solvents in designated containers. Close and seal partially used containers of paint to maintain quality as necessary for reuse. Store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste in designated containers. Set aside extra paint for future color matches or reuse by the Government.

## 3.11 PAINT TABLES

All DFT's are minimum values. Use only interior paints and coatings that meet VOC requirements of LEED low emitting materials credit where such paints meet coating specifications. Acceptable products are listed in the MPI Green Approved Products List, available at http://www.specifygreen.com/APL/ProductIdxByMPInum.asp.

PAINTED FINISHES TO EXTERIOR CONCRETE SURFACES

New concrete; vertical surfaces, undersides of balconies and soffits, but excluding tops of slabs:

Latex, System DFT: 3.5 mils
a. New; MPI EXT 3.1A-G2 (Flat)/Existing; MPI REX 3.1A-G2 (Flat); Primer: MPI 10, Intermediate: MPI 10, Topcoat: MPI 10
b. New; MPI EXT 3.1A-G5 (Semigloss) / Existing; MPI REX 3.1A-G5 (Semigloss); Primer: MPI 11, Intermediate: MPI 11, Topcoat: MPI 11

PAINTED FINISHES TO EXTERIOR CONCRETE MASONRY SURFACES

New concrete masonry:

Latex, System DFT: 11 mils
a. New; MPI EXT 4.2A-G1 (Flat)/Existing; MPI REX 4.2A-G1 (Flat); Block filler: MPI 4, Primer: N/A, Intermediate: MPI 10, Topcoat: MPI 10
b. New; MPI EXT 4.2A-G5 (Semigloss) / Existing; MPI REX 4.2-G5 (Semigloss); Block filler: MPI 4, Primer: N/A, Intermediate: MPI 11, Topcoat: MPI 11

PAINTED FINISHES TO EXTERIOR METAL SURFACES

New Steel that has been blast cleaned to SSPC SP 6:

Epoxy System with Waterborne Light Industrial
Coating Topcoat, DFT: 8.5 mils
a. New; MPI EXT 5.1D-G5 (Semigloss); Primer: MPI 101, Intermediate:
MPI 108, Topcoat: MPI 163

New Galvanized surfaces:

Epoxy System with Waterborne Light Industrial
Coating Topcoat, System DFT: 8.5 mils
a. New; MPI REX 5.3L-G5 (Semigloss); Primer: MPI 101, Intermediate:
MPI 108, Topcoat: MPI 163

PAINTED FINISHES TO GYPSUM BOARD WALL SURFACES

New, previously painted gypsum wallboard not otherwise
specified:

High Performance Architectural Latex, System DFT:
4 mils
a. New; MPI INT 9.2B-G2 (Flat)/Existing; MPI RIN 9.2B-G2 (Flat);
Primer: MPI 50, Intermediate: MPI 138, Topcoat: MPI 138
b. New; MPI INT 9.2B-G3 (Eggshell) / Existing; MPI RIN 9.2B-G3
(Eggshell); Primer: MPI 50, Intermediate: MPI 139, Topcoat: MPI 139
c. New; MPI INT 9.2B-G5 (Semigloss) / Existing; MPI RIN 9.2B-G5
(Semigloss); Primer: MPI 50, Intermediate: MPI 141, Topcoat: MPI 141

Institutional Low Odor / Low VOC Latex, System DFT:
4 mils
a. New; MPI INT 9.2M-G3 (Eggshell) / Existing; MPI RIN 9.2M-G3
(Eggshell); Primer: MPI 50, Intermediate: MPI 145, Topcoat: MPI 145
b. New; MPI INT 9.2M-G4 (Satin) / Existing; MPI RIN 9.2M-G4 (Satin);
Primer: MPI 50, Intermediate: MPI 146, Topcoat: MPI 146
c. New; MPI INT 9.2M-G5 (Semigloss) / Existing; MPI RIN 9.2M-G5
(Semigloss); Primer: MPI 50, Intermediate: MPI 147, Topcoat: MPI 147

New, previously painted gypsum wallboard in toilets,
restrooms, shower areas, areas requiring a high degree of sanitation, and
other high humidity areas not otherwise specified:

Waterborne Light Industrial Coating, Use for high
traffic areas. System DFT: 4 mils
New; MPI INT 9.2L-G5(Semigloss) / Existing; MPI RIN 9.2L-G5 (Semigloss)
Primer: MPI 50, Intermediate: MPI 110-G5, Topcoat: MPI 110-G5

New, previously painted gypsum wallboard in Janitor’s
Closet.
Water-based Epoxy, MPI No. 115. Apply at not less
than manufacturer’s recommended spreading rate.

PAINTED FINISHES TO BLOCK WALL SURFACES

New concrete masonry, (Fill all holes in masonry
surface):

High Performance Architectural Latex, System DFT:
11 mils
a. New; MPI INT 4.2D-G2 (Flat) Filler: MPI 4, Primer: N/A,

Intermediate: MPI 138, Topcoat: MPI 138
b. New; MPI INT 4.2D-G3 (Eggshell) Filler: MPI 4, Primer: N/A,
Intermediate: MPI 139, Topcoat: MPI 139
c. New; MPI INT 4.2D-G5 (Semigloss) Filler: MPI 4, Primer: N/A,
Intermediate: MPI 141, Topcoat: MPI 141

Institutional Low Odor / Low VOC Latex, System DFT:
4 mils
a. New; MPI INT 4.2E-G3 (Eggshell) Filler: MPI 4, Primer: N/A,
Intermediate: MPI 145, Topcoat: MPI 145
b. New; MPI INT 4.2E-G5 (Semigloss) Filler: MPI 4, Primer: N/A,
Intermediate: MPI 147, Topcoat: MPI 147

New concrete masonry units in toilets, food-preparation, food-serving, restrooms, laundry areas, shower areas, areas requiring a high degree of sanitation, and other high humidity areas unless otherwise specified, (Fill all holes in masonry surface):

Waterborne Light Industrial Coating, System DFT:
11 mils
a. MPI INT 4.2K-G3(Eggshell) Filler: MPI 4, Primer: N/A,
Intermediate: MPI 110-G3, Topcoat: MPI 110-G3
b. MPI INT 4.2K-G5(Semigloss) Filler: MPI 4, Primer: N/A,
Intermediate: MPI 110-G5, Topcoat: MPI 110-G5

PAINTED FINISHES TO INTERIOR GRILLES, REGISTERS, DIFFUSERS, ACCESS PANELS AND PANEL BOXES
Interior grilles, registers, diffusers, access panels and panel boxes shall be painted with a primer and two coats of high performance latex or alkyd semi gloss or have a factory finish in a color to match the adjacent surfaces.

-End of Section

SECTION 10 14 02

INTERIOR SIGNAGE
**02/09**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

| | |
|---|---|
| AA DAF-45 | (2003) Designation System for Aluminum Finishes |
| AA PK-1 | (2008) Pink Sheets: Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings and Ingot |

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

| | |
|---|---|
| AAMA 2604 | (2005) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels |

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI Z97.1 | (2004) Safety Glazing Materials Used in Buildings |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.2/D1.2M | (2008) Structural Welding Code - Aluminum |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM B 209 | (2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate |
| ASTM B 221 | (2008) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 36 CFR 1191 | Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities |

1.1.1 Sub Title

Text

1.2 SUBMITTALS

1.2 [Enter Appropriate Subpart Title Here]

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings G

Drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, mounting height, shape and thickness of materials, and details of construction. A schedule showing the location, each sign type, and message shall be included.

SD-03 Product Data

Installation G

Manufacturer's descriptive data, catalogs cuts, installation and cleaning instructions.

SD-04 Samples

Interior Signage G

One sample of each of the following sign types showing typical quality, workmanship and color. The samples may be installed in the work, provided each sample is identified and location recorded.

a. Directional sign.

b. Standard Room sign.

c. Changeable message strip sign.

SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions G
Protection and Cleaning G

Six copies of operating instructions outlining the step-by-step procedures required for system operation shall be provided. The instructions shall include simplified diagrams for the system as installed. Six copies of maintenance instructions listing routine procedures, repairs, and guides shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number.

1.3 GENERAL

Interior signage shall be of the design, detail, sizes, types, and message content shown on the drawings/attachments/signage placement schedule (as applicable), shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Signage shall be obtained from a single manufacturer with edges and corners of finished letterforms and graphics true and clean.

1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening.

1.5 DELIVERY AND STORAGE

Materials shall be packaged to prevent damage and deterioration during shipment, handling, storage and installation. Product shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 ROOM IDENTIFICATION/DIRECTIONAL SIGNAGE SYSTEM

2.1.1 Standard Room Signs

Signs shall consist of acrylic plastic 0.090 inch thickness minimum conforming to ANSI Z97.1 laminated thermosetting Type MP plastic (three-ply melamine plastic laminate with phenolic core and shall conform to the following:

Frames shall be aluminum. Frames shall be 1/8 inch thick.

End caps shall be molded acrylic with square style corners.

2.1.2 Changeable Message Strip Signs

Changeable message strip signs shall be of same construction as standard room signs to include a clear sleeve that will accept a paper or plastic insert identifying changeable text. Sliding inserts or slide knobs that slide horizontally exposing different graphic information shall be provided as identified in the signage placement schedule.

2.1.3 Type of Mounting For Signs

Extruded aluminum brackets shall be provided for hanging, projecting, and double-sided signs. Mounting for framed, hanging, and projecting signs shall be by mechanical fasteners. Surface mounted signs shall be mounted with countersunk mounting holes in plaques and mounting screws fabricated from materials that are not corrosive to sign material and mounting surface.

2.1.4 Graphics

Signage graphics for modular signs shall conform to the following:

Surface Applied Photopolymer: Integral graphics and braille achieved by photomechanical stratification processes. Photopolymer used for ADA compiant graphics shall be of the type that has a minimum durometer reading of 90. Tactile graphics shall be raised 1/32 inch from the first surface of plaque by photomechanical stratification process.

2.1.5 Character Proportions and Heights

Letters and numbers on signs conform to 36 CFR 1191.

2.1.6 Raised and Braille Characters and Pictorial Symbol Signs (Pictograms)

Raised letters and numbers on signs shall conform to 36 CFR 1191.

2.2 ALUMINUM ALLOY PRODUCTS

Aluminum extrusions shall be at least 1/8 inch thick, and aluminum plate or sheet shall be at least 0.0508 inch thick. Extrusions shall conform to ASTM B 221; plate and sheet shall conform to ASTM B 209. Where anodic coatings are specified, alloy shall conform to AA PK-1 alloy designation 514.0. Exposed anodized aluminum finishes shall be as shown. Welding for aluminum products shall conform to AWS D1.2/D1.2M.

2.3 ANODIC COATING

Anodized finish shall conform to AA DAF-45 as follows:

Clear (natural) designation AA-M10-C22-A31, Architectural Class II 0.4 mil or thicker.

Integral color anodized designation AA-M10-C22-A32, Architectural Class 0.4 to 0.7 mil.

Electrolytically deposited color-anodized designation AA-M10-C22-A34, Architectural Class II 0.4 to 0.7 mil.

2.4 ORGANIC COATING

Organic coating shall conform to AAMA 2604, with total dry film thickness not less than 1.2 mils.

2.5 FABRICATION AND MANUFACTURE

2.5.1 Factory Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

2.5.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

2.6 COLOR, FINISH, AND CONTRAST

Finish of all signs shall be eggshell, matte, or other non-glare finish as required in handicapped-accessible buildings.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Signs shall be installed plumb and true and in accordance with approved manufacturer's instructions at locations shown on the attachment. Mounting height and mounting location shall conform to 36 CFR 1191. Required blocking shall be installed. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed. Signs installed on glass surfaces shall be installed with matching blank back-up plates in accordance with manufacturer's instructions.

#### 3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Exposed anchor and fastener materials shall be compatible with metal to which applied and shall have matching color and finish. Where recommended by signage manufacturer, foam tape pads may be used for anchorage. Foam tape pads shall be minimum 1/16 inch thick closed cell vinyl foam with adhesive backing. Adhesive shall be transparent, long aging, high tech formulation on two sides of the vinyl foam. Adhesive surfaces shall be protected with a 5 mil green flatstock treated with silicone. Foam pads shall be sized for the signage in accordance with signage manufacturer's recommendations. Signs mounted to painted gypsum board surfaces shall be removable for painting maintenance. Signs mounted to lay-in ceiling grids shall be mounted with clip connections to ceiling tees.

#### 3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned at completion of sign installation in accordance with the manufacturer's approved instructions.

-- End of Section --

SECTION 10 28 13

TOILET ACCESSORIES
**07/06**

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Finishes; G, AE
Accessory Items; G, AE

Manufacturer's descriptive data and catalog cuts indicating materials of construction, fasteners proposed for use for each type of wall construction, mounting instructions, operation instructions, and cleaning instructions.

1.2 DELIVERY, STORAGE, AND HANDLING

Wrap toilet accessories for shipment and storage, then deliver to the jobsite in manufacturer's original packaging, and store in a clean, dry area protected from construction damage and vandalism.

1.3 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

Provide toilet accessories shall be provided where indicated in accordance with paragraph SCHEDULE. Porcelain type, tile-wall accessories are specified in Section 09 30 00 CERAMIC TILE QUARRY TILE, AND PAVER TILE. Provide each accessory item shall be complete with the necessary mounting plates of sturdy construction with corrosion resistant surface.

2.1.1 Anchors and Fasteners

Provide anchors and fasteners capable of developing a restraining force commensurate with the strength of the accessory to be mounted and suited for use with the supporting construction. Provide tamperproof design exposed fasteners with finish to match the accessory.

2.1.2 Finishes

Except where noted otherwise, provide the following finishes on metal:

| Metal | Finish |
|---|---|
| Stainless steel | No. 4 satin finish |
| Carbon steel, copper alloy, and brass | Chromium plated, bright |

2.2 ACCESSORY ITEMS

Conform to the requirements for accessory items specified below.

2.2.1 Grab Bar (GB)

Provide an 18 gauge, 1-1/4 inch grab bar(s) OD Type 304 stainless steel as required to meet installation conditions. Provide form and length for grab bar as indicated. Provide concealed mounting flange. Provide grab with satin finish. Furnish installed bars capable of withstanding a 500 pound vertical load without coming loose from the fastenings and without obvious permanent deformation. Allow 1-1/2 inch space between wall and grab bar. Products equal to Bradley 800 Series.

2.2.2 Mirrors, Metal (MM)

2.2.2.1 Mirror shelf

Provide brightly polished stainless steel, angle-frame mirror shelf(s) with welded corners, integral shelf and theft-resistant mounting as required to meet installation conditions. Mirror shall be framed with heavy gauge, one-piece, roll-formed, 3/4" x 3/4" stainless steel angle with double strength continuous integral stiffener. Integral 18 gauge stainless steel shelf shall have front and side flanges. Mirror shall be guaranteed for 15 years against silver spoilage and protected by a shock-absorbing, neoprene tubing with Poly-Glaze protective finish. Product equal to Bradley 7805-1824.

2.2.2.2 Mirror

Provide a brightly polished stainless steel metal mirror(s), edges turned back 1/4 inch and with angle frame, welded corners and theft-resistant mounting. Provide 24" x 60" in size as required to meet installation conditions. Mirror shall be framed with heavy gauge, one-piece, roll-formed, 3/4" x 3/4" stainless steel angle with double strength continuous integral stiffener. Mirror shall be guaranteed for 15 years against silver spoilage and protected by a shock-absorbing, neoprene tubing with Poly-Glaze protective finish. Product equal to Bradley 780-2460

2.2.3 Combination Paper Towel Dispenser/Hand Dryer/Waste Receptacle (PTDHDWR)

Provide semi-recessed dispenser/dryer/receptacle(s) with a capacity of 500 sheets of multi-fold towels or 370 sheets of C-fold towels as required to meet installation conditions. Design waste receptacle to be locked in unit and removable for service. Provide tumbler key locking mechanism. Provide waste receptacle capacity of 4.37 gallons. Provide waste receptacle that accepts reusable liner standard for unit manufacturer. Product equal to Bradley 270-10.

2.2.4 Sanitary Napkin Disposer (SND)

Provide stainless steel sanitary napkin disposals with removable leak-proof receptacle for disposable liners as required to meet installation conditions. Provide disposable liners of the type standard with the manufacturer. Retain receptacle in cabinet by tumbler lock. Provide disposer with a door for inserting disposed napkins, surface mounted. Product equal to Bradley 4781-15.

2.2.5 Sanitary Napkin and Tampon Dispenser (SNTD)

Provide sanitary napkin and tampon dispenser surface mounted. Dispenser, including door of Type 304 stainless steel that dispense both napkins and tampons with a minimum capacity of 28 tampons and 30 napkins. Furnish dispensing mechanism for complimentary operation. Provide coin mechanisms with minimum denominations of 10 cents, 25 cents, 50 cents, free. Hang doors with a full-length corrosion-resistant steel piano hinge and secure with a tumbler lock. Provide keys for coin box different from the door keys. Products equal to Bradley 401 series.

2.2.5 Shower Curtain Rods (SCR)

Provide stainless steel shower curtain rod(s) 1-1/4 inch OD as required to meet installation conditions. Products equal to Bradley 9531 Models.

2.2.8 Shower Curtain (SC)

Provide shower curtain, size to suit installation conditions. Provide anti-bacterial nylon/vinyl fabric curtain. Furnish green color. Product equal to Bradley 9535.

2.2.6 Soap Holder (SH)

In shower(2), provide surface mounted Type 304 stainless steel soap holder(s) as required to meet installation conditions. Product equal to Bradley 921-60.

2.2.10 Soap Dispenser (SD)

Provide soap dispenser(s) surface mounted, liquid type consisting of a vertical Type 304 stainless steel tank with holding capacity of 40 fluid ounces with a corrosion-resistant all-purpose valve that dispenses liquid soaps, lotions, detergents and antiseptic soaps as required to meet installation conditions. Product equal to Bradley 6542.

2.2.11 Shelf, Metal, Heavy Duty (SMHD)

Furnish a minimum 18 gauge stainless surface-mounted, steel heavy duty metal shelves with hemmed edges as required to meet installation conditions Provide shelves over 30 inch with intermediate supports. Provide minimum of 16 gauge supports, welded to the shelf, and spaced no more than 30 inch apart. Product equal to Bradley 7512.

2.2.7 Towel Bar (TB)

Provide stainless steel towel bars with a minimum thickness of 0.015 inch as required to meet installation conditions. Provide minimum 3/4 inch diameter bar, or 5/8 inch square. Provide bright polish finish.

2.2.8 Toilet Tissue Dispenser (TTD)

Furnish surface mounted toilet tissue holders with two rolls of standard tissue. Provide bright polish finish. Product equal to Bradley 5235.

2.2.15 Toilet Seat Cover Dispenser (TSCD)

Provide stainless steel with surface mounted toilet seat cover dispensers as required to meet installation conditions. Provide dispenser with a minimum capacity of 250 seat covers. Product equal to Bradley 5831.

2.2.9 Toothbrush and Tumbler Holder (TTH)

Provide stainless steel, surface mounted toothbrush and tumbler holders as required to meet installation conditions. Furnish holder to hold a minimum of four toothbrushes in a vertical position. Provide 2-1/4 plus or minus 1/8 inch in diameter size of hole for securing tumbler. Product equal to Bradley 924.

2.2.17 Mop and Broom Holder

Provide stainless steel, surface mounted mop and broom holders as required to meet installation conditions. Product equal to Bradley 9954.

2.2.18 Clothes Hook

Provide stainless steel surface mounted clothes hooks as required to meet installation conditions. Product equal to Bradley 917.

2.2.19 Shower Seat

Provide L-Shaped, folding, Bariatric Shower Seats as required to meet installation conditions. Bariatric Bench Seat frame shall be fabricated of stainless steel tube, 1-1/4" x 18 gauge sq. main frame with 1" x 18" gauge rd. cross members. Overall dimensions 32" x 22-1/2". Product white in color, equal to Bradley 957 or 9571 as required for installation.

PART 3 EXECUTION

3.1 INSTALLATION

Provide the same finish for the surfaces of fastening devices exposed after installation as the attached accessory. Provide oval exposed screw heads. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

3.1.1 Recessed Accessories

Fasten accessories with wood screws to studs, blocking or rough frame in wood construction.

3.1.2 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Conceal

fasteners on accessories without backplates. Install accessories with wood screws. Install backplates in the same manner, as required by the construction. Fasten accessories mounted on gypsum board and plaster walls to wood studs or to solid wood blocking secured between wood studs, or to metal backplates secured to metal studs.

3.2 CLEANING

Clean material in accordance with manufacturer's recommendations. Do mot use alkaline or abrasive agents. Take precautions to avoid scratching or marring exposed surfaces.

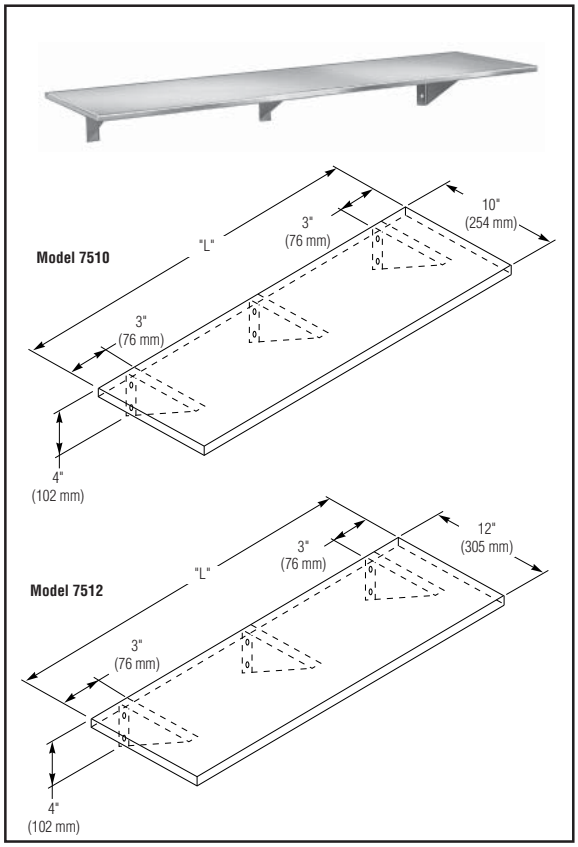
-- End of Section --

# 7510, 7512
**Shelf**

### Surface-mounted shelf:

☐ **Model 7510-XX (10" depth, specify length)**

☐ **Model 7512-XX (12" depth, specify length)**




## Product Materials

**SHELF:** 18 gauge stainless steel with exposed surfaces in architectural satin finish.

**BRACKETS:** 16 gauge stainless steel.

## Installation

Verify all rough-in dimensions prior to installation. Secure to wall with mounting screws (included) at holes provided.

| Length "L" | Quantity of Center Brackets |
|---|---|
| 12" to 24" | 0 |
| 25" to 48" | 1 |
| 49" to 72" | 2 |
| 73" to 96" | 3 |
| 97" to 112" | 4 |

## Guide Specification

Surface-mounted shelf shall be fabricated of 18 gauge stainless steel with exposed surfaces in satin finish. Shelf support brackets to be stainless steel, 16 gauge and welded to shelf. Shelves over 24" long shall have intermediate bracket.

**Surface-Mounted Shelf shall be Bradley Model 7510- (7512)-_____ (specify length).**

**Washroom Accessories**
**Document No. 8760**



This information is subject to change without formal notice.

Always consult local and national codes for proper installation guidelines. Conformity and compliance to local and national codes is the responsibility of the installer.

9-30-2008

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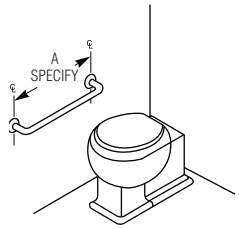
bradleycorp.com

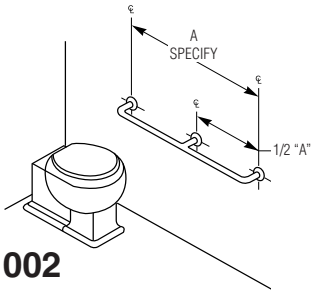
| | | |
|---|---|---|
| **Product:** 7510, 7512 | **Quantity:** n/a | **Date:** 4/24/09 |
| **Project & Location:** Gulfport, MS. | | |
| **Distributor/Wholesaler:** Partitions of Gulfport | | |

# 800 Series
## Grab Bar Applications

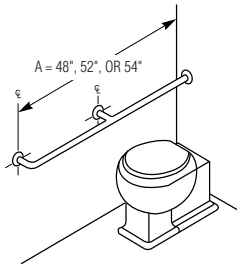
## Typical Water Closet Applications:




**□ 001**
SPECIFY LENGTH DESIRED. SEE 048 AND 049 FOR 45° MOUNTING. 001 OVER 54" REQUIRES A CENTER SUPPORT AND BECOMES 002.




**□ 002**



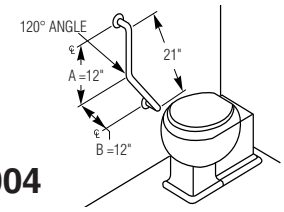

**□ 003**
ONLY ONE END RETURN. SPECIAL SIZE "A" DIMENSIONS, CENTER POST WILL ONLY BE ADDED TO MODELS GREATER THAN 24.

**NOTE:** When Grab Bar dimensions are modified, a support will be added to all sections longer than 54".

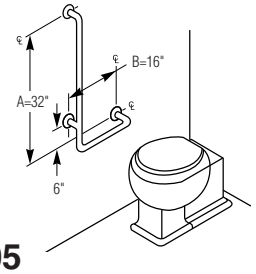
## ADA Compliant

- ☑ Consult local and national accessibility codes for proper installation guidelines.
- ☑ Conformity and compliance to local and national codes is the responsibility of the installer.

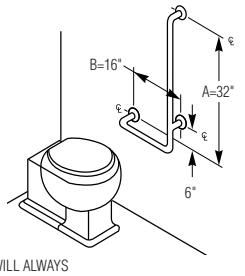
**Washroom Accessories**
**Document No. 8856**



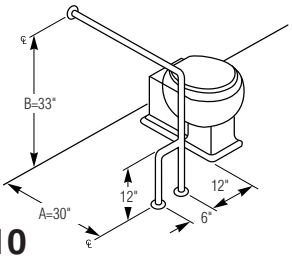

**□ 004**



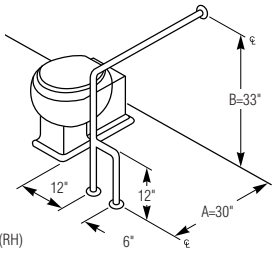

**□ 005**
A DIMENSION WILL ALWAYS HAVE STAND OFF (LF).



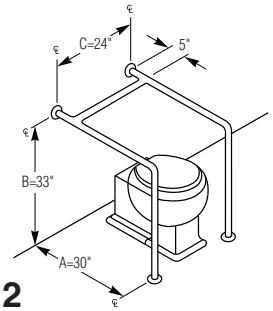

**□ 006**
OPPOSITE 005
A DIMENSION WILL ALWAYS HAVE STAND OFF (RH).



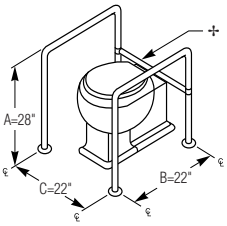

**□ 010**
(LH)



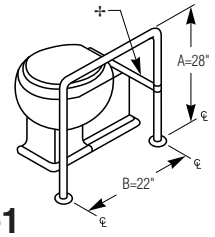

**❑ 011**
OPPOSITE 010 (RH)



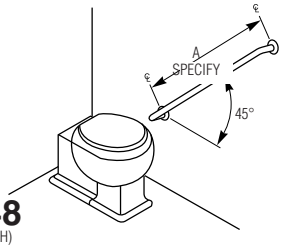

**□ 012**
CONFIRM CLEARANCE BETWEEN FIXTURE OR PLUMBING AND GRAB BAR IN INDIVIDUAL APPLICATIONS.




**□ 039**
✢ BAR SLIDES TO ACCOMMODATE VARIOUS SIZE WATER CLOSETS. FLAT BAR-2" WIDE X 1/8" THICK 11 GA. BOLTS TO TOILET




**□ 039-1**
✢ BAR ADJUSTABLE FOR RIGHT OR LEFT HAND MOUNTING.




**□ 048**
(SHOWN) (RH)

**□ 049**
OPPOSITE HAND (LF)

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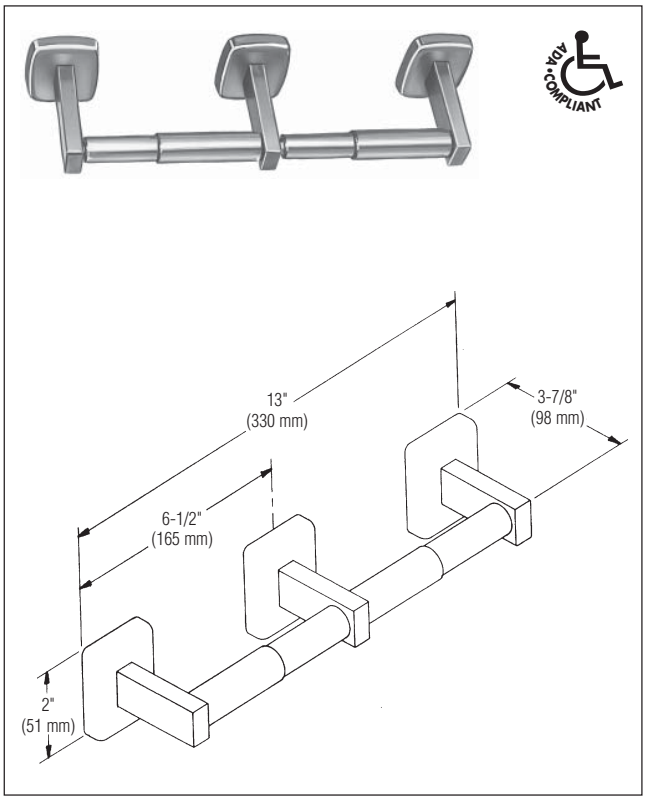
| | | |
|---|---|---|
| **Product:** 001, 002, 003, 004, 005, 006, 010, 011, 012, 039, 039-1, 048, 049 | **Quantity:** n/a | **Date:** 4/24/09 |
| **Project & Location:** Gulfport, MS. | | |
| **Distributor/Wholesaler:** Partitions of Gulfport | | |

# 5234, 5235
**Toilet Tissue Dispenser**

## ☐ Model 5234 — Satin Stainless Steel *Bradex®*
## ☐ Model 5235 — Bright Polish *Bradex®*

☑ Non-Controlled Delivery
☑ Dual Roll (For Single Roll see Models 5084 and 5085)




## Product Materials

**POSTS:** 22 gauge stainless steel with exposed surfaces in architectural satin finish (Model 5234) or bright polish finish (Model 5235).

**ESCUTCHEONS:** heavy stainless steel with exposed surfaces in architectural satin finish (Model 5084) or bright polish finish (Model 5085).

**SPINDLES:** chrome-plated plastic.

**MOUNTING BRACKET:** 18 gauge stainless steel.

## Capacity

Two standard core toilet tissue rolls through 5-1/2" in diameter.

## Operation

Concealed spring permits spindle to telescope for servicing. Spindle turns freely for non-controlled delivery.

## Installation

Verify all rough-in dimensions prior to installation. Secure concealed wall mounting bracket to wall with screws (included) at holes provided. Mount projecting arms and escutcheons to bracket and secure with concealed locking screw. Snap escutcheons into place.

## Optional Features

| Feature | Suffix |
|---|---|
| ☐ Anti-theft spindle | -52 |

## Guide Specification

**Model 5234:** Surface-mounted dual roll toilet tissue dispenser shall be heavy gauge stainless steel with satin finish and hold two standard core toilet tissue rolls.

**Model 5235:** Surface-mounted dual roll toilet tissue dispenser shall be heavy gauge stainless steel with bright polish finish and hold two standard core toilet tissue rolls.

**Overall dimensions: 13"W x 2"H x 3-7/8"D.**

## ADA Compliant

☑ Consult local and national accessibility codes for proper installation guidelines.

☑ Conformity and compliance to local and national codes is the responsibility of the installer.

**Washroom Accessories**
**Document No. 8515**

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| | | |
|---|---|---|
| **Product:** 5234 | **Quantity:** n/a | **Date:** 4/24/09 |
| **Project & Location:** Gulfport, MS. | | |
| **Distributor/Wholesaler:** Partitions of Gulfport | | |

# 6542
## Soap Dispenser

- ☑ Tank Type Horizontal ***Bradex®***
- ☑ Surface-Mounted
- ☑ ADA Compliant

## Product Materials

**BODY:** 20 gauge stainless steel with exposed surfaces in architectural satin finish.

**BACK:** 20 gauge stainless steel; welded to the body.

**WALL PLATE:** stainless steel.

**SOAP VALVE:** chrome-plated brass housing with ABS plastic mechanism.

## Capacity

40 oz. liquid soap.

## Operation

Push-in valve dispenses measured amount of vegetable or coconut oil liquid soaps, synthetic detergents, and antiseptic solutions with less than 5 lbs. of force. Signt gauge indicates refill time. Locked filler top opens with special key provided.

☑ Bradley liquid soap valves operate best with any vegetable oil or coconut oil hand soap having a 10–15% soap concentration.

## Installation

Verify all rough-in dimensions prior to installation. Secure separate mounting bracket to wall. Slide dispenser into place and secure locking screw through filler hole.

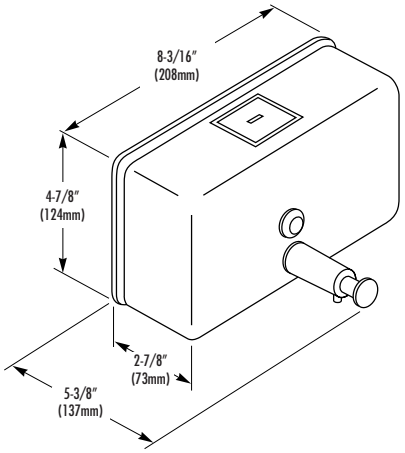
## Guide Specification

Surface-mounted liquid soap dispenser shall be fabricated of 20 gauge satin finish stainless steel. Dispenser shall have completely concealed mounting, vandal-resistant filler hole cover and sight gauge. Push-in corrosion-resistant liquid soap valve. Capacity: 40 oz. liquid soap. Requires less than 5 lbs. of force to dispense soap.

**Overall dimensions: 8-3/16"W x 4-7/8"H x 2-7/8"D.**

## ADA Compliant

- ☑ Consult local and national accessibility codes for proper installation guidelines.
- ☑ Conformity and compliance to local and national codes is the responsibility of the installer.




**Washroom Accessories**
**Document No. 8680**

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| | | |
|---|---|---|
| **Product:** 6542 | **Quantity:** n/a | **Date:** 4/24/09 |
| **Project & Location:** Gulfport, MS. | | |
| **Distributor/Wholesaler:** Partitions of Gulfport | | |

# 780
## Angle-Frame Mirror

### Mirror with angle frame, welded corners and theft-resistant mounting:

- ☐ **Standard Model 780-1830 (18" x 30") *Bradex*®**
- ☐ **Standard Model 780-1836 (18" x 36") *Bradex*®**
- ☐ **Standard Model 780-2436 (24" x 36") *Bradex*®**
- ☐ **Standard Model 780-2460 (24" x 60") *Bradex*®**
- ☐ **Model 780-XXXX (Specify width and height)**

## Product Materials

**FRAME:** one-piece roll-formed stainless steel, 3/4" x 3/4" angle with corners welded, ground and polished smooth to a satin finish. Double strength continuous integral stiffener on all sides for added strength. Bevel on front of angle secures frame flush against mirror.

**BACK:** galvanized steel, secured to frame with concealed screws, equipped with integral horizontal hanging brackets.

**MIRROR:** first quality 1/4" float glass, triple-silver-plated with electro-copper-plated layer and thermosetting infrared cured-paint backing with Poly-Glaze protective finish. Manufactured in accordance with ASTM C 1036. All edges protected by shock-absorbing, neoprene tubing.

**WALL HANGER:** 18 gauge cold rolled steel, all welded construction to form rigid template.

## Optional Features

| | Features | Suffix |
|---|---|---|
| ☐ | 1/4" tempered glass mirror in lieu of polished float glass mirror* | -2 |
| ☐ | Laminate glass | -3 |
| ☐ | Highly polished No. 8 architectural finish, 20 gauge stainless steel in lieu of polished float glass mirror | -4 |
| ☐ | Bright annealed 20 gauge stainless steel in lieu of polished float glass mirror | -5 |
| ☐ | Plexiglass | -6 |

*Either the Length (L) or the Width (W) must be greater than 25".

## Guide Specification

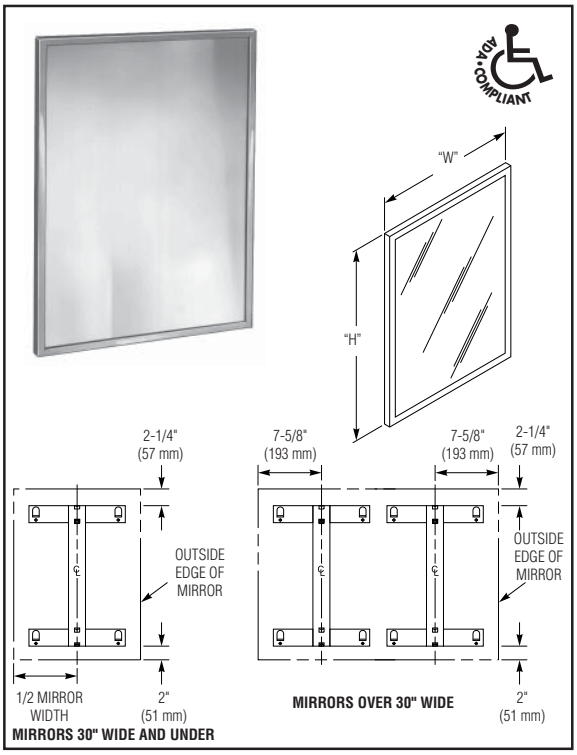
Mirror shall be framed with heavy gauge, one-piece roll-formed 3/4" x 3/4" stainless steel angle with double strength continuous integral stiffener. Welded corners shall be polished to a uniform satin finish. Mirror shall be of first quality 1/4" float glass guaranteed for 15 years against silver spoilage and protected by a shock-absorbing, neoprene tubing with Poly-Glaze protective finish. Back of unit shall be galvanized steel secure to frame with concealed screws, equipped with integral horizontal hanging brackets and separate wall hanger for concealed mounting.

**Framed Mirror shall be Bradley Model 780-_____" W x_____" H (specify width and height).**

## ADA Compliant

- ☑ Consult local and national accessibility codes for proper installation guidelines.
- ☑ Conformity and compliance to local and national codes is the responsibility of the installer.

**Washroom Accessories Document No. 8775**




## *Bradex*® Models

| Width (Inches) W | Height (Inches) H | Overall Dimension (Inches) | Overall Dimensions (Millimeters) | Standard Model Number |
|---|---|---|---|---|
| 18" | 30" | 18 x 30 | 457 x 762 | 780-1830 |
| 18" | 36" | 18 x 36 | 457 x 914 | 780-1836* |
| 24" | 36" | 24 x 36 | 610 x 914 | 780-2436* |
| 24" | 60" | 24 x 60 | 610 x 1524 | 780-2460 |

Model 780 series angle framed mirrors can be fabricated to fit any architectural requirement.

* Indicates available Tempered glass. ***Bradex***®

☑ An inherent characteristic of a manufacturing process for tempered glass is distortion which may vary from mirror to mirror.

## Installation

Verify all rough-in dimensions prior to installation. Secure concealed mounting bracket to wall with screws (not included) at holes provided. Mounting kits available through Bradley (ref. #899-026). Refer to technical data sheet #8880. Provide in-wall backing at mounting screw locations. Position mirror over mounting bracket to engage hanger tabs. Slide mirror down and lock into position.

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| | | |
|---|---|---|
| **Product:** 780 | **Quantity:** n/a | **Date:** 4/24/09 |
| **Project & Location:** Gulfport, MS. | | |
| **Distributor/Wholesaler:** Partitions of Gulfport | | |

# 957, 9571

## L-shaped Bariatric Shower Seat

☑ Folding Shower Seat

☑ Color – White

## Product Materials

**FRAME**: stainless steel tubing, 1-1/4" x 18 gauge sq. main frame with 1" x 18 gauge rd. cross-members.

**WALL FLANGES**: stainless steel, 10 gauge x 3" dia. heliarc welded to 1" rd. x 18 gauge 90 degree leg supports, and to 1-1/4" rd. x 12 gauge frame hinge couplings. Three mounting holes in each flange.

**SWING DOWN LEG**: "H"-shaped yoke of stainless steel 1" dia. x 18 gauge rd. tubing, heliarc welded to 1-1/4" rd. x 12 gauge frame hinge couplings.

**SEAT**: 1/2" thick solid phenolic. White matte finish Melamine bonded onto the phenolic for color. All exposed edges are machined smooth to a uniform dark finish.

## Operation

Seat is automatically held in a raised position by a stainless cross member attached to the front and rear support legs. When the seat is lowered into its down position the Swing Down Leg automatically aligns the front and rear support legs with the help of the stainless cross member. **NOTE:** When properly installed, the seat can support up to 900 lbs. static load.

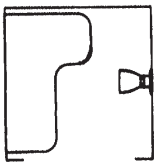
## Installation

Verify all rough-in dimensions prior to installation. All shower seats must be installed using suitable fasteners and sufficient in-wall backing materials. Place the seat in an upright position with the mounting flanges placed firmly against the shower wall. Level the seat to the mounting height (17"-19") by modifying the adjustable rubber feet. After marking the three holes in each flange, drill the appropriate holes. Secure the two hinge bracket flanges to the wall. Place the seat in the down position and make any final changes to the adjustable rubber feet.

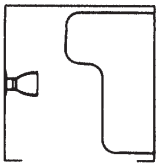
## Guide Specification

Bariatric Bench Seat frame shall be fabricated of stainless steel tube, 1-1/4" x 18 gauge sq. main frame with 1" x 18" gauge rd. cross members. The leg is "H"-shaped yoke of stainless steel tubing, 1" x 18 gauge rd. tubing, Heliarc welded to 1-1/4" rd. x 12 gauge frame hinge.

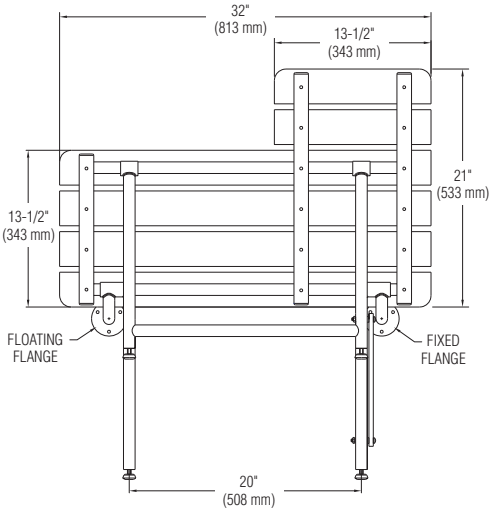
Overall dimensions: 32" x 22-1/2".

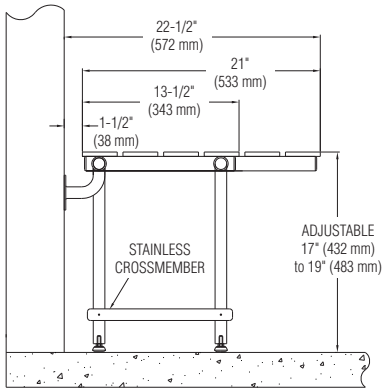


□ **957**
(LEFT HAND)



□ **9571**
(RIGHT HAND)




**Washroom Accessories**
**Document No. 9031**

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| | | |
|---|---|---|
| **Product:** 957, 9571 | **Quantity:** n/a | **Date:** 4/24/09 |
| **Project & Location:** Gulfport, MS. | | |
| **Distributor/Wholesaler:** Partitions of Gulfport | | |

- ☑ Polished Chrome Finish
- ☑ Surface-Mounted
- ☑ Concealed Wall Plates

## Product Materials

**UNITS:** die cast, high quality Zamac zinc alloy. Copper, nickel plated with a highly polished chrome finish.

**WALL PLATES:** heavy steel, cadmium plated.

## Installation

Verify all rough-in dimensions prior to installation. Secure wall plate(s) to wall with screws (included) at holes provided. Slip notched section of unit over top lip of wall plate. Tighten concealed set screw to lock unit in place.

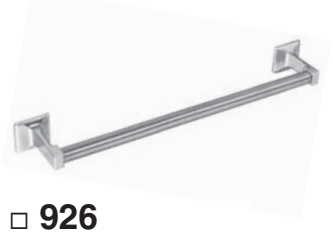
## Guide Specification

Surface-mounted accessory shall be fabricated of die cast, high quality Zamac zinc alloy and copper, nickel plated with highly polished chrome finish.

**☐ 921 *Bradex*®**
SOAP DISH (SHOWN) 3-15/16"W x 2-7/8"D

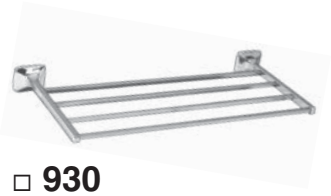
**☐ 921-60**
SOAP DISH WITH DRAIN HOLES

**☐ 924**
4-1/2"W x 3-1/2"D
TUMBLER AND TOOTHBRUSH HOLDER



**☐ 926**
3/4" ROUND TOWEL BAR. PROJECTS 3-1/4"
☐ 18"W ☐ 24"W ☐ 30"W

**☐ 927**
3/4" SQUARE TOWEL BAR. PROJECTS 3"
☐ 18"W *Bradex*®
☐ 24"W *Bradex*®
☐ 30"W



**☐ 930**
8-1/2" DEEP TOWEL SHELF
☐ 18"W

**☐ 9301**
8-1/2" DEEP TOWEL SHELF WITH
TOWEL BAR AND SUPPORT BRACES
☐ 18"W ☐ 24"W

**☐ 931 *Bradex*®**
SINGLE ROBE HOOK. 2-1/8"W x 2"D

**☐ 9311 *Bradex*®**
TOWEL HOOK. PROJECTS 5-1/8"

**☐ 932 *Bradex*®**
DOUBLE ROBE HOOK. PROJECTS 2-1/8"W x 1-5/8"D

**☐ 933**
TOWEL RING WITH
LUCITE RING

**☐ 934**
TOWEL RING WITH
CHROME PLATED RING (SHOWN)
PROJECTS 1-3/4"

**Washroom Accessories**
**Document No. 8910**

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| | | |
|---|---|---|
| **Product:** 921, 921-60, 931, 924, 930, 9311, 9301, 926, 927, 932, 933, 934 | **Quantity:** n/a | **Date:** 4/24/09 |
| **Project & Location:** Gulfport, MS. | | |
| **Distributor/Wholesaler:** Partitions of Gulfport | | |

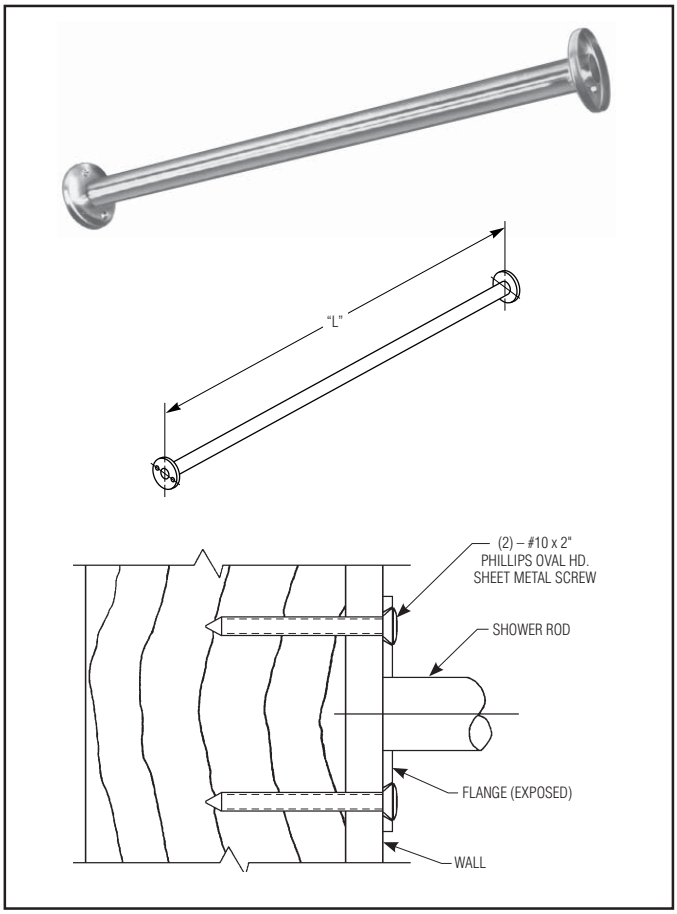
# 953, 9531
## Shower Curtain Rod

☑ Exposed Mounting

☑ Model 953 – 1" O.D.
- ☐ 36" ***Bradex***®
- ☐ 42"
- ☐ 48"
- ☐ 60" ***Bradex***®
- ☐ 72"

☑ Model 9531 – 1-1/4" O.D.
- ☐ 36" ***Bradex***®
- ☐ 42" ***Bradex***®
- ☐ 48" ***Bradex***®
- ☐ 60" ***Bradex***®
- ☐ 72"

*For 72" lengths and greater, model 9522 Shower Rod Ceiling Support is required! Must specify distance from the ceiling!*




## Product Materials

**FLANGES:** 22 gauge stainless steel. One-piece drawn construction with exposed surfaces in architectural satin finish.

**TUBING:** 18 gauge stainless steel, seamless construction with exposed surfaces in architectural satin finish.

## Installation

Verify all rough-in dimensions prior to installation. To properly engage rod in support flanges, rod length must be no less than approximately 1/4" shorter than wall opening. Secure one flange to wall with mounting screws (included) at holes provided. Align mounting holes vertically. Slip opposite flange over rod and secure to opposite wall with rod in place.

## Optional Features

| Feature | | Suffix |
|---|---|---|
| ☐ | Bright polished finish | -78 |

## Guide Specification

Shower curtain rod shall be fabricated of 18 gauge stainless steel in satin finish. Flanges shall be of 22 gauge stainless steel.

**Washroom Accessories**
**Document No. 8970**

Orders composed of products indicated as ***Bradex***® will be available to ship in three days after receipt of order at the factory. There is no pricing penalty for this service from Bradley.

This information is subject to change without formal notice.

Always consult local and national codes for proper installation guidelines. Conformity and compliance to local and national codes is the responsibility of the installer.

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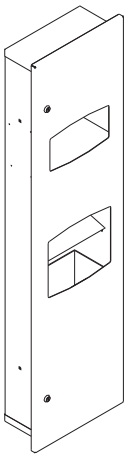
| | | |
|---|---|---|
| **Product:** 953, 9531 | **Quantity:** n/a | **Date:** 4/24/09 |
| **Project & Location:** Gulfport, MS. | | |
| **Distributor/Wholesaler:** Partitions of Gulfport | | |

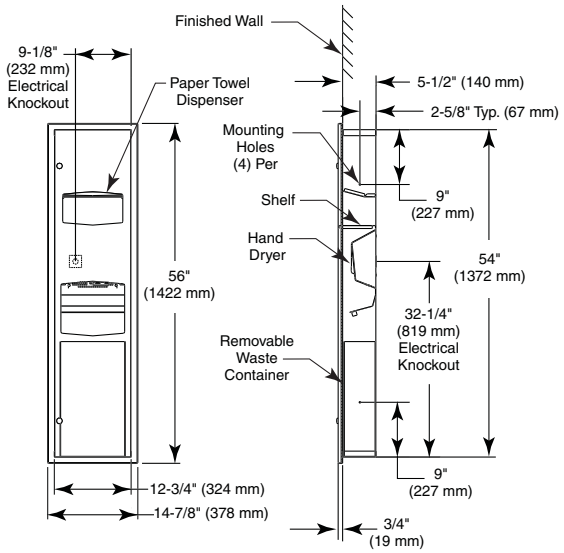
# 270

## Multi-Purpose Unit - Towel Dispenser/Hand Dryer/Waste Receptacle

- ☐ **Model 270 — Recessed (recesses 5-1/2"; projects 3/4")**
- ☐ **Model 270-10 — Semi-Recessed (recesses 3-1/2"; projects 2-3/4")**
- ☐ **Model 270-11 — Surface-Mounted (projects 6-1/4")**

- ☑ Contemporary Series — Satin Finish
- ☑ C-Fold/Multi-Fold/Single-Fold Towels






## Product Materials

**CABINET:** 22 gauge stainless steel with exposed surfaces in architectural satin finish. Welded construction with seamless corners and burr-free edges.

**DOOR:** 18 gauge stainless steel. Warp resistant, with full length piano hinge and (2) tumbler locks keyed like other Bradley units.

**TOWEL DISPENSER:** 22 gauge stainless steel. Rolled edge on dispenser opening.

**HAND DRYER:** sensor activation. Universal voltage. European Export available.

☑ To comply with EU standards, purchase model with option -49 (required for CE certification only).

**WASTE CONTAINER LINER:** natural color linear low density polyethylene — Part #M44-081.

## Capacity

Towel Dispenser — 710 single-fold, 500 multi-fold or 370 C-fold paper towels.

Waste Container — 4.37 gal. (16.5 L)

## Operation

Towel dispenser holds single-fold, multi-fold or C-fold towels without use of special adapter. Receptacle removable for easy servicing by unlocking door.

## Installation

Verify all rough-in dimensions prior to installation. Recessed unit requires rough wall opening 13"W x 54-1/4"H x 5-1/2"D. Secure to framing with mounting screws (included) at holes provided. Shim at screw points as required. Surface-mounted units need to have holes drilled by installer. Mounting screws are included. Please refer to the installation instructions with the hand dryer for directions.

## Guide Specification

Recessed combination towel dispenser, hand dryer, and waste receptacle shall be fabricated of 18 gauge stainless steel with exposed surfaces in satin finish. Warp-free door equipped with piano hinge and secured by (2) tumbler locks. Towel dispenser capacity — 710 single-fold, 500 multi-fold, or 370 C-fold towels. 4.37 gal. linear low density polyethylene waste receptacle included.

**Overall dimensions: 14-7/8"W x 56"H x 6-1/4"D.**

## Optional Features

| Feature | Suffix |
|---|---|
| ☐ For Export (CE Certified) | -49 |

**Washroom Accessories**
**Document No. 8137**

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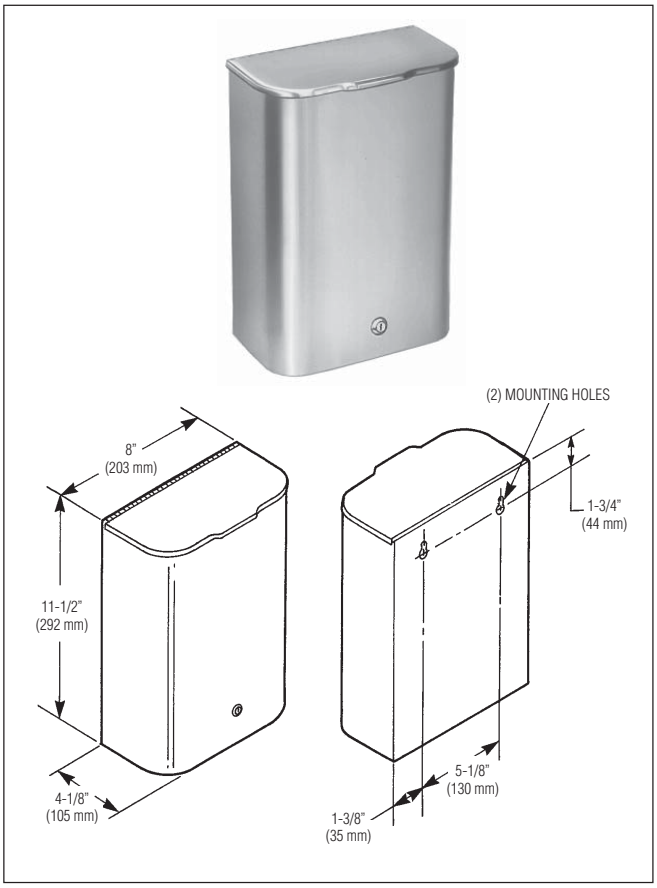
| | | |
|---|---|---|
| **Product:** 270 | **Quantity:** n/a | **Date:** 4/24/09 |
| **Project & Location:** Gulfport, MS. | | |
| **Distributor/Wholesaler:** Partitions of Gulfport | | |

# ☐ Model 4781-15 — Surface-Mounted
***Bradex®***

☑ Standard Series — Satin Finish




## Product Materials

**COVER:** 22 gauge stainless steel with exposed surfaces in architectural satin finish. Heavy-duty stainless steel piano hinge.

**CONTAINER:** 22 gauge stainless steel with exposed surfaces in architectural satin finish. All welded construction with rounded front corners. Bottom equipped with lock and heavy-duty stainless steel piano hinge.

## Operation

Bottom opens for removal of waxed paper liner. Additional liners available from Bradley.

## Installation

Verify all rough-in dimensions prior to installation. Secure to wall or partition with mounting screws (included) at holes provided.

## Guide Specification

Surface-mounted napkin disposal shall be fabricated of 22 gauge stainless steel with exposed surfaces in satin finish. Top attached by piano hinge. Bottom hinged for easy servicing.

**Overall dimensions: 8"W x 11-1/2"H x 4-1/8"D.**

**Washroom Accessories**
**Document No. 8415**

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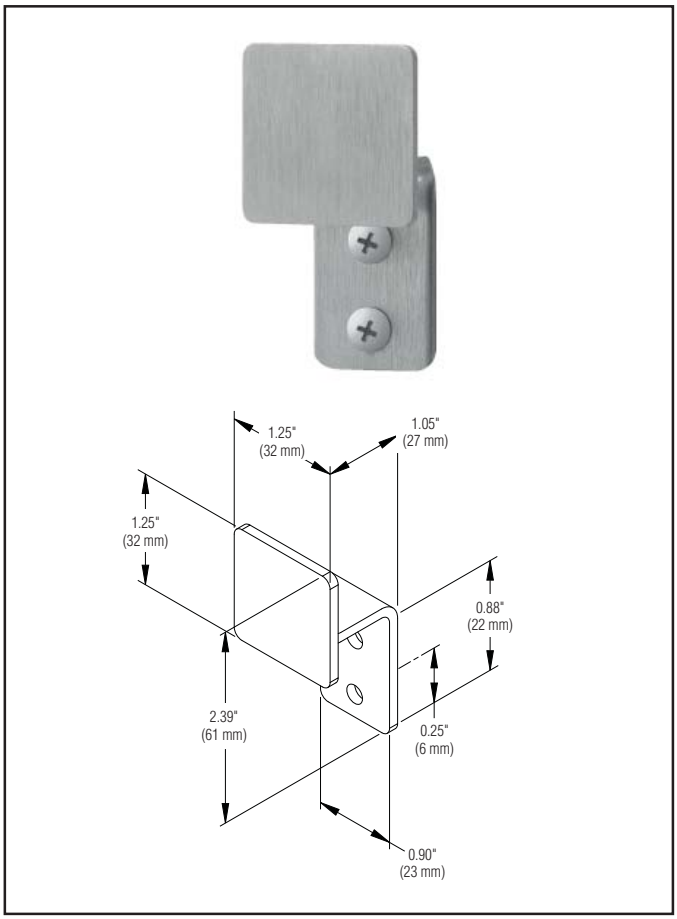
| | | |
|---|---|---|
| **Product:** 4781-15 | **Quantity:** n/a | **Date:** 4/24/09 |
| **Project & Location:** Gulfport, MS. | | |
| **Distributor/Wholesaler:** Partitions of Gulfport | | |

# 917
## Clothes Hook

- ☑ Exposed Mounting
- ☑ Stainless Steel ***Bradex®***




## Product Materials

**CLOTHES HOOK:** 12 gauge stainless steel with exposed surfaces in satin finish. All welded construction.

**MOUNTING PLATE:** 12 gauge plated steel in bright chrome finish.

## Installation

Verify all rough-in dimensions prior to installation. Secure to wall with mounting screws (included) at holes provided.

## Guide Specification

Clothes hook shall be 12 gauge stainless steel with exposed surfaces in satin finish.

**Washroom Accessories**
**Document No. 8927**

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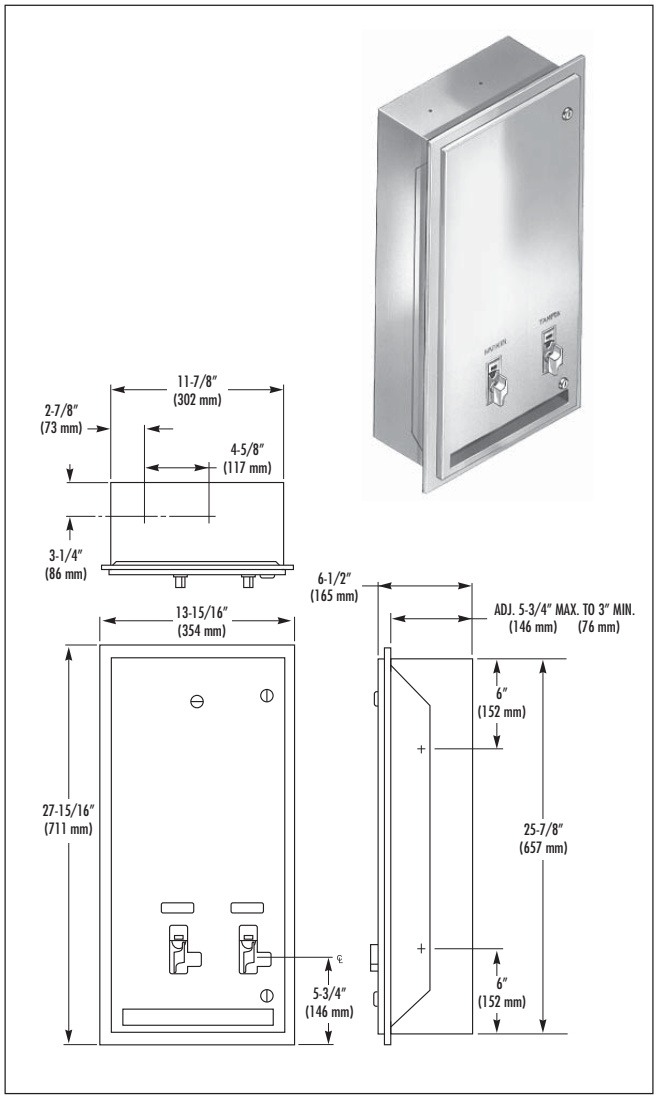
| | | |
|---|---|---|
| **Product:** 917 | **Quantity:** n/a | **Date:** 4/24/09 |
| **Project & Location:** Gulfport, MS. | | |
| **Distributor/Wholesaler:** Partitions of Gulfport | | |

# 401
## Napkin/Tampon Vendor

## Must Specify Operation:
- ☐ **Free — 40**
- ☐ **10¢ — 42**
- ☐ **25¢ — 45 *Bradex®***
- ☐ **50¢ — 43**
- ☐ **$1.00 — 44**

☑ Standard Series — Satin Finish
☑ Slip-Type Flange




## Product Materials

**FLANGE:** 22 gauge stainless steel with exposed surfaces in architectural satin finish. Flange of one-piece seamless construction, 1" wide with 1/4" return. Slip-type flange permits partial or full recess installation, or can be discarded for surface mounting.

**CABINET:** 22 gauge stainless steel with exposed surfaces in architectural satin finish. Welded construction with burr-free edges.

**DOOR:** 18 gauge stainless steel with exposed surfaces in architectural satin finish, with full-length piano hinge and two tumbler locks keyed like other Bradley units.

**COIN BOX:** inside cabinet is 22 gauge stainless steel, secured by a separate lock keyed differently than door locks. Coin mechanisms are available with free, $.10, $.25, $.50 or $1.00 operation. Two mechanisms are included. Coin mechanisms may be replaced in the field without removing cabinet from wall.

## Capacity

30 napkins (3" x 4-1/4" x 1" or smaller) and 28 tampons (5-1/8" long x 3/4" dia. or smaller). Dispenses all popular brands.

## Operation

Insertion of coin permits clockwise rotation of handle to dispense product. Will not accept coin when vendor is empty. Access door allows servicing of unit.

## Installation

Verify all rough-in dimensions prior to installation. Requires rough wall opening 12-1/2"W x 26-3/8"H x 6"D (fully recessed). Secure flange to rough wall opening using screws (included). Insert cabinet through flange into wall opening. Secure cabinet to framing with screws (not included) at holes provided. Shim at screw points as required.

## Guide Specification

Combination napkin/tampon vendor shall be fabricated of 22 gauge stainless steel with exposed surfaces in satin finish. Door shall be fabricated of 18 gauge stainless steel with a full-length piano hinge and two tumbler locks keyed like other Bradley units. Two coin mechanisms shall permit dispensing thirty napkins and twenty-eight tampons and be available with free, $.10, $.25, $.50 and $1.00 coin operation.

**Washroom Accessories**
**Document No. 8335**

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| | | |
|---|---|---|
| **Product:** 401 | **Quantity:** n/a | **Date:** 4/24/09 |
| **Project & Location:** Gulfport, MS. | | |
| **Distributor/Wholesaler:** Partitions of Gulfport | | |

# 7805
## Angle-Frame Mirror Shelf

**Mirror shelf with angle frame, welded corners, integral shelf and theft-resistant mounting:**

- ☐ **Standard Model 7805-1824 (18" x 24") *Bradex*®**
- ☐ **Standard Model 7805-1836 (18" x 36") *Bradex*®**
- ☐ **Model 7805-XXXX (Specify width and height)**

## Product Materials

**FRAME:** one-piece, roll-formed stainless steel, 3/4" x 3/4" angle with corners welded, ground and polished smooth to a satin finish. Double strength continuous integral stiffener on all sides for added strength. Bevel on front of angle secures frame flush against mirror.

**BACK:** galvanized steel, secured to frame with concealed screws, equipped with integral horizontal hanging brackets.

**MIRROR:** first quality 1/4" float glass triple-silver-plated with electro-copper-plated layer and thermosetting infrared-cured paint backing with Poly-Glaze protective finish. Manufactured in accordance with ASTM C 1036. All edges protected by shock-absorbing, neoprene tubing.

**SHELF:** 18 gauge stainless steel with exposed surfaces in architectural satin finish. Flanged front and side, welded to frame.

**SHELF BRACKETS:** 16 gauge stainless steel are provided on units exceeding 48" width.

## Optional Features

| Features | | Suffix |
|---|---|---|
| ☐ | 1/4" tempered glass mirror in lieu of polished float glass mirror* | -2 |
| ☐ | Laminate glass | -3 |
| ☐ | Highly polished No. 8 architectural finish, 20 gauge stainless steel in lieu of polished float glass mirror | -4 |
| ☐ | Bright annealed 20 gauge stainless steel in lieu of polished float glass mirror | -5 |
| ☐ | Plexiglass | -6 |

*Either the Length (L) or the Width (W) must be greater than 25".

## Guide Specification

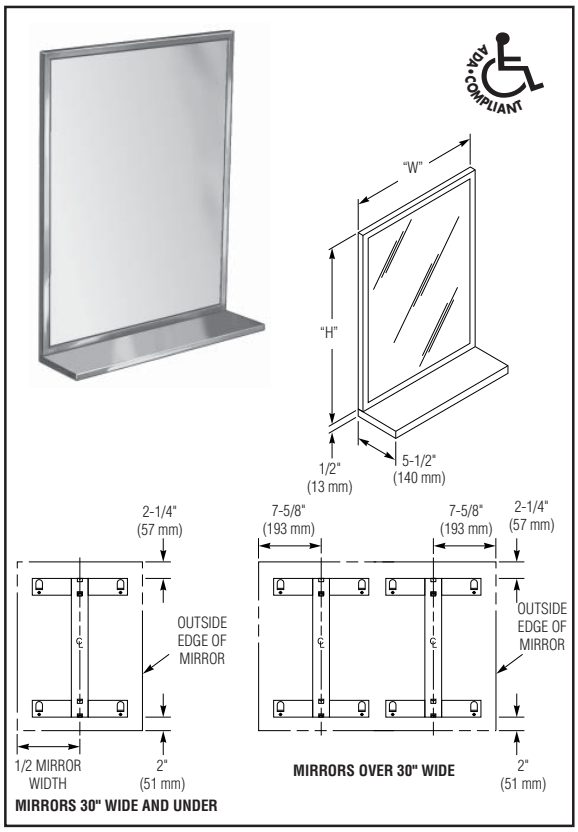
Mirror shall be framed with heavy gauge, one-piece, roll-formed, 3/4" x 3/4" stainless steel angle with double strength continuous integral stiffener. Welded corners shall be polished to a uniform satin finish. Integral 18 gauge stainless steel shelf shall have front and side flanges. Mirror shall be of first quality 1/4" float glass guaranteed for 15 years against silver spoilage and protected by a shock-absorbing, neoprene tubing with Poly-Glaze protective finish. Back of unit shall be galvanized steel secured to frame with concealed screws, equipped with integral horizontal hanging brackets and separate wall hanger for concealed mounting.

**Framed Mirror and Shelf shall be Bradley Model 7805-_____" W x_____" H (specify width and height).**

## ADA Compliant

- ☑ Consult local and national accessibility codes for proper installation guidelines.
- ☑ Conformity and compliance to local and national codes is the responsibility of the installer.

**Washroom Accessories Document No. 8780**




## *Bradex*® Models

| Width (Inches) W | Height (Inches) H | Overall Dimension (Inches) | Overall Dimensions (Millimeters) | Standard Model Number |
|---|---|---|---|---|
| 18" | 24" | 18 x 24 | 457 x 610 | 7805-1324 |
| 18" | 36" | 18 x 36 | 457 x 914 | 7805-1836 |

Model 7805 series angle framed mirrors can be fabricated to fit any architectural requirement.

☑ An inherent characteristic of a manufacturing process for tempered glass is distortion which may vary from mirror to mirror.

## Installation

Verify all rough-in dimensions prior to installation. Secure concealed mounting bracket to wall with screws (not included) at holes provided. Mounting kits available through Bradley (ref. #899-026). Refer to technical data sheet #8880. Provide in-wall backing at mounting screw locations. Position mirror over mounting bracket to engage hanger tabs. Slide mirror down and lock into position.

Orders composed of products indicated as ***Bradex***® will be available to ship in three days after receipt of order at the factory. There is no pricing penalty for this service from Bradley.

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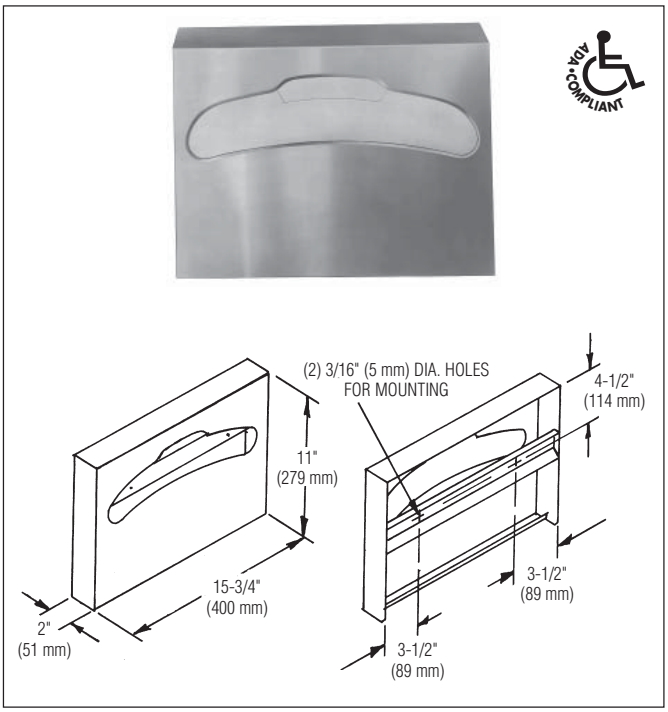
| | | |
|---|---|---|
| **Product:** 7805 | **Quantity:** n/a | **Date:** 4/24/09 |
| **Project & Location:** Gulfport, MS. | | |
| **Distributor/Wholesaler:** Partitions of Gulfport | | |

# 5831
**Seat Cover Dispenser**

## ☐ Model 5831 — Surface-Mounted
***Bradex®***

☑ 250 Capacity




## Product Materials
**UNIT:** 22 gauge stainless steel with exposed surfaces in architectural satin finish. Welded construction with burr-free edges.

## Capacity
250 standard single-fold or half-fold toilet seat covers.

## Operation
Insert seat covers through bottom of unit.

## Guide Specification
Surface-mounted toilet seat cover dispenser shall be fabricated of 22-gauge stainless steel with exposed surfaces in satin finish. Capacity 250 toilet seat covers.

**Overall dimensions: 15-3/4"W x 11"H x 2"D.**

## ADA Compliant
☑ Consult local and national accessibility codes for proper installation guidelines.

☑ Conformity and compliance to local and national codes is the responsibility of the installer.

**Washroom Accessories**
**Document No. 8565**

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| | | |
|---|---|---|
| **Product:** 5831 | **Quantity:** n/a | **Date:** 4/24/09 |
| **Project & Location:** Gulfport, MS. | | |
| **Distributor/Wholesaler:** Partitions of Gulfport | | |

# 9533, 9534, 9535, 9537
## Shower Curtain

- ☑ Model 9533 – Vinyl Shower Curtain (White) ***Bradex***®
- ☑ Model 9534 – Duck Shower Curtain (White)
- ☑ Model 9535 – Anti-Bacterial Shower Curtain (Green)
- ☑ Model 9537 – Anti-Bacterial Shower Curtain (White) ***Bradex***®

## Model 9533 Vinyl Shower Curtain

### Guide Specification

Shower curtain 6 gauge vinyl material with hemmed top edges and aluminum grommets on 6" centers. White only.
**Vinyl Shower Curtain shall be Bradley**
**Model 9533-_____"W x _____"H (insert size).**

## Model 9534 Duck Shower Curtain

### Guide Specification

Shower curtain 8 ounces, 100% cotton duck material with hemmed top edges and chrome plated nickel grommets on 6" centers. White only.
**Duck Shower Curtain shall be Bradley**
**Model 9534-_____"W x _____"H (insert size).**

## Model 9535 & 9537 Anti-Bacterial Shower Curtain

### Guide Specification

Shower curtain shall be of 10 ounce nylon reinforced anti-bacterial vinyl fabric, flameproof, stain resistant, self-deodorizing, furnished with aluminum grommets on 6" centers. Ideal for hospital applications. All sides hemmed. Model 9535 is Green. Model 9537 is White.
**Antibacterial Shower Curtain shall be Bradley**
**Model 9535, 9537-_____"W x _____"H (insert size).**

☑ Shower curtains have a tolerance of +/- 1" length and +/- 2" width, all sides hemmed.

## 9533 *Bradex*® Models

| Width | Height | Overall Dimensions (Inches) | Overall Dimensions (Millimeters) | # of 9536 Shower Hooks Required (Order Separately) |
|---|---|---|---|---|
| 36" (914 mm) | 72" (1829 mm) | 36 x 72 | 914 x 1829 | 7 |
| 42" (1067 mm) | 72" (1829 mm) | 42 x 72 | 1067 x 1829 | 8 |
| 48" (1219 mm) | 72" (1829 mm) | 48 x 72 | 1219 x 1829 | 9 |
| 72" (1829 mm) | 72" (1829 mm) | 72 x 72 | 1829 x 1829 | 13 |
| Other sizes available upon request. | | | | |

## 9537 *Bradex*® Models

| Width | Height | Overall Dimensions (Inches) | Overall Dimensions (Millimeters) | # of 9536 Shower Hooks Required (Order Separately) |
|---|---|---|---|---|
| 42" (1067 mm) | 72" (1829 mm) | 42 x 72 | 1067 x 1829 | 8 |
| 48" (1219 mm) | 72" (1829 mm) | 48 x 72 | 1219 x 1829 | 9 |
| 72" (1829 mm) | 72" (1829 mm) | 72 x 72 | 1829 x 1829 | 13 |
| Other sizes available upon request. | | | | |

**Washroom Accessories**
**Document No. 8980**

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| | | |
|---|---|---|
| **Product:** 9533, 9534, 9535, 9536, 9537 | **Quantity:** n/a | **Date:** 4/24/09 |
| **Project & Location:** Gulfport, MS. | | |
| **Distributor/Wholesaler:** Partitions of Gulfport | | |

# 9953, 9954, 9955

## Mop and Broom Holder

- ☑ Model 9953 – 3 Holders ***Bradex***®
- ☑ Model 9954 – 4 Holders ***Bradex***®
- ☑ Model 9955 – 5 Holders

## Product Materials

**BACKPLATE:** 22 gauge stainless steel with exposed surfaces in architectural satin finish.

**HOLDERS:** spring-activated rubber cams on plated steel retainers.

## Operation

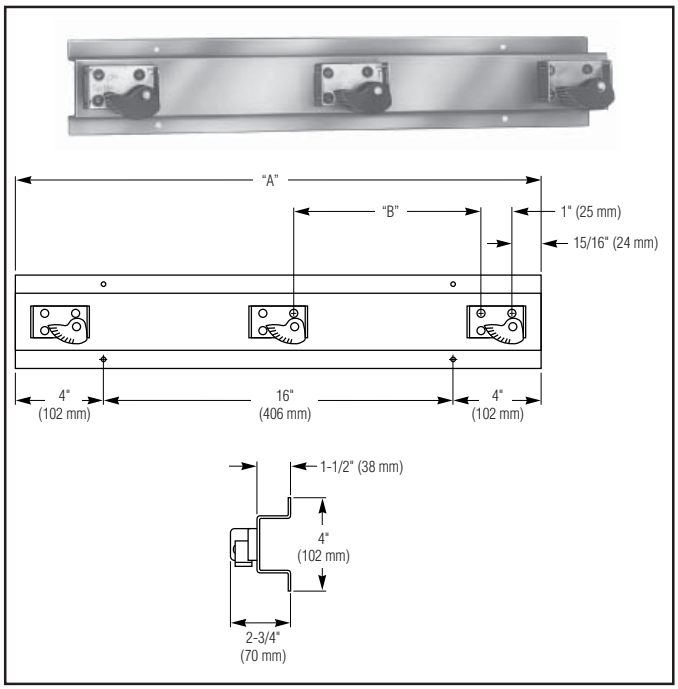
Weight of mop or broom holds handle in place.

## Installation

Verify all rough-in dimensions prior to installation. Secure to wall with mounting screws (included) at holes provided.

## Guide Specification

Surface mounted mop and broom holder shall be fabricated of 22 gauge stainless steel in satin finish with spring-activated rubber cam holders.




## Dimensions

| Model No. | Dim. "A" | Dim. "B" | Hooks |
|---|---|---|---|
| 9953 | 24" (610 mm) | 9-1/8" (232 mm) | 3 |
| 9954 | 36" (914 mm) | 9-3/4" (248 mm) | 4 |
| 9955 | 48" (1219 mm) | 10" (254 mm) | 5 |

**Washroom Accessories**
**Document No. 9160**

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| | | |
|---|---|---|
| **Product:** 9953, 9954, 9955 | **Quantity:** n/a | **Date:** 4/24/09 |
| **Project & Location:** Gulfport, MS. | | |
| **Distributor/Wholesaler:** Partitions of Gulfport | | |

SECTION 10 44 16

FIRE EXTINGUISHERS
**06/06**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 10 | (2007; Errata 2007; AMD 1 2007) Standard for Portable Fire Extinguishers |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 299 | (2002; Rev thru Aug 2007) Standards for Dry Chemical Fire Extinguishers |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Manufacturer's Data for each type of required Fire Extinguisher with all related details, cabinets, accessories, and recommended operation manuals.

SD-02 Shop Drawings

Submit fabrication drawings for the following items consisting of fabrication and assembly details to be performed in the factory. Submit installation drawings for the following items in accordance with the paragraph entitled, "Installation," of this section.

Fire Extinguishers
Accessories
Cabinets
Wall Brackets

SD-03 Product Data

Submit Manufacturer's catalog and warranty data for the following items:

Fire Extinguishers
Accessories
Cabinets
Wall Brackets

Replacement Parts

SD-04 Samples

One Fire Extinguisher of each type to be installed

One full-sized sample of each type of Cabinet to be installed

Three samples of Wall Brackets and Accessories of each type to be used

Approved samples may be used for installation, with proper identification and storage.

SD-07 Certificates

Submit Certificates showing the following:

Certification that Fire Extinguishers comply with local codes and regulations.

Certification that Fire Extinguishers comply with OSHA, NFPA, and UL requirements.

Submit Manufacturer's Warranty with Inspection Tag on each extinguisher.

1.3 DELIVERY, HANDLING, AND STORAGE

Protect materials from weather, soil, and damage during delivery, storage, and construction.

Deliver materials in their original packages, containers, or bundles bearing the brand name and the name and type of the material.

PART 2 PRODUCTS

2.1 TYPES

Fire Extinguishers must conform to NFPA 10 Quantity and placement must comply with the applicable sections of NFPA 10.

Provide dry chemical type fire extinguishers compliant with UL 299.

Submit Manufacturer's Data for each type of Fire Extinguisher required, detailing all related Cabinet, Wall Mounting and Accessories information, complete with Manufacturer's Warranty with Inspection Tag.

2.2 MATERIAL

Extinguisher shell must be enameled steel.

2.3 SIZE

Extinguishers must be coordinated with Base Fire Department.

## 2.4 CABINETS

### 2.4.1 Material

Provide enameled steel cabinets.

### 2.4.2 Type

Provide recessed type cabinets.

### 2.4.3 Size

Dimensions of cabinets must be of adequate size to accommodate the specified fire extinguishers.

## 2.5 WALL BRACKETS

Provide wall-hook fire extinguisher wall brackets in mechanical and electrical spaces.

Wall bracket and Accessories must be as approved.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Install Fire Extinguishers where indicated on the drawings. Verify exact locations prior to installation.

Comply with the manufacturer's recommendations for all installations.

Provide extinguishers which are fully charged and ready for operation upon installation. Provide extinguishers complete with Manufacturer's Warranty with Inspection Tag attached.

## 3.2 ACCEPTANCE PROVISIONS

### 3.2.1 Repairing

Remove and replace damaged and unacceptable portions of completed work with new work at no additional cost to the Government.

Provide Replacement Parts list indicating specified items replacement part, replacement cost, and name, address and contact for replacement parts distributor.

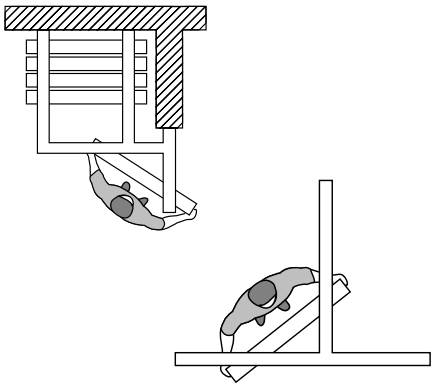
### 3.2.2 Cleaning

Clean all surfaces of the work, and adjacent surfaces which are soiled as a result of the work. Remove from the site all construction equipment, tools, surplus materials and rubbish resulting from the work.

-- End of Section --

# Individual, Omni-Directional Panels

**(Former Model Numbers 5600R & 6603)**



**Top Supported**
**Side Stack**
**Individual, Omni-Directional Panels**
**Manually Operated**
**Maximum Opening Height**: 24'3" [7391]
**Maximum Opening Width**: Unlimited
**STC Ratings**: 41, 43, 47, 49, 51

## PRODUCT OVERVIEW:

**Select for Value**: Series 631 panels offer a wide choice of finish options, accessories, and sound control levels.

**Standard Features**: The panels are nominally 3" [76] thick, and have a frame of 16 ga. steel. The top horizontal sound seal is of multi-finger vinyl, and the bottom sound seal is retractable and provides up to 2" [50] floor clearance (to accommodate out-of-level floors). The faces may be covered from a wide selection of vinyl colors and patterns. The face substrate varies by the level of sound control required (STC rating).

**Individual, Omni-Directional Panels:** Individual, manually operated panels offer optimum room flexibility. The track system enables panels to negotiate turns and be used in alternate locations.

**How to Obtain**: Hufcor partitions are sold, installed, and serviced by factory-trained local authorized Distributors in the United States and by Licensees and Distributors outside the U.S.A.

**Delivery:** Panels are custom built for your specific project. Lead times vary due to seasonal fluctuations. Check with your Distributor for the current schedule.

**Warranty:** Track and panels are guaranteed for ***two years*** against defects in material and workmanship.

## "Standard" Product Features and Benefits:

Look for these features when comparing similar products.

1. **Feature:** Protective vertical trim (Available option: no vertical face trim.)
   **Benefit**: Trim protects the panel edges and faces plus it provides a handhold when moving panels.
2. **Feature**: Quick-set 2" [50] retractable bottom seals
   **Benefit**: Retractable seals accommodate out-of-level floor conditions. When retracted, nothing drags on the floor when the panels are moved. Panels can be "locked" in place.
3. **Feature:** Retractable bottom seals exert downward seal force
   **Benefit:** Provides constant force against floor for optimum acoustics even on carpet or other porous floor materials. Maintains panel stability when the seals are set.
4. **Feature**: Waist high seal activator
   **Benefit**: Fast, easy seal activation without bending or stooping.
5. **Feature**: Removable operating handle.
   **Benefit**: Prevents unauthorized operation.
6. **Feature:** Expanding Jamb Closure (Lever Closure) Panel
   **Benefit:** Exerts 250 lbs [113.4 kg] of force against the fixed wall. The compression creates tight panel joints for optimum sound control.
7. **Feature**: Interlocking, universal vertical seals
   **Benefit**: Ensures panel-to-panel alignment and prevents sound leaks between panels.

HUFCOR

Optional track systems, seals, and accessories enable the standard product to be modified for optimum versatility. See details provided or ask your Hufcor representative for the features you want.

## Individual, Omni-Directional Operable Partitions

**PART 1 - GENERAL**

1.01 DESCRIPTION

A. General

1. Furnish and install operable partitions and suspension system. Provide all labor, materials, tools, equipment, and services for operable walls in accordance with provisions of contract documents.

1.02 RELATED WORK BY OTHERS

A. Preparation of opening will be by General Contractor. Any deviation of site conditions contrary to approved shop drawings must be called to the attention of the architect.

B. All header, blocking, support structures, jambs, track enclosures, surrounding insulation, and sound baffles as required in 1.04 Quality Assurance.

C. Prepunching of support structure in accordance with approved shop drawings.

D. Paint or otherwise finishing all trim and other materials adjoining head and jamb of operable partitions.

1.03 SUBMITTALS

A. Complete shop drawings are to be provided prior to fabrication indicating construction and installation details. Shop drawings must be submitted within 60 days after receipt of signed contract.

1.04 QUALITY ASSURANCE

A. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions

B. The partition STC (Sound Transmission Classification) shall be achieved per the standard test methods ASTM E90.

C. Noise isolation classifications shall be achieved per the standard test methods ASTM E336 and ASTM E413.

D. Noise Reduction Coefficient (NRC) ratings shall be per ASTM C423.

E. Rack testing for 10 years. (tensional strength stress test)

F. The manufacturer shall have a quality system that is registered to the ISO 9001 standards.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Proper storage of partitions before installation and continued protection during and after installation will be the responsibility of the General Contractor.

1.06 WARRANTY

A. Partition system shall be guaranteed for a period of two years against defects in material and workmanship, excluding abuse.

**PART 2 - PRODUCTS**

2.01 ACCEPTABLE MANUFACTURERS

A. Upon compliance with all of the criteria specified in this section, Manufacturers wishing to bid products equal to the product specified must submit to the architect 10 days prior to bidding complete data in support of compliance and a list of three past installations of products similar to those listed. The submitting manufacturer guarantees the proposed substituted product complies with the performance items specified and as detailed on the drawings.

2.02 MATERIALS

A. Product to be top supported Series 631 individual, omni-directional panels as manufactured by Hufcor Inc.

1. Panels shall be nominally 3" [76] thick and to 48" [1219] in width.
2. Panel faces shall be laminated to appropriate substrate to meet the STC requirement in 2.04 Acoustical Performance.
   a. Optional face material (Not all substrates are available for all STC ratings. Consult your Hufcor Distributor for more information):
      Steel
      Non-steel
      Medium Density Fiberboard
   b. Horizontal Splice: Heights over 16'3" [4953] with non-steel faces require a structural splice placed at approximately 12'3" [3734] from the floor.
3. Frames shall be of 16 gauge [1.42mm] painted steel with integral factory applied aluminum vertical edge and face protection. Optional: Face finish shall wrap around the vertical panel edges and provide no protective vertical face trim.
4. Vertical sound seals shall be of tongue and groove configuration, ensure panel-to-panel alignment and prevent sound leaks between panels.
5. Horizontal top seals shall be fixed continuous contact dual 4-finger vinyl. (Option: Horizontal top seals shall be retractable, provide 1" [25] nominal operating clearance, and exert upward force when extended. All panels, including pass door panels and lever closure panels must have retractable top and bottom seals. Not available with automatic bottom seals.)
6. Horizontal bottom seals shall be retractable, provide up to 2" [50] nominal operating clearance, and exert downward force when extended.
   Optional Seals:
   (a) Horizontal bottom seals shall be automatic and provide up to 2" [50] nominal operating clearance. Consult your Hufcor Distributor for more information.)
   (b) Horizontal bottom seals shall be fixed continuous contact dual 4-finger vinyl.
7. Horizontal trim shall be of aluminum.

B. Weight of the panels shall be 5.7-10.2 lbs. per sq. ft. [27.8-49.8kg/sq.m] based on options selected.

C. Suspension system:

1. Track shall be of clear anodized architectural grade extruded aluminum alloy 6063-T6. Track design shall provide precise alignment at the trolley running surfaces and provide integral support for adjoining ceiling, soffit, or plenum sound barrier. Track shall be connected to the structural support by pairs of minimum 3/8" [10] dia. threaded steel hanger rods. Pairs of rods are directly attached to the track, no single point attachment allowed. L, T, or X intersections shall be factory assembled and welded.
   a. Each panel shall be supported by two 2-wheeled counter-rotating horizontal carriers. Wheels to be of precision ground steel ball bearings with heat treated and hardened races encased with molded polymer tires.
      (Optional Type 38 (for panels weighing up to 400 lbs. [182 kg]): Each panel shall be supported by two 1-wheel horizontal rotating carriers. Wheel to be of precision ground steel ball bearings with heat treated and hardened races encased with molded polymer tires.)
2. Plenum closure (by others): Design of plenum closure must permit lifting out of header panels to adjust track height. Plenum closure required for optimum sound control of partition.
3. Option (available for select layouts-consult your Hufcor Distributor): The panels shall be supported by the Unispan pre-engineered truss and post system fabricated of steel and aluminum. Unispan is attached to the building structure for lateral support only. The load of the truss and partition is supported by end columns and the system transfers the partition weight to the floor.

D. Finishes

1. Face finish shall be: (**select as required**):
   a. Factory applied reinforced vinyl fabric with woven backing, weighing not less than 15 oz. per lineal yard [465 g/m]. Color shall be selected from manufacturer's standard color selectors.
   b. Standard upgrade fabrics (color shall be selected from manufacturer's standard color selector):
      (1) Factory applied vertical ribbed carpet (N.R.C. .20)
      (2) Factory applied 100% polyolefin stain resistant fabric
      (3) DiVISIONS™ stain repellant fabric by Milliken
   c. Optional:
      (1) Customer selected (requires factory approval for manufacturing compatibility)
      (2) Unfinished for field decoration
      (3) Wood veneer (factory installed on trimmed models)
      (4) High pressure laminate (factory installed on trimmed models)
2. Exposed metal trim and seal color shall be (**select from Hufcor's Standard Trim selector**):
   a. Lamb's Wool (standard)
   b. Brown (standard)
   c. Gray (standard)
   d. Custom powder coated (optional upgrade for metal trim)
3. Aluminum track shall be clear anodized
   a. Optional upgrade:
      (1) Custom anodized
      (2) Custom powder coated

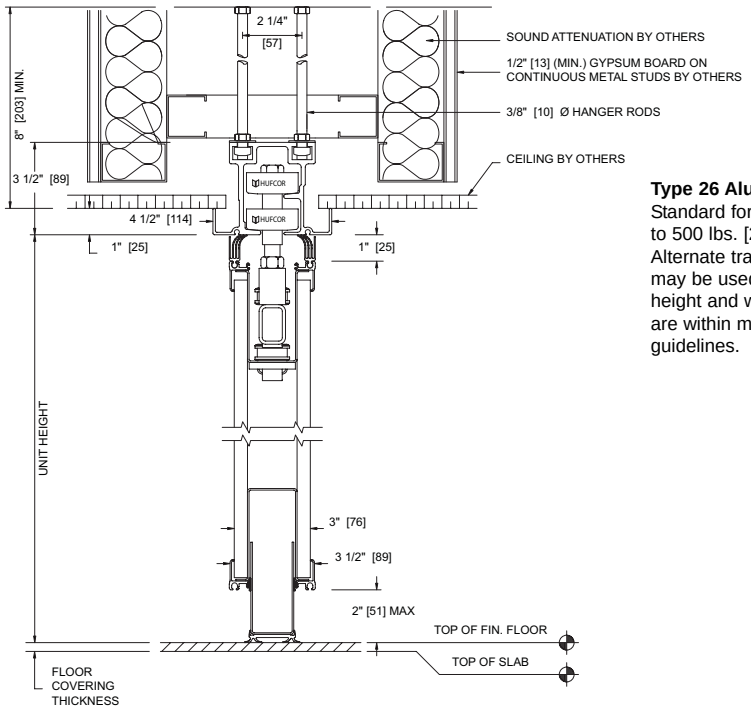
E. Available Accessories/Options
1. ADA compliant pass door of the same thickness and construction as the basic panels. Pass door panel legs require bottom seals that provide downward force to maintain stability during door operation. Pass door leaf has perimeter trim to protect face finish and to provide visual identification as required by International Building Code. Pass door leaf incorporates a self-adjusting retractable bottom seal providing sound control when door is closed.
   a. Automatic door closer
   b. Door lock
   c. Exit sign (consult your local code)
   d. Prepped for window
2. Inset chalk/writing/projection surfaces
3. Inset tackboards
4. Inset eraser pocket
5. Segmented faces
6. Finished end cover
7. Pocket doors
8. Inset chair rail pan (for field installation of chair rail).
9. Custom design options (consult your local Hufcor Distributor)

2.03 OPERATION
A. Panels are manually moved from the storage area, positioned in the opening, and seals set.
B. Retractable Seals
1. Retractable seals shall be activated by a removable quick-set operating handle located approximately 42" [1067] from the floor in the panel edge. Seal activation requires approximately 15 lbs. [6.8 kg] of force per panel and approximately a 190 degree turn of the removable handle. Top and bottom retractable seals on each panel shall be operated simultaneously.
C. Automatic Floor Seals
1. Horizontal seals shall be activated by pressing the edge of the panel into the edge of the adjacent panel or wall.
2. Seal activation requires approximately 15 lbs. [6.8 kg] of force per panel.
D. Final partition closure to be by (select one):
1. Lever closure panel with expanding jamb which compensates for minor wall irregularities and provides a minimum of 250 lbs. [113.4 kg] seal force against the adjacent wall for optimum sound control. The jamb activator shall be located approximately 45" [1143] from the floor in the panel face and be accessed from either side of the panel. The jamb is equipped with a mechanical rack and pinion gear drive mechanism and shall extend 4"-6" [100-152] by turning the removable operating handle.
2. Pivot Panel (Optional for heights to 12'3" [3734] and a maximum of 10 panels): Pivot panel is attached to the wall and permits access between adjacent rooms. Pivot panel is of the same construction as basic panels but with continuous contact multi-ply vinyl top and bottom seals. The lead end of the panel has full height finger pull and vertical seal of multi-ply vinyl.

2.04 ACOUSTICAL PERFORMANCE
A. Acoustical performance shall be tested at a laboratory accredited by the U.S. Dept. of Commerce, National Institute of Standards and Technology, under the National Voluntary Laboratory Accreditation Program (NVLAP) and in accordance with ASTM E90 Test Standards. Standard panel construction shall have obtained an STC rating of _____ (**select as required**): 41, 43, 47, 49, 51
(Not all substrates are available in all STC ratings)
1. Complete, unaltered written test report is to be made available upon request.

**PART 3 - EXECUTION**
A. Installation. The complete installation of the operable wall system shall be by an authorized factory-trained installer and be in strict accordance with the approved shop drawings and manufacturer's standard printed specifications, instructions, and recommendations.
B. Cleaning
1. All track and panel surfaces shall be wiped clean and free of handprints, grease, and soil.
2. Cartoning and other installation debris shall be removed to onsite waste collection area, provided by others.
C. Training
1. Installer shall demonstrate proper operation and maintenance procedures to owner's representative.
2. Operating handle and owners manuals shall be provided to owner's representative.

Header shown for plenum sound enclosure is one of several that may be used. See ASTM E557 Standard Practice for Archl Application & Installation of Operable Partitions for other recommendations.

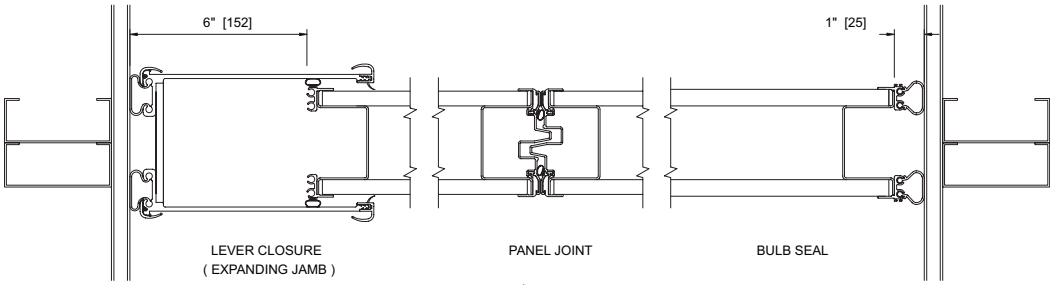



**Type 26 Aluminum track**. Standard for panel weights to 500 lbs. [227 kg]. Alternate track systems may be used providing the height and weight limits are within manufacturer's guidelines.

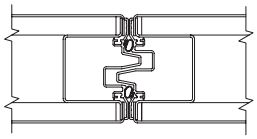
**VERTICAL SECTION** **No Scale**

## HORIZONTAL SECTION

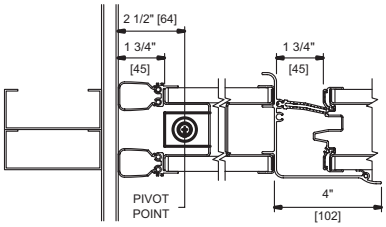
Final partition closure using **Lever Closure** with expanding jamb. Solid blocking required at both ends to withstand 250 lbs. [113.4 kg] of lateral force.




**Optional: No vertical face trim panel joint.**

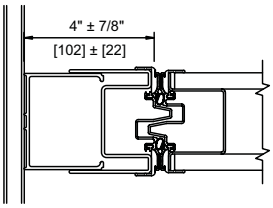


## OPTIONAL CLOSURES



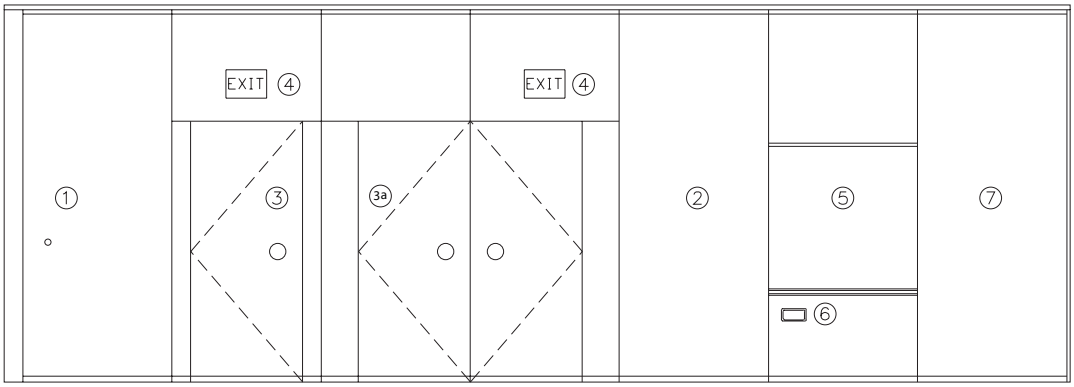

**Pivot Panel.** This closure is optional for openings with a maximum of 10 panels per opening.

Optional: Wall Jamb Assembly




## OPTIONS & ACCESSORIES

### ELEVATION

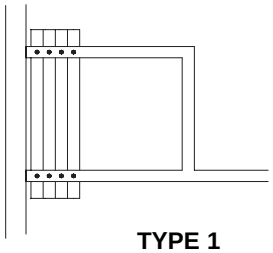



1. **Expanding Jamb Closure (Lever Closure) Panel**. Expanding jamb exerts 250 lbs. [113.4kg] force against adjacent wall for optimum sound control.
2. **Basic panel**
3. **ADA compliant pass doors** - Single 3/0 x 7/0 [914 x 2132] or 3/0 x 6/8 [914 x 2030]. Of the same construction, thickness, and finish as the basic panels. Push/pull latching handle. Options include key lock, windows, and automatic door closer. No threshold is required.
   3a. Double doors (batwings) also available.
4. **Exit Sign** - Recessed or surface mounted, self-illuminated.
5. **Work Surfaces** 4'0" [1219] high x panel width, recessed, mounted approx. 30" [762] above the floor:
   a. Markerboard and projection/writing surfaces (from Hufcor standard color selector).
   b. Tackboards of 2mm cork board covered with vinyl (from Hufcor standard color selector).
   c. Chalk/marker tray (standard on chalk and projection/writing boards).
6. **Recessed Eraser Pocket** (8" x 2" x 1-1/4" deep [203 x 50 x 31]).
7. **Lead panel** with bulb seal to prevent sound leaks at adjacent wall.
   Optional: Lead panel closure to 4" adjustable, full height, acoustic wall jamb assembly.

# Individual, Omni-Directional Operable Partitions

### Stack Dimensions using Lever Closure Panel

**Stack depth and width dimensions are based on a flat stack and standard construction with vinyl faces. Optional construction and/or face covering may increase stack depth dimensions. Angled stacks require additional space. Contact your Hufcor Distributor for angled stack requirements. (Contact the factory for pivot panel closure stack information.)**



**TYPE 1**

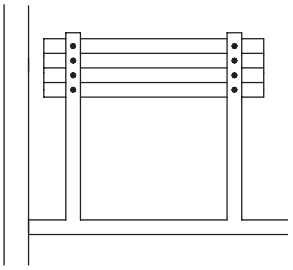
Stack Depth: 3-3/4 [95] per panel plus 1" [25]
Optional panic hardware will add to the depth of the stack. Please contact your Hufcor distributor for assistance.

Stack Width:
Retractable & sweep seal models: Panel width + 12" [300] clearance.
Automatic bottom seals: Panel width + 14" [356] clearance

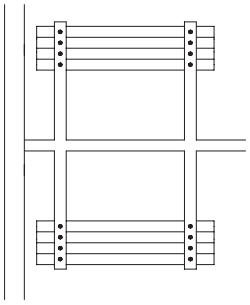
For Pocket Storage: Due to the wide variety of stack configurations possible, consult your Hufcor representative for space requirements.

---

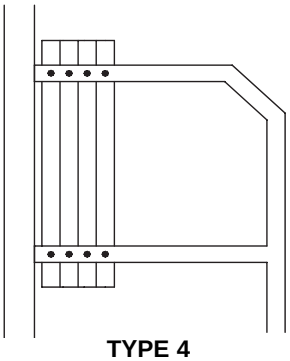
**The Type 1 stack shown above is the most often used for simple omni-directional layouts. Following are additional common stack configurations. Stacks are not limited to these configurations and may be built to fit each job requirement. Consult your Hufcor representative for design assistance.**



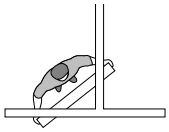
**TYPE 2** *



**TYPE 3**



**TYPE 4** *



*

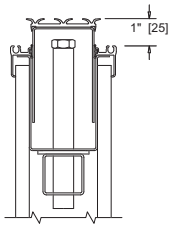
**CAUTION**

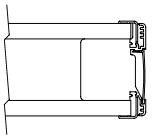
Body space is needed to access the panels and move them into position. Be certain to consult your Hufcor representative before constructing walls in pocket/stack areas. This is important for all configurations, but can be especially important for those stacks marked with an asterisk.

HUFCOR

| Hanging Weight | | |
|---|---|---|
| STC | Lbs./Sq. Ft. | Kg./Sq. M |
| 41 | 5.7 | 27.8 |
| 43 | 7.3 | 35.6 |
| 47 | 7.8 | 38.1 |
| 49 | 8.9 | 43.5 |
| 51 | 10.2 | 49.8 |

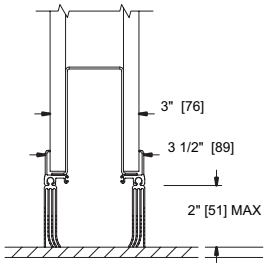
Optional retractable top seal (not available with automatic bottom seal)



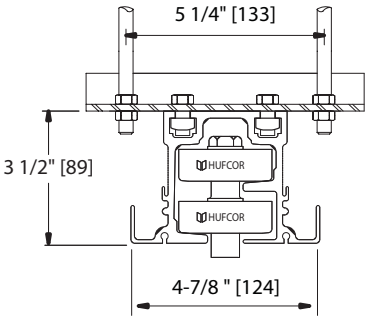



**Optional finished end cover -** provides finished panel end when partition run does not extend from wall-to-wall.

Optional continuous contact bottom seal.

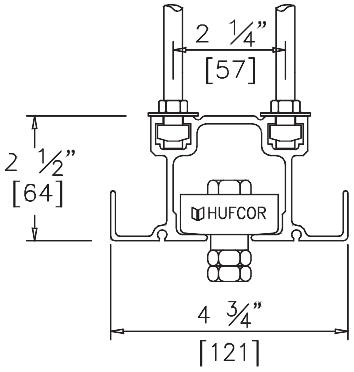



**OPTIONAL TRACKS - Alternate Hufcor track systems may be used providing the height and weight limits are within manufacturer's guidelines.**




**Type 36 Aluminum Track**

Shown with optional suspension bracket for 5-1/4" [133] rod spacing. Available for all aluminum tracks. Required for panel weights over 500 lbs. [227 kg]. Each panel shall be supported by two carriers. Each carrier has two horizontal counter-rotating wheels that roll in the track. Each wheel has precision ground bearings encased with Delrin for quiet operation.




**Type 38 Aluminum Track**

Optional for panel weights to 400 lbs. [182 kg]. Each panel shall be supported by two 1-wheel horizontal rotating carriers. Wheel to be of precision ground steel ball bearings with heat treated and hardened races encased with molded polymer tires.

The manufacturer reserves the right to improve and change product without notice.


**Worldwide headquarters:**
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Janesville, WI USA 53547-0591
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FAX: 1-608-758-8253
E-mail: info@hufcor.com
Internet address: http://www.hufcor.com

Select Hufcor products are also manufactured in the U.S. at:
Hufcor/Airwall, Inc., 8739 E. Artesia Blvd., Bellflower, CA 90707
1-562-634-3116 FAX 1-562-630-8203

SECTION 12 21 00

WINDOW BLINDS
**02/09**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 701 | (2004) Fire Tests for Flame Propagation of Textiles and Films |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES

SD-02 Shop Drawings

Installation

Drawings showing fabrication and installation details. Show layout and locations of track, direction of draw, mounting heights, and details.

SD-03 Product Data

Window Blinds G
Installation

Manufacturer's data composed of catalog cuts, brochures, product information, and maintenance instructions.

SD-04 Samples

Window Blinds G

Samples of each type and color of window treatment. Provide [aluminum] [horizontal louver blind slats][vertical louvers] 6 inch in length for each color. Provide 6 inch sample of [horizontal blind slats][vertical louvers] in each color specified.

SD-06 Test Reports

Window Blinds

Fire resistance, Flame Spread, and smoke contribution data.

SD-08 Manufacturer's Instructions

Window Blinds G

SD-10 Operation and Maintenance Data

Window Blinds G

1.3 SYSTEM DESCRIPTION

Provide window treatment, conforming to NFPA 701, complete with necessary brackets, fittings, and hardware. Each window treatment type shall be a complete unit provided in accordance with paragraph WINDOW TREATMENT PLACEMENT SCHEDULE. Mount and operate equipment in accordance with manufacturer's instructions. Windows to receive a treatment shall be completely covered.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver components to the jobsite in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated and free from dust, water, or other contaminants and has easy access for inspection and handling. Store materials flat in a clean dry area with temperature maintained above 50 degrees F. Do not open containers until needed for installation unless verification inspection is required.

1.5 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 WINDOW BLINDS

Provide each blind, including hardware, accessory items, mounting brackets and fastenings, as a complete unit produced by one manufacturer. All parts shall be one color, unless otherwise indicated, to match the color of the blind slat. Treat steel features for corrosion resistance.

2.1.1 Horizontal Blinds

Provide horizontal blinds with 1 inch slats. Blind units shall be capable of nominally 180 degree partial tilting operation and full-height raising. Tapes for 1 inch slats shall be braided polyester or nylon.

2.1.1.1 Head Channel and Slats

Provide head channel made of steel or aluminum with corrosion-resistant finish nominal 0.024 inch for 1 inch slats. Provide slats of aluminum, not less than 0.008 inch thick, and of sufficient strength to prevent sag or bow in the finished blind. Provide a sufficient amount of slats to assure proper control, uniform spacing, and adequate overlap. Enclose all hardware in the headrail.

2.1.1.2 Controls

The slats shall be tilted by a transparent tilting wand, hung vertically by

its own weight, and shall swivel for easy operation. Provide a tilter control of enclosed construction. Provide moving parts and mechanical drive made of compatible materials which do not require lubrication during normal expected life. The tilter shall tilt the slats to any desired angle and hold them at that angle so that any vibration or movement of ladders and slats will not drive the tilter and change the angle of slats. Include a mechanism to prevent over tightening. Provide a wand of sufficient length to reach to within 5 feet of the floor.

#### 2.1.1.3 Intermediate Brackets

Provide intermediate brackets for installation, as recommended by the manufacturer, of blinds over 48 inch wide.

#### 2.1.1.4 Bottom Rail

Provide bottom rail made of corrison-resistant steel with factory applied finish. Provide closed oval shaped bottom rail with double-lock seam for maximum strength. Bottom rail and end caps to match slats in color.

#### 2.1.1.5 Braided Ladders

Provide braided ladders of 100 percent polyester yarn, color to match the slat color. Space ladders 15.2 slats per foot of drop in order to provide a uniform overlap of the slats in a closed position.

#### 2.1.1.6 Hold-Down Brackets

Provide universal type hold-down brackets for sill or jamb mount where indicated on placement list.

#### 2.1.2.5 Controls

Provide tilting and traversing controls that hang compactly at the side of the blinds and reach within 5 feet of the floor. The [tilt/traverse control][bead chain tilting control] shall tilt all vanes simultaneously to any desired angle and hold them at that angle.

### 2.1.2 Intermediate Brackets

Provide intermediate installation brackets for blinds over 62 inches wide.

## 2.2 COLOR

Provide color, pattern and texture selected from manufacturer's standard colors.

# PART 3 EXECUTION

## 3.1 EXAMINATION

After becoming familiar with details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

## 3.2 INSTALLATION

### 3.2.1 Horizontal Blinds

Perform installation of Horizontal and Audio Visual Blinds in accordance with the approved detail drawings and manufacturer's installation instructions. Install units level, plumb, secure, and at proper height and location relative to window units. Provide and install supplementary or miscellaneous items in total, including clips, brackets, or anchorages incidental to or necessary for a sound, secure, and complete installation. Do not start installation until completion of room painting and finishing operations.

## 3.3 CLEAN-UP

Upon completion of the installation, free window treatments from soiling, damage or blemishes; and adjust them for form and appearance and proper operating condition. Repair or replace damaged units as directed by the Contracting Officer. Isolate metal parts from direct contact with concrete, mortar, or dissimilar metals. Ensure blinds installed in recessed pockets can be removable without disturbing the pocket. The entire blind, when retracted, shall be contained behind the pocket. For blinds installed outside the jambs and mullions, overlap each jamb and mullion 0.75 inch or more when the jamb and mullion sizes permit. Include all hardware, brackets, anchors, fasteners, and accessories necessary for a complete, finished installation.

-- End of Section --

SECTION 12 32 00

MANUFACTURED WOOD CASEWORK
**01/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN HARDBOARD ASSOCIATION (AHA)

| | |
|---|---|
| AHA A135.4 | (2004) Basic Hardboard |

ASME INTERNATIONAL (ASME)

| | |
|---|---|
| ASME B18.6.1 | (1981; R 2008) Wood Screws (Inch Series) |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 325 | (2007a) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength |
| ASTM D 4689 | (1999; R 2005) Standard Specification for Adhesive, Casein-Type |
| ASTM D 4690 | (1999; R 2005) Standard Specification for Urea Formaldehyde Resin Adhesives |
| ASTM F 594 | (2008) Standard Specification for Stainless Steel Nuts |

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

| | |
|---|---|
| BHMA A156.9 | (2003) Cabinet Hardware |

HARDWOOD PLYWOOD AND VENEER ASSOCIATION (HPVA)

| | |
|---|---|
| HPVA HP-1 | (2004) American National Standard for Hardwood and Decorative Plywood |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|---|---|
| ICC IPC | (2006; Supplement 2007) International Plumbing Code |

KITCHEN CABINET MANUFACTURERS ASSOCIATION (KCMA)

| | |
|---|---|
| KCMA A161.1 | (2000) Performance & Construction Standards for Kitchen and Vanity Cabinets |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA LD 3 | (2005) Standard for High-Pressure |

| | |
|---|---|
| | Decorative Laminates |
| NEMA LD 3.1 | (1995) Performance, Application, Fabrication, and Installation of High-Pressure Decorative Laminates |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| FS FF-B-588 | (Rev E) Bolt, Toggle: and Expansion Sleeve, Screw |
| FS FF-S-325 | (Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry) |
| FS MM-L-736 | (1983c) Lumber; Hardwood |
| FS MM-L-751 | (Rev H) Lumber; Softwood |
| FS TT-F-336 | (Rev E) Filler, Wood, Paste |
| FS TT-V-121 | (Rev H) Varnish, Spar, Water-Resisting |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit fabrication drawings for steel and wood cabinets in accordance with the paragraphs entitled, "Wood CabinetFabrication," of this section.

Submit Installation Drawings for wood cabinets in accordance with the paragraph entitled, "Installation," of this section.

SD-03 Product Data

Submit Manufacturer's catalog data for the following items:

Cabinets
Corrosion-Resistant Steel
Plywood
Hardwood
Hardwood Plywood
Glass
Adhesives
Filler Material
Fasteners
Accessories and Hardware
Plastic Laminate (Cabinet Liner)
Countertops

SD-04 Samples

Samples must include:

Accessories and Hardware, one each.

Submit Manufacturer's Standard Color Charts in accordance with paragraph entitled, "General," of this section.

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions for in accordance with paragraph entitled, "General," of this section.

1.3 DELIVERY, STORAGE, AND HANDLING

Cabinets must be delivered, stored, and handled in a manner that will prevent damage and disfigurement.

1.4 DESIGN

Cabinets must be wood, factory-fabricated and finished in the manufacturer's standard sizes and finishes of the type, design, and configuration indicated. Construct cabinets as specified and meet the requirements of KCMA A161.1. Wall and base cabinet assemblies must consist of individual units joined into continuous sections. Accomplish fastenings to permit removal and replacement of individual units without affecting the remainder of the installation. Provide counters with watertight sink rim when indicated. Drawers must be removable and will be equipped with position stops to avoid accidental complete withdrawals. Fix or adjust shelves as indicated.

PART 2 PRODUCTS

2.1 GENERAL

Submit Manufacturer's Standard Color Charts for wood and metal cabinets showing the manufacturer's recommended color and finish selections.

Submit Manufacturer's Instructions for wood and metal cabinet systems including special provisions required to install equipment components and system packages. Special notices must detail impedances, hazards and safety precautions.

Cabinets must be the manufacturer's standard sizes of type and design indicated. Provide both wall and base cabinet assemblies will consisting of individual units joined into continuous sections as indicated. Provide fastenings to permit removal and replacement of individual units without affecting the remainder of the installation.

2.2 MATERIALS

Douglas-fir Plywood must conform to ICC IPC, exterior type, fully waterproof bond.

Adhesives for application of plastic laminate must be a thermosetting urea-resin Type II conforming to ASTM D 4690 as recommended by the manufacturer of the laminate. Adhesive for wood members will conform to ASTM D 4689.

Filler Material must conform to FS TT-F-336.

Hardwood must conform to FS MM-L-736, standard hardwood lumber, S2S.

Hardwood plywood must conform to ICC IPC.

Provide Softwoods conforming to FS MM-L-751, factory and shop grade.

Provide Varnish conforming to FS TT-V-121.

Provide Accessories and Hardware conforming to the following requirements, as applicable:

Extension drawer slides: BHMA A156.9, Type B85071

Semiconcealed hinges: BHMA A156.9, Type B81201, 1-1/2 inches

Full surface hinges: BHMA A156.9, Type B81131, 1-1/2 inches

Knob pulls: BHMA A156.9, 1-inch diameter, Type B12132

Bar type pulls: BHMA A156.9, 4-inch overall length, Type B12012

Semiconcealed hinges: BHMA A156.9, Type B81201, 40 millimeter

Full surface hinges: BHMA A156.9, Type B81131, 40 millimeter

Knob pulls: BHMA A156.9, 25 millimeter diameter, Type B12132

Bar type pulls: BHMA A156.9, 100 millimeter overall length, Type B12012

Locks, keying, and keys: As directed

Catches: Magnetic, 5-pound pull

Sliding door set:

Impregnated fiberboard track

Nylon glides

Fasteners must conform to the following:

Screws: ASME B18.6.1, Group, Type and Class as applicable

Anchoring Devices: FS FF-S-325, Group, Type, and Class as applicable

Toggle bolts: FS FF-B-588, Type I, Class A, Style 2

Nuts: ASTM F 594, corrosion-resistant steel

Bolts: ASTM A 325, heavy, hexagon head bolts corrosion-resistant steel

Nuts: ASTM F 836M, corrosion-resistant steel

Bolts: ASTM A 325M, heavy, hexagon head bolts corrosion-resistant steel

## 2.3 WOOD CABINET FABRICATION

Wall and base cabinets must be essentially of same construction and same outside appearance. Construct cabinets with frame fronts and solid ends,

or frame construction throughout. Frame members must be3/4-by 1-1/2-inch kiln-dried hardwood, using mortise and tenon, dovetailed or doweled, and glued together. Brace top and bottom corners with hardwood blocks that are glued with water-resistant glue and nailed in place. Provide base cabinets with an integral toe space at least 2-1/2 inches deep and 4 inches high. Mount drawers on metal guides. Shelves must be adjustable, as indicated.

Minimum thicknesses of materials for frame-front, solid-end cabinet construction will be as follows:

Backs and bottoms of base cabinets and tops of wall cabinets: 1/8-inch tempered hardboard. Brace bottoms with wood members glued in place.

Cabinet ends: 1/2-inch hardwood-veneer plywood

Doors: 3/4-inch hardwood core doors

Drawer fronts: 3/4-inch hardwood

Drawer bottoms: 3/16-inch plywood. Drawer bottoms over 1 foot 3 inches wide will be braced with wood members glued in place.

Drawer sides and backs: 1/2-inch hardwood

Interior partitions or dividers: 1/2-inch hardwood

Shelves: Grade A-B plywood, supported on ends and 24 inches on centers

Adjustable shelves: glued-up solid wood

Base cabinet shelves: glued-up solid wood

Wall cabinet shelves: glued-up solid wood

Minimum thicknesses of materials for frame-type cabinet construction must be as follows:

Cabinet ends: 1/4-inch hardwood plywood

Backs, bottoms, partitions, and dividers: 3/16-inch tempered hardboard in a frame

Materials for other components must be as specified.

2.3.1 High-Pressure Decorative Laminate (HPDL)

NEMA LD 3, satin finish, unless otherwise indicated.

2.3.1.1 Cabinet Liner

CL 20.

2.3.2 Hardwood Plywood

HPVA HP-1, Type II (Interior), three- or five-ply, with face veneer of good grade (1) or better. Cover all exposed edges.

2.3.3 Hardwood

All exposed wood surfaces must be hardwood of species consistent with specified finish. Species used need not be that indicated by finish named, but must be similar in grain character and appearance.

2.3.4 Hardboard

AHA A135.4, tempered.

2.3.5 Sinks , Lavatories and Fittings

As specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.4 ACCESSORIES AND HARDWARE

Furnish accessories such as utility shelves and racks for extracts, condiments, and towels; bins for sugar and flour; breadboxes; and trays for cutlery and flatware as indicated.

Hardware must be corrosion resistant. Exposed hardware must have a chromium-plated finish or a corrosion-resistant finish as approved.

2.5 CABINETS

The work includes providing new factory-finished kitchen wall and base cabinets. The cabinets must conform to KCMA A161.1, requirements specified herein, and bear the "KCMA Certified Cabinet" seal of the Kitchen Cabinet Manufacturers Association. In lieu of this, manufacturer must submit test reports from an approval laboratory that cabinets meet requirements of KCMA A161.1. Provide Countertops conforming to NEMA LD 3.1 and requirements specified herein.

2.5.1 Frame Type Cabinets

Construct the cabinets with frame fronts and solid ends. Frame members must be 3/4 inch thick by 1-1/2 inch wide; kiln-dried hardwood, glued together, and must be either mortised and tenoned, dovetailed or doweled, nailed, stapled or screwed. Brace top and bottom corners with either hardwood blocks that are glued together with water resistant glue and nailed in place, or metal or plastic corner braces. Backs of wall cabinets and base and tall cabinets must be 3/8 inch thick hardwood . Bottoms of cabinets must be minimum 3/8 inch thick hardwood plywood and will be braced with wood members glued in place. Cabinet ends must be 5/8 inch thick hardwood plywood.

2.6 FINISH

2.6.1 Cabinet Finish

Provide cabinets with a factory-applied durable finish in accordance with KCMA A161.1 requirements and of a type standard with the manufacturer. Fabricate natural finish wood doors, drawer fronts, cabinet fronts, and exposed cabinet sides of wood which will be free of extreme color variations within each panel or between adjacent panels. Exposed exterior surfaces must be hardwood with natural stain and sprayed on factory applied finish. Drawer fronts, cabinet fronts, and exposed cabinet sides must be fabricated of hardwood.

2.6.2 Melamine Laminated Interior Cabinet Finish

Finish plywood with a melamine laminate on the exposed side. Provide Melamine laminate that conforms to the requirements of NEMA LD 3 and laminate adhesive that is contact type applied to both surfaces.

2.6.3 Backer Sheets

Backer Sheets of high pressure plastic laminate, must conform to NEMA LD 3, Grade BK20 and must be applied to the underside of all core material.

2.7 COLOR, TEXTURE, AND PATTERN

Color must be selected from manufacturers standard colors.

PART 3 EXECUTION

3.1 INSTALLATION

Install casework plumb with countertops level to within 1/16 inch in 10 feet. Level base cabinets by adjusting leveling screws. Scribe and fit scribe strips to irregularities of adjacent surfaces. Gap opening must not exceed.

Secure cases permanently to floor and wall construction using 1/4-inch diameter masonry anchors, spaced 30 inches maximum on center, minimum of two for each case.

Support wall cases on continuous 18-gage galvanized steel hanging brackets. Secure wall cases in position with screws to blocking. Bolt adjoining cases together. Width of joints must not exceed 1/32 inch. Provide closer strips, filler strips, and finish moldings as required. Doors must be aligned, hardware adjusted, and surfaces cleaned and waxed.

Submit Installation Drawings for wood cabinets. Drawings must include location of cabinets, details of cabinets related and dimensional positions, and locations for roughing in plumbing, including sinks, faucets, strainers and cocks.

3.2 CLEANING

On completion of cabinet installation, touch up marred or abraded finished surfaces. Remove crating and packing materials from premises. Wipe down surfaces to remove fingerprints and markings and leave in clean condition.

3.3 INSPECTION

Examine casework grounds and supports for adequate anchorage, foreign material, moisture, and unevenness that could prevent quality casework installation. Ensure that electrical and plumbing rough-ins for casework are complete. Do not proceed with installation until defects are corrected.

-- End of Section --

SECTION 13 34 19

METAL BUILDING SYSTEMS
**01/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

| | |
|---|---|
| AA ADM1 | (2005; Errata 2005) Aluminum Design Manual |
| AA ASD1 | (2006; Errata 2007) Aluminum Standards and Data |

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

| | |
|---|---|
| AISC 325 | (2005) Manual of Steel Construction |
| AISC 341 | (2005; Supp 2005) Seismic Provisions for Structural Steel Buildings |
| AISC 350 | (2005) Load and Resistance Factor Design (LRFD)Specification for Structural Steel Buildings |
| AISC 360 | (2005) Specification for Structural Steel Buildings, with Commentary |

AMERICAN IRON AND STEEL INSTITUTE (AISI)

| | |
|---|---|
| AISC/AISI 121 | (2004) Standard Definitions for Use in the Design of Steel Structures |
| AISI SG03-3 | (2002) Cold-Formed Steel Design Manual Set |

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

| | |
|---|---|
| ASCE/SEI 7-05 | (2006) Minimum Design Loads for Buildings and Other Structures, Including Supplement No. 1 |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS A5.1/A5.1M | (2004; Errata 2004) Carbon Steel Electrodes for Shielded Metal Arc Welding |
| AWS D1.1/D1.1M | (2008) Structural Welding Code - Steel |
| AWS D1.3/D1.3M | (2008; Errata 2008) Structural Welding Code - Sheet Steel |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 1008/A 1008M | (2008a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened |
| ASTM A 1011/A 1011M | (2008) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability |
| ASTM A 123/A 123M | (2008) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A 153/A 153M | (2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| ASTM A 193/A 193M | (2008b) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service |
| ASTM A 307 | (2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength |
| ASTM A 325 | (2007a) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength |
| ASTM A 36/A 36M | (2008) Standard Specification for Carbon Structural Steel |
| ASTM A 463/A 463M | (2006) Standard Specification for Steel Sheet, Aluminum-Coated |
| ASTM A 475 | (2003) Standard Specification for Zinc-Coated Steel Wire Strand |
| ASTM A 500/A 500M | (2007) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes |
| ASTM A 501 | (2007) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing |
| ASTM A 529/A 529M | (2005) Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality |
| ASTM A 53/A 53M | (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |

| | |
|---|---|
| ASTM A 563 | (2007a) Standard Specification for Carbon and Alloy Steel Nuts |
| ASTM A 572/A 572M | (2007) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel |
| ASTM A 606 | (2004) Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance |
| ASTM A 653/A 653M | (2008) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A 755/A 755M | (2003; R 2008) Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products |
| ASTM A 780 | (2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings |
| ASTM A 792/A 792M | (2008) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process |
| ASTM A 992/A 992M | (2006a) Standard Specification for Structural Steel Shapes |
| ASTM B 209 | (2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate |
| ASTM B 221 | (2008) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes |
| ASTM B 695 | (2004) Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel |
| ASTM C 1289 | (2008) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board |
| ASTM C 920 | (2008) Standard Specification for Elastomeric Joint Sealants |
| ASTM D 1056 | (2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber |
| ASTM E 119 | (2008a) Standard Test Methods for Fire Tests of Building Construction and |

| | |
|---|---|
| | Materials |
| ASTM E 1592 | (2005) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference |
| ASTM E 84 | (2008a) Standard Test Method for Surface Burning Characteristics of Building Materials |
| ASTM F 1554 | (2007a)Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength |

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

| | |
|---|---|
| MBMA MBSM | (2002) Metal Building Systems Manual |

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

| | |
|---|---|
| NAAMM AMP 500 | (2006) Metal Finishes Manual |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 252 | (2007) Standard Methods of Fire Tests of Door Assemblies |
| NFPA 80 | (2006; Errata 2008) Standard for Fire Doors and Other Opening Protectives |

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

| | |
|---|---|
| NRCA RWM | (2003) Roofing and Waterproofing Manual |

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

| | |
|---|---|
| SMACNA 1793 | (2006) Architectural Sheet Metal Manual, Sixth Edition, Second Printing |

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

| | |
|---|---|
| SSPC A | (2000) Good Painting Practice Steel Structures Painting Manual, Volume 1 |
| SSPC Paint 15 | (1999; E 2004) Steel Joist Shop Primer/Metal Building Primer |
| SSPC SP 2 | (1982; E 2004) Hand Tool Cleaning |

U.S. FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

| | |
|---|---|
| FEMA 302 | (Feb 1998) NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 580 | (2006) Tests for Uplift Resistance of Roof |

Assemblies

1.2 GENERAL REQUIREMENTS

1.2.1 Structural Performance

Provide metal building systems capable of withstanding the effects of gravity loads and the following loads and stresses within the limits and conditions indicated.

1.2.1.1 Engineering

Design metal building systems conforming to procedures described in MBMA MBSM.

1.2.1.2 Design Loads

Conform to the requirements of MBMA MBSM, ASCE/SEI 7-05, and the building code applicable to the project geographical location.

1.2.1.3 Live Loads

Include all vertical loads induced by the building occupancy indicated on the drawings, as well as loads induced by maintenance workers, materials and equipment for roof live loads.

1.2.1.4 Wind Loads

Include horizontal loads induced by a basic wind speed corresponding to a 50-year, mean-recurrence interval at Project site of 130 mph.

1.2.1.5 Collateral Loads

Include additional dead loads other than the weight of metal building system for permanent items such as sprinklers, mechanical systems, electrical systems, and ceilings.

1.2.1.6 Auxiliary Loads

Include dynamic live loads, such as those generated by cranes and materials-handling equipment indicated on detail drawings.

1.2.1.7 Load Combinations

Design metal building systems to withstand the most critical effects of load factors and load combinations as required by MBMA MBSM, ASCE/SEI 7-05, and the building code applicable to the project location.

1.2.1.8 Deflection Limits

Engineer assemblies to withstand design loads with deflections no greater than the following:

a. Purlins and Rafters; vertical deflection of 1/180 of the span.

b. Girts; horizontal deflection of 1/180 of the span.

c. Metal Roof Panels; vertical deflection of 1/180 of the span.

d. Metal Wall Panels; horizontal deflection of 1/120 of the span.

Design secondary framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings. Provide metal panel assemblies capable of withstanding the effects of loads and stresses indicated, based on testing according to ASTM E 1592.

1.2.2 Seismic Performance

Design and engineer metal building system capable of withstanding the effects of earthquake motions determined according to ASCE/SEI 7-05, AISC 341, and the applicable portions of the building code in the geographic area where the construction will take place.

1.2.3 Thermal Movements

Provide metal panel systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.

1.2.4 Wind-Uplift Resistance

Provide metal roof panel assemblies that comply with UL 580 for Class 90.

1.3 DEFINITIONS

ASTM DEF applies to this definition paragraph.

a. Bay: Dimension between main frames measured normal to frame (at centerline of frame) for interior bays, and dimension from centerline of first interior main frame measured normal to end wall (outside face of end-wall girt) for end bays.

b. Building Length: Dimension of the building measured perpendicular to main framing from end wall to end wall (outside face of girt to outside face of girt).

c. Building Width: Dimension of the building measured parallel to main framing from sidewall to sidewall (outside face of girt to outside face of girt).

d. Clear Span: Distance between supports of beams, girders, or trusses (measured from lowest level of connecting area of a column and a rafter frame or knee).

e. Eave Height: Vertical dimension from finished floor to eave (the line along the sidewall formed by intersection of the planes of the roof and wall).

f. Clear Height under Structure: Vertical dimension from finished floor to lowest point of any part of primary or secondary structure, not including crane supports, located within clear span.

g. Terminology Standard: Refer to MBMA "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in

referenced standards.

## 1.4 SYSTEM DESCRIPTION

General: Provide a complete, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior. Include primary and secondary framing, metal roof panels, metal wall panels, and accessories complying with requirements indicated.

a. Provide metal building system of size and with spacing, slopes, and spans indicated.

### 1.4.1 Primary Frame Type

a. Rigid Clear Span: Solid-member, structural-framing system without interior columns.

b. Lean To: Solid- or truss-member, structural-framing system without interior columns, designed to be partially supported by another structure.

### 1.4.2 Fixed End-Wall Framing

Provide manufacturer's standard fixed end wall, for buildings not required to be expandable, consisting of [ primary frame, capable of supporting one-half of a bay design load, and end-wall columns][ load-bearing end-wall with corner columns, and rafters].

### 1.4.3 Secondary Frame Type

Provide manufacturer's standard purlins and joists and bypass girts.

## 1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Metal Building Systems; G

SD-03 Product Data

Metal Building Systems; G

SD-10 Operation and Maintenance Data

Metal Building Systems, Data Package 1; G

## 1.6 QUALITY ASSURANCE

### 1.6.1 Pre-Erection Conference

After submittals are received and approved but before metal building system work, including associated work, is performed, the Contracting Officer will hold a pre-erection conference to review the following:

a. The detail drawings, specifications, and manufacturer's descriptive and technical literature.

b. Finalize construction schedule and verify availability of materials, erector's personnel, equipment, and facilities needed to make progress and avoid delays

c. Methods and procedures related to metal building system erection, including, but not limited to: qualification of manufacturer, qualification of erector, manufacturer's catalog data, building design analysis, written instructions and test reports.

d. Support conditions for compliance with requirements, including alignment between and erection of structural members

e. Flashing, special roofing and siding details, roof and wall penetrations, openings, and condition of other construction that will affect metal building system, including coatings and base metals, factory color finish performance requirements, system components, and certificates for coil stock.

f. Governing regulations and requirements for, certificates, insurance, tests and inspections if applicable

g. Temporary protection requirements for metal panel assembly during and after installation

h. Samples of aluminized steel repair paint, galvanizing repair paint, and enamel repair paint.

#### 1.6.1.1 Pre-Roofing and Siding Installation Conference

After structural framing system erection and approval but before roofing, siding, insulation and vapor barrier work, including associated work, is performed; the Contracting Officer will hold a pre-roofing and siding conference to review the following:

a. Examine purlins, sub-girts and formed shapes conditions for compliance with requirements, including flatness and attachment to structural members.

b. Review structural limitations of purlins, sub-girts and formed shapes during and after roofing and siding.

c. Review flashings, special roof and wall details, roof drainage, roof and wall penetrations, roof equipment curbs, and condition of other construction that will affect the metal building system.

d. Review temporary protection requirements for metal roof and wall panels' assembly during and after installation.

e. Review roof and wall observation and repair procedures after metal building system erection.

1.6.2 Manufacturer's Technical Representative

The representative must have authorization from manufacturer to approve field changes and be thoroughly familiar with the products, erection of structural framing and installation of roof and wall panels in the geographical area where construction will take place.

1.6.3 Manufacturer's Qualifications

Metal building system manufacturer must have a minimum of five (5) years experience as a quailed manufacturer and a member of MBMA of metal building systems and accessory products.

Provide engineering services by an authorized currently licensed engineer in the geographical area where construction will take place, having a minimum of four (4) years experience as an engineer knowledgeable in building design analysis, protocols and procedures for the "Metal Building Systems Manual" MBMA MBSM; ASCE/SEI 7-05, the building code in the geographic area where the construction will take place and ASTM E 1592.

Provide certified engineering calculations using the products submitted for:

a. Roof and Wall Wind Loads with basic wind speed, exposure category, co-efficient, importance factor, designate type of facility, negative pressures for each zone, methods and requirements of attachment.

b. Roof Dead and Live Loads

c. Collateral Loads

d. Foundation Loads

f. Seismic Loads

1.6.4 Qualification of Erection Contractor

An experienced erector who has specialized in erecting and installing work similar in material, design, and extent to that indicated for this Project and must be approved and certified by the metal building system manufacturer.

1.6.5 Single Source

Obtain primary and secondary components and structural framing members, each type of metal roof, wall and liner panel assemblies, clips, closures and other accessories from the standard products of the single source from a single manufacturer to operate as a complete system for the intended use.

1.6.6 Welding

Qualify procedures and personnel according to AWS A5.1/A5.1M, AWS D1.1/D1.1M, and AWS D1.3/D1.3M."

1.6.7 Structural Steel

Comply with AISC 325, AISC 341 for seismic impacted designs, AISC 350, and AISC 360, for design requirements and allowable stresses.

1.6.8 Cold-Formed Steel

Comply with AISC/AISI 121 and AISI SG03-3 for design requirements and allowable stresses.

1.6.9 Fire-Resistance Ratings

Where indicated, provide metal panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

Indicate design designations from UL Bld Mat Dir or from the listings of another qualified testing agency. Combustion Characteristics must conform to ASTM E 136.

1.6.10 Surface-Burning Characteristics

Provide metal panels having material with the following surface-burning characteristics as determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency showing:

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

1.6.11 Fabrication

Fabricate and finish metal panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles with dimensional and structural requirements

Provide metal panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel. Aluminum and aluminum-alloy sheet and plate must conform to ASTM B 209.

Fabricate metal panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weather-tight and minimize noise from movements within panel assembly.

Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of item indicated:

a. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

b. End Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

c. Sealed Joints: Form non-expansion but movable joints in metal to

accommodate elastomeric sealant to comply with SMACNA standards.

d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

e. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA or by metal building system manufacturer for application, but not less than thickness of metal being secured.

1.6.12 Finishes

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes.

Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

1.7 SHIPPING, HANDLING AND STORAGE

1.7.1 Delivery

Package and deliver components, sheets, metal panels, and other manufactured items so as not to be damaged or deformed and protected during transportation and handling.

Stack and store metal panels horizontally on platforms or pallets, covered with suitable weather-tight and ventilated covering to ensure dryness, with positive slope for drainage of water. Store in a manner to prevent bending, warping, twisting, and surface damage. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage. Retain strippable protective covering on metal panel for entire period up to metal panel installation.

Complete installation and concealment of plastic materials as rapidly as possible in each area of construction to minimize ultraviolet exposure.

1.8 PROJECT CONDITIONS

1.8.1 Weather Limitations

Proceed with installation preparation only when existing and forecasted weather conditions permit Work to proceed without water entering into existing panel system or building.

1.8.2 Field Measurements

1.8.2.1 Established Dimensions for Foundations

Comply with established dimensions on approved anchor-bolt plans, established foundation dimensions, and proceed with fabricating structural framing. Do not proceed without verifying field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.

1.8.2.2 Established Dimensions for Metal Panels

Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming metal panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.8.2.3 Verification Record

Verify locations of all framing and opening dimensions by field measurements before metal panel fabrication and indicate measurements on Shop Drawings.

1.9 COORDINATION

Coordinate size and location of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete".

Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leak-proof, secure, and non-corrosive installation.

1.10 WARRANTY

1.10.1 Building System Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal building system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government. The warranty must provide that if within the warranty period, the metal building system shows evidence of deterioration resulting from defective materials and/or workmanship, correcting of any defects is the responsibility of the metal building system manufacturer. Repairs that become necessary because of defective materials and workmanship while metal building system is under warranty are to be performed within 32hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 32 hours of notification will constitute grounds for having emergency repairs performed by others and will not void the warranty.

1.10.2 Roof System Weather-Tightness Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal panel system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government.

The warranty is to provide that if within the warranty period the roof panel system shows evidence of corrosion, perforation, rupture, lost of weather-tightness or excess weathering due to deterioration of the panel system resulting from defective materials and correction of the defective workmanship is to be the responsibility of the metal building system manufacturer.

Repairs that become necessary because of defective materials and workmanship while roof panel system is under warranty are to be performed

within 24 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform temporary repairs within 24 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty. Immediate follow-up and completion of permanent repairs must be performed within 7 days from date of notification.

1.10.3 Roof and Wall Panel Finish Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal panel system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government.

The warranty is to provide that if within the warranty period the metal panel system shows evidence of checking, delaminating cracking, peeling, chalk in excess of a numerical rating of eight, as determined by ASTM D 4214 test procedures; or change colors in excess of five CIE or Hunter units in accordance with ASTM D 2244 or excess weathering due to deterioration of the panel system resulting from defective materials and finish or correction of the defective workmanship is to be the responsibility of the metal building system manufacturer.

Liability under this warranty is exclusively limited to replacing the defective coated materials.

Repairs that become necessary because of defective materials and workmanship while roof and wall panel system is under warranty are to be performed within 32 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 32 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty.

PART 2 PRODUCTS

2.1 STRUCTURAL FRAMING MATERIALS

2.1.1 W-Shapes

ASTM A 992/A 992M; ASTM A 572/A 572M or ASTM A 529/A 529M.

2.1.2 Channel, Angles, M-Shapes and S-Shapes

ASTM A 36/A 36M; ASTM A 572/A 572M or ASTM A 529/A 529M.

2.1.3 Plate and Bar

ASTM A 36/A 36M, ASTM A 572/A 572M or ASTM A 529/A 529M.

2.1.4 Steel Pipe

ASTM A 36/A 36M, ASTM A 53/A 53M, ASTM A 572/A 572M or ASTM A 529/A 529M.

2.1.5 Cold-Formed and Hot Formed Hollow Structural Sections

Cold formed:ASTM A 500/A 500M or ASTM B 221, ASTM B 221M. Hot-formed: ASTM A 501.

2.1.6 Structural-Steel Sheet

Hot-rolled, ASTM A 1011/A 1011M or cold-rolled, ASTM A 1008/A 1008M.

2.1.7 Metallic-Coated Steel Sheet

ASTM A 653/A 653M, ASTM A 606.

2.1.8 Metallic-Coated Steel Sheet Pre-painted with Coil Stock Coating

Steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.

a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, and ASTM A 123/A 123M.

b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, and ASTM A 463/A 463M.

2.1.9 High-Strength Bolts, Nuts, and Washers

ASTM A 325, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

Finish: Hot-dip zinc coating, ASTM A 153/A 153M.

2.1.10 Non-High-Strength Bolts, Nuts, and Washers

ASTM A 307, ASTM A 563, and ASTM F 844.

Finish: Plain ASTM A 153/A 153M, ASTM B 695.

2.1.11 Anchor Rods

ASTM F 1554, ASTM A 572/A 572M, ASTM A 36/A 36M, ASTM A 307.

a. Configuration: Straight.
b. Nuts: ASTM A 563 heavy hex carbon steel.
c. Plate Washers: ASTM A 36/A 36M carbon steel.
d. Washers: ASTM F 436 hardened carbon steel.
e. Finish: Hot-dip zinc coating, ASTM A 153/A 153M.

2.1.12 Threaded Rods

ASTM A 193/A 193M, ASTM A 572/A 572M, ASTM A 36/A 36M, ASTM A 307.

a. Nuts: ASTM A 563 heavy hex carbon steel.
b. Washers: ASTM A 36/A 36M carbon steel.
c. Finish: Hot-dip zinc coating, ASTM A 153/A 153M.

2.1.13 Primer

SSPC-Paint 15, Type I, red oxide.

2.2 FABRICATION

2.2.1 General

Comply with MBMA MBSM - "Metal Building Systems Manual": Chapter IV,

Section 9, "Fabrication and Erection Tolerances."

## 2.3 STRUCTURAL FRAMING

### 2.3.1 General

Clean all framing members to remove loose rust and mill scale. Provide 1 shop coat of primer to an average dry film thickness of 1 mil according to SSPC SP 2. Balance of painting and coating procedures must conform to SSPC Paint 15 and SSPC A.

### 2.3.2 Primary Framing

Manufacturer's standard structural primary framing system includes transverse and lean-to frames; rafter, rakes, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing designed to withstand required loads and specified requirements. Provide frames with attachment plates, bearing plates, and splice members. Provide frame span and spacing indicated.

Shop fabricate framing components by welding or by using high-strength bolts to the indicated size and section with base-plates, bearing plates, stiffeners, and other items required. Cut, form, punch, drill, and weld framing for bolted field erection.

### 2.3.3 Secondary Framing

Manufacturer's standard secondary framing members, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet pre-painted with coil coating, unless otherwise indicated.

Shop fabricate framing components by roll-forming or break-forming to the indicated size and section with base-plates, bearing plates, stiffeners, and other plates required for erection. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

### 2.3.4 Bracing

Provide adjustable wind bracing as follows:

a. Rods: ASTM A 36/A 36M; ASTM A 572/A 572M; or ASTM A 529/A 529M

b. Cable: ASTM A 475, extra-high-strength grade, zinc-coated, stranded steel; with threaded end anchors.

c. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.

d. Rigid Portal Frames: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

e. Fixed-Base Columns: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

f. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.

g. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.

2.4 PANEL MATERIALS

2.4.1 Aluminum Sheet

Roll-form aluminum panels to the specified profile, thickness and depth as indicated. Material must be plumb and true, and within the tolerances listed:

a. Aluminum Sheet conforming to ASTM B 209, AA ADM1 and AA ASD1.

b. Individual panels to have continuous length to cover the entire length of any roof slope wall area] with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.

c. Provide panels with thermal expansion and contraction consistent with the type of system specified.

2.4.2 Steel Sheet

Roll-form steel panels to the specified profile, gauge and depth as indicated. Material must be plumb and true, and within the tolerances listed:

a. Galvanized Steel Sheet conforming to ASTM A 653/A 653M and AISI SG03-3.

b. Aluminum-Zinc Alloy-coated Steel Sheet conforming to ASTM A 792/A 792M and AISI SG03-3.

c. Individual panels to have continuous length to cover the entire length of any unbroken roof slope or wall area with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.

d. Provide panels with thermal expansion and contraction consistent with the type of system specified.

2.4.3 Foam-Insulation Core Wall Panel

Provide factory-formed wall panel assembly fabricated from two sheets of metal with modified polyisocyanurate or polyurethane foam insulation core foamed-in-place during fabrication with joints between panels designed to form weather-tight seals. Include accessories required for weather-tight installation.

a. Closed-Cell Content: 90 percent when tested according to ASTM D 2856, ASTM C 1289.

b. Density: 2.0 to 2.6 lb/cu. ft. (32 to 42 kg/cu. m) when tested according to ASTM D 1622.

c. Compressive Strength: Minimum 20 psi (140 kPa) when tested according to ASTM D 1621.

d. Shear Strength: 26 psi (179 kPa) when tested according to ASTM C 273/C 273M.

2.4.4 Insulated Panel Construction

Shop fabricate or field assemble insulated panel construction with specified exterior and interior sheet in accordance with manufacturer's printed instructions.

Insulation fasteners to be adhesively attached, plate welded to projecting spindle anchors; capable of holding insulation of thickness indicated, secured in position with self-locking washer and complying with the following requirements:

2.4.5 Finish

All panels are to receive a factory-applied finish consisting of a baked-on top-coat with a manufacturer's recommended prime coat conforming to the following:

a. Metal Preparation: All metal is to have the surfaces carefully prepared for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with acid rinse, and thorough drying.

b. Prime Coating: A base coat of epoxy paint, specifically formulated to interact with the top-coat, is to be applied to the prepared surfaces by roll coating to a dry film thickness of 0.20 + 0.05 mils. This prime coat must be oven cured prior to application of finish coat.

c. Exterior Finish Coating: Apply the finish coating over the primer by roll coating to dry film thickness of 0.80 + 5 mils (3.80 + 0.50 mils for Vinyl Plastisol) for a total dry film thickness of 1.00 + 0.10 mils (4.00 + 0.10 mils for Vinyl Plastisol). This finish coat must be oven-cured.

d. Interior Finish Coating: Apply a wash-coat on the reverse side over the primer by roll coating to a dry film thickness of 0.30 + 0.05 mils for a total dry film thickness of 0.50 + 0.10 mils. The wash-coat must be oven-cured.

e. Color: The exterior finish chosen from the manufacturer's color charts and chips.

f. Physical Properties: Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

Chalking: ASTM DEF
Color Change and Conformity: ASTM D 2244
Weatherometer: ASTM G 23 and ASTM D 822
Humidity: ASTM D 2247 and ASTM D 714
Salt Spray: ASTM B 117
Chemical Pollution: ASTM D 1308
Gloss at 60°: ASTM D 523

Pencil Hardness: ASTM D 3363
Reverse Impact: ASTM D 2794
Flexibility: ASTM D 522
Abrasion: ASTM D 968
Flame Spread: ASTM E 84

2.4.6 Repair Of Finish Protection

Repair paint for color finish enameled metal panel must be compatible paint of the same formula and color as the specified finish furnished by the metal panel manufacturer, conforming to ASTM A 780.

2.5 MISCELLANEOUS METAL FRAMING

2.5.1 General

Cold-formed metallic-coated steel sheet conforming to ASTM A 653/A 653M and specified in Division 05 Section 05 40 00 "Cold-Formed Metal Framing" unless other wise indicated.

2.5.2 Fasteners for Miscellaneous Metal Framing

Refer to the following paragraph "FASTENERS".

2.6 FASTENERS

2.6.1 General

Type, material, corrosion resistance, size and sufficient length to penetrate the supporting member a minimum of 1 inch with other properties required to fasten miscellaneous metal framing members to substrates in accordance with the metal panel manufacturer's and ASCE/SEI 7-05 requirements.

2.6.2 Exposed Fasteners

Fasteners for metal panels to be stainless steel, and of a type and size recommended by the manufacturer to meet the performance requirements and design loads. Fasteners for accessories to be the manufacturer's standard. Provide an integral metal washer matching the color of attached material with compressible sealing EPDM gasket approximately 3/32 inch thick.

2.6.3 Screws

Screws to be stainless steel being the type and size recommended by the manufacturer to meet the performance requirements.

2.6.4 Rivets

Rivets to be closed-end type, stainless steel where watertight connections are required.

2.6.5 Attachment Clips

Fabricate clips from Series 300 stainless steel. Size, shape, thickness and capacity as required meeting the insulation thickness and design load criteria specified.

## 2.7 FRAMES AND MATERIALS FOR OPENINGS

### 2.7.1 Doors

Fire-Rated and Non-Fire-Rated Door Assemblies conforming with NFPA 80 and based on testing according to NFPA 252 as specified in Division 08 - OPENINGS unless other wise indicated.

### 2.7.2 Windows

Window Assemblies conforming to as specified in Division 08 - OPENINGS unless other wise indicated.

## 2.8 ACCESSORIES

### 2.8.1 General

All accessories to be compatible with the metal panels; sheet metal flashing, trim, metal closure strips, caps and similar metal accessories must not be less than the minimum thickness specified for the metal panels. Exposed metal accessories/finishes to match the panels furnished, except as otherwise indicated. Molded foam rib, ridge and other closure strips to be non-absorbent closed-cell or solid-cell synthetic rubber or pre-molded neoprene to match configuration of the panels.

### 2.8.2 Roof and Wall Accessories and Specialties

Aluminum or Steel roof curbs, equipment supports, roof hatches, dropout-type heat and smoke vents, hatch-type heat and smoke vents, gravity and roof ridge ventilators, wall louvers and other miscellaneous roof and wall equipment or penetrations conforming to AAMA, ASTM, and UL as specified in Division 07 unless other wise indicated.

### 2.8.3 Insulation

Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Class A, membrane-faced surface with a flame spread of 25 and a smoke developed rating of 150 or less when tested in accordance with ASTM E 84.

### 2.8.4 Rubber Closure Strips

Closed-cell, expanded cellular rubber conforming to ASTM D 1056 and ASTM D 1667; extruded or molded to the configuration of the specified metal panel and in lengths supplied by the metal panel manufacturer.

### 2.8.5 Metal Closure Strips

Factory fabricated closure strips to be the same gauge, color, finish and profile of the specified panel.

### 2.8.6 2.6.6 Joint Sealants

#### 2.8.6.1 Sealants

Sealants are to be an approved gun type for use in hand or air-pressure caulking guns at temperatures above 40 degrees F 4 degrees C (or frost-free application at temperatures above 10 degrees F minus 12 degrees C) with minimum solid content of 85 percent of the total volume. Sealant is to dry with a tough, durable surface skin which permits it to remain soft and

pliable underneath, providing a weather-tight joint. No migratory staining is permitted on painted or unpainted metal, stone, glass, vinyl, or wood.

Prime all joints to receive sealants with a compatible one-component or two-component primer as recommended by the metal panel manufacturer.

2.8.6.2 Shop-Applied

Sealant for shop-applied caulking must be an approved gun grade, non-sag one component polysulfide or silicone conforming to ASTM C 920, Type II, and with a curing time to ensure the sealant's plasticity at the time of field erection.

2.8.6.3 Field-Applied

Sealant for field-applied caulking must be an approved gun grade, non-sag one component polysulfide or two-component polyurethane with an initial maximum Shore A durometer hardness of 25, and conforming to ASTM C 920, Type II. Color to match panel colors.

2.8.6.4 Tape Sealant

Pressure sensitive, 100% solid with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the metal panel manufacturer.

2.9 SHEET METAL FLASHING AND TRIM

2.9.1 Fabrication

Shop fabricate sheet metal flashing and trim where practicable to comply with recommendations in SMACNA 1793 that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.

Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

2.10 FINISHES

2.10.1 General

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes.

2.10.2 Appearance of Finished Work

Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 EXAMINATION

Before erection proceeds examine with the erector present the concrete

foundation dimensions, concrete and/or masonry bearing surfaces, anchor bolt size and placement, survey slab elevation, locations of bearing plates, and other embedment's to receive structural framing with the metal building manufacturer's templates and drawings before erecting any steel components for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

Examine primary and secondary framing to verify that rafters, purlins, angles, channels, and other structural and metal panel support members and anchorages have been installed within alignment tolerances required by metal building manufacturer, UL, ASTM, ASCE/SEI 7-05 and as required by the building code for the geographical area where construction will take place.

Examine roughing-in for components and systems penetrating metal roof or wall panels to verify actual locations of penetrations relative to seam locations of metal panels before metal roof or wall panel installation.

Submit to the Contracting Officer a written report, endorsed by Erector, listing conditions detrimental to performance of the Work.

Proceed with erection only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

Provide temporary shoring, guys, braces, and other supports during erection to keep the structural framing secure, plumb, and in alignment against temporary construction loading or loads equal in intensity of the building design loads. Remove temporary support systems when permanent structural framing, connections, and bracing are in place, unless otherwise indicated.

Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment and performance.

Miscellaneous Framing: Install sub-purlins, girts, angles, furring, and other miscellaneous support members or anchorage for the metal roof or wall panels, doors, windows, roof curbs, ventilators and louvers according to metal building manufacturer's written instructions.

## 3.3 ERECTION OF STRUCTURAL FRAMING

Erect metal building system according to manufacturer's written erection instructions, approved shop drawings and other erection documents in accordance with MBMA MBSM - "Metal Building Systems Manual".

Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer and the Contracting Officer.

Set structural framing accurately in locations and to elevations indicated and according to AISC 325 specifications. Maintain structural stability of frame during erection.

Clean and roughen concrete and masonry bearing surfaces prior to setting plates. Clean bottom surface of plates.

Align and adjust structural framing before permanent bolt-up and connections. Perform necessary adjustments and alignment to compensate for

changes or discrepancies in elevations.

Maintain erection tolerances of structural framing in accordance with AISC 360.

## 3.4 METAL WALL PANEL INSTALLATION

Provide metal wall panels of full length from sill to eave as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal wall panels and other components of the Work securely in place, in accordance with MBMA MBSM.

Erect wall panel system in accordance with the approved erection drawings, the printed instructions and safety precautions of the metal building manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Do not install bent, chipped, or defective sheets.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated eave, and sill.

Work is to allow for thermal movement of the wall panel, movement of the building structure, and to provide permanent freedom from noise due to wind pressure.

Field cutting metal wall panels by torch is not permitted.

## 3.5 ROOF PANEL INSTALLATION

Provide metal roof panels of full length from eave to ridge or eave to wall as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place in accordance with NRCA RWM and MBMA MBSM.

Erect roofing system in accordance with the approved erection drawings, the printed instructions and safety precautions of the metal building manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Do not install bent, chipped, or defective sheets.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated rake and eave overhang.

Work must allow for thermal movement of the roofing, movement of the building structure, and provide permanent freedom from noise due to wind pressure.

Field cutting metal roof panels by torch is not permitted.

Roofing sheets must be laid with corrugations in the direction of the roof slope. End laps of exterior roofing must not be less than 8 inches; the side laps of standard exterior corrugated sheets must not be not less than 2-1/2 corrugations.

Do not permit storage, walking, wheeling, and trucking directly on applied

roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to the installed roofing materials, and to distribute weight to conform to the indicated live load limits of roof construction.

## 3.6 METAL PANEL FASTENER INSTALLATION

Anchor metal panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

## 3.7 FLASHING, TRIM AND CLOSURE INSTALLATION

A. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Sheet metalwork is to be accomplished to form weather-tight construction without waves, warps, buckles, fastening stresses or distortion, and allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades is to be performed by sheet metal mechanics.

## 3.8 DOOR AND FRAME INSTALLATION

Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturer's written instructions. Coordinate installation with metal panel flashings and other components. Caulk and seal perimeter of each door frame with elastomeric sealant compatible with metal panels. Comply with installation requirements in Division 08 -OPENINGS.

## 3.9 WINDOW INSTALLATION

Install windows plumb, rigid, properly aligned, without warp or rack of frames or sash, and securely fastened in place according to manufacturer's written instructions. Coordinate installation with metal panel flashings and other components. Caulk and seal perimeter of each window frame with elastomeric sealant compatible with for metal panels. Comply with installation requirements in Division 08 - OPENINGS.

## 3.10 ACCESSORY INSTALLATION

### 3.10.1 General

Install accessories with positive anchorage to building and weather-tight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

### 3.10.2 Dissimilar Metals

Where dissimilar metals contact one another or corrosive substrates are present, protect against galvanic action by painting dissimilar metal surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each surface, or by other permanent separation techniques as recommended by the metal building manufacturer.

3.10.3 Gutters and Downspouts

Comply with performance requirements, manufacturer's written installation instructions, and install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA 1793 recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

3.10.4 Insulation

Comply with performance requirements and manufacturer's written installation instructions. Install insulation concurrently with metal panel installation, in thickness indicated to cover entire roof and wall area, as specified in Division 07 - THERMAL AND MOISTURE PROTECTION.

3.10.5 Roof and Wall Accessories and Specialties

Install roof and wall accessories and specialties complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports as specified in Division 07 - THERMAL AND MOISTURE PROTECTION, unless other wise indicated.

3.11 CLEAN-UP AND PROTECTION

3.11.1 Structural Framing

Clean all exposed structural framing at completion of installation. Remove metal shavings, filings, bolts, and wires from work area. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces to be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

3.11.2 Metal Panels

Clean all exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from work area. Remove protective coverings/films, grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces to be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

3.11.3 Touch-Up Painting

After erection, promptly clean, prepare, and prime or re-prime field connections, rust spots, and abraded surfaces of prime-painted structural framing and accessories. Clean and touch-up paint with manufacturer's touch-up paint.

3.12 WASTE MANAGEMENT

Separate waste in accordance with the Waste Management Plan, placing copper materials, ferrous materials, and galvanized sheet metal in designated areas for reuse. Close and seal tightly all partly used adhesives and solvents; store protected in a well-ventilated, fire-safe area at moderate temperature.

Collect and place scrap/waste debris in containers. Promptly dispose of scrap/waste debris. Do not allow scrap/waste debris to accumulate on-site; transport scrap/waste debris from government property and legally dispose of them.

## 3.13 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Perform special inspections and testing for seismic-resisting systems and components as specified. Verify that the required system and component tests for seismically isolated structures have been done in accordance with FEMA 302 and comply with all acceptance provisions contained therein.

## 3.14 WARRANTY

### 3.14.1 MANUFACTURER'S WARRANTY

Submit all manufacturers' signed warranties to Contracting Officer prior to final commissioning and acceptance.

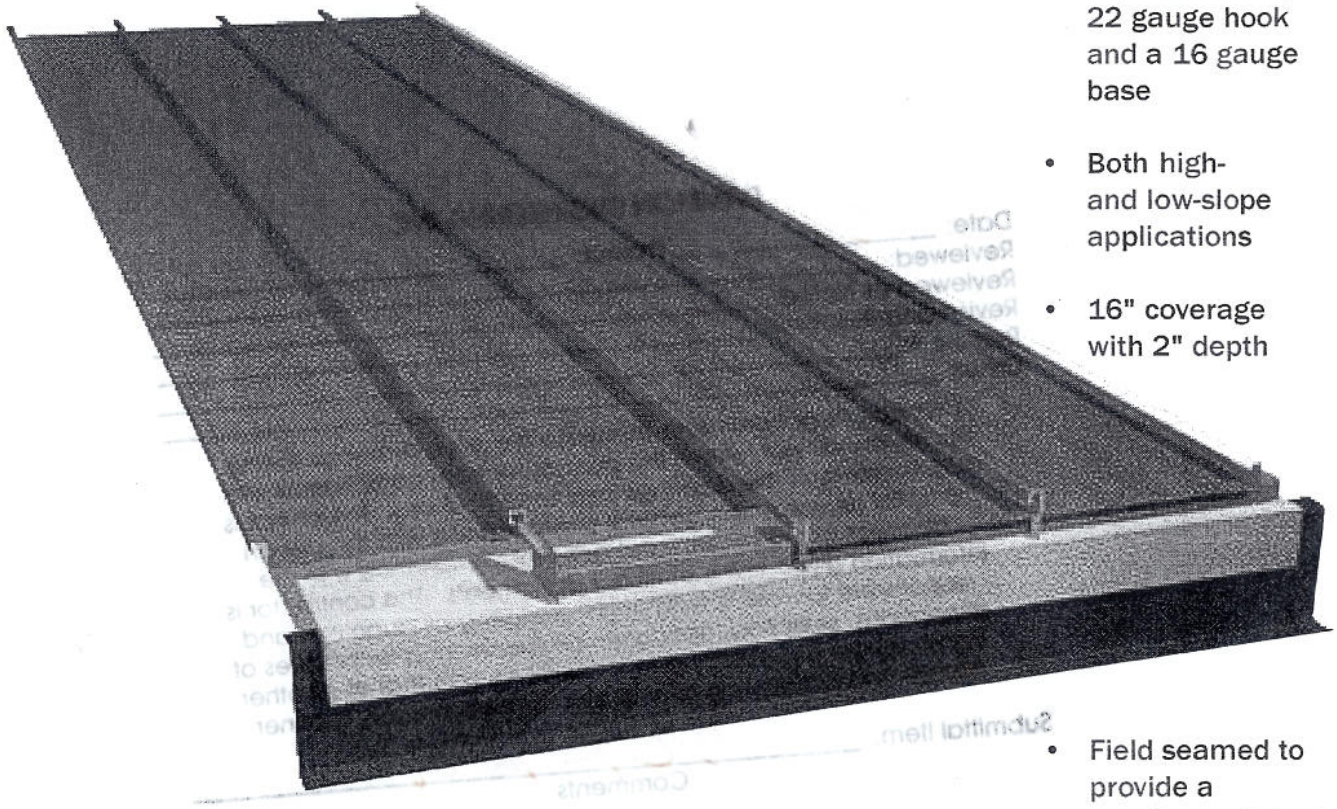
### 3.14.2 CONTRACTOR'S WARRANTY for INSTALLATION

Submit contractor's warranty for installation to the Contracting Officer prior to final commissioning and acceptance.

-- End of Section --

# VP ROOF SYSTEMS

| STYLE | FEATURES |
| --- | --- |
| SLR ROOF | ARCHITECTURAL AND STRUCTURAL STANDING SEAM ROOF SYSTEM WITH LOW SLOPE CAPABILITIES Dammon # 22 |



- Thermally responsive galvanized panel clips combining a 22 gauge hook and a 16 gauge base
- Both high- and low-slope applications
- 16" coverage with 2" depth
- Field seamed to provide a weather resistant joint
- Includes ThermalBlock

For a roof that combines good looks, flexibility and strength, choose SLR. Using factory installed sealant, galvanized clips and field seaming, this roof system provides unsurpassed performance and leak resistance.

Project NAME: Stennis Riverine
Contract: N69450-05-D-0096
BREW Proj.: 3013-70
Submittal: 13125-03
Reviewed
Reviewed by: J. Collins
DATE: 2/12/09

VP BUILDINGS
VARCO PRUDEN

**BROADMOOR, L.L.C.**

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

Robert Wells E.S.C.S
DQC Manager — Date

[signature]
QC Officer — Date 5/8/09

**DAMMON ENGINEERING INC**

Date: 5-8-09
Project: STEWARTS ROAD
Reviewed: X
Reviewed as Noted:
Revise and Resubmit:
Rejected:
Other:

Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. This contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his or her work with that at all other trades and performing all in a safe and satisfactory manner.

Submittal Item: SL R Roof
Comments

- Comply with NRCA Manual

# SLR PANELS FORM A SINGLE-UNIT MEMBRANE ROOF COMBINING STRENGTH, DURABILITY AND GOOD LOOKS

## SLR ROOF

For a roof that combines good looks, flexibility and strength, VP ś SLR Standing Seam Roof delivers an attractive and versatile solution.

SLR panels are standard in either 24 gauge steel or 22 gauge steel with a 2 inch standing seam. The panel is 16" wide and is available in lengths up to 42'. The panel includes a factory installed sealant bead in the side joint for increased weathertightness.

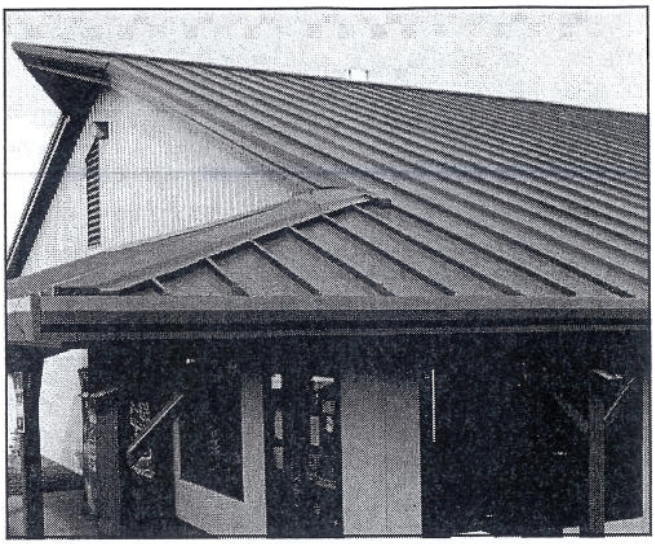
SLR panels are field-machine seamed in place, yielding a single unit membrane. The panels are installed with thermally responsive galvanized panel clips combining a 22 gauge hook and a 16 gauge base. These clips allow for thermal movement 1 "in either direction. SLR ś concealed clips attach the panels to structural members and minimize the need for through-the-roof fasteners. SLR can be installed over a variety of substrates or open framing. Roof slopes can be as low as 1/4:12.

SLR Roofs can accommodate up to 6 inches of fiberglass blanket insulation for high levels of energy efficiency.

All gauges of SLR Roof are available with KXL finish in 13 standard colors as well as a variety of custom colors.

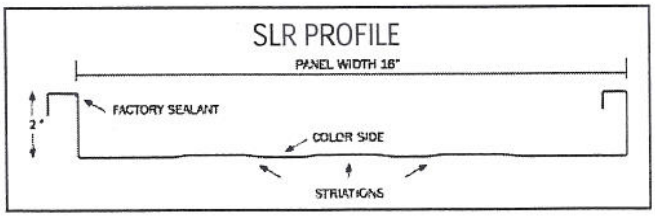
The KXL paint system is a PVDF finish applied to the Galvalume® surface to give a long-life color that resists fading and chalking. KXL is a 1 mil nom. PVDF finish with a 70% Kynar®500 or Hylar®5000 standard.

UL 90 wind uplift rating is available with supports at 5'-0" on center. SLR is also US Army Corps of Engineers approved for wind uplift resistance. ThermalBlock is included.



### FEATURES

- Roof slope as low as 1/4" in 12"
- Field seamed to provide a weather resistant joint
- 16" coverage with 2" depth
- UL 90 rated system
- US Army Corps of Engineers approved per CEGS 07416
- 24 & 22 gauge Galvalume® steel




*NOTE: ALL PANELS FORMED FROM LIGHT GAUGE METAL MAY EXHIBIT WAVINESS, ALSO KNOWN AS "OIL CANNING," COMMONLY OCCURRING IN, BUT NOT RESTRICTED TO, FLAT PORTIONS OF A PANEL. THIS INHERENT CHARACTERISTIC IS NOT A DEFECT OF MATERIAL OR MANUFACTURING AND IS NOT CAUSE FOR REJECTION.*

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VARCO PRUDEN

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Memphis, TN 38125
1-800-238-3246 • vp.com

2077 Revised 9/05

IAS

FM APPROVED

QUALITY CERTIFICATION METAL BUILDINGS

Dammy # 32



Dow Building Solutions

# 1 PRODUCT NAME
# THERMAX™ Sheathing

## 2 Manufacturer

The Dow Chemical Company
Building Solutions
200 Larkin
Midland, MI 48674
1-866-583-BLUE (2583)
Fax 1-989-832-1465
www.dowbuildingsolutions.com

## 3 Product Description

THERMAX™ Sheathing is a non-structural, rigid board insulation consisting of a glass-fiber-reinforced polyisocyanurate foam core laminated between 1.0 mil smooth, reflective aluminum foil facers on both sides. The glass-fiber reinforcement, along with chemical modifications, contributes to improved fire performance and dimensional stability. THERMAX Sheathing can be installed exposed to the interior without a thermal barrier.

### BASIC USE

THERMAX™ Sheathing is specially designed to have a Class A fire rating and can be used in a range of concealed and exposed applications, above and below grade. Because of its improved fire performance, THERMAX Sheathing is especially appropriate for hourly rated assemblies. THERMAX Sheathing also has approval in exterior multistory steel stud walls with brick cladding. See IBC Section 2603.5.

### SIZES

Width and length:
4' x 8', 4' x 9', 4' x 10'
Edge treatments:
Square edge, shiplap

Product thicknesses and R-values are shown in Table 1. Not all products are available in all parts of the country. Additional product sizes are available by custom order.

TABLE 1

| THERMAX™ Sheathing R-Values | |
|---|---|
| Nominal Foam Thickness, in. | Stabilized R-Value[1, 2] |
| 0.5 | 3.3 |
| 0.75 | 5.0 |
| 1.0 | 6.5 |
| 1.25 | 8.1 |
| 1.55 | 10.1 |
| 1.75 | 11.4 |
| 2.0 | 13.0 |
| 2.5 | 15.8 |
| 3.0 | 19.0 |
| 3.5 | 22.1 |
| 4.0 | 25.2 |

(1) R means resistance to heat flow. The higher the R-value, the greater the insulating power. Stabilized R-values @ 75°F mean temperature determined in accordance with ASTM C518.
(2) R-values expressed in ft²•h•°F/Btu.

Consult your Dow representative about other sizes and lead-time requirements.

## 4 Technical Data

### APPLICABLE STANDARDS

THERMAX™ Sheathing meets ASTM C1289 – Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board, Type I, Class 2, which includes:

- C203 – Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
- C209 – Standard Test Methods for Cellulosic Fiber Insulating Board
- C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- D1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics
- D2126 – Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
- E96 – Standard Test Method for Water Vapor Transmission of Materials
- D1623 – Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics

Project Name: Stennis Riverine
Contract: N69450-05-D-009C
Bldg Proj.: 3013-70
Submittal: 13125-07
Reviewed
Reviewed by: J. Collins
Date: 2/17/09

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32

**DAMMON ENGINEERING INC**

**Date:** 5-8-09 **Project:** STORAGE ROOF

**Reviewed:** X

**Reviewed as Noted:** _____

**Revise and Resubmit:** _____

**Rejected:** _____

**Other:** _____

Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. This contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his or her work with that at all other trades and performing all in a safe and satisfactory manner.

**Submittal Item:** THERMAX SHEATING

Comments

**BROADMOOR, L.L.C.**

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

Richard Hall 5.8.09

DQC Manager Date

Audrey McCulloch 5/8/09

QC Official Date

TABLE 2

| Physical Properties of THERMAX™ Sheathing | |
|---|---|
| **Property and Test Method** | **Value** |
| Compressive Strength[1], ASTM D1621, psi, min. | 25.0 |
| Flexural Strength, ASTM C203, psi, min. | 55.0 |
| Dimensional Stability, ASTM D2126, % linear change, max. | 0.1 |
| Water Absorption, ASTM C209, % by volume, max. | 0.05 |
| Water Vapor Permeance, ASTM E96, perms, max. | <0.03 |
| Maximum Use Temperature, °F | 250 |

(1) Vertical compressive strength is measured at 10 percent deformation or at yield, whichever occurs first.

## PHYSICAL/CHEMICAL PROPERTIES

THERMAX™ Sheathing exhibits the properties and characteristics indicated in Table 2 when tested as represented.

For chemical resistance properties of THERMAX Sheathing, see Table 3.

## ENVIRONMENTAL DATA

THERMAX™ Sheathing is manufactured with hydrocarbon blowing agents, which have no ozone depletion potential.

## FIRE PROTECTION

THERMAX™ products should be used only in strict accordance with product application instructions. THERMAX products, when used in a building containing combustible materials, may contribute to the spread of fire. For more information, consult MSDS and/or call Dow at 1-866-583-BLUE (2583). In an emergency, call 1-989-636-4400.

## CODE COMPLIANCES

THERMAX™ Sheathing complies with the following codes:

- International Residential Code (IRC) and International Building Code (IBC); see ICC-ES NER-681
- FM 4880 – Wall-Ceiling Construction Metal-Faced – Class 1 Fire Rated to Max. 30' High, 4.25" Thick, 4' Wide, When Installed as Described in the Current Edition of FMRC Approval Guide
- THERMAX products are classified by Underwriters Laboratories Inc. (UL)
- UL 1256 – Fire Test of Roof Deck Constructions, Roof Deck Construction No. 120 and No. 123
- UL 723 (ASTM E84) Surface Burning Characteristics of Building Materials
- The following designs are 1, 2, 3 or 4 hour wall rated assemblies as listed in the UL Fire Resistance Directory: U026, U324, U325, U326, U330, U354, U355, U460, U902, U904, U905, U906, U907, V454
- Fire Performance Evaluation of an Exterior Masonry Wall System Incorporating THERMAX Insulation Tested in Accordance With NFPA 285, 1998 Edition (UBC 26.9, intermediate scale – multistory testing)

TABLE 3

| Chemical Resistance of THERMAX™ Sheathing | |
|---|---|
| Acid, inorganic | Not recommended |
| Acid, organic | Excellent |
| Alcohol | Excellent |
| Asphalt, water-based | Good |
| Bases (caustics) | Poor |
| Brines and other salts | Excellent |
| Cements and mortar | Poor |
| Gases, carbon dioxide ($CO_2$) | Excellent |
| Gasoline | Excellent |
| Hydrocarbons | Excellent |
| Insecticides | Excellent |
| Kerosene | Excellent |
| Mineral oil USP | Excellent |
| Naphtha | Excellent |
| Paints, alcohol-based | Excellent |
| Paints, water-based | Excellent |
| Polyglycols, including propylene glycol | Excellent |
| Water[1] | Excellent |

(1) Water may cause discoloration of aluminum facers. This does not impact the R-value of dry, core insulation.
NOTE: This table should be used as a guide only. For design purposes, specific test data on the intended application may be needed.

- FMVSS No. 302 – Flammability of Interior Materials – Passenger Cars, Multipurpose Passenger Vehicles, Trucks and Buses (Docket No. 3-3; Notice 4)
- Miami-Dade NOA 02-0703.02 Interior Insulation on CMU Block
- Miami-Dade NOA 02-0703.03 Insulated Wall
- Miami-Dade NOA 02-0703.05 Insulated Roof Assembly

Contact your Dow sales representative or local authorities for state and local building code requirements and related acceptances.

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## 5 Installation

Boards of THERMAX™ Sheathing are lightweight and can be sawed or cut with a knife. They install quickly to walls and ceilings – inside and outside of purlins, trusses or bar joints. Butt joints must be installed over structural members. "Best practice" recommendations for high-humidity environments include continuously sealing the surface of the insulation at all joints with a Dow joint closure system.

Contact a local Dow representative or access the literature library at www.dowstyrofoam.com/architect for more specific instructions.

## 6 Availability

THERMAX™ Sheathing is manufactured in several locations and is distributed through an extensive network. For more information, call 1-800-232-2436.

## 7 Warranty

Fifteen-year limited thermal warranty.

## 8 Maintenance

Not applicable.

## 9 Technical Services

Dow can provide technical information to help address questions when using THERMAX™ Sheathing. Technical personnel are available to assist with any insulation project. Call 1-866-586-BLUE (2583).

## 10 Filing Systems

- www.dowbuildingsolutions.com
- www.sweets.com

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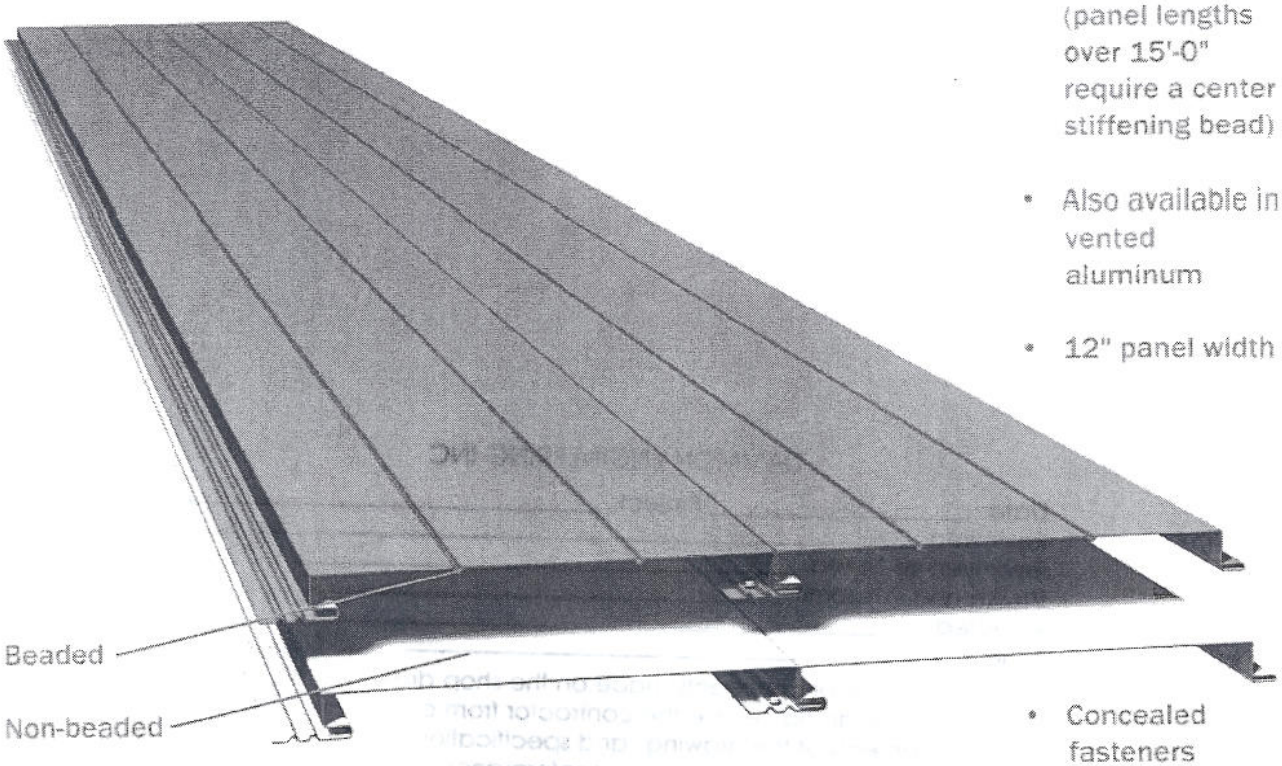
# VP ROOF PANELS

| STYLE | FEATURES |
|---|---|
| **FP-12 SOFFIT** | THIS FLUSH PANEL OFFERS THE FINISHING TOUCH FOR BUILDING SOFFITS. Dammon #33 |




- Lengths from 2'-0" to 30'-0" (panel lengths over 15'-0" require a center stiffening bead)
- Also available in vented aluminum
- 12" panel width
- Concealed fasteners

Provides an attractive, architectural appearance for buildings, entrances, covered walkways or anywhere a smooth finish is required.

Project Name: Stennis Riverine
Contract: N62450-05-D-0096
BRM Proj.: 3013-70
Submittal: 13125-08
Revised
Reviewed by: J. Collins
Date: 2/17/09

VP BUILDINGS
VARCO PRUDEN

**BROADMOOR, L.L.C.**

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

Robert V. Ke B.E.C.G. — Date

DQC Manager

John W. Culls 5/8/09 — Date

QC Official

**DAMMON ENGINEERING INC**

Date: 5-8-05 Project: Stennis ROF

Reviewed: X

Reviewed as Noted: _____

Revise and Resubmit: _____

Rejected _____

Other: _____

Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. The contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his or her work with that of all other trades and performing all in a safe and satisfactory manner.

Submittal Item: 30FF17

Comments

# VP'S FLUSH PANEL SOFFITS OFFER A DECORATIVE TREATMENT FOR WALKWAYS AND ENTRANCES

## FP-12 SOFFIT

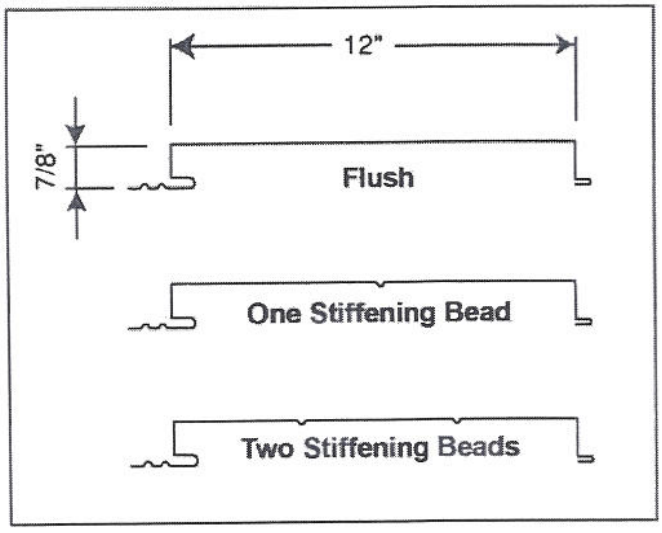
FP-12 a concealed-fastener panel, offers a high quality and low maintenance option for providing a smooth, flush appearance on your building. Manufactured to install easily, the FP-12 panel incorporates a hidden fastener attachment and advanced side joint design. The panel can be installed over open framing and offers superior wind disengagement resistance performance. Also, the 7/8" profile depth of panel allows for field application of sealant, if required for the installation.

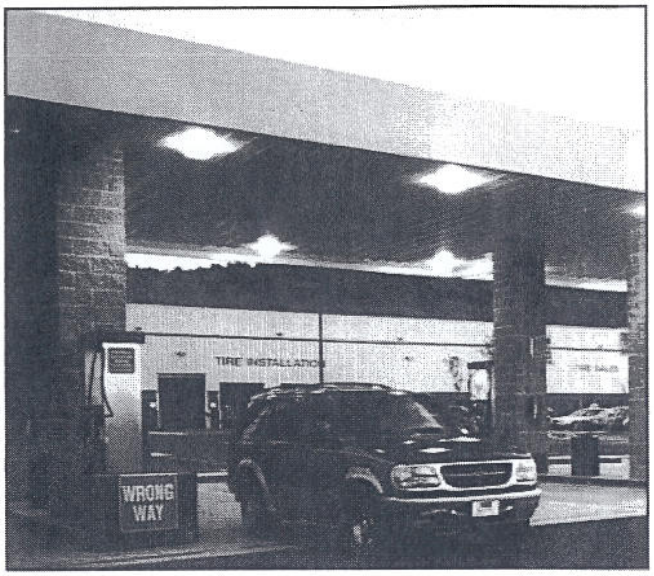
These 12" wide panels are available in lengths from 2' to 30'. FP-12 can be rolled in a selection of profile appearances including:

- Smooth face (12" flat – limited to applications less than 15')
- One stiffening bead (6"/6")
- Two stiffening beads (4"/4"/4")

Besides giving the FP-12 panels a high-tech appearance, the grooved "stiffening beads" optimize the panel performance in applications with panel lengths 15'-0 or greater.

FP-12 is available in standard 24 gauge or optional 22 gauge; PVDF finish and offered in 15 Architectural panel colors. FP-12 is also available in a .032 aluminum in Cool Regal White or Cool Parchment in either vented or unvented.




## FEATURES

- Choose solid steel or vented aluminum
- Concealed fasteners
- Flush in appearance
- 12" wide coverage with lengths from 2'-0" to 30'-0" (Note: panel lengths over 15'-0" require a center stiffening bead)

***NOTE: ALL PANELS FORMED FROM LIGHT GAUGE METAL MAY EXHIBIT WAVINESS, ALSO KNOWN AS "OIL CANNING," COMMONLY OCCURRING IN, BUT NOT RESTRICTED TO, FLAT PORTIONS OF A PANEL. THIS INHERENT CHARACTERISTIC IS NOT A DEFECT OF MATERIAL OR MANUFACTURING AND IS NOT CAUSE FOR REJECTION.***

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2049 Revised 5/06

APPROVED ROOF ASSEMBLIES

QUALITY CERTIFICATION METAL BUILDINGS

# Flush Panel

## Contents Section

### 2D Soffit / Wall Panels

Panel Profiles.....FP-0
High Eave Detail .....FP-1
Inside Corner .....FP-2
Outside Corner .....FP-3
Panel Sill .....FP-4
Fascia/Soffit Transition .....FP-5
Soffit to Wall Transition .....FP-6

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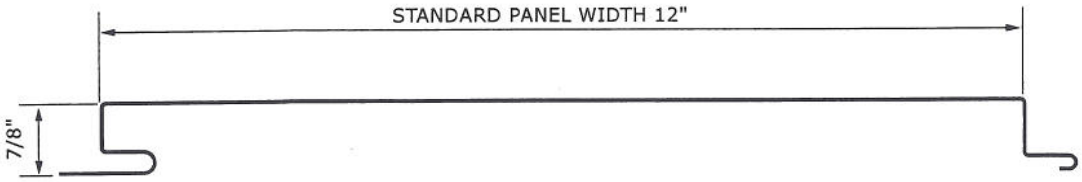
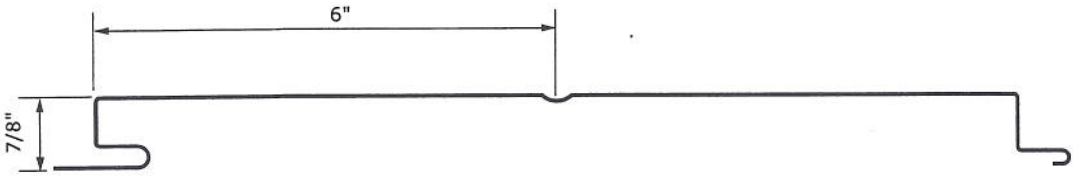



FP-12-0




FP-12-1

FP-12-2

AVAILABLE MATERIAL & THICKNESS

STEEL = 24 GA. OR 22 GA.

ALUMINUM = .032

PERFORATED ALUMINUM = .032

AEP SPAN
*Engineered Solutions in Metal*

# FLUSH-PANEL

PANEL PROFILE

FP-0

REV. 05/01/02

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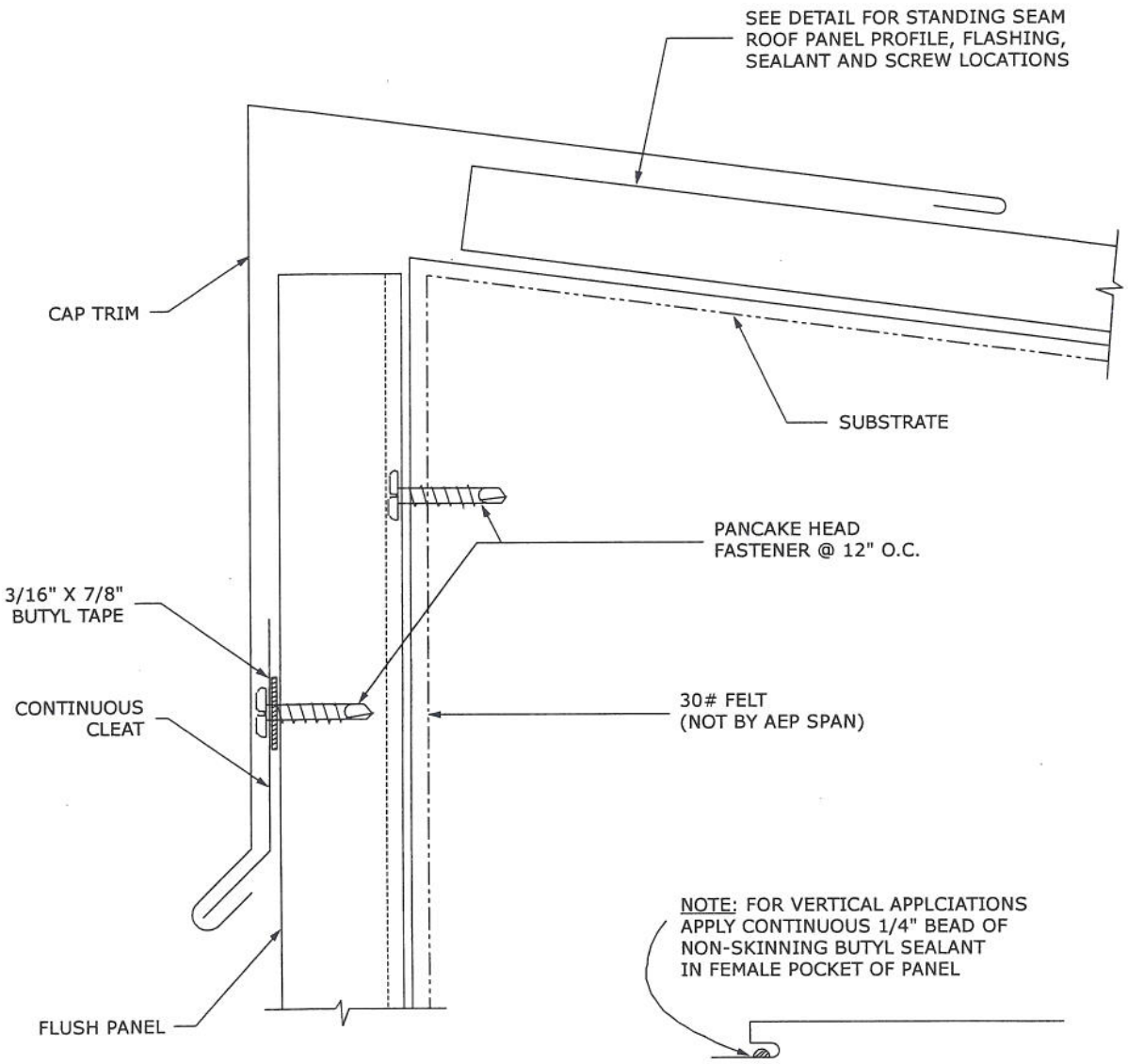


AEP SPAN
*Engineered Solutions in Metal*

# FLUSH-PANEL

HIGH EAVE

FP-1

REV. 05/01/02

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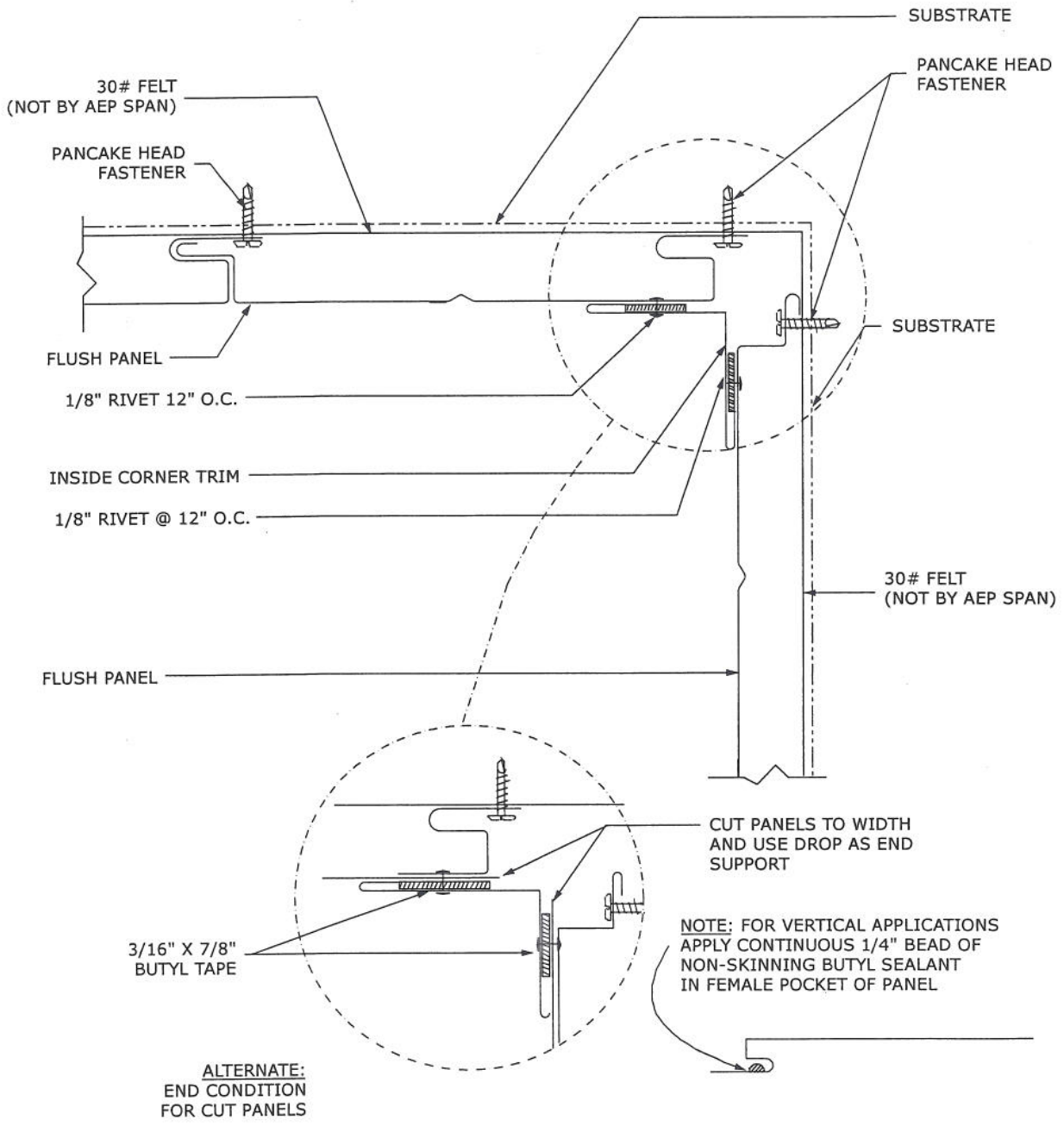


AEP SPAN
*Engineered Solutions in Metal*

# FLUSH-PANEL

INSIDE CORNER

FP-2

REV. 05/01/02

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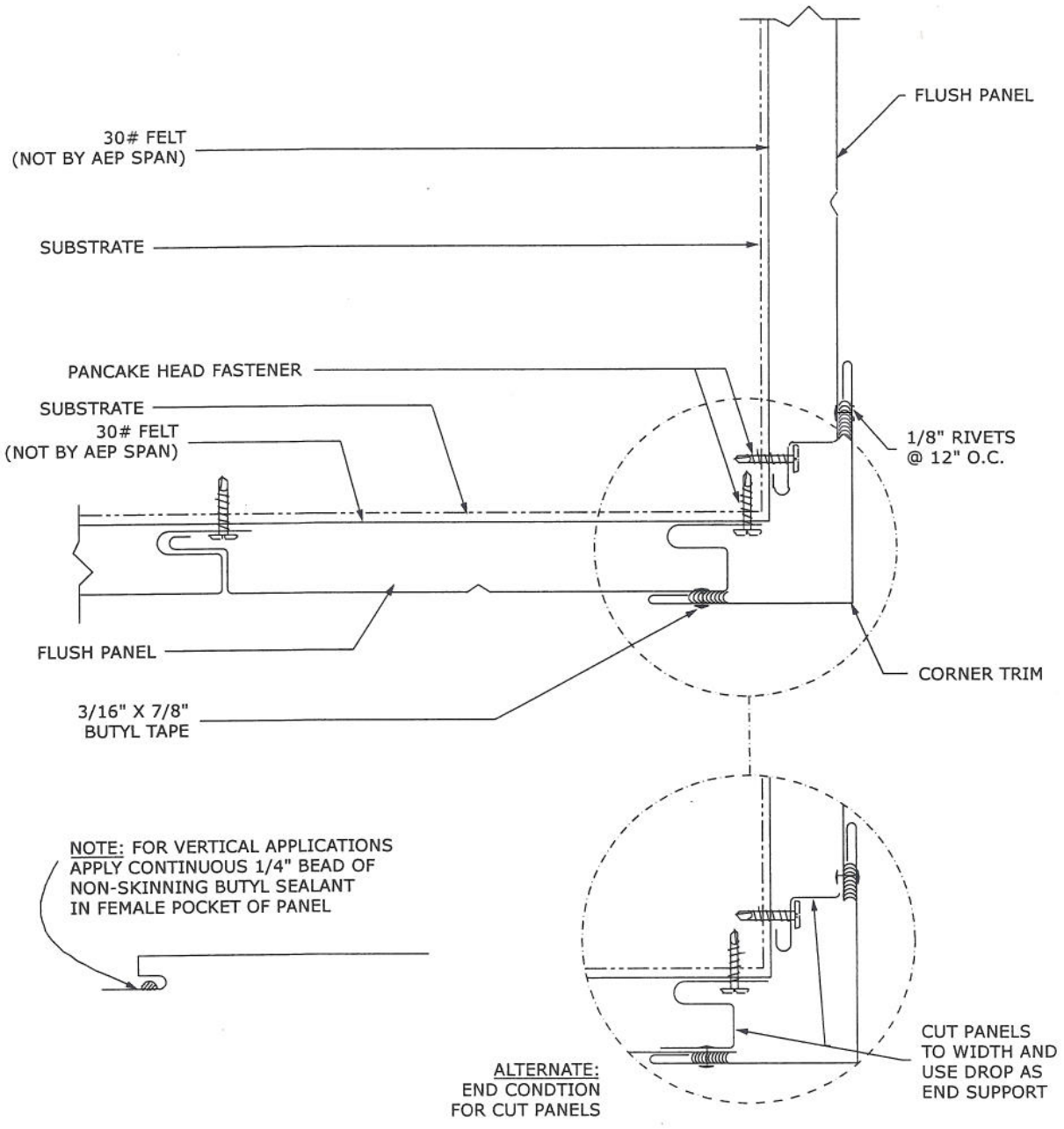



AEP SPAN
*Engineered Solutions in Metal*

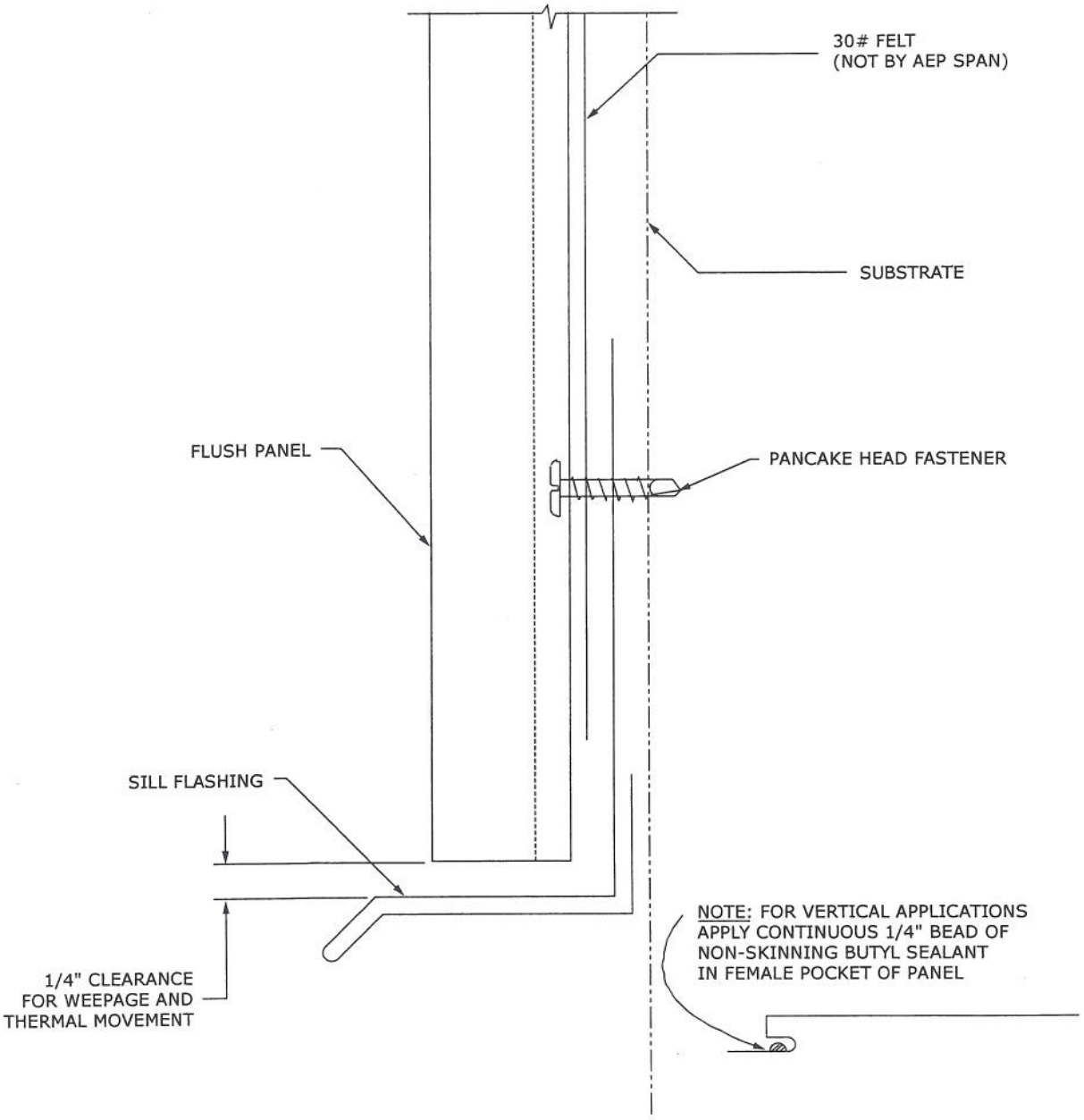
# FLUSH-PANEL

OUTSIDE CORNER

FP-3

REV. 05/01/02

< RETURN TO TABLE OF CONTENTS




AEP SPAN
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# FLUSH-PANEL

PANEL SILL

FP-4

REV. 05/01/02

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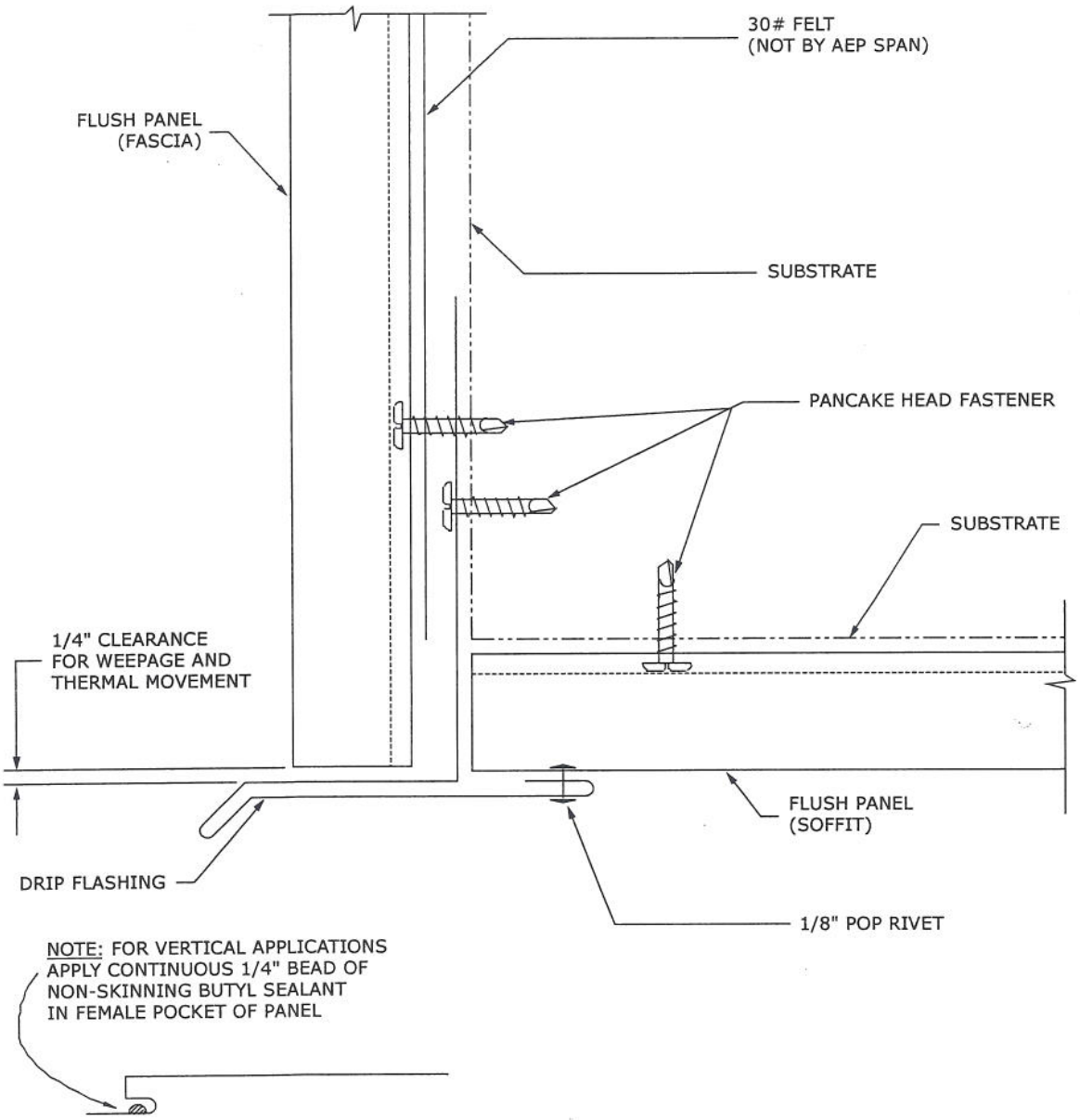


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# FLUSH-PANEL

FASCIA –
SOFFIT TRANSITION

FP-5

REV. 05/01/02

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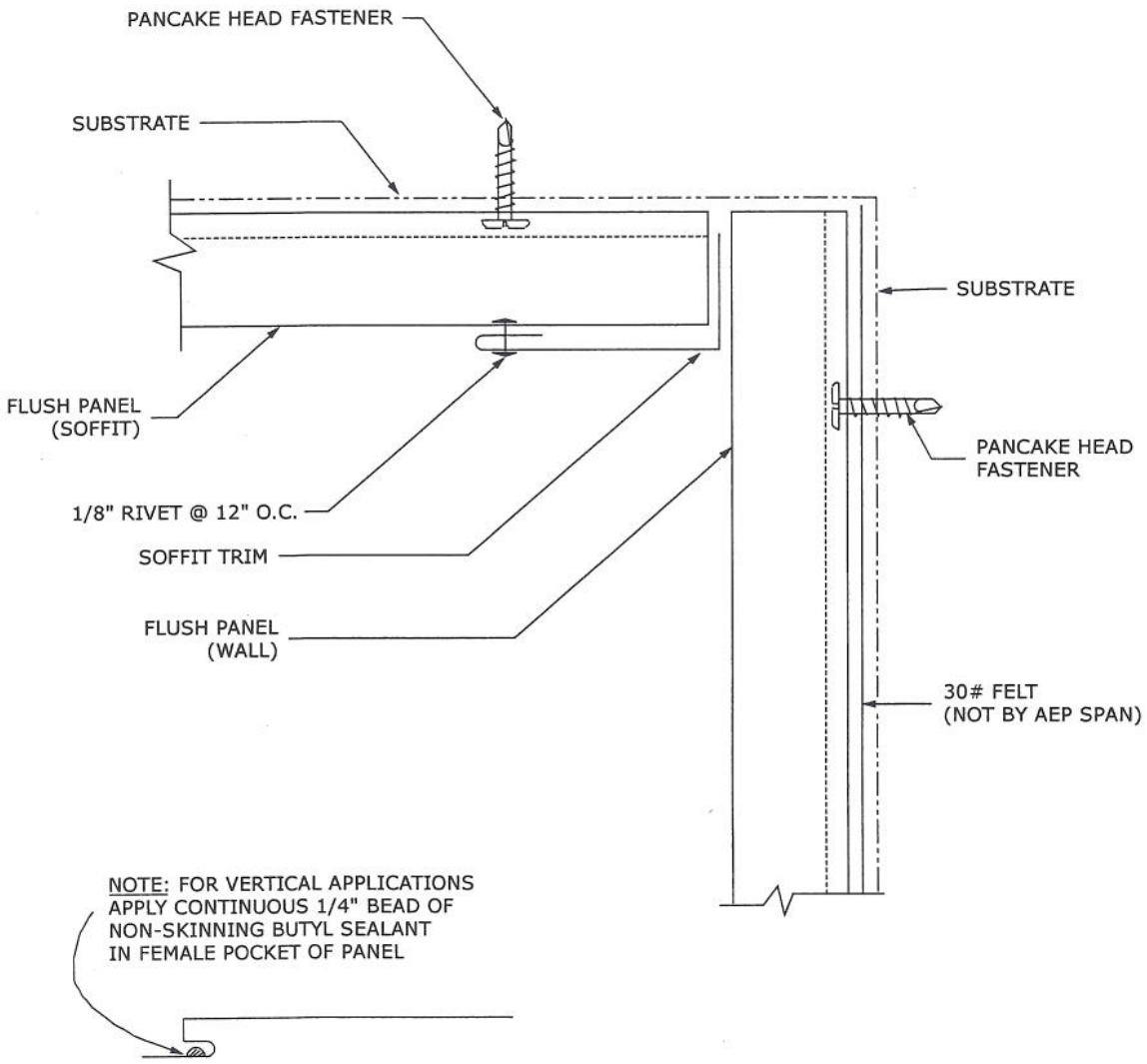


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# FLUSH-PANEL

SOFFIT –
WALL TRANSITION

FP-6

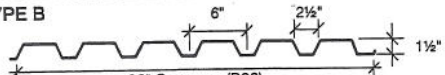
REV. 05/01/02

Dammron # 35

## B, BI, BA, BIA Deck Uplift

Note:
Fy = 40 ksi

TYPE B




36" Coverage (B36)
(30" Coverage (B30) and (BI30) is also available)

TYPE BI

36" Coverage (BI36)

(Uniform Total Load, psf/Load Producing L/240 or 1", psf)

| Span Condition | Gage | Span 5'0" | 5'6" | 6'0" | 6'6" | 7'0" | 7'6" | 8'0" | 8'6" | 9'0" | 9'6" | 10'0" |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Single | 22 | 122/84 | 100/63 | 84/49 | | | | | | | | |
| | 20 | 154/105 | 127/79 | 107/61 | 91/48 | | | | | | | |
| | 18 | 205/152 | 169/114 | 142/88 | 121/69 | 104/56 | 91/45 | 80/37 | | | | |
| | 16 | 262/200 | 217/150 | 182/116 | 155/91 | 134/73 | 117/59 | 103/49 | 91/41 | 81/34 | | |
| Double | 22 | 119/202 | 99/152 | 83/117 | 71/92 | 61/74 | | | | | | |
| | 20 | 144/253 | 120/190 | 101/146 | 86/115 | 74/92 | 65/75 | | | | | |
| | 18 | 200/367 | 166/276 | 140/212 | 120/167 | 103/134 | 90/109 | 79/90 | 70/75 | 63/63 | 56/53 | |
| | 16 | 256/481 | 213/361 | 179/278 | 153/219 | 132/175 | 115/142 | 102/117 | 90/98 | 80/82 | 72/70 | 65/60 |
| Triple | 22 | 148/158 | 123/119 | 103/92 | 88/72 | 76/58 | | | | | | |
| | 20 | 179/198 | 148/149 | 125/115 | 107/90 | 92/72 | 81/59 | | | | | |
| | 18 | 248/287 | 206/216 | 174/166 | 149/131 | 128/105 | 112/85 | 99/70 | 88/58 | 78/49 | 70/42 | |
| | 16 | 317/376 | 263/283 | 222/218 | 190/171 | 164/137 | 144/111 | 126/92 | 112/77 | 100/64 | 90/55 | 81/47 |

ASD

(Uniform Total Load, psf/Load Producing L/240 or 1", psf)

| Span Condition | Gage | Span 5'0" | 5'6" | 6'0" | 6'6" | 7'0" | 7'6" | 8'0" | 8'6" | 9'0" | 9'6" | 10'0" |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Single | 22 | 193/84 | 159/63 | 134/49 | | | | | | | | |
| | 20 | 243/105 | 201/79 | 169/61 | 144/48 | | | | | | | |
| | 18 | 324/152 | 268/114 | 225/88 | 192/69 | 165/56 | 144/45 | 127/37 | | | | |
| | 16 | 415/200 | 343/150 | 289/116 | 246/91 | 212/73 | 185/59 | 162/49 | 144/41 | 128/34 | | |
| Double | 22 | 188/202 | 156/152 | 132/117 | 112/92 | 97/74 | | | | | | |
| | 20 | 228/253 | 189/190 | 159/146 | 136/115 | 118/92 | 103/75 | | | | | |
| | 18 | 316/367 | 263/276 | 221/212 | 189/167 | 163/134 | 143/109 | 125/90 | 111/75 | 99/63 | 89/53 | |
| | 16 | 405/481 | 336/361 | 283/278 | 242/219 | 209/175 | 183/142 | 161/117 | 142/98 | 127/82 | 114/70 | 103/60 |
| Triple | 22 | 233/158 | 194/119 | 163/92 | 140/72 | 121/58 | | | | | | |
| | 20 | 282/198 | 235/149 | 198/115 | 169/90 | 146/72 | 128/59 | | | | | |
| | 18 | 391/287 | 325/216 | 275/166 | 235/131 | 203/105 | 177/85 | 156/70 | 139/58 | 124/49 | 111/42 | |
| | 16 | 500/376 | 416/283 | 351/218 | 301/171 | 260/137 | 227/111 | 200/92 | 177/77 | 158/64 | 142/55 | 129/47 |

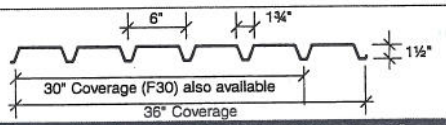
LRFD

Areas marked with this symbol exceed SDI recommended maximum spans. (see database)

## F Deck Uplift

Web crippling is considered at gravity loads but is not considered a limit state during uplift. Fasteners must be designed separately for uplift and/or diaphragm shear.

TYPE F




30" Coverage (F30) also available
36" Coverage

(Uniform Total Load, psf/Load Producing L/240 or 1", psf)

| Span Condition | Gage | Span 4'0" | 4'6" | 5'0" | 5'6" | 6'0" | 6'6" | 7'0" | 7'6" | 8'0" | 8'6" |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Single | 22 | 140/133 | 111/94 | 90/68 | 74/51 | | | | | | |
| | 20 | 170/164 | 134/114 | 109/84 | 90/63 | 76/49 | | | | | |
| | 18 | 230/246 | 182/173 | 147/126 | 122/95 | 102/73 | 87/57 | 75/46 | | | |
| Double | 22 | 129/321 | 102/226 | 83/164 | 68/124 | 58/95 | 49/75 | | | | |
| | 20 | 158/395 | 125/278 | 102/202 | 84/152 | 71/117 | 60/92 | 52/74 | | | |
| | 18 | 217/593 | 172/416 | 140/303 | 116/228 | 97/176 | 83/138 | 72/111 | 62/90 | 55/74 | 49/62 |
| Triple | 22 | 160/251 | 127/176 | 103/129 | 85/97 | 72/74 | 61/59 | | | | |
| | 20 | 197/309 | 156/217 | 127/158 | 105/119 | 88/92 | 75/72 | 65/58 | | | |
| | 18 | 270/464 | 214/326 | 174/238 | 144/178 | 121/137 | 103/108 | 89/87 | 78/70 | 68/58 | 61/48 |

ASD

(Uniform Total Load, psf/Load Producing L/240 or 1", psf)

| Span Condition | Gage | Span 4'0" | 4'6" | 5'0" | 5'6" | 6'0" | 6'6" | 7'0" | 7'6" | 8'0" | 8'6" |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Single | 22 | 222/133 | 175/94 | 142/68 | 117/51 | | | | | | |
| | 20 | 269/164 | 213/115 | 172/84 | 142/63 | 120/49 | | | | | |
| | 18 | 364/246 | 288/173 | 233/126 | 193/95 | 162/73 | 138/57 | 119/46 | | | |
| Double | 22 | 204/321 | 161/226 | 131/164 | 108/124 | 91/95 | 78/75 | | | | |
| | 20 | 250/395 | 198/278 | 161/202 | 133/152 | 112/117 | 96/92 | 82/74 | | | |
| | 18 | 344/593 | 272/416 | 221/303 | 183/228 | 154/176 | 131/138 | 113/111 | 99/90 | 87/74 | 77/62 |
| Triple | 22 | 253/251 | 201/176 | 163/129 | 135/97 | 114/74 | 97/59 | | | | |
| | 20 | 311/309 | 247/217 | 201/158 | 166/119 | 140/92 | 119/72 | 103/58 | | | |
| | 18 | 428/464 | 339/326 | 275/238 | 228/178 | 192/137 | 164/108 | 141/87 | 123/70 | 108/58 | 96/48 |

LRFD

# LOAD TABLES

Project Name: Stennis Riverine
Contract: N69450-05-D-0096
BRM Proj.: 3013-70
Submittal: 13125-10
Reviewed
Reviewed by: J. Collins
Date: 2/17/09

**BROADMOOR, L.L.C.**

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

Robert Hite 5.8.09

DQC Manager Date

Anthony M Colletta 5/8/09

QC Officer Date

DESIGN ENGINEERING INC

**Date:** 5-8-09 Project Stennis Lore

**Reviewed:** X

**Reviewed as Noted**

**Revise and Resubmit**

**Rejected**

**Other:**

Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The contractor is responsible for confirming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating his work with that of all other trades and performing his work in a safe and satisfactory manner.

**Submittal Item** Deck Upliff

## Roof Deck Design Example Problem

THE NOMINAL ROOF SNOW LOAD (S) FOR A BUILDING HAS BEEN DETERMINED TO BE 35 psf. 20 psf IS TO BE INCLUDED AS A CONSIDERATION OF MAINTENANCE LOAD FROM WORKERS ($L_r$). THE DEAD LOAD (D) IS 10 psf. A WIND UPLIFT LOAD (W) IS 30 psf. RAIN SURCHARGE IS NOT REQUIRED. ANY LATERAL EARTHQUAKE LOAD WOULD BE CONSIDERED IN THE DIAPHRAGM DESIGN. FOR FLEXURE, (E) = 0. THE DECK IS IN A THREE (OR MORE) SPAN CONDITION AND THE SPAN IS 6'-6". LOAD COMBINATIONS GIVEN APPLY TO THIS EXAMPLE. SEE ASCE 07-05 OR GOVERNING CODE FOR ALL OTHER NOMINAL LOADS.

### Load Combinations On This Roof

LRFD

1. 1.4D
2. 1.2D + 1.6L + 0.5($L_r$ or S)
3. 1.2D + 1.6($L_r$ or S) + (0.5*L or 0.8W)
4. 1.2D + 1.6W + 0.5*L + 0.5($L_r$ or S)
5. 1.2D + 1.0E + 0.5*L + 0.2S
6. 0.9D + 1.6W
7. 0.9D + 1.0E

ASD

1. D
2. D + L
3. D + ($L_r$ or S)
4. D + .75L + .75($L_r$ or S)
5. D + (W or 0.7E)
6. D + .75(W or 0.7E) + .75L + .75($L_r$ or S)
7. .6D + W
8. .6D + .7E

### Load Definitions

D = dead load
E = earthquake load
L = live load due to occupancy
$L_r$ = roof live load
S = snow load
W = wind load

* The 0.5 multiplier is acceptable for this occupancy per exception Note 1 of ASCE 07-05, section 2.3.2.

**LRFD**

The governing load combinations are 3 and 6, (1.2D + 1.6S + 0.5L) where L=0, and (0.9D + 1.6W), which total **68 psf and -39 psf** respectively. The deflection load is S = **35 psf.** The B deck LRFD load tables show that three span 22 gage deck can carry a factored gravity load or an uplift load of 140 psf based on stress and 72 psf based on a live load deflection of span/240. **140>68 O.K.; 72>35 O.K.; -140>-39 O.K.; -72>-30 for simplicity O.K.**

**ASD**

The governing load combinations are 3 and 7, D + ($L_r$ or S)) and (.6D + W), which total **45 psf** (for stress) and **-24 psf** respectively. The B deck ASD load table shows that three span 22 gage B deck can carry a gravity load or an uplift load of 88 psf based on stress and 72 psf based on a live load deflection of span/240. **88>45 O.K.; 72>35 O.K.; -88> -24 O.K.; -72>-24 O.K.**

Note the deflection values are exactly the same for both ASD and LRFD. The gage choice is the same regardless of the analysis used. Fasteners must be designed for uplift and/or diaphragm shear.
Final check: Maximum multi span limits is 6'9" which is O.K. If FM class 1 construction is required, then the maximum span is 6'0" and 20 gage deck would be required.

## Uplift Load Example Problem

The uplift resistance U, in psf, can be calculated for a given fastener pattern by the equation: $U = \frac{kP}{CL}$

Where P is obtained from the chart of tensile strength of arc spot (puddle) welds for the listed gage and weld size. (k) is the equivalent number of connectors from the table below, C is the deck cover width and L is the deck span measured at center lines. (k) defines the weighted resistance of welds across the cover width. It is acceptable to include a reaction coefficient in the denominator, e.g. (1.1) for a multi-span condition.

A 22 gage 1 ½" deep deck is fastened with a 36/4 pattern (12" o.c.). The deck span is 6'-6". Calculate the resisting uplift using ASD for 5/8" (0.625) diameter welds and for #12 screws with a head diameter of 0.430. Supports are joists, so pull out is not a concern.

**WELDS:**

From the Tensile Strength of Arc Spot (Puddle) Welds for A653 SS40 (galvanized) Chart (see page 20), P=1460 lbs., C = 3 feet; k = 2.7 (k reflects prying reduction at side lap.)

**Interior support**

$U_n = \frac{2.7\ (1460)}{3 \times 6.5} = 202$ psf

**Exterior support**

$U_n = \frac{2.7\ (1460)}{3\ (6.5/2)\ 2} = 202$ psf

Note: End prying factor of 2 is applied at all exterior supports and is critical for single span. The same end prying factor of 2 may be used for screws.

**Safety Factor** $\Omega_u = 2.5$

U = 202/2.5 = 80.86 ≈ 81 psf
> 24 psf (includes allowance for DL)

**SCREWS:**

From Wind Uplift Values for Screws, pull over nominal value @ 22 gage base deck material with screw head $d_w = 0.430$ is (see page 19):

P = 990 lbs.

$U_n = \frac{3.0\ (990)}{3 \times 6.5} = 152.31$ psf

(k reflects no required prying reduction at side laps.)

Note: See uplift tables for flexural limits. If the roof deck resists diaphragm shear due to wind, the interaction of uplift and shear at support fasteners reduces diaphragm shear resistance. See the interaction design tool on the CMC Joist & Deck website.

**Safety Factor** $\Omega_u = 3.0$

U = 152.31/3 = 50.77 ≈ 51 psf > 24 psf

| Weld Pattern | C | Welds (k) | Screws (k) |
|---|---|---|---|
| 24/4 | 2 | 2.7 | 3 |
| 30/3 | 2.5 | 1.7 | 2 |
| 30/4 | 2.5 | 2.7 | 3 |
| 30/6 | 2.5 | 4.7 | 5 |
| 36/4 | 3 | 2.7 | 3 |
| 36/5 | 3 | 3.7 | 4 |
| 36/7 | 3 | 5.7 | 6 |

# EXAMPLE PROBLEMS

## Wind Uplift Values for Screws

**DECK TO STRUCTURAL STEEL, OPEN WEB STEEL JOISTS, GAGE FRAMING**

### Pull Out Nominal Strengths, $P_{not}$, Lbs.

Screw pull out from structural steel framing or from steel joists rarely controls. Pull out is a definite possibility when light gage framing is used. The table shows pull out values for A653 steel (galvanized) with 40, 50 and 80 ksi yields. The tensile strength, $F_u$ = 62 ksi, is used for determining nominal strength of Grade 80 steel per AISI section A2.3.2. **The lesser of pull out and pull over controls connection design.**

$P_{not} = 0.85\, t_2\, d\, F_{u2}$ $t_2$ (steel thickness receiving the screw point & engaging the threads) $F_{u2}$ = tensile strength on that material

| Screw | Size(d) | $F_u$ | Grade | 1/4" | 3/16" | 10 | 1/8" | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 0.2500 | 0.1875 | 0.1345 | 0.1250 | 0.1046 | 0.0747 | 0.0598 | 0.0474 | 0.0358 | 0.0295 | 0.0239 | 0.0179 | 0.0149 |
| #10 | 0.190 | 55 | 40 | | | | | | 664 | 531 | 421 | 318 | 262 | | | |
| #10 | 0.190 | 65 | 50 | | | | | | 784 | 628 | 498 | 376 | 310 | | | |
| #10 | 0.190 | 62 | 80 | | | | | | 748 | 599 | 475 | 358 | 295 | 239 | 179 | 149 |
| #12 | 0.216 | 55 | 40 | 2525 | 1893 | 1358 | 1262 | 1056 | 754 | 604 | 479 | 362 | 298 | | | |
| #12 | 0.216 | 65 | 50 | 2896 | 2238 | 1605 | 1492 | 1248 | 891 | 714 | 566 | 427 | 352 | | | |
| #12 | 0.216 | 62 | 80 | 2846 | 2134 | 1531 | 1423 | 1191 | 850 | 681 | 540 | 408 | 336 | 272 | 204 | 170 |
| 1/4" | 0.250 | 55 | 40 | 2922 | 2191 | 1572 | 1461 | 1223 | 873 | 699 | 554 | 418 | 345 | | | |
| 1/4" | 0.250 | 65 | 50 | 3453 | 2590 | 1858 | 1727 | 1445 | 1032 | 826 | 655 | 494 | 407 | | | |
| 1/4" | 0.250 | 62 | 80 | 3294 | 2470 | 1772 | 1647 | 1378 | 984 | 788 | 624 | 472 | 389 | 315 | 236 | 196 |

Table uses the SDI decimal thickness for gage. Note that actual support frame, $t_2$, gage thickness may differ from the SDI thickness. The safety factor for pull out (ASD) is 3. The $\phi$ factor (LRFD) is 0.5. Consult screw manufacturer for proper thread and drill point types at each support thickness. Threads must engage full thickness for table to apply. Shaded area equals 80% of screw breaking strength to avoid brittle failure. #10 screws not recommended for steel thickness in crossed out areas. $F_u$ and $F_y$ for hot rolled shapes will vary from this table. Linear interpolation for $F_u$ is acceptable - see page 160.

### Pull Over Nominal Values, $P_{nov}$, Lbs.

Pull over strength generally controls the uplift values of screws. The roof deck range is 16 to 22; the form deck typical gages are 24, 26, 28. Form deck is typically high strength (SS Grade 80) and uses Fu = 62 ksi in design.

$P_{nov} = 1.5\, t_1\, d_w\, F_u$; $d_w \leq .5"$ $t_1$ (steel thickness contacting screw head)

| | Gage | | | | | | |
|---|---|---|---|---|---|---|---|
| | 16 | 18 | 20 | 22 | 24 | 26 | 28 |
| 0.400 | 1870 | 1480 | 1120 | 920 | 890 | 670 | 550 |
| 0.415 | 1940 | 1530 | 1160 | 960 | 920 | 690 | 580 |
| 0.430 | 2010 | 1590 | 1200 | 990 | 960 | 720 | 600 |
| 0.480 | 2240 | 1780 | 1340 | 1100 | 1070 | 800 | 670 |
| 0.500 | 2330 | 1850 | 1400 | 1150 | 1110 | 830 | 690 |

The table pullover strengths lbs., are based on $F_u$ = 52 ksi (A1008 steel) for 16 through 22 gage, and 62 ksi for 24 through 28 gage. The safety factor for pull over is 3. The $\phi$ factor (LRFD) is 0.5. If A653 (galvanizing) is provided, the designer may linearly prorate the capacity using the $F_u$ listed in the Pull Out table.

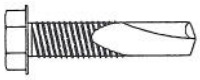
### Screw Breaking Nominal Strength, Kips.

Breaking values are obtained from screw manufacturer. This table contains representative numbers.

| Screw Data | | | | |
|---|---|---|---|---|
| Screw Size | d (dia.) | $d_w$ (nom. head dia.) | Avg. tested tensile strength | |
| 10 | 0.190 | 0.415 or 0.400 | 2.56 | |
| 12 | 0.216 | 0.430 or 0.400 | 3.62 | |
| 1/4" | 0.250 | 0.480 or 0.520 | 4.81 | |



### Typical Screw Types

| Self Drilling, Self Tapping | Diam. - threads per inch - screw length | Drill Point | Usage |
|---|---|---|---|
| | #10 - 16 x 3/4" | Type 1 | Side lap |
| | #12 - 14 x 3/4" | Type 3 | Side lap |
| | #12 - 24 x 7/8" | Type 4 | SUPPORTS drilling and fastening metal up to 5/16" thick |
|  | #12 - 24 x 1 1/4" | Type 5 | drilling and fastening metal up to 1/2" thick |

# SCREWS

## Tensile Strength of Arc Spot (Puddle) Welds

$P_n = 0.8 (F_u / F_y)^2 \times t (d - t) \times F_u$

The weld tensile strengths, in pounds, shown in the table cover the range of properties and thickness for roof deck. Weld washers are recommended for thickness less than 22 gage. The AISI's **North American Specification For The Design Of Cold-Formed Steel Structural Members** 2007 is the basis of the table. The strengths are the nominal (ultimate) values. For LRFD apply a $\phi$ factor of 0.60, and for ASD use a safety factor, $\Omega$, of 2.5. Isolated (non repetitive) applications require $\phi = 0.50$, and $\Omega = 3.0$. Follow AWS D1.3 procedures for arc puddle welding. A minimum electrode strength of 60 ksi is required. The clear distance between the weld edges and the end of the deck must be greater than or equal to the weld visible diameter. Follow the local codes for design loads, load combinations, and load factors. If no code exists, use ASCE 7.

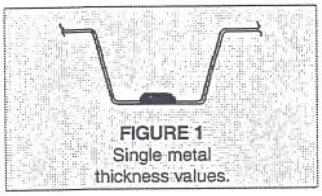


FIGURE 1
Single metal thickness values.

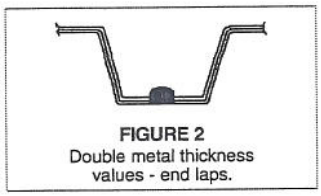


FIGURE 2
Double metal thickness values - end laps.

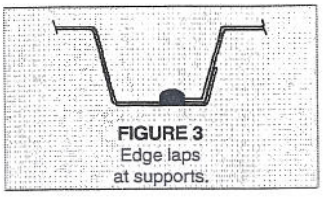


FIGURE 3
Edge laps at supports.

| Steel | Gage | Visible Weld Diameter (Inches) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Figure 1 | | | | Figure 2 | | | | Figure 3 | | | |
| | | 0.5 | 0.625 | 0.75 | 1 | 0.5 | 0.625 | 0.75 | 1 | 0.5 | 0.625 | 0.75 | 1 |
| A653 Grade 40 Fy = 40 ksi Fu = 55 ksi | 22 | 1150 | 1460 | 1770 | 2380 | 2160 | 2780 | 3390 | 4540 | 810 | 1020 | 1240 | 1670 |
| | 20 | 1380 | 1750 | 2130 | 2870 | 2550 | 3300 | 4040 | 4540 | 970 | 1230 | 1490 | 2010 |
| | 18 | 1780 | 2280 | 2770 | 3760 | 2030 | 4110 | 4540 | 4540 | 1250 | 1590 | 1940 | 2630 |
| | 16 | 2190 | 2810 | 3430 | 4540 | 1370 | 3140 | 4540 | 4540 | 1530 | 1970 | 2400 | 3180 |
| A1008 Grade 40 Fy = 40 ksi Fu = 52 ksi | 22 | 980 | 1240 | 1490 | 2010 | 1830 | 2350 | 2870 | 3900 | 680 | 860 | 1050 | 1410 |
| | 20 | 1170 | 1480 | 1800 | 2430 | 2160 | 2790 | 3410 | 4060 | 820 | 1040 | 1260 | 1700 |
| | 18 | 1510 | 1920 | 2340 | 3170 | 2030 | 3530 | 4060 | 4060 | 1060 | 1350 | 1640 | 2220 |
| | 16 | 1850 | 2380 | 2900 | 3950 | 1370 | 3140 | 4060 | 4060 | 1300 | 1660 | 2030 | 2770 |
| A653 Grade 50 Fy = 50 ksi Fu = 65 ksi | 22 | 1220 | 1540 | 1870 | 2520 | 2290 | 2930 | 3580 | 4060 | 850 | 1080 | 1310 | 1760 |
| | 20 | 1460 | 1850 | 2250 | 3030 | 2700 | 3480 | 4060 | 4060 | 1020 | 1300 | 1570 | 2120 |
| | 18 | 1890 | 2410 | 2930 | 3970 | 2030 | 4060 | 4060 | 4060 | 1320 | 1680 | 2050 | 2780 |
| | 16 | 2310 | 2970 | 3630 | 4060 | 1370 | 3140 | 4060 | 4060 | 1620 | 2080 | 2540 | 2840 |
| Grade 80 Fy = 60 ksi Fu = 62 ksi | 22 | 740 | 930 | 1130 | 1520 | 1380 | 1770 | 2160 | 2560 | 510 | 650 | 790 | 1060 |
| | 20 | 880 | 1120 | 1350 | 1830 | 1620 | 2100 | 2560 | 2560 | 620 | 780 | 950 | 1280 |
| | 18 | 1140 | 1450 | 1760 | 2390 | 2030 | 2560 | 2560 | 2560 | 800 | 1020 | 1230 | 1670 |
| | 16 | 1390 | 1790 | 2190 | 2560 | 1370 | 2560 | 2560 | 2560 | 980 | 1250 | 1530 | 1790 |

## Tensile Strength of Arc Spot (Puddle) Welds Through Weld Washers

Weld washer table values are based on the AISI Specification and use $F_y = 33$ ksi and $F_u = 48$ ksi for resistance limits through the 16 gage washer. Washers have 3/8" holes. The table is based on Structural Steel Grade 80 deck and considers pullover of the deck around the washer. The edge lap value is based on (Figure 3 or 3B) and applies a 0.7 prying factor to the lesser of the single or double sheet resistance. The table waives the minimum weld effective diameter of 3/8" at supports. LRFD values are Factored Nominal and ASD values are allowable resistance. LRFD table strength already includes the controlling $\phi$ factor. Limit states for weld washers in tension have variance in $\phi$ and $\Omega$ factors. This is why the controlling factored resistance is shown. The weld shear strength, pounds, is based on the value presented in the SDI Diaphragm Design Manual 3rd Ed. When welds are used as part of a diaphragm, the system $\phi$ and $\Omega$ factors will apply.

| | Gage | Visible Weld Diameter (Inches) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Figure 1 | | Figure 2 | | Figure 3, 3B | |
| | | 0.5 | 0.625 | 0.5 | 0.625 | 0.5 | 0.625 |
| LRFD | 28 | 1529 | 1529 | 1314 | 2338 | 920 | 1070 |
| | 26 | 1541 | 1837 | 1207 | 2446 | 845 | 1286 |
| | 24 | 1424 | 2209 | 1006 | 2155 | 704 | 1509 |
| ASD | 28 | 1006 | 1006 | 876 | 1559 | 613 | 704 |
| | 26 | 1027 | 1208 | 805 | 1630 | 563 | 846 |
| | 24 | 950 | 1472 | 670 | 1437 | 469 | 1006 |

Factored Nominal Tensile Strength of Welds Through 16 Gage Weld Washers - LRFD

Allowable Tensile Strength of Welds Through 16 Gage Weld Washers - ASD.

| Shear Strength of Welds Through 16 Gage Weld Washers | | |
|---|---|---|
| Gage | Factored LRFD $\phi$ = 0.60 | Allowable ASD $\Omega$ = 2.65 |
| 28 | 679 | 427 |
| 26 | 873 | 549 |
| 24 | 1319 | 829 |

FIGURE 3B

## Shear Strength of Arc Spot (Puddle) Welds

See the diaphragm tables for the nominal shear strength of welds, $Q_f$, or consult Section E2.2 of the AISI Specifications. If shear is caused by diaphragm action use the system factors shown in the diaphragm tables. Otherwise consult the AISI Specifications for the appropriate safety and resistance factors.

# WELDS

## Roof Construction Fire Ratings

| U.L Design | Hours |
|---|---|
| P201 | 1 |
| P202 | 1 |
| P203 | ¾ |
| P204 | 1 |
| P206 | 1 |
| P210 | 1 |
| P211 | 1 |
| P214 | 1 |
| P215 | 2 |
| P216 | 1 |
| P219 | 2 |
| P225 | 1,1½ |
| P227 | 1,1½ |
| P230 | 1, 1½ |
| P231 | 1,1½ |
| P235 | 1 |
| P237 | 2 |
| P238 | 1 |
| P241 | 2 |
| P246 | 1 |
| P250 | 1,1½ |
| P251 | 1,1½,2 |
| P254 | 1 |
| P255 | 1 |
| P257 | 1 |
| P259 | 1,1½ |
| P261 | 1 |
| P264 | 1 |
| P266 | 1½,2 |
| P267 | 1 |
| P269 | 1,1½ |
| P301 | 1,1½,2 |
| P303 | 1 |
| P404 | 1½,2 |
| P405 | 3 |
| P407 | 2 |
| P409 | 2 |
| P410 | 2 |
| P411 | 2 |
| P503 | 2 |
| P508 | 1 |
| P509 | 1 |
| P510 | 1,1½ |
| P511 | 1 |
| P512 | 1 |
| P513 | 1½ |
| P514 | 1, 2 |
| P515 | 1 |
| P518 | 1 |
| P519 | 1, 2 |
| P520 | 2 |
| P521 | 1,1½,2 |
| P525 | 1, 1½, 2 |
| P526 | 1, 1½ |
| P527 | 1, 1½ |
| P528 | 1 |
| P529 | 1, 1½ |
| P532 | 1, 1½, 2 |
| P536 | 1, 1½, 2 |
| P540 | 1 |
| P541 | 1 |
| P542 | 1 |

| U.L Design | Hours |
|---|---|
| P543 | 2 |
| P546 | 1 |
| P701 | ¾ ,1,1½,2 |
| P709 | 1,1½,2 |
| P710 | 1 |
| P711 | 1,1½,2 |
| P712 | 1,1½,2,3 |
| P713 | 1,1½,2,3 |
| P714 | 1,1½,2 |
| P717 | 1,1½,2 |
| P718 | 2 |
| P719 | 1,1½,2,3 |
| P720 | 2 |
| P721 | 1 |
| P722 | 1,1½,2,3 |
| P723 | 1,1½,2,3 |
| P725 | 1,1½,2 |
| P726 | 1,1½,2 |
| P727 | 1,1½,2,3 |
| P728 | 1½,2 |
| P729 | 2 |
| P730 | 1,1½,2,3 |
| P731 | 1,1½,2,3 |
| P732 | 1,1½,2,3 |
| P733 | 1,1½,2,3 |
| P734 | 1,1½,2 |
| P735 | 1 |
| P736 | 1,1½,2 |
| P738 | 1,1½,2 |
| P739 | 1,1½,2 |
| P740 | 1,1½,2 |
| P741 | 1,1½,2 |
| P742 | 1,1½,2 |
| P743 | 1,1½,2 |
| P801 | 1,1½,2 |
| P811 | 1,1½,2,3 |
| P815 | 1,1½,2 |
| P816 | 1,1½,2 |
| P819 | 1,1½,2 |
| P824 | 1 |
| P825 | 1,1½,2 |
| P826 | 1,1½,2,3 |
| P827 | 1,1½,2 |
| P828 | 1,1½,2 |
| P901 | 1,1½,2 |
| P902 | 1,1½,2 |
| P903 | 1 |
| P907 | 1,1½,2 |
| P908 | 1,1½,2 |
| P919 | 1,1½ |
| P920 | 1,1½,2 |
| P921 | 1,1½,2 |
| P922 | 1,1½,2 |
| P923 | 1,1½,2 |
| P925 | 1,1½,2 |
| P926 | 1,1½,2 |
| P927 | 1,1½,2 |
| P928 | 1,1½,2 |
| P929 | 1,1½,2 |
| P930 | 1,1½,2 |
| P936 | 1,1½,2 |
| P937 | 1,1½,2 |

Roof - ceiling fire rated assemblies listed in the Underwriters Laboratory, Inc. Fire Resistance Directory, follow this numbering code: P2xx have suspended acoustical ceilings with an exposed grid system; P3xx have mineral or fiber board applied to the underside of the deck; P4xx have suspended gypsum board; P7xx and P8xx have **spray applied fire resistive material (SFRM)** applied to the steel deck; P9xx assemblies have no SFRM applied to the deck although it is still required on the beams or the joists. The P9xx ratings (with steel deck) in the directory are all with insulating concrete. Individual designs in each of the categories can have a variety of insulation systems: insulating boards of various materials, vermiculite or perlite or cellular concrete, foamed plastic, and combinations of these. Some designs in the P2xx, P4xx, P5xx, and P9xx series allow galvanized form type products but not fluted roof deck. Roof deck may be painted or galvanized when used in designs that include suspended ceilings (Designs P2xx, P4xx, P5xx and P9xx). **Please note that the deck is only one component of the fire rated assembly. Be sure to check the U.L. Fire Resistance Directory for all details of construction.**

All of the designs describe the steel deck in generic terms. Some show, in addition to the general description, a list of classified products. CMC Joist & Deck or United Steel Deck, Inc. is specifically listed in some assemblies but, even if not specifically named, CMC Joist & Deck can meet the general requirements with one or more of our deck products and therefore can supply the required deck component for the assembly.

It is also important to note that U.L. will allow the substitution of heavier (thicker), deeper and stronger members than shown in the assembly requirements. However the designer should review the details of the assembly to check span limits, spacing considerations, and connection requirements. When U.L. calls for the use of welding washers, the washers can be eliminated for deck that is 22 gage or thicker.

Galvanized deck should be used for constructions that require the use of sprayed-on fire protection material. Designs marked with an (■) allow the use of classified painted roof deck with SFRM. Designers must note in the roof deck project specification that spray proofing is required over painted deck. **CMC Joist & Deck is not responsible for the adhesive ability of any SFRM, or for any treatment, cleaning, or preparation of the deck surface required for the adhesion of SFRM.** Consult the SFRM manufacturer for application directions and limitations.

This listing is based on the Underwriters Laboratories *Fire Resistance Directory*, 2007 Edition

# FIRE RATINGS

## ANSI/SDI-RD1.0 Standard for Steel Roof Deck

# 1. General

### 1.1 Scope:

A. This Specification for Steel Roof Deck shall govern the materials, design, and erection of cold formed steel deck used for the support of roofing materials, design live loads and SDI construction loads.

B. Commentary shall not be considered part of the mandatory document.

### 1.2 Reference Codes, Standards and Documents:

A. Codes and Standards: For purposes of this Standard, comply with applicable provisions of the following Codes and Standards:

1. American Iron and Steel Institute (AISI) Standard - *North American Specification for the Design of Cold-Formed Steel Structural Members,* 2001 Edition with Supplement 2004
2. American Welding Society - ANSI/AWS D1.3 Structural Welding Code/Sheet Steel - 98 Structural Welding Code - Sheet Steel
3. American Society for Testing and Materials (ASTM) A653 (A653M)-06, A924 (A924M)-06, A1008 (A1008M)-06
4. American Society of Civil Engineering (ASCE) – SEI/ASCE7-05
5. Underwriters Laboratories (UL) Fire Resistance Directory - http://www.ul.com/database 2006

B. Reference Documents: Refer to the following documents:

1. SDI Manual of Construction with Steel Deck - MOC2-2006
2. SDI Standard Practice Details - SPD2-2001
3. SDI Position Statement - Field Painting of Steel Deck-2004
4. SDI Diaphragm Design Manual - DDM03-2004

# 2. Products

### 2.1 Material:

A. Sheet steel for galvanized deck shall conform to ASTM A653 (A653M) Structural Quality, with a minimum yield strength of 33 ksi (230 MPa).

B. Sheet steel for cold rolled plus painted deck shall conform to ASTM A1008 (A1008M) with a minimum yield strength of 33 ksi (230 MPa). Other structural sheet steels or high strength low alloy steels are acceptable, and shall be selected from the *North American Specification for the Design of Cold-Formed Steel Structural Members.*

C. Sheet steel for accessories shall conform to ASTM A653 (A653M) Structural Quality for structural accessories, ASTM A653 (A653M) Commercial Quality for non-structural accessories, or ASTM A1008 (A1008M) for either structural or non-structural accessories. Other structural sheet steels or high strength low alloy steels are acceptable, and shall be selected from the *North American Specification for the Design of Cold-Formed Steel Structural Members.*

D. The deck type (profile) and thickness (gage) shall be as shown on the plans.

### 2.2 Tolerance:

A. Uncoated thickness shall not be less than 95% of the design thickness as listed in Table 2.2.1:

**Table 2.2.1**

| Gage No. | Design Thickness | | Minimum Thickness | |
|---|---|---|---|---|
| | in. | mm. | in. | mm. |
| 22 | 0.0295 | 0.75 | 0.028 | 0.71 |
| 21 | 0.0329 | 0.84 | 0.031 | 0.79 |
| 20 | 0.0358 | 0.91 | 0.034 | 0.86 |
| 19 | 0.0418 | 1.06 | 0.040 | 1.01 |
| 18 | 0.0474 | 1.20 | 0.045 | 1.14 |
| 17 | 0.0538 | 1.37 | 0.051 | 1.30 |
| 16 | 0.0598 | 1.52 | 0.057 | 1.44 |

B. Panel length shall be within plus or minus 1/2 inch (12 mm) of specified length.

C. Panel cover width shall be no greater than minus 3/8 inch (10 mm), plus 3/4 inch (20 mm).

D. Panel camber and/or sweep shall be no greater than 1/4 inch in 10 foot length (6 mm in 3 m).

E. Panel end out of square shall not be greater than 1/8 inch per foot of panel width (10 mm per m).

### 2.3 Finish:

A. Galvanizing shall conform to ASTM A653 (A653M).

B. Painted with a shop coat of primer shall be applied to steel sheet conforming to ASTM A1008 (A1008M).

C. The finish of the steel roof deck shall be suitable for the environment of the structure.

## 2.3 Finish:

***Commentary:*** The primer coat is intended to protect the steel for only a short period of exposure in ordinary atmospheric conditions and shall be considered an impermanent and provisional coating. Field painting of prime painted deck is recommended especially where the deck is exposed. (See SDI *Field Painting of Steel Deck*).

In corrosive or high moisture atmospheres, a galvanized finish is desirable in a G60 (Z180) or G90 (Z275) coating. In highly corrosive or chemical atmospheres or where reactive materials could be in contact with the steel deck, special care in specifying the finish should be used.

## 2.4 Design:

A. The deck shall be selected by the designer to provide the load capabilities shown on the drawings (design live and dead loads and the SDI construction loads).

1. The section properties of the steel roof unit deck shall be computed in accordance with the *North American Specification for the Design of Cold-Formed Steel Structural Members.*
2. Allowable Stress Design (ASD): Bending stress shall not exceed 0.60 times the yield strength with a maximum of 36 ksi (250 MPa) under the combined dead and design live loads.
3. Load and Resistance Factor Design (LRFD): The load factors are defined in the governing code. ASCE 7 (See section 1.2.A.5) shall be used in the absence of a governing code. The resistance factors and nominal resistances shall be determined in accordance with the *North American Specification for the Design of Cold-Formed Steel Structural Members.*
4. Deck Deflection: Deflection of the deck shall not exceed 1/240 of the span (centerline to centerline) or 1 inch (25 mm), whichever is less, under the uniformly distributed design live load. All spans are to be considered center-to-center of supports.

***Commentary:*** The adequacy of deck edge support details should be reviewed by the designer. At the building perimeter or any other deck termination or direction change, occasional concentrated loading of the roof deck could result in temporary differences in deflection between the roof deck and the adjacent stationary building component. Supplemental support such as a perimeter angle may be warranted.

5. Suspended Loads: All suspended loads shall be included in the analysis and calculations for stress and deflection.

***Commentary:*** The designer must take into account the sequence of loading. Suspended loads may include ceilings, light fixtures, ducts or other utilities. The designer must be informed of any loads applied after the roofing has been installed.

6. Construction and Maintenance Loads: Deck shall be selected by the designer to provide a minimum 30 lbs/sq.ft. (1.44 kPa) construction load. Span lengths shall be governed by a maximum stress of 0.7 Fy and a maximum deflection of 1/240 of the span with a 200-pound (0.89 kN) concentrated load at midspan on a 1 foot (300 mm) wide section of deck. If the designer contemplates loads of greater magnitude, spans shall be decreased or the thickness of the steel deck increased as required. All loads shall be distributed by appropriate means to prevent damage to the completed assembly during construction.
7. Cantilever loads: The cantilever span shall be determined by the lowest value considering, (a) construction phase load of 10 psf (0.48 kPa) on adjacent span and cantilever, plus 200 pound load (0.89 kN) at end of cantilever with a stress limit of 0.7 Fy (ASD), (b) a service load of 45 psf (2.15 kPa) on adjacent span and cantilever, plus 100 pound load (0.44 kN) at end of cantilever with a stress limit of 0.6 Fy (ASD), or (c) with service loads, a deflection limitation of 1/240 of adjacent span for interior span and deflection limitation at end of cantilever of 1/120 of overhang.

***Commentary:*** Under Construction and Maintenance Loads, and Cantilever Loads, 0.7 Fy maximum stress was selected to unify the ASD and LRFD values. Apply a load factor of 1.4 to 200 pound load when LRFD is used.

8. Diaphragm Shear Capacity: Roof deck shear capacity shall be determined in accordance with the SDI *Diaphragm Design Manual* or from tests conducted by an independent professional engineer.

***Commentary:*** Calculations of diaphragm strength and stiffness should be made using the SDI *Diaphragm Design Manual.* If testing is used as the means for determining the diaphragm strength and stiffness, then it should follow the AISI TS 7-02 test protocol.

B. Load Tables: Uniform loads determined for published tables shall be based on equal adjacent two and three span conditions and on single spans. Appropriate combinations of shear and bending shall be made to determine the published loads. Lengths of 1-1/2 inches (38 mm) for end bearing and 4 inches (100 mm) for interior bearing shall be used to check web crippling. Deflection coefficients shall be 0.013 for single spans, 0.0054 for double spans and 0.0069 for triple spans.

***Commentary:*** For deck layouts that provide more than three equal spans, the user can apply the loads published for three spans. Published uniform load tables do not apply for adjacent spans that differ in length by more than 10%.

### 2.5 Accessories:

A. Ridge and valley plates, and flat plates at change of deck direction shall be furnished as shown on plans to provide a flat (finished) surface for the application of roof insulation and roof cover.

B. Sump pans shall be furnished to receive roof drains as shown on plans. Holes for drains are to be field cut (by others) in the field.

C. Mechanical fasteners or welds shall be permitted for deck and accessory attachment.

## 3. Execution

### 3.1 Installation/General:

A. Support framing and field conditions shall be examined for compliance with requirements for installation tolerances and other conditions affecting performance of work of this section. All OSHA rules for erection shall be followed.

B. Deck panels and accessories shall be installed according to the SDI *Manual of Construction with Steel Deck*, placement plans, and requirements of this Section.

C. Deck panels shall be placed on structural supports and adjusted to final position with ends aligned, and attached securely to the supports immediately after placement in order to form a safe working platform. All deck sheets shall have adequate bearing and fastening to all supports to prevent slip off during construction. Deck ends over supports shall be installed with a minimum end bearing of 1-1/2 inches (38 mm). Deck areas subject to heavy or repeated traffic, concentrated loads, impact loads, wheel loads, etc. shall be adequately protected by planking or other approved means to avoid overloading and/or damage.

D. Lapped or Butted Ends: Deck ends shall be either lapped or butted over supports. Gaps up to 1 inch (25 mm) shall be permitted at butted ends.

E. Deck units and accessories shall be cut and neatly fit around scheduled openings and other work projecting through or adjacent to the decking.

***Commentary:*** It is the responsibility of the designer to designate holes/openings to be decked over in compliance with applicable federal and state OSHA directives. Care should be taken to analyze spans between supports at openings, when determining those holes/openings to be decked over. When a framed opening span exceeds the maximum deck span limits for construction loads, the opening must be detailed around instead of decked over. (Minimum roof construction load 30 lbs/sq ft (1.44kPa), unless job specific requirements dictate otherwise).

F. Trades that subsequently cut unscheduled openings through the deck shall be responsible for reinforcing these openings based upon an approved engineered design.

### 3.2 Installation/Anchorage:

A. Roof deck units shall be anchored to steel supporting members including perimeter support steel and/or bearing walls by arc spot welds of the following diameter and spacing, fillet welds of equal strength, or mechanical fasteners. Anchorage shall provide lateral stability to the top flange of the supporting structural members and resist the following minimum gross uplifts; 45 pounds per square foot (2.15 kPa) for eave overhang; 30 pounds per square foot (1.44 kPa) for all other roof areas. The dead load of the roof deck construction shall be deducted from the above forces.

1. All welding of deck shall be in accordance with ANSI/AWS D1.3, *Structural Welding Code - Sheet Steel.* Each welder shall demonstrate an ability to produce satisfactory welds using a procedure such as shown in the SDI *Manual of Construction with Steel Deck*, and/or as described in ANSI/AWS D1.3.
2. Welding washers shall be used on all deck units with metal thickness less than 0.028 inches (0.7 mm). Welding washers shall be a minimum thickness of 0.0598 inches (16 gage, 1.50 mm) and have a nominal 3/8 inch (10 mm) diameter hole.
3. Where welding washers are not used, a minimum visible 5/8 inch (15 mm) diameter arc puddle weld shall be used. Weld metal shall penetrate all layers of deck material at end laps and shall have good fusion to the supporting members.
4. Weld spacing: Ribs of panels shall be welded at each support. Space additional welds an average of 12 inches (300 mm) apart but not more than 18 inches (460 mm).
5. When used, fillet welds shall be at least 1-1/2 inches (38 mm) long.
6. Mechanical fasteners, either powder actuated, pneumatically driven, or screws, shall be permitted in lieu of welding to fasten deck to supporting framing if fasteners meet all project service requirements. When the fasteners are powder actuated or pneumatically driven, the load value per fastener used to determine the maximum fastener spacing is based on a minimum structural support thickness of not less than 1/8 inch (3 mm) and on the fastener providing a minimum 5/16 inch (8 mm) diameter bearing surface (fastener head size). When the structural support thickness is less than 1/8 inch (3 mm), powder actuated or pneumatically driven fasteners shall not be used, but screws are acceptable.

***Commentary:*** Mechanical fasteners (screws, powder or pneumatically driven fasteners, etc.) are recognized as viable anchoring methods, provided the type and spacing of the fastener satisfies the design criteria. Documentation in the form of test data, design calculations, or design charts should be submitted by the fastener manufacturer as the basis for obtaining approval.

7. For deck units with spans greater than 5 feet (1.5 m), side laps and perimeter edges of units between span supports shall be fastened at intervals not exceeding 36 inches (1 m) on center, using one of the following methods:
   a. #10 self drilling screws.
   b. Crimp or button punch.
   c. Arc puddle welds 5/8 inch (15 mm) minimum visible diameter, or minimum 1 inch (25 mm) long fillet weld.

***Commentary:*** The above side lap spacing is a minimum. Service loads or diaphragm design may require closer spacing. Good metal to metal contact is necessary for a good side lap weld. Burn holes are to be expected.

B. Accessory Attachment:

1. Accessories shall be anchored to supporting members by arc spot welds or self drilling screws at 12 inches (300 mm) maximum intervals or as shown on design drawings.

## Form Deck General Information

**TABLES**

The most common use of form deck is to support concrete fills but they can be used for a variety of structural applications. Therefore, two sets of tables are shown. The **Uniform Load tables are** for the deck as the sole load carrying member; ASD and LRFD tables both show **stress load/deflection load** in psf. The loads are uniformly applied and the deflection limit is 1/180 of the span. It is acceptable to ignore the contribution of insulation fill and to use the load tables for the appropriate form deck. When BV or NV is used, the tables are shown in the roof deck section. The **Concrete Slab tables** show the slab capacities for structural (normal weight) concrete with draped mesh placed over the various form decks. The effects of the deck profile are considered in determining the slab load values. The transformed moment of inertia (I) is provided for deflection checks. Diaphragm tables are available in the Diaphragm section of the catalog.

**DESIGN CONSIDERATIONS – SLABS ON FORM DECK**

The live loads shown in the tables are the loads that the reinforced concrete slab can carry. Live loads are based on unshored galvanized deck. See the maximum recommended unshored span tables and the corresponding notes. If uncoated form is used, or if shoring is used, the load shown in the table must either be reduced by the weight of the slab (the quick method) or, more precisely, by solving the equation:

$M = 1.2M_{DL} + 1.6M_{LL}$.

$M_{DL}$ is the moment caused by the slab weight.

Load values shown in the tables are for continuous (3 or more) spans; $-M = WL^2/12$ for spans less than 10 feet, or $WL^2/10$ for spans greater than 10 feet, and $+M = WL^2/16$ per ACI 318 (see page 85). In most cases negative moments control. Load values for end spans, dual spans, single spans, or for unequal adjacent spans should be appropriately reduced to compensate for increased moment coefficients; use the tabulated factored design moments to determine the allowable design loads. A design tool is also available on the CMC Joist & Deck website to determine these uniform loads. All slab tables included in this section are for 3,000 psi concrete and utilize a phi factor of 0.9. Consult ACI 318 for the appropriate phi factor if the concrete exceeds 4,000 psi.

***Example 1:***

Check the end span of a 4" slab with welded wire mesh 6 x 6 - W4.0 x W4.0; the slab is continuous over 4' spans. The UFX deck is to be unshored and is galvanized.

End span: $+M = WL^2/11$

From the UFX table: $+M = 10.785$ kip in.

$W(4)^2(12)/11 = 10.785(1000)/1.6$

$W = 386$ psf

-M at the first interior support controls and the table value of W = 368 psf is therefore the limiting load.

***Example 2:***

Use the same parameters of the previous example to check a single span – the mesh is not draped but is placed on top of the deck.

$+M = W(4)^2(12)/8 = 10.785(1000)/1.6$

$W = 281$ psf

***Example 3:***

A 4" slab on UFX is spanning 6'; the mesh is 6 x 6 - W4.0 x W4.0. The deck was shored during construction. Determine the allowable live load.

Quick Method: The table shows W = 163 psf

The slab weighs 40 psf. The live load is then:

$W_{LL} = 163 - 40 - 1$(deck weight) $= 122$ psf

Precise Method: $M = 9408$ lb inches $= WL^2/12$

$M_{DL} = 1.2(40+1)(6)^2(12)/12 = 1771$ lb inches

$9408 = 1771 + 1.6W_{LL}(6)^2(12)/12$

$W_{LL} = 133$ psf

In the slab capacity tables, shear has been checked for uniform loads. The factored nominal shear force is:

$$\phi V_n = 0.75 \times 2 \times (f'_c)^{.5} \times A_c$$

($A_c$ is the area of concrete as defined by SDI – see the **Content of Composite Deck Tables on page 29** for further explanation of $A_c$.)

The table values are based on $f'_c = 3000$ psi and, for the reinforcing steel (welded wire fabric), $F_y = 60{,}000$ psi.

### values in the table represent uniform live loads greater than 400 psf. Loads higher than this limit are usually caused by concentrated loads such as those caused by fork lift trucks. When heavy concentrated loads are to be considered, the slab system, including supports, should be given additional analysis.

Slab span to depth ratios are limited to 24. Spot checks have shown that the tabulated (live) loads would not cause a deflection greater than L/360. **In no case should the table values be used to predict slab performance using randomly placed fibers in lieu of wire mesh. Fibrous admixtures are not to be considered as primary reinforcement.**

In some short span layouts, the galvanized form deck is capable of carrying all of the required loading without considering the concrete slab strength. For these cases a minimum of 6 x 6-W1.4 x W1.4 is recommended for crack control.

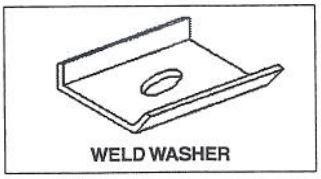
**CONCRETE AND PLACING CONCRETE**

To prevent leakage at side laps, concrete should be placed in the opposite direction to which the sheets were erected so that the concrete flow is away from the lap rather than into the lap. Care should be taken during pouring operations not to allow heavy concentrated loads or equipment to be placed on the steel forms. When buggies are used to deliver the concrete, the runways should be planked to avoid local damage. Concrete admixtures containing calcium chloride (or other salts) should not be used over steel forms.

**FASTENING**

Welding patterns 1 and 2 on page 73 represent minimum acceptable fastening that will allow slabs to be designed on a continuous basis and also stabilize joists. More frequent fastening may be required to satisfy diaphragm or fire rating requirements. Consult the U.L. Fire Resistance Directory for specific details on fire rated constructions. Diaphragm values can be obtained from the SDI Diaphragm Design Manual or in the diaphragm section of the catalog.

Welding washers are recommended for attaching deck lighter than 22 gage to structural steel (or joists). Welding washers are not recommended for attaching deck that is 22 gage or heavier. Welding washers are never recommended for attaching side laps except at supports. Welding washers furnished by CMC Joist & Deck are 16 gage with 3/8" diameter holes. The welder strikes an arc, burns a hole through the sheet and builds a plug weld from the joist (or beam) into the washer. Fasteners other than welds are acceptable to CMC Joist & Deck providing that the designer has checked all of the design parameters of the fasteners.



WELD WASHER

**FINISHES**

Form deck is commonly available in two finishes, galvanized (conforming to ASTM A653) and uncoated (black – conforming to ATSM A1008). Galvanized steel should always be specified for carrying non-structural insulating concrete fills. Painted form deck is available on special order. Use galvanized deck for vented deck or when spray fireproofing is required.

VENTED DECK



# GENERAL INFORMATION

Project Name: Stennis Riverstone
Contract: N69450-05-D-0096
Brm Proj.: 3013-70
Submittal: 13125-09
Reviewer
Reviewed by: J. Collins
Date: 2/17/09

3X

**BROADMOOR, L.L.C.**

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

R. Bart Vick 5.8.09

DQC Manager Date

J. W. Collins 5/8/09

QC Officer Date

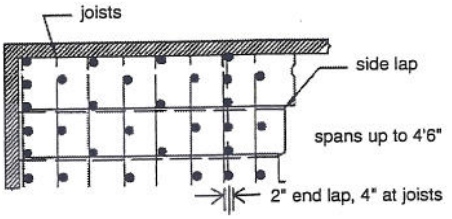
**DAMMON ENGINEERING INC**

**Date:** 5.8.09 **Project:** Stennis RAP
**Reviewed:** X
**Reviewed as Noted:**
**Revise and Resubmit:**
**Rejected:**
**Other:**

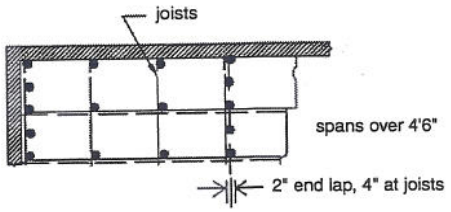
**Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. This contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his or her work with that of all other trades and performing all in a safe and satisfactory manner.**

**Submittal Item:** Metal Deck
**Comments**

## Details

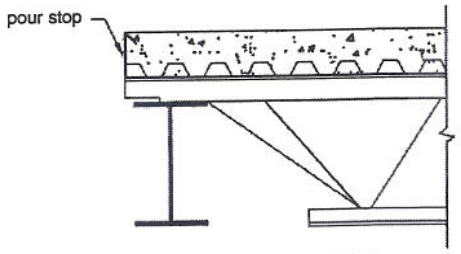



MINIMUM WELD PATTERN #1

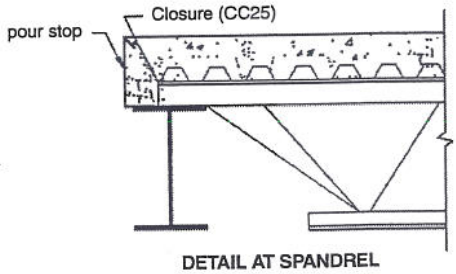



MINIMUM WELD PATTERN #2

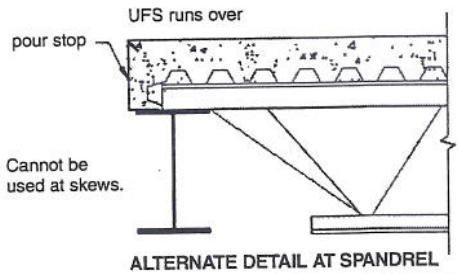
Note: dots represtend welds. Fasten side laps at 36" o.c. (max) if span exceeds 5'0".




DETAIL AT SPANDREL




DETAIL AT SPANDREL




ALTERNATE DETAIL AT SPANDREL

## Suggested Form Deck Specifications

**1. Material**

DECK

Steel form deck shall be as manufactured by CMC Joist & Deck. Steel shall conform to one of the following:
(1) ASTM A1008 SS grade 80 (for uncoated UFS, UF1X, UFX, and UF2X);
(2) ASTM A653 SS grade 80 (for galvanized UFS, UFSV, UF1X, UF1XV, UFX, UFXV, UF2X, and UF2XV);
(3) ASTM A1008 SS grade 40 (for painted or uncoated B or Inv. B deck);
(4) ASTM A653 SS grade 40 (for galvanized B, BV, Inv. B, N, NV, LF2X, LF3X, or LS deck);
(5) ASTM A653 SS grade 33 or grade 40 (for galvanized HPD deck).

VENTING – (if required – V at end of product name indicates availability.)
Deck shall be galvanized and provide a minimum venting area of XX percent based on the projected horizontal area. (Maximum area available for NV is 0.5%, all others are 1.5%. Venting area requirements should be obtained from the concrete manufacturer.) The form deck section of the catalog includes load tables for both vented and non-vented form deck. With insulating fill it is acceptable to ignore the contribution of the fill. When BV or NV is used, use the load table in the roof deck section. However, insulating fill manufacturers have determined load capacities of various combinations of fill and deck both with and without foamed plastic insulations boards. Refer to the fill manufacturer's literature for more specific loading limitations. Some dripping and deck staining is to be expected at vents.

**2. Design**

The section properties of the steel form units shall be calculated in accordance with the AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
For Allowable Stress Design (ASD) of forms:
(1) Bending stress for UFS(V), UF1X(V), UFX(V), or UF2X(V) shall not exceed 36 ksi; or
(2) Bending stress for B (V), Inv. B, N(V), LF2X, LF3X, LS, or grade 40 HPD shall not exceed 24 ksi;
(3) Bending stress for grade 33 HPD shall not exceed 20 ksi;
(4) Deck used as a form for structural concrete slabs shall meet SDI construction loading criteria.

For LRFD:
(1) The steel yield stress for UFS(V), UF1X(V), UFX(V), or UF2X(V) is 60 ksi.
(2) Deck used as a form for structural concrete shall meet SDI construction loading criteria.
**Note:** Shoring impacts slab live load capacity.
See the form deck general information section.

**3. Tolerances**

The standard tolerance for deck sheet lengths is plus or minus 1/2". Base steel thickness tolerance is minus 5% as per SDI and AISI.

**4. Installation**

Steel Deck shall be erected and fastened in accordance with the project's specifications, the approved erection layouts, and the SDI Manual of Construction with Steel Deck. Place form deck sheets end to end and maintain alignment. **In order to form a working platform, immediately fasten sheets to the supports.** Place sheets with edges up and end lapped or butted at the ends over supports; nest side laps one-half corrugation. Minimum bearing on supports of deck ends shall be 1 1/2" unless otherwise shown.

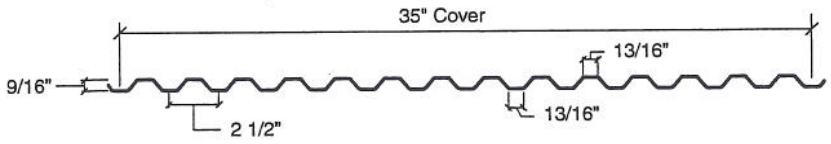
Welding washers are required for attaching deck lighter than 22 gage to structural steel (or joists). *Welding washers are not recommended for attaching deck that is 22 gage or heavier. Welding washers are never recommended for attaching side laps except at supports.* Welding washers, when required, shall be furnished by CMC Joist & Deck. For thicknesses 22 gage and greater, arc puddle welds shall be at least 5/8 inch in diameter, or elongated, having an equal perimeter. Support arc puddle welds shall be ¾ inch in diameter or elongated arc seam welds having equal perimeter when either the combined thickness at end laps exceeds 20/18 or the single thickness is equal to or greater than 12 gage. Side laps are to be fastened at a maximum spacing of 36" on center for spans greater than 5'0". Fasten side laps at 12" on center at cantilevers. *Welds or screws are acceptable for side lap connections, however welds are not recommended for thickness 22 gage and less.* HPD side laps are to be fastened at 24" on center with 1" minimum butt welds. All sheets from opened bundles must be fastened before the end of the working day; bundles must be left secured to prevent wind blowing the individual sheets.

**5. Site Storage**

*Steel deck delivery should be scheduled to arrive at the jobsite as required for erection.* If site storage is needed, the bundles of deck (either painted, uncoated, or galvanized) shall be stored off the ground with one end elevated to provide drainage, and shall be protected against condensation with a ventilated waterproof covering.

# SPECIFICATIONS

| UFS, UFSV - $F_y$ = 80 ksi | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Section Properties | | | | | | ASD | | | LRFD | | |
| Metal Thickness | | Wt. (psf) | $I_p$ (in⁴) | $S_p$ (in³) | $S_n$ (in³) | V (lbs) | $R_{be}$ (lbs) | $R_{bi}$ (lbs) | $\phi V$ (lbs) | $\phi R_{be}$ (lbs) | $\phi R_{bi}$ (lbs) |
| Gage | Inches | | | | | | | | | | |
| 28 | 0.0149 | 1.00 | 0.011 | 0.036 | 0.037 | 1320 | 670 | 800 | 2010 | 1020 | 1180 |
| 26 | 0.0179 | 1.00 | 0.014 | 0.045 | 0.047 | 1580 | 930 | 1140 | 2410 | 1430 | 1690 |
| 24 | 0.0239 | 1.00 | 0.019 | 0.063 | 0.063 | 2100 | 1570 | 1980 | 3190 | 2390 | 2950 |
| 22 | 0.0295 | 1.50 | 0.023 | 0.078 | 0.078 | 2580 | 2290 | 2960 | 3920 | 3500 | 4400 |
| 20 | 0.0358 | 2.00 | 0.028 | 0.094 | 0.094 | 3110 | 3240 | 4260 | 4730 | 4950 | 6340 |




UFS, UFSV

| UNIFORM TOTAL LOAD / Load that Produces L/180 Deflection, psf | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Gage | Span Condition | Span | | | | | | | | |
| | | | 2'0" | 2'6" | 3'0" | 3'6" | 4'0 | 4'6" | 5'0" | 5'6" | 6'0" |
| ASD | 28 | Single | 216 / 120 | 138 / 62 | 96 / 36 | 71 / 22 | 54 / 15 | 43 / 11 | 35 / 8 | 29 / 6 | 24 / 4 |
| | | Double | 217 / 290 | 140 / 148 | 98 / 86 | 72 / 54 | 55 / 36 | 44 / 25 | 35 / 19 | 29 / 14 | 25 / 11 |
| | | Triple | 269 / 227 | 174 / 116 | 122 / 67 | 90 / 42 | 69 / 28 | 54 / 20 | 44 / 15 | 37 / 11 | 31 / 8 |
| | 26 | Single | 270 / 153 | 173 / 78 | 120 / 45 | 88 / 29 | 67 / 19 | 53 / 13 | 43 / 10 | 36 / 7 | 30 / 6 |
| | | Double | 275 / 369 | 178 / 189 | 124 / 109 | 91 / 69 | 70 / 46 | 55 / 32 | 45 / 24 | 37 / 18 | 31 / 14 |
| | | Triple | 341 / 289 | 221 / 148 | 154 / 86 | 114 / 54 | 87 / 36 | 69 / 25 | 56 / 18 | 46 / 14 | 39 / 11 |
| | 24 | Single | 378 / 208 | 242 / 106 | 168 / 62 | 123 / 39 | 94 / 26 | 75 / 18 | 60 / 13 | 50 / 10 | 42 / 8 |
| | | Double | 369 / 501 | 238 / 256 | 166 / 148 | 122 / 93 | 94 / 63 | 74 / 44 | 60 / 32 | 50 / 24 | 42 / 19 |
| | | Triple | 456 / 392 | 296 / 201 | 207 / 116 | 152 / 73 | 117 / 49 | 93 / 34 | 75 / 25 | 62 / 19 | 52 / 15 |
| | 22 | Single | 468 / 252 | 300 / 129 | 208 / 75 | 153 / 47 | 117 / 31 | 92 / 22 | 75 / 16 | 62 / 12 | 52 / 9 |
| | | Double | 456 / 606 | 295 / 310 | 206 / 180 | 152 / 113 | 116 / 76 | 92 / 53 | 75 / 39 | 62 / 29 | 52 / 22 |
| | | Triple | 564 / 474 | 366 / 243 | 256 / 141 | 189 / 88 | 145 / 59 | 115 / 42 | 93 / 30 | 77 / 23 | 65 / 18 |
| | 20 | Single | 564 / 306 | 361 / 157 | 251 / 91 | 184 / 57 | 141 / 38 | 111 / 27 | 90 / 20 | 75 / 15 | 63 / 11 |
| | | Double | 550 / 738 | 355 / 378 | 248 / 219 | 183 / 138 | 140 / 92 | 111 / 65 | 90 / 47 | 74 / 35 | 62 / 27 |
| | | Triple | 680 / 577 | 441 / 296 | 308 / 171 | 227 / 108 | 175 / 72 | 138 / 51 | 112 / 37 | 93 / 28 | 78 / 21 |
| LRFD | 28 | Single | 342 / 120 | 219 / 62 | 152 / 36 | 112 / 22 | 85 / 15 | 68 / 11 | 55 / 8 | 45 / 6 | 38 / 4 |
| | | Double | 343 / 290 | 222 / 148 | 155 / 86 | 114 / 54 | 87 / 36 | 69 / 25 | 56 / 19 | 46 / 14 | 39 / 11 |
| | | Triple | 425 / 227 | 275 / 116 | 192 / 67 | 142 / 42 | 109 / 28 | 86 / 20 | 70 / 15 | 58 / 11 | 49 / 8 |
| | 26 | Single | 428 / 153 | 274 / 78 | 190 / 45 | 140 / 29 | 107 / 19 | 84 / 13 | 68 / 10 | 57 / 7 | 48 / 6 |
| | | Double | 435 / 369 | 281 / 189 | 196 / 109 | 145 / 69 | 111 / 46 | 88 / 32 | 71 / 24 | 59 / 18 | 49 / 14 |
| | | Triple | 538 / 289 | 349 / 148 | 244 / 86 | 180 / 54 | 138 / 36 | 109 / 25 | 89 / 18 | 73 / 14 | 62 / 11 |
| | 24 | Single | 599 / 208 | 383 / 106 | 266 / 62 | 195 / 39 | 150 / 26 | 118 / 18 | 96 / 13 | 79 / 10 | 67 / 8 |
| | | Double | 583 / 501 | 376 / 256 | 263 / 148 | 194 / 93 | 149 / 63 | 118 / 44 | 95 / 32 | 79 / 24 | 66 / 19 |
| | | Triple | 720 / 392 | 467 / 201 | 327 / 116 | 241 / 73 | 185 / 49 | 147 / 34 | 119 / 25 | 98 / 19 | 83 / 15 |
| | 22 | Single | 741 / 252 | 474 / 129 | 329 / 75 | 242 / 47 | 185 / 31 | 146 / 22 | 119 / 16 | 98 / 12 | 82 / 9 |
| | | Double | 721 / 606 | 466 / 310 | 325 / 180 | 240 / 113 | 184 / 76 | 146 / 53 | 118 / 39 | 98 / 29 | 82 / 22 |
| | | Triple | 891 / 474 | 578 / 243 | 405 / 141 | 299 / 88 | 229 / 59 | 182 / 42 | 147 / 30 | 122 / 23 | 102 / 18 |
| | 20 | Single | 893 / 306 | 572 / 157 | 397 / 91 | 292 / 57 | 223 / 38 | 176 / 27 | 143 / 20 | 118 / 15 | 99 / 11 |
| | | Double | 869 / 738 | 562 / 378 | 392 / 219 | 289 / 138 | 222 / 92 | 175 / 65 | 142 / 47 | 118 / 35 | 99 / 27 |
| | | Triple | 1074 / 577 | 697 / 296 | 487 / 171 | 360 / 108 | 276 / 72 | 219 / 51 | 177 / 37 | 147 / 28 | 123 / 21 |

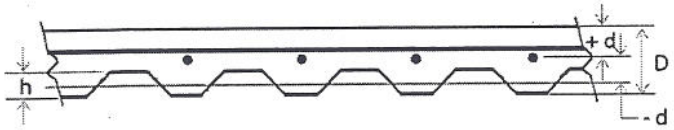
NOTES:
Vented deck with 1.5% maximum open area is available for use with insulating fills. It is acceptable to ignore the contribution of the insulating fill and use the load table above, however, insulating fill manufacturers have determined load capacities of various combinations of fill and deck both with and without foamed plastic insulation boards. Refer to the fill manufacturer's literature for more specific loading limitations.
$R_{be}$ is the bearing capacity at an **exterior** condition based on 1 1/2" of bearing. $R_{bi}$ is the bearing capacity at an **interior** condition based on 3" of bearing.

# UFS, UFSV

## Profile Considerations

Draped Mesh Slabs: Deck depth = h; Total Slab Depth = D; Wire diameter = w.

D = 2.5" to 3"
+ d = (D - h)/2
- d = (D - h)/2 + h/2 = D/2
TOP COVER = 0.75"

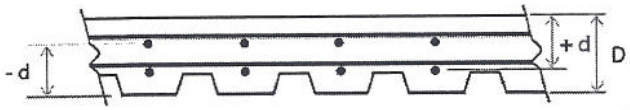



D > 3"
- d = (D - h/2 - 3w/2 - 0.75")
+ d = (D - h - w/2)
TOP COVER = 0.75"

(Mesh is draped, not layered.)

UFS, UF1X and UFX-36 have a b width of 12" for both positive and negative bending. For D < 3" place the mesh in the center of the concrete that is above the ribs. For D > 3", mesh is draped, not layered.

- d = (D - 0.75 - 3w/2)
+ d = (D - h - w/2)
TOP COVER = 0.75"

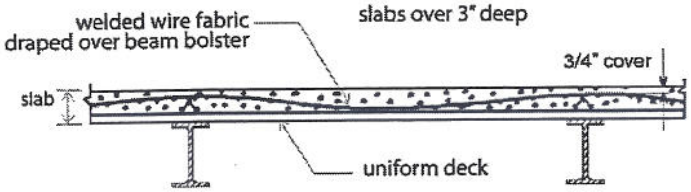



(Mesh is draped, not layered.)

Inverted B and UF2X have a b width of 12" for positive bending. For negative bending the b width for Inverted B deck is 7.5"; for UF2X the negative bending b width is 6". For D > 3" mesh is draped, not layered.

Minimum concrete cover is 1 1/2"

**DRAPED MESH**




## FORM DECK - weights and volumes

| Total Slab Depth | | UFS | UF1X | UFX | INV. B | UF2X | LF2X | LF3X |
|---|---|---|---|---|---|---|---|---|
| | | $C_v$ = .0234 | $C_v$ = .0417 | $C_v$ = .0547 | $C_v$ = .0781 | $C_v$ = .0833 | $C_v$ = .0833 | $C_v$ = .1250 |
| 2.5" | Wt | 27 | | | | | | |
| | Vol. | 0.185 | | | | | | |
| 3.0" | Wt | 33 | 30 | 28 | | | | |
| | Vol. | 0.226 | 0.208 | 0.195 | | | | |
| 3.5" | Wt | 39 | 36 | 34 | 36 | | | |
| | Vol. | 0.268 | 0.250 | 0.237 | 0.245 | | | |
| 4.0" | Wt | 45 | 42 | 40 | 41 | 36 | 36 | |
| | Vol. | 0.310 | 0.292 | 0.279 | 0.286 | 0.250 | 0.250 | |
| 4.5" | Wt | 51 | 48 | 46 | 48 | 42 | 42 | 36 |
| | Vol. | 0.352 | 0.333 | 0.320 | 0.328 | 0.292 | 0.292 | 0.250 |
| 5.0" | Wt | 57 | 54 | 52 | 54 | 48 | 48 | 42 |
| | Vol. | 0.393 | 0.375 | 0.362 | 0.370 | 0.333 | 0.333 | 0.292 |
| 5.5" | Wt | 63 | 60 | 59 | 60 | 54 | 54 | 48 |
| | Vol. | 0.435 | 0.417 | 0.404 | 0.411 | 0.375 | 0.375 | 0.333 |
| 6.0" | Wt | 69 | 66 | 65 | 66 | 60 | 60 | 54 |
| | Vol. | 0.476 | 0.458 | 0.445 | 0.453 | 0.417 | 0.417 | 0.375 |
| 6.5" | Wt | 75 | 73 | 71 | 72 | 67 | 67 | 60 |
| | Vol. | 0.518 | 0.500 | 0.487 | 0.495 | 0.458 | 0.458 | 0.417 |
| 7.0" | Wt | 81 | 79 | 77 | 78 | 73 | 73 | 66 |
| | Vol. | 0.560 | 0.542 | 0.528 | 0.536 | 0.500 | 0.500 | 0.458 |

The weights are shown in pounds per square foot and are based on 145 pcf concrete. Volumes are in $ft.^3$ per $ft.^2$. $C_v$ is the volume of concrete required to fill the ribs. Multiply the volume shown in the table by 144 to find the gross area of concrete in $in^2/ft$.



# SLAB DESIGN DATA

Note:
f'c = 3 ksi

## Concrete slabs on UFS form deck

| Slab | Mesh | +d | -d | +ϕM | -ϕM | ϕV | $I_{av}$ | UNIFORM UNFACTORED SERVICE LIVE LOADS, PSF Spans, feet 2'0" | 2'3" | 2'6" | 2'9" | 3'0" | 3'3" | 3'6" |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.5" | 6 x 6 - W1.4 x W1.4* | 0.969 | 1.250 | 1.423 | 1.848 | 1.633 | 0.319 | 289 | 228 | 185 | 153 | 128 | 109 | 94 |
| | 6 x 6 - W2.0 x W2.0* | 0.969 | 1.250 | 2.008 | 2.615 | 1.633 | 0.327 | ### | 323 | 262 | 216 | 182 | 155 | 133 |
| | 6 x 6 - W2.9 x W2.9 | 0.969 | 1.250 | 2.856 | 3.737 | 1.633 | 0.338 | ### | ### | 374 | 309 | 260 | 221 | 191 |
| 3.0" | 6 x 6 - W1.4 x W1.4* | 1.219 | 1.500 | 1.801 | 2.226 | 1.959 | 0.580 | 348 | 275 | 223 | 184 | 155 | 132 | 114 |
| | 6 x 6 - W2.0 x W2.0* | 1.219 | 1.500 | 2.548 | 3.155 | 1.959 | 0.592 | ### | 390 | 316 | 261 | 219 | 187 | 161 |
| | 6 x 6 - W2.9 x W2.9* | 1.219 | 1.500 | 3.639 | 4.520 | 1.959 | 0.609 | ### | ### | ### | 374 | 314 | 267 | 231 |
| 3.5" | 6 x 6 - W2.9 x W2.9* | 2.842 | 2.181 | 8.721 | 6.652 | 2.286 | 1.106 | ### | ### | ### | ### | ### | 394 | 339 |
| | 6 x 6 - W4.0 x W4.0 | 2.825 | 2.131 | 11.865 | 8.868 | 2.286 | 1.162 | ### | ### | ### | ### | ### | ### | ### |
| 4.0" | 6 x 6 - W2.9 x W2.9* | 3.342 | 2.681 | 10.287 | 8.218 | 2.613 | 1.694 | ### | ### | ### | ### | ### | ### | ### |
| | 6 x 6 - W4.0 x W4.0* | 3.325 | 2.631 | 14.025 | 11.028 | 2.613 | 1.780 | ### | ### | ### | ### | ### | ### | ### |

## Concrete slabs on UF1X form deck

| Slab | Mesh | +d | -d | +ϕM | -ϕM | ϕV | $I_{av}$ | UNIFORM UNFACTORED SERVICE LIVE LOADS, PSF Spans, feet 2'0" | 2'6" | 3'0" | 3'6" | 4'0" | 4'6" | 5'0" | 5'6" | 6'0" | 6'6" |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.0" | 6 x 6 - W2.0 x W2.0* | 1.000 | 1.500 | 2.075 | 3.155 | 1.972 | 0.467 | ### | 277 | 192 | 141 | 108 | 85 | 69 | 57 | 48 | |
| | 6 x 6 - W2.9 x W2.9 | 1.000 | 1.500 | 2.954 | 4.520 | 1.972 | 0.482 | ### | 394 | 274 | 201 | 154 | 122 | 98 | 81 | 68 | |
| 3.5" | 6 x 6 - W4.0 x W4.0 | 2.388 | 1.913 | 9.975 | 7.923 | 2.300 | 0.925 | ### | ### | ### | ### | 309 | 245 | 198 | 164 | 138 | 117 |
| | 4 x 4 - W2.9 x W2.9 | 2.404 | 1.962 | 10.893 | 8.817 | 2.300 | 0.946 | ### | ### | ### | ### | 344 | 272 | 220 | 182 | 153 | 130 |
| | 4 x 4 - W4.0 x W4.0 | 2.388 | 1.913 | 14.709 | 11.631 | 2.300 | 1.001 | ### | ### | ### | ### | ### | 359 | 291 | 240 | 202 | 172 |
| 4.0" | 6 x 6 - W4.0 x W4.0 | 2.888 | 2.413 | 12.135 | 10.083 | 2.629 | 1.467 | ### | ### | ### | ### | 394 | 311 | 252 | 208 | 175 | 149 |
| | 4 x 4 - W2.9 x W2.9 | 2.904 | 2.462 | 13.242 | 11.166 | 2.629 | 1.500 | ### | ### | ### | ### | ### | 345 | 279 | 231 | 194 | 165 |
| | 4 x 4 - W4.0 x W4.0 | 2.888 | 2.413 | 17.949 | 14.871 | 2.629 | 1.590 | ### | ### | ### | ### | ### | ### | 372 | 307 | 258 | 220 |
| 4.5" | 4 x 4 - W2.9 x W2.9 | 3.404 | 2.962 | 15.591 | 13.515 | 2.958 | 2.225 | ### | ### | ### | ### | ### | ### | 338 | 279 | 235 | 200 |
| | 4 x 4 - W4.0 x W4.0 | 3.388 | 2.913 | 21.189 | 18.111 | 2.958 | 2.362 | ### | ### | ### | ### | ### | ### | ### | 374 | 314 | 268 |
| 5.0" | 4 x 4 - W4.0 x W4.0 | 3.888 | 3.413 | 24.429 | 21.351 | 3.286 | 3.336 | ### | ### | ### | ### | ### | ### | ### | ### | 371 | 316 |
| 5.5" | 4 x 4 - W4.0 x W4.0 | 4.388 | 3.913 | 27.669 | 24.591 | 3.615 | 4.534 | ### | ### | ### | ### | ### | ### | ### | ### | ### | 364 |
| 6.0" | 4 x 4 - W4.0 x W4.0 | 4.888 | 4.413 | 30.909 | 27.831 | 3.944 | 5.977 | ### | ### | ### | ### | ### | ### | ### | ### | ### | ### |

## Concrete slabs on UFX-36 form deck

| Slab | Mesh | +d | -d | +ϕM | -ϕM | ϕV | $I_{av}$ | UNIFORM UNFACTORED SERVICE LIVE LOADS, PSF Spans, feet 3'6" | 4'0" | 4'6" | 5'0" | 5'6" | 6'0" | 6'6" | 7'0" | 7'6" | 8'0" |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.0" | 6 x 6 - W2.0 x W2.0* | 0.844 | 1.500 | 1.738 | 3.155 | 1.946 | 0.390 | 118 | 91 | 72 | 58 | 48 | 40 | | | | |
| | 6 x 6 - W2.9 x W2.9 | 0.844 | 1.500 | 2.465 | 4.520 | 1.946 | 0.405 | 168 | 128 | 101 | 82 | 68 | 57 | | | | |
| 3.5" | 6 x 6 - W4.0 x W4.0 | 2.075 | 1.756 | 8.625 | 7.248 | 2.271 | 0.776 | 370 | 283 | 224 | 181 | 150 | 126 | 107 | 92 | | |
| | 4 x 4 - W2.9 x W2.9 | 2.092 | 1.806 | 9.425 | 8.083 | 2.271 | 0.794 | ### | 316 | 249 | 202 | 167 | 140 | 120 | 103 | | |
| | 4 x 4 - W4.0 x W4.0 | 2.075 | 1.756 | 12.684 | 10.618 | 2.271 | 0.835 | ### | ### | 328 | 265 | 219 | 184 | 157 | 135 | | |
| 4.0" | 6 x 6 - W4.0 x W4.0 | 2.575 | 2.256 | 10.785 | 9.408 | 2.595 | 1.267 | ### | 368 | 290 | 235 | 194 | 163 | 139 | 120 | 105 | 92 |
| | 4 x 4 - W2.9 x W2.9 | 2.592 | 2.306 | 11.774 | 10.432 | 2.595 | 1.295 | ### | ### | 322 | 261 | 216 | 181 | 154 | 133 | 116 | 102 |
| | 4 x 4 - W4.0 x W4.0 | 2.575 | 2.256 | 15.924 | 13.858 | 2.595 | 1.368 | ### | ### | ### | 346 | 286 | 241 | 205 | 177 | 154 | 135 |
| 4.5" | 4 x 4 - W2.9 x W2.9 | 3.092 | 2.806 | 14.123 | 12.781 | 2.920 | 1.961 | ### | ### | 394 | 320 | 264 | 222 | 189 | 163 | 142 | 125 |
| | 4 x 4 - W4.0 x W4.0 | 3.075 | 2.756 | 19.164 | 17.098 | 2.920 | 2.077 | ### | ### | ### | ### | 353 | 297 | 253 | 218 | 190 | 167 |
| 5.0" | 4 x 4 - W4.0 x W4.0 | 3.575 | 3.256 | 22.404 | 20.338 | 3.244 | 2.982 | ### | ### | ### | ### | ### | 353 | 301 | 259 | 226 | 199 |
| 5.5" | 4 x 4 - W4.0 x W4.0 | 4.075 | 3.756 | 25.644 | 23.578 | 3.568 | 4.103 | ### | ### | ### | ### | ### | ### | 349 | 301 | 262 | 230 |
| 6.0" | 4 x 4 - W4.0 x W4.0 | 4.575 | 4.256 | 28.884 | 26.818 | 3.893 | 5.463 | ### | ### | ### | ### | ### | ### | 397 | 342 | 298 | 262 |

## Concrete slabs on UF2X form deck

| Slab | Mesh | +d | -d | +ϕM | -ϕM | ϕV | $I_{av}$ | UNIFORM UNFACTORED SERVICE LIVE LOADS, PSF Spans, feet 4'6" | 5'0" | 5'6" | 6'0" | 6'6" | 7'0" | 7'6" | 8'0" | 8'6" | 9'0" |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.0" | 6 x 6 - W2.0 x W2.0* | 1.919 | 3.007 | 4.060 | 6.326 | 2.629 | 1.365 | 167 | 135 | 112 | 94 | 80 | 69 | 60 | 53 | | |
| | 6 x 6 - W2.9 x W2.9 | 1.904 | 2.962 | 5.785 | 8.921 | 2.629 | 1.422 | 238 | 193 | 159 | 134 | 114 | 98 | 86 | 75 | | |
| 4.5" | 6 x 6 - W4.0 x W4.0 | 2.388 | 3.413 | 9.975 | 14.064 | 2.958 | 2.128 | ### | 333 | 275 | 231 | 197 | 170 | 148 | 130 | 115 | 103 |
| | 4 x 4 - W2.9 x W2.9 | 2.404 | 3.462 | 10.893 | 15.463 | 2.958 | 2.170 | ### | 363 | 300 | 252 | 215 | 185 | 161 | 142 | 126 | 112 |
| | 4 x 4 - W4.0 x W4.0 | 2.388 | 3.413 | 14.709 | 20.588 | 2.958 | 2.291 | ### | ### | ### | 340 | 290 | 250 | 218 | 192 | 170 | 151 |
| 5.0" | 6 x 6 - W4.0 x W4.0* | 2.888 | 3.913 | 12.135 | 16.224 | 3.286 | 2.943 | ### | ### | 334 | 281 | 239 | 206 | 180 | 158 | 140 | 125 |
| | 4 x 4 - W2.9 x W2.9 | 2.904 | 3.962 | 13.242 | 17.812 | 3.286 | 3.000 | ### | ### | 365 | 307 | 261 | 225 | 196 | 172 | 153 | 136 |
| | 4 x 4 - W4.0 x W4.0 | 2.888 | 3.913 | 17.949 | 23.828 | 3.286 | 3.171 | ### | ### | ### | ### | 352 | 304 | 265 | 233 | 206 | 184 |
| 5.5" | 4 x 4 - W2.9 x W2.9* | 3.404 | 4.462 | 15.591 | 20.161 | 3.615 | 4.020 | ### | ### | ### | 350 | 298 | 257 | 224 | 197 | 174 | 156 |
| | 4 x 4 - W4.0 x W4.0 | 3.388 | 4.413 | 21.189 | 27.068 | 3.615 | 4.253 | ### | ### | ### | ### | ### | 345 | 301 | 264 | 234 | 209 |
| 6.0" | 4 x 4 - W4.0 x W4.0 | 3.888 | 4.913 | 24.429 | 30.308 | 3.944 | 5.557 | ### | ### | ### | ### | ### | 387 | 337 | 296 | 262 | 234 |
| 6.5" | 4 x 4 - W4.0 x W4.0 | 4.388 | 5.413 | 27.669 | 33.548 | 4.272 | 7.103 | ### | ### | ### | ### | ### | ### | 373 | 328 | 290 | 259 |
| 7.0" | 4 x 4 - W4.0 x W4.0* | 4.888 | 5.913 | 30.909 | 36.788 | 4.601 | 8.914 | ### | ### | ### | ### | ### | ### | ### | 359 | 318 | 284 |

# SLAB TABLES

Note:
f'c = 3 ksi

## Concrete slabs on B-INV form deck

| Slab | Mesh | +d | -d | +ϕM | -ϕM | ϕV | $I_{av}$ | UNIFORM UNFACTORED SERVICE LIVE LOADS, PSF Spans, feet 4'0" | 4'6" | 5'0" | 5'6" | 6'0" | 6'6" | 7'0" | 7'6" | 8'0" | 8'6" |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.5" | 6 x 6 - W2.0 x W2.0* | 1.919 | 2.507 | 4.060 | 5.280 | 2.348 | 1.039 | 206 | 163 | 132 | 109 | 92 | 78 | 67 | | | |
| | 6 x 6 - W2.9 x W2.9* | 1.904 | 2.462 | 5.785 | 7.426 | 2.348 | 1.081 | 290 | 229 | 186 | 153 | 129 | 110 | 95 | | | |
| 4.0" | 6 x 6 - W4.0 x W4.0 | 2.388 | 2.913 | 9.975 | 12.040 | 2.739 | 1.700 | ### | 372 | 301 | 249 | 209 | 178 | 154 | 134 | 118 | |
| | 4 x 4 - W2.9 x W2.9 | 2.404 | 2.962 | 10.893 | 13.274 | 2.739 | 1.735 | ### | ### | 332 | 274 | 230 | 196 | 169 | 147 | 130 | |
| | 4 x 4 - W4.0 x W4.0 | 2.388 | 2.913 | 14.709 | 17.653 | 2.739 | 1.829 | ### | ### | ### | 365 | 306 | 261 | 225 | 196 | 172 | |
| 4.5" | 6 x 6 - W4.0 x W4.0* | 2.888 | 3.413 | 12.135 | 14.200 | 3.143 | 2.441 | ### | ### | 355 | 293 | 247 | 210 | 181 | 158 | 139 | 123 |
| | 4 x 4 - W2.9 x W2.9 | 2.904 | 3.462 | 13.242 | 15.623 | 3.143 | 2.488 | ### | ### | 391 | 323 | 271 | 231 | 199 | 174 | 153 | 135 |
| | 4 x 4 - W4.0 x W4.0 | 2.888 | 3.413 | 17.949 | 20.893 | 3.143 | 2.630 | ### | ### | ### | ### | 363 | 309 | 266 | 232 | 204 | 181 |
| 5.0" | 4 x 4 - W2.9 x W2.9* | 3.404 | 3.962 | 15.591 | 17.972 | 3.560 | 3.432 | ### | ### | ### | 371 | 312 | 266 | 229 | 200 | 176 | 155 |
| | 4 x 4 - W4.0 x W4.0 | 3.388 | 3.913 | 21.189 | 24.133 | 3.560 | 3.630 | ### | ### | ### | ### | ### | 357 | 308 | 268 | 236 | 209 |
| 5.5" | 4 x 4 - W4.0 x W4.0 | 3.888 | 4.413 | 24.429 | 27.373 | 3.992 | 4.850 | ### | ### | ### | ### | ### | ### | 349 | 304 | 267 | 237 |
| 6.0" | 4 x 4 - W4.0 x W4.0 | 4.388 | 4.913 | 27.669 | 30.613 | 4.437 | 6.311 | ### | ### | ### | ### | ### | ### | 390 | 340 | 299 | 265 |
| 6.5" | 4 x 4 - W4.0 x W4.0* | 4.888 | 5.413 | 30.909 | 33.853 | 4.895 | 8.033 | ### | ### | ### | ### | ### | ### | ### | 376 | 331 | 293 |

## Concrete slabs on LF2X form deck

| Slab | Mesh | +d | -d | +ϕM | -ϕM | ϕV | $I_{av}$ | UNIFORM UNFACTORED SERVICE LIVE LOADS, PSF Spans, feet 4'6" | 5'0" | 5'6" | 6'0" | 6'6" | 7'0" | 7'6" | 8'0" | 8'6" | 9'0" |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.0" | 6 x 6 - W2.0 x W2.0* | 1.919 | 3.007 | 4.060 | 6.326 | 2.300 | 1.365 | 167 | 135 | 112 | 94 | 80 | 69 | 60 | 53 | | |
| | 6 x 6 - W2.9 x W2.9* | 1.904 | 2.962 | 5.785 | 8.921 | 2.300 | 1.422 | 238 | 193 | 159 | 134 | 114 | 98 | 86 | 75 | | |
| 4.5" | 6 x 6 - W4.0 x W4.0 | 2.388 | 3.413 | 9.975 | 14.064 | 2.680 | 2.128 | ### | 333 | 275 | 231 | 197 | 170 | 148 | 130 | 115 | 103 |
| | 4 x 4 - W2.9 x W2.9 | 2.404 | 3.462 | 10.893 | 15.463 | 2.680 | 2.170 | ### | 363 | 300 | 252 | 215 | 185 | 161 | 142 | 126 | 112 |
| | 4 x 4 - W4.0 x W4.0 | 2.388 | 3.413 | 14.709 | 20.588 | 2.680 | 2.291 | ### | ### | ### | 340 | 290 | 250 | 218 | 192 | 170 | 151 |
| 5.0" | 6 x 6 - W4.0 x W4.0* | 2.888 | 3.913 | 12.135 | 16.224 | 3.081 | 2.943 | ### | ### | 334 | 281 | 239 | 206 | 180 | 158 | 140 | 125 |
| | 4 x 4 - W2.9 x W2.9 | 2.904 | 3.962 | 13.242 | 17.812 | 3.081 | 3.000 | ### | ### | 365 | 307 | 261 | 225 | 196 | 172 | 153 | 136 |
| | 4 x 4 - W4.0 x W4.0 | 2.888 | 3.913 | 17.949 | 23.828 | 3.081 | 3.171 | ### | ### | ### | ### | 352 | 304 | 265 | 233 | 206 | 184 |
| 5.5" | 4 x 4 - W2.9 x W2.9* | 3.404 | 4.462 | 15.591 | 20.161 | 3.502 | 4.020 | ### | ### | ### | 350 | 298 | 257 | 224 | 197 | 174 | 156 |
| | 4 x 4 - W4.0 x W4.0 | 3.388 | 4.413 | 21.189 | 27.068 | 3.502 | 4.253 | ### | ### | ### | ### | ### | 345 | 301 | 264 | 234 | 209 |
| 6.0" | 4 x 4 - W4.0 x W4.0 | 3.888 | 4.913 | 24.429 | 30.308 | 3.944 | 5.557 | ### | ### | ### | ### | ### | 387 | 337 | 296 | 262 | 234 |
| 6.5" | 4 x 4 - W4.0 x W4.0 | 4.388 | 5.413 | 27.669 | 33.548 | 4.406 | 7.103 | ### | ### | ### | ### | ### | ### | 373 | 328 | 290 | 259 |
| 7.0" | 4 x 4 - W4.0 x W4.0* | 4.888 | 5.913 | 30.909 | 36.788 | 4.888 | 8.914 | ### | ### | ### | ### | ### | ### | ### | 359 | 318 | 284 |

## Concrete slabs on LF3X form deck

| Slab | Mesh | +d | -d | +ϕM | -ϕM | ϕV | $I_{av}$ | UNIFORM UNFACTORED SERVICE LIVE LOADS, PSF Spans, feet 7'6" | 8'0" | 8'6" | 9'0" | 9'6" | 10'0" | 10'6" | 11'0" | 11'6" | 12'0" |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.0" | 6 x 6 - W4.0 x W4.0 | 1.888 | 3.913 | 7.815 | 16.224 | 2.739 | 2.827 | 116 | 102 | 90 | 80 | 72 | 65 | | | | |
| | 4 x 4 - W2.9 x W2.9 | 1.904 | 3.962 | 8.544 | 17.812 | 2.739 | 2.877 | 127 | 111 | 99 | 88 | 79 | 71 | | | | |
| | 4 x 4 - W4.0 x W4.0 | 1.888 | 3.913 | 11.469 | 23.828 | 2.739 | 3.023 | 170 | 149 | 132 | 118 | 106 | 96 | | | | |
| 5.5" | 4 x 4 - W2.9 x W2.9 | 2.404 | 4.462 | 10.893 | 20.161 | 3.088 | 3.829 | 161 | 142 | 126 | 112 | 101 | 91 | 82 | 75 | | |
| | 4 x 4 - W4.0 x W4.0 | 2.388 | 4.413 | 14.709 | 27.068 | 3.088 | 4.029 | 218 | 192 | 170 | 151 | 136 | 123 | 111 | 101 | | |
| 6.0" | 4 x 4 - W4.0 x W4.0 | 2.888 | 4.913 | 17.949 | 30.308 | 3.451 | 5.235 | 266 | 234 | 207 | 185 | 166 | 150 | 136 | 124 | 113 | 104 |
| 6.5" | 4 x 4 - W4.0 x W4.0 | 3.388 | 5.413 | 21.189 | 33.548 | 3.827 | 6.661 | 314 | 276 | 244 | 218 | 196 | 177 | 158 | 144 | 132 | 121 |
| 7.0" | 4 x 4 - W4.0 x W4.0 | 3.888 | 5.913 | 24.429 | 36.788 | 4.217 | 8.328 | 362 | 318 | 282 | 251 | 226 | 204 | 174 | 158 | 145 | 133 |
| 7.5" | 4 x 4 - W4.0 x W4.0* | 4.388 | 6.413 | 27.669 | 40.028 | 4.621 | 10.259 | ### | 360 | 319 | 285 | 255 | 231 | 189 | 172 | 158 | 145 |
| 8.0" | 4 x 4 - W4.0 x W4.0* | 4.888 | 6.913 | 30.909 | 43.268 | 5.039 | 12.473 | ### | ### | 357 | 318 | 285 | 258 | 204 | 186 | 170 | 156 |

Notes:

1. Refer to the maximum unshored span tables on page 84 to verify that the desired span is acceptable.
2. Tables are based on unshored conditions using galvanized deck. If shoring is required or if the deck is uncoated, refer to the design considerations section of the Form Deck General Information for additional requirements regarding load capacity. Tables provide middle of floor capacities. See the design tool on the CMC Joist & Deck website for perimeter and other options.
3. Tables are based on 145 pcf concrete and a 3 or more span condition.
4. Slab, +d, and -d are in inches.
5. +ϕM and -ϕM are in kip inches (per foot of width) and apply to NW and LW structural concrete.
6. * means $A_s$ does not meet ACI criterion. (.0018 $A_c$ for temperature steel) See reinforcement properties on page 85.
7. $I_{av}$ is the weighted average of the cracked and uncracked I in the positive and negative region and is based on the equation for $E_c$ in ACI-08 318. $[I_{av} = (I_c + I_{uc})/4 + (-I_c/2)]$ and is based on NW concrete.
8. ϕV is based on NW concrete. Multiply by 0.75 for LW concrete.
9. ### means the calculated live loads exceed the SDI maximum of 400 psf.
10. Blank cells indicate that the calculated live loads are less than 40 psf or the span-to-depth ratio exceeds 24.

## Maximum Span Table for Multispan Conditions

| | Slab Depth | CMC Joist & Deck Profile | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | UFS | | | | | UF1X | | | | UFX | | | | UF2X | | | |
| | | 28 | 26 | 24 | 22 | 20 | 26 | 24 | 22 | 20 | 26 | 24 | 22 | 20 | 24 | 22 | 20 | 18 |
| Normal Weight Concrete (145 pcf) | 2.50" | 3'0" | 3'8" | 4'9" | 5'1" | 5'5" | 5'1" | 6'9" | 7'8" | 8'3" | | | | | | | | |
| | 3.00" | 2'11" | 3'6" | 4'6" | 4'9" | 5'1" | 4'10" | 6'4" | 7'2" | 7'8" | 5'11" | 7'8" | 8'8" | 9'4" | | | | |
| | 3.50" | 2'10" | 3'4" | 4'3" | 4'6" | 4'10" | 4'7" | 6'0" | 6'9" | 7'3" | 5'7" | 7'3" | 8'2" | 8'9" | 9'9" | 11'3" | 11'7" | 13'0" |
| | 4.00" | 2'9" | 3'3" | 4'0" | 4'4" | 4'7" | 4'5" | 5'9" | 6'5" | 6'11" | 5'4" | 6'10" | 7'9" | 8'4" | 9'3" | 10'7" | 11'1" | 12'5" |
| | 4.50" | 2'8" | 3'1" | 3'11" | 4'2" | 4'5" | 4'3" | 5'6" | 6'2" | 6'8" | 5'1" | 6'6" | 7'5" | 8'0" | 8'9" | 10'1" | 10'6" | 12'0" |
| | 5.00" | 2'7" | 3'0" | 3'8" | 4'0" | 4'3" | 4'1" | 5'3" | 5'11" | 6'5" | 4'11" | 6'3" | 7'1" | 7'8" | 8'4" | 9'7" | 10'1" | 11'7" |
| | 5.50" | 2'6" | 2'11" | 3'7" | 3'10" | 4'1" | 3'11" | 5'1" | 5'9" | 6'2" | 4'9" | 6'0" | 6'10" | 7'5" | 8'0" | 9'2" | 9'9" | 11'4" |
| | 6.00" | 2'5" | 2'10" | 3'6" | 3'9" | 4'0" | 3'10" | 4'11" | 5'6" | 6'0" | 4'7" | 5'10" | 6'8" | 7'2" | 7'8" | 8'10" | 9'5" | 10'11" |
| | 6.50" | 2'5" | 2'9" | 3'5" | 3'8" | 3'11" | 3'9" | 4'9" | 5'4" | 5'10" | 4'5" | 5'8" | 6'5" | 7'0" | 7'4" | 8'6" | 9'1" | 10'8" |
| | 7.00" | 2'4" | 2'9" | 3'4" | 3'6" | 3'9" | 3'7" | 4'8" | 5'3" | 5'8" | 4'4" | 5'5" | 6'3" | 6'9" | 7'1" | 8'3" | 8'10" | 10'4" |
| Light Weight Concrete (115 pcf) | 2.50" | 3'2" | 3'10" | 5'0" | 5'6" | 5'10" | 5'4" | 7'2" | 8'3" | 8'10" | | | | | | | | |
| | 3.00" | 3'1" | 3'8" | 4'9" | 5'2" | 5'6" | 5'1" | 6'9" | 7'8" | 8'3" | 6'3" | 8'2" | 9'4" | 10'0" | | | | |
| | 3.50" | 3'0" | 3'6" | 4'7" | 4'10" | 5'2" | 4'10" | 6'5" | 7'3" | 7'10" | 5'11" | 7'9" | 8'9" | 9'5" | 10'6" | 11'11" | 12'3" | 13'8" |
| | 4.00" | 2'10" | 3'5" | 4'4" | 4'8" | 4'11" | 4'8" | 6'2" | 6'11" | 7'5" | 5'8" | 7'4" | 8'4" | 9'0" | 9'11" | 11'5" | 11'9" | 13'1" |
| | 4.50" | 2'9" | 3'4" | 4'2" | 4'5" | 4'9" | 4'6" | 5'11" | 6'7" | 7'2" | 5'6" | 7'1" | 7'11" | 8'7" | 9'6" | 10'10" | 11'4" | 12'8" |
| | 5.00" | 2'9" | 3'3" | 4'0" | 4'4" | 4'7" | 4'4" | 5'8" | 6'4" | 6'10" | 5'3" | 6'9" | 7'8" | 8'3" | 9'1" | 10'5" | 10'10" | 12'3" |
| | 5.50" | 2'8" | 3'2" | 3'11" | 4'2" | 4'5" | 4'3" | 5'6" | 6'2" | 6'8" | 5'1" | 6'6" | 7'5" | 8'0" | 8'8" | 10'0" | 10'6" | 11'11" |
| | 6.00" | 2'7" | 3'1" | 3'9" | 4'0" | 4'4" | 4'1" | 5'4" | 6'0" | 6'5" | 4'11" | 6'4" | 7'2" | 7'9" | 8'4" | 9'7" | 10'1" | 11'8" |
| | 6.50" | 2'6" | 3'0" | 3'8" | 3'11" | 4'2" | 4'0" | 5'2" | 5'9" | 6'3" | 4'9" | 6'1" | 6'11" | 7'6" | 8'1" | 9'4" | 9'10" | 11'5" |
| | 7.00" | 2'6" | 2'11" | 3'7" | 3'10" | 4'1" | 3'11" | 5'0" | 5'8" | 6'1" | 4'8" | 5'11" | 6'9" | 7'4" | 7'10" | 9'0" | 9'6" | 11'1" |

Notes:

1. Spans are based on SDI construction loading and LRFD method.
2. Quick selection table uses the lesser of the 2 or 3 span condition and truncates all span lengths down to the nearest inch.
3. Blank cells indicate that the SDI 1 1/2" cover requirement is not met for the slab depth.
4. **Maximum unshored spans for LF2X and LF3X are the same as for the 2" and 3" Lok Floor. Refer to the maximum unshored span tables in the composite deck section.**
5. Minimize time between deck installation and concrete placement or plank heavy traffic areas, especially for 28 and 26 gage product.

## Form Deck Maximum Cantilevers

| | Slab Depth | CMC Joist & Deck Profile | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | UFS | | | | | UF1X | | | | UFX | | | | UF2X | | | |
| | | 28 | 26 | 24 | 22 | 20 | 26 | 24 | 22 | 20 | 26 | 24 | 22 | 20 | 24 | 22 | 20 | 18 |
| Normal Weight Concrete (145 pcf + 5 pcf for rebar) | 2.50" | 9" | 11" | 1'2" | 1'5" | 1'8" | 1'4" | 1'10" | 2'3" | 2'8" | | | | | | | | |
| | 3.00" | 8" | 10" | 1'1" | 1'4" | 1'7" | 1'3" | 1'9" | 2'2" | 2'7" | 1'6" | 2'1" | 2'7" | 3'2" | | | | |
| | 3.50" | 8" | 10" | 1'1" | 1'4" | 1'6" | 1'3" | 1'8" | 2'1" | 2'5" | 1'6" | 2'0" | 2'6" | 3'0" | 2'11" | 3'7" | 4'3" | 5'5" |
| | 4.00" | 8" | 10" | 1'1" | 1'3" | 1'6" | 1'2" | 1'7" | 2'0" | 2'4" | 1'5" | 1'11" | 2'4" | 2'10" | 2'9" | 3'4" | 4'0" | 5'2" |
| | 4.50" | 8" | 10" | 1'0" | 1'3" | 1'5" | 1'2" | 1'7" | 1'11" | 2'3" | 1'5" | 1'10" | 2'3" | 2'9" | 2'8" | 3'3" | 3'10" | 4'10" |
| | 5.00" | 8" | 9" | 1'0" | 1'2" | 1'5" | 1'2" | 1'6" | 1'10" | 2'2" | 1'4" | 1'10" | 2'2" | 2'8" | 2'6" | 3'1" | 3'8" | 4'8" |
| | 5.50" | 8" | 9" | 1'0" | 1'2" | 1'4" | 1'1" | 1'6" | 1'10" | 2'1" | 1'4" | 1'9" | 2'2" | 2'6" | 2'5" | 3'0" | 3'6" | 4'5" |
| | 6.00" | 7" | 9" | 1'0" | 1'2" | 1'4" | 1'1" | 1'6" | 1'9" | 2'1" | 1'4" | 1'9" | 2'1" | 2'6" | 2'4" | 2'10" | 3'5" | 4'4" |
| | 6.50" | 7" | 9" | 1'0" | 1'2" | 1'4" | 1'1" | 1'5" | 1'9" | 2'0" | 1'3" | 1'8" | 2'1" | 2'5" | 2'4" | 2'10" | 3'4" | 4'2" |
| | 7.00" | 7" | 9" | 11" | 1'1" | 1'4" | 1'1" | 1'5" | 1'9" | 2'0" | 1'3" | 1'8" | 2'0" | 2'5" | 2'3" | 2'9" | 3'3" | 4'1" |

Notes:

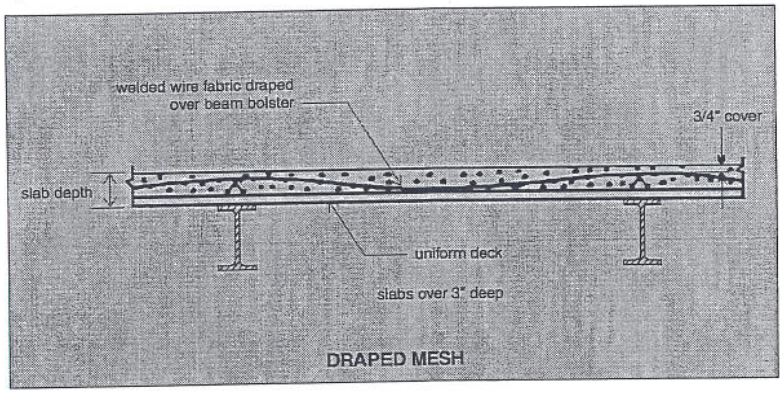
1. This table is based on 145 pcf concrete with an additional 5 pcf to account for a significant amount of rebar at the cantilever.
2. Table uses the SDI single span loading combinations and loading including a concentrated load at the end.
3. Table is LRFD based. Factored resistance values are shown in the slab load tables.
4. Cantilever deflection limits are: cantilever/90 and 3/4 inch.
5. Web crippling considers 3 inch bearing for UFS, UF1X, and UFX and 5 inch bearing of UF2X. It also considers a backspan of two times the cantilever. SDI concentrated load is located over the beam.
6. Blank cells indicate that the SDI 1 1/2" cover requirement is not met for the slab depth.
7. **Maximum cantilevers for LF2X and LF3X are the same as for the 2" and 3" Lok Floor. Refer to the maximum cantilever table in the composite deck section. When Inverted B deck is used as a form, use the cantilever tables for B-LOK on page 60.**
8. **Fasten side laps at 12" on center maximum at the catilever. Deck must be fastened at back spans before any construction loading is applied.**

# FORM DECK MAX SPANS AND CANTILEVERS

## Reinforcement Properties

| Welded Wire Fabric used in this manual** | | | | | |
|---|---|---|---|---|---|
| Conventional (USA) | Metric (International) | Wire Area ($A_s$) | | Wire Diameter | |
| | | in²/ft | mm²/m | inches | mm |
| 6 x 6 - W1.4 x W1.4 | 152 x 152 - MW9.1 x MW9.1 | 0.028 | 59.3 | 0.134 | 3.39 |
| 6 x 6 - W2.0 x W2.0 | 152 x 152 - MW12.9 x MW12.9 | 0.040 | 84.7 | 0.160 | 4.05 |
| 6 x 6 - W2.9 x W2.9 | 152 x 152 - MW18.7 x MW18.7 | 0.058 | 122.8 | 0.192 | 4.88 |
| 6 x 6 - W4.0 x W4.0 | 152 x 152 - MW25.8 x MW25.8 | 0.080 | 169.4 | 0.226 | 5.73 |
| 4 x 4 - W1.4 x W1.4 | 102 x 102 - MW9.1 x MW9.1 | 0.042 | 88.9 | 0.134 | 3.39 |
| 4 x 4 - W2.0 x W2.0 | 102 x 102 - MW12.9 x MW12.9 | 0.060 | 127.0 | 0.160 | 4.05 |
| 4 x 4 - W2.9 x W2.9 | 102 x 102 - MW18.7 x MW18.7 | 0.087 | 184.2 | 0.192 | 4.88 |
| 4 x 4 - W4.0 x W4.0 | 102 x 102 - MW25.8 x MW25.8 | 0.120 | 254.0 | 0.226 | 5.73 |

** Values taken from the Wire Reinforcement Institute Standard.




| REBAR - Area of steel per foot of width | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bar No. | Dia. | Wt. (plf) | Spacing, inches | | | | |
| | | | 4 | 6 | 8 | 10 | 12 |
| 3 | 3/8" | 0.38 | .33 | .22 | .17 | .13 | .11 |
| 4 | 1/2" | 0.67 | .60 | .40 | .30 | .24 | .20 |
| 5 | 5/8" | 1.04 | .93 | .62 | .47 | .37 | .31 |
| 6 | 3/4" | 1.50 | 1.32 | .88 | .66 | .53 | .44 |
| 7 | 7/8" | 2.04 | 1.80 | 1.20 | .90 | .72 | .60 |
| 8 | 1" | 2.67 | 2.37 | 1.58 | 1.19 | .95 | .79 |
| 9 | 1 1/8" | 3.40 | 3.00 | 2.00 | 1.50 | 1.20 | 1.00 |

## ACI Coefficients

| | | THREE OR MORE SPANS | | | | | | TWO SPANS | | | | ONE SPAN | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ACI Coefficients | | | | | | | | | | | | | |
| moment wl² | + M | 0.091 | | 0.063 | | 0.063 | | 0.091 | | 0.091 | | 0.125 | |
| | - M | | 0.10 | | 0.091 | | 0.091 | | 0.111 | | | | |
| | | - M: SPANS 10' OR LESS | | | | | | | | | | | |
| | + M | | 0.083 | | 0.083 | | 0.083 | | 0.083 | | | | |
| shear wl | V | 0.5 | 0.58 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.58 | 0.58 | 0.5 | 0.5 | 0.5 |

Notes:

1. These coefficients should not be used where (a) the larger of two adjacent spans exceed the shorter by more than 20 percent; (b) slabs are not uniformly loaded; (c) the unit live load exceeds three times the unit dead load.
2. The values to be used for clear span length (l) in determining negative moments should be the average of the two adjacent clear spans.
3. For positive moments and for shears, the clear span of the particular span should be used.
4. Most codes permit different coefficients for the negative moment for spans equal to or less than 10 feet.



# SLAB AND REINFORCEMENT DATA

RESTRAINED ASSEMBLY RATINGS (HOURLY)

| | U.L Design No | Concrete Cover and Type | CMC Joist & Deck Product |
|---|---|---|---|
| 1 | D780 | 2 1/2" NW,LW | UFS,UFX |
| | D903 | 3" NW, 2 3/4" LW | H6, H7.5, J, LS4.5, LS6, LS7.5 fluted; HC6, HC7.5, JC cellular |
| | G205 | 2 1/2" NW | UFS, UF1X, UFX |
| | G208 | 2" NW | UFS, UF1X, UFX |
| | G255 | 2 1/2" NW | UFS |
| | G256 | 2 1/2" NW | UFS, UF1X, UFX |
| | G262 | 2 1/2" NW | UFS, UF1X, UFX (24 ga. min.) |
| | G264 | 2 1/2" NW | UFS, UF1X, UFX |
| | G501 | 2" NW | UFS |
| | G531 | 2 3/16" NW | UFX (24 ga. min.) |
| | G534 | 1 1/2" LW | UFS |
| | G540 | 2" NW, LW | UFS, UF1X, UFX |
| | G542 | 2" NW, LW | UFS, UF1X, UFX |
| | G543 | 2" NW, LW | UFS, UF1X, UFX |
| | G546 | 2" NW, LW | UFS, UF1X, UFX |
| | G548 | 2 1/2" NW | UF1X (22 ga. min.) |
| | G701 | 2 1/2" NW, LW | UFS |
| | G703 | 3 1/8" NW, 2 3/8" LW | UFX |
| | G705 | 2 1/2" NW, LW | UFS |
| | G707 | 3 1/8" NW, 2 3/8" LW | UFX |
| | G708 | 2 1/2" NW, LW | UFS |
| | G709 | 2 1/2" NW, LW | UFS |
| | G710 | 2 1/2" NW, LW | UFS |
| | G801 | 2 1/2" NW, LW | UFS |
| | G805 | 3 1/8" NW, 2 3/8" LW | UFX |
| 1 1/2 | D780 | 2 1/2" NW,LW | UFS,UFX |
| | D903 | 3 1/2" NW, 3" LW | H6, H7.5, J, LS4.5, LS6, LS7.5 fluted; HC6, HC7.5, JC cellular |
| | G203 | 2" NW | UFS |
| | G204 | 2 1/2" NW | UFS |
| | G205 | 2 1/2" NW | UFS, UF1X, UFX |
| | G208 | 2" NW | UFS, UF1X, UFX |
| | G211 | 2 1/2" NW | UFS, UFX (24 ga. min) |
| | G213 | 3" NW | UFS, B |
| | G228 | 2 1/2" NW | UFS |
| | G229 | 2" NW | UFS |
| | G231 | 2 1/2" NW | UFS |
| | G236 | 2 1/2" NW | UFS |
| | G243 | 2" NW | UFS |
| | G244 | 3" NW | UFS |
| | G262 | 2 1/2" NW | UFS, UF1X, UFX (24 ga. min.) |
| | G264 | 2 1/2" NW | UFS, UF1X, UFX |
| | G267 | 2 1/2" NW | UFS, UF1X, UFX (24 ga. min.) |
| | G268 | 2 1/2" NW | UFS |
| | G502 | 2" NW | UFS |
| | G508 | 2" NW | UFS |
| | G509 | 2" NW | UFS |
| | G530 | 2 1/2" NW, LW | UF1X (24 ga. min.) |
| | G531 | 2 3/16" NW | UFX (24 ga. min.) |
| | G701 | 2 1/2" NW, LW | UFS |
| | G703 | 3 7/8" NW, 2 7/8" LW | UFX |
| | G705 | 2 1/2" NW, LW | UFS |
| | G707 | 3 7/8" NW, 2 7/8" LW | UFX |
| | G708 | 2 1/2" NW, LW | UFS |
| | G709 | 2 1/2" NW, LW | UFS |
| | G801 | 2 1/2" NW, LW | UFS |
| | G805 | 3 7/8" NW, 2 7/8" LW | UFX |
| 2 | D780 | 2 1/2" NW, LW | UFS,UFX |
| | D903 | 4 1/4" NW, 3 1/2" LW | H6, H7.5, J, LS4.5, LS6, LS7.5 fluted; HC6, HC7.5, JC cellular |
| | G008 | 2 1/2" NW | UFS |
| | G023 | 2 1/4" NW | UFS |
| | G028 | 2 1/2" NW | UFS |
| | G031 | 2 1/2" NW | UFS, UF1X, UFX |
| | G036 | 2 1/2" NW | UFS |
| | G203 | 2 1/2" NW | UFS |
| | G204 | 2 1/2" NW | UFS |
| | G205 | 2 1/2" NW | UFS, UF1X, UFX |
| | G208 | 2 1/2" NW | UFS, UF1X, UFX |
| | G209 | 3" NW | UFS |
| | G211 | 2 1/2" NW | UFS, UFX (24 ga. min.) |
| | G213 | 3" NW | UFS, B |
| | G227 | 2 1/2" NW | UFS |
| | G228 | 2 1/2" NW | UFS |
| | G229 | 2 1/2" NW | UFS |
| | G231 | 2 1/2" NW | UFS |
| | G236 | 2 1/2" NW | UFS |
| | G243 | 2 1/2" NW | UFS |
| | G244 | 3" NW | UFS |
| | G250 | 2 1/2" NW | UFS |
| | G255 | 2 1/2" NW | UFS |
| | G256 | 2 1/2" NW | UFS, UF1X, UFX |
| | G258 | 2 1/2" NW | UF1X, UFX |
| | G268 | 2 1/2" NW | UFS |

RESTRAINED ASSEMBLY RATINGS (HOURLY)

| | U.L Design No | Concrete Cover and Type | CMC Joist & Deck Product |
|---|---|---|---|
| 2 cont'd | G503 | 2 1/2" NW | UFS |
| | G504 | 2 1/2" NW | UFS |
| | G505 | 2" NW | UFS |
| | G510 | 2 1/2" NW | UFS |
| | G515 | 2 3/4" NW | UFS |
| | G521 | 2 1/2" NW | UFS |
| | G523 | 2 1/2" NW | UFS, BL |
| | G529 | 2 1/2" NW, LW | UFS, BL |
| | G530 | 2 1/2" NW, LW | UF1X (24 ga. min.) |
| | G531 | 2 3/16" NW | UFX (24 ga. min.) |
| | G531 | 2 1/2" LW | UFS |
| | G533 | 2" LW | UFS |
| | G538 | 2 1/2" NW | UFS |
| | G540 | 2" NW, LW | UFS, UF1X, UFX |
| | G542 | 2" NW, LW | UFS, UF1X, UFX |
| | G545 | 2" NW, LW | UFS, UF1X, UFX |
| | G546 | 2" NW, LW | UFS, UF1X, UFX |
| | G547 | 2 1/2" NW | UFS, B, UF2X,LF2X, LF3X fluted or cellular |
| | G554 | 2 7/16" NW, LW | UFX (24 ga. min.) |
| | G701 | 2 1/2" NW, LW | UFS |
| | G703 | 4 5/8" NW, 3 3/8" LW | UFX |
| | G705 | 2 1/2" NW, LW | UFS |
| | G707 | 4 5/8" NW, 3 3/8" LW | UFX |
| | G708 | 2 1/2" NW, LW | UFS |
| | G709 | 2 1/2" NW, LW | UFS |
| | G710 | 2 1/2" NW, LW | UFS |
| | G801 | 2 1/2" NW, LW | UFS |
| | G805 | 4 5/8" NW, 3 3/8" LW | UFX |
| 3 | D753 | 2 3/4" NW, LW | UFS, UF1X, UFX |
| | D776 | 2 3/4" NW, LW | UFS, UF1X, UFX |
| | D780 | 2 1/2" NW, LW | UFS,UFX |
| | D863 | 2 3/4" NW, LW | UFS, UF1X, UFX |
| | D903 | 4" LW | H6, H7.5, J, LS4.5, LS6, LS7.5 fluted; |
| | G033 | 3 1/2" NW | UFS, UF1X, UFX |
| | G036 | 3 1/4" NW | UFS |
| | G205 | 3" NW | UFS, UF1X, UFX |
| | G211 | 3" NW | UFX (24 ga. min.) |
| | G213 | 3 1/2" NW | UFS, B |
| | G229 | 3 1/4" NW | UFS |
| | G256 | 3 1/2" NW | UFS, UF1X, UFX |
| | G268 | 2 5/8" NW | UFS |
| | G512 | 2 1/2" NW | UFS |
| | G523 | 3" NW | BL |
| | G529 | 2 3/4" NW | UFS, BL |
| | G547 | 3" NW | B, UF2X; LF2X, LF3X fluted or cellular |
| | G701 | 2 3/4" NW, LW | UFS |
| | G703 | 2 3/8" NW | UF2X, B, LF2X, LF3X (22 ga. min.) |
| | G705 | 2 3/4" NW, LW | UFS |
| | G707 | 2 3/8" NW | UF2X, B, LF2X, LF3X (22 ga. min.) |
| | G708 | 2 3/4" NW, LW | UFS |
| | G709 | 2 3/4" NW, LW | UFS |
| | G710 | 2 3/4" NW, LW | UFS |
| | G801 | 2 3/4" NW, LW | UFS |
| | G805 | 2 3/8" NW | UF2X, B, LF2X, LF3X (22 ga. min.) |
| 4 | G401 | 2 1/2" NW | UFS |

The table shows constructions that are normally used for floors. For roofs see U.L. Pxxx and page 23 of this manual. For composite floors see U.L. Dxxx and page 63 of this manual. In general, heavier and deeper form members may be used without compromising the fire rating; however, concrete cover must remain and any beam and joist spacing restrictions still apply. **In all cases the U.L. Fire Resistance Directory should be consulted for concrete densities, fastening requirements, and all details of construction.** Some ratings have the concrete cover vary with the span - particularly the 700 numbers. This table was prepared using the 2007 U.L. Fire Resistance Directory.

| FIRE PROTECTION CODE | |
|---|---|
| U.L. # | |
| 000-099 | Concealed Grid |
| 200-299 | Exposed Grid |
| 400-499 | Suspended Plaster |
| 500-599 | Suspended Gypsum Board |
| 700-799 | Spray Applied Fire Resistive Material |
| 800-899 | |

# FIRE RATINGS

## ANSI/SDI-NC1.0 Standard for Non-Composite Steel Floor Deck

# 1. General

### 1.1 Scope:

A. This Specification for Non-Composite Steel Floor Deck shall govern the materials, design, and erection of cold formed non-composite steel deck used as a form for reinforced concrete slabs.

***Commentary:*** In the past, most of the steel decking used in the manner this specification covers was referred to as "centering," however, various roof deck units have successfully been used as non-composite forms. This specification is intended to also include these applications.

B. Commentary shall not be considered part of the mandatory document.

### 1.2 Reference Codes, Standards and Documents:

A. Codes and Standards: For purposes of this standard, comply with applicable provisions of the following Codes and Standards:

1. American Iron and Steel Institute (AISI) Standard - *North American Specification for the Design of Cold-Formed Steel Structural Members,* 2001 Edition with Supplement 2004
2. American Welding Society - ANSI/AWS D1.3 Structural Welding Code/Sheet Steel - 98 Structural Welding Code - Sheet Steel
3. American Society for Testing and Materials (ASTM) A653 (A653M)-06, A924 (A924M)-06, A1008 (A1008M)-06
4. American Society of Civil Engineering (ASCE) -SEI/ASCE7-05
5. American Concrete Institute (ACI) Building Code Requirements for Reinforced Concrete – ACI 318-05
6. Underwriters Laboratories (UL) Fire Resistance Directory - http://www.ul.com/database2006

B. Reference Documents: Refer to the following documents:

1. SDI White Paper - Designing with Steel Form Deck-2003
2. SDI Manual of Construction with Steel Deck - MOC2-2006
3. SDI Standard Practice Details - SPD2-2001
4. SDI Diaphragm Design Manual - DDMO3-2004

# 2. Products

### 2.1 Material:

A. Sheet steel for galvanized deck shall conform to ASTM A653 (A653M) Structural Quality, with a minimum yield strength of 33 ksi (230 MPa).

B. Sheet steel for uncoated deck shall conform to ASTM A1008 (A1008M) with a minimum yield strength of 33 ksi (230 MPa). Other structural sheet steels or high strength low alloy steels are acceptable, and shall be selected from the *North American Specification for the Design of Cold-Formed Steel Structural Members.*

***Commentary:*** Materials are offered in A653 (A653M) grade 80 steel (galvanized) or ASTM A1008 (A1008M) grade 80 steel (uncoated). This steel has a minimum yield strength of 80 ksi (550 MPa) and is generally over 90 ksi (620 MPa). The AISI specifications allow a maximum allowable stress of 36 ksi (250 MPa) for this material.

C. Sheet steel for accessories shall conform to ASTM A653 (A653M) Structural Quality for structural accessories, ASTM A653 (A653M) Commercial Quality for non-structural accessories, or ASTM A1008 (A1008M) for either structural or non-structural accessories. Other structural sheet steels or high strength low alloy steels are acceptable, and shall be selected from the *North American Specification for the Design of Cold-Formed Steel Structural Members.*

D. The deck type profile and thickness (gage) shall be as shown on the plans.

### 2.2 Tolerance:

A. Uncoated thickness shall not be less than 95% of the design thickness as listed in Table 2.2.1:

**Table 2.2.1**

| Gage No. | Design Thickness | | Minimum Thickness | |
|---|---|---|---|---|
| | in. | mm. | in. | mm. |
| 28 | 0.0149 | 0.38 | 0.014 | 0.35 |
| 26 | 0.0179 | 0.45 | 0.017 | 0.43 |
| 24 | 0.0238 | 0.60 | 0.023 | 0.57 |
| 22 | 0.0295 | 0.75 | 0.028 | 0.71 |
| 20 | 0.0358 | 0.91 | 0.034 | 0.86 |
| 18 | 0.0474 | 1.20 | 0.045 | 1.14 |
| 16 | 0.0598 | 1.52 | 0.057 | 1.44 |

B. Panel length shall be within plus or minus 1/2 inch (12 mm) of specified length.

C. Panel cover width shall be no greater than minus 3/8 inch (10 mm), plus 3/4 inch (20 mm).

D. Panel camber and/or sweep shall be no greater than 1/4 inch in 10 foot length (6 mm in 3 m).

E. Panel end out of square shall not be greater than 1/8 inch per foot of panel width (10 mm per m).

### 2.3 Finish:

A. Galvanizing shall conform to ASTM A924 (A924M) and/or ASTM A653 (A653M).

B. Uncoated (black) shall conform to ASTM A1008 (A1008M).

C. Painted with a shop coat of primer paint (one or both sides) shall be applied to steel sheet conforming to ASTM A1008 (A1008M).

D. The finish on the steel non-composite floor deck shall be suitable for the environment of the structure.

***Commentary:*** The uncoated finish is, by custom, referred to as "black" by some users and manufacturers; the use of the word "black" does not refer to paint color on the product. When galvanized material is used to support a reinforced concrete slab, the slab dead load is considered to be permanently carried by the deck. For any permanent load carrying function, a minimum galvanized coating conforming to ASTM A653 (A653M), G30 (Z090) is recommended.

### 2.4 Design:

A. Deck used as a form for structural (reinforced) concrete slab:

1. The section properties of the steel floor deck unit shall be computed in accordance with the *North American Specification for the Design of Cold-Formed Steel Structural Members.*

2. Allowable Stress Design (ASD): Bending stress shall not exceed 0.60 times the yield strength, nor exceed 36 ksi (250 MPa) under the combined loads of wet concrete, deck weight, and the following construction live loads: 20 pounds per square foot (1 kPa) uniform load or 150 pound concentrated load on a 1'-0" (300 mm) wide section of deck (2.2 kN per m). The interaction of shear and bending shall be considered in the calculations. (See Figure 1 - Attachment NC1)

3. Load and Resistance Factor Design (LRFD): The load combination for construction are as shown in Attachment NC1. Load factors shall be in accordance with ASCE 7. (See Section 1.2.A.5) The resistance factors and nominal resistances shall be in accordance with the *North American Specification for the Design of Cold-Formed Steel Structural Members.*

***Commentary:*** The loading shown in Figure 1, Attachment NC1 is representative of the sequential loading of wet concrete on the form. The 150 pound load (per foot of width) is the result of distributing a 300 pound man over a 2 foot (600 mm) width. Experience has shown this to be a conservative distribution. The metric equivalent of the 150 pound load is 2.2 kN per meter of width. For single span deck conditions, the ability to control the concrete placement may be restricted and a factor of 1.5 is applied to the concrete load to address this condition; however, in order to keep this 50% load increase within a reasonable limit, the increase is not to exceed 30 psf (1.44 kPa). Whenever possible, the deck shall be multi-span and not require shoring during the concrete placement procedure.

4. Deck Deflection: Calculated deflections of the deck shall be based on the load of the wet concrete, as determined by the design slab thickness and the weight of the steel deck, uniformly loaded on all spans, and shall be limited to 1/180 of the clear span or 3/4 inch (20 mm), whichever is smaller. Calculated deflections shall be relative to supporting members.

***Commentary:*** The deflection calculations do not take into account construction loads because these are considered temporary loads. The deck is designed to always be in the elastic range so removal of temporary loads should allow the deck to recover. The structural steel also deflects under the loading of the wet concrete.

The designer is urged to check the deflection of the total system, especially if composite beams and girders are being used. If the designer wants to include additional concrete loading on the deck because of frame deflection, the additional load should be shown on the design drawings or stated in the deck section of the job specifications.

## 2.4 Design:

5. Minimum Bearing: Minimum bearing lengths shall be determined in accordance with the web crippling provisions of the *North American Specification for the Design of Cold-Formed Steel Structural Members;* the uniform loading case of wet concrete, plus the weight of the steel deck, plus 20 psf (1 kPa) construction load shall be used.

***Commentary:*** Experience has shown that 1-1/2 inches (38 mm) of bearing is sufficient for non-composite floor decks. If less than 1-1/2 inches (38 mm) of end bearing is available, or if high support reactions are expected, the design professional should check the deck web crippling capacity. The deck must be adequately attached to the structure to prevent slip off.

6. Diaphragm Shear Capacity: Diaphragms without concrete shall be designed in accordance with the SDI *Diaphragm Design Manual,* or from tests conducted by an independent professional engineer.

***Commentary:*** Calculations of diaphragm strength and stiffness should be made using the SDI *Diaphragm Design Manual.* If testing is used as the means for determining the diaphragm strength and stiffness, then it should follow the AISI TS 7-02 test protocol.

B. Concrete Slab Design:
   1. General: The design of the concrete slabs shall be done in accordance with the ACI *Building Code Requirements for Reinforced Concrete.* The minimum concrete thickness above the top of the deck shall be 1-1/2 inches (38 mm). Randomly distributed fibers or fibrous admixtures shall not be substituted for welded wire fabric tensile reinforcement.

***Commentary:*** In following the ACI requirements for temperature reinforcement, the designer may eliminate the concrete area that is displaced by the deck ribs. For slabs with total depth of 3 inches (75 mm) or less, the reinforcing mesh may be considered to be at the center of the concrete above the deck. (Refer to the SDI *Designing with Steel Form Deck* for slab design information) If uncoated or painted deck is used as the form, the load from concrete slab weight must be deducted from the calculated capacity of the reinforced concrete slab. If galvanized form is used, the load from the slab weight is considered to be permanently carried by the deck and need not be deducted from the live load. If temporary shoring is used, the load of the slab must be deducted from the calculated capacity of the reinforced slab, regardless of the deck finish. Except for some diaphragm values, the deck should not be assumed to act compositely with the concrete even though strong chemical bonds can, and do, develop.

   2. Concrete: Concrete design shall be in accordance with the applicable sections of the ACI *Building Code Requirements for Reinforced Concrete.* Minimum compressive strength (f'c) shall be 3 ksi (20 MPa) or as required for fire ratings or durability. Admixtures containing chloride salts shall not be used.

***Commentary:*** The use of admixtures containing chloride salts is not allowed because the salts will corrode the steel non-composite floor deck.

   3. Cantilever Loads: When cantilevered slabs are encountered, top reinforcing steel shall be proportioned by the designer. For construction loads, the deck shall be designed for the more severe of (a) deck plus slab weight plus 20 psf (1kPa) construction load on both cantilever and adjacent span, or (b) deck plus slab weight on both cantilever and adjacent span plus a 150 pound (665N) concentrated load per foot of width at end of cantilever. The load factors shall be in accordance with ASCE7. Resistance factors for bending, shear, and interior bearing shall be by the *North American Specification for the Design of Cold-Formed Steel Structural Members.*

      The maximum cantilever deflection as a form, under deck plus slab weight, shall be a/90 where "a" is the clear cantilever length, and shall not exceed 3/4 inch (19 mm).

      Side laps shall be attached at the end of the cantilever and a maximum spacing of 12 inches (300 mm) on center from cantilever end. Each corrugation shall be fastened

at both the perimeter support and the first interior support. The deck shall be completely attached to the supports and at the side laps before any load is applied to the cantilever. Concrete shall not be placed on the cantilever until after placement on the adjacent span.

### 2.5 Accessories:

A. Pour stops, column closures, end closures, cover plates, and girder fillers shall be the type suitable for the application. Pour stop minimum gages shall be in accordance with the Steel Deck Institute. (See *Pour Stop Selection Table*, Attachment NC2)

B. Mechanical fasteners or welds shall be permitted for deck and accessory attachment.

## 3. Execution

### 3.1 Installation/General:

A. Support framing and field conditions shall be examined for compliance with requirements for installation tolerances and other conditions affecting performance of work of this section. All OSHA rules for erection shall be followed.

B. Deck panels shall be installed on a concrete support structure only after concrete has attained 75% of its specified design strength.

C. Deck panels and accessories shall be installed according to the SDI *Manual of Construction with Steel Deck*, placement plans, and requirements of this Section.

D. Temporary shoring, if required, shall be installed before placing deck panels. Temporary shoring shall be designed to resist a minimum uniform load of 50 psf (2.4 kPa), and loading indicated on Attachment NC1. Shoring shall be securely in place before the floor deck erection begins. The shoring shall be designed and installed in accordance with the ACI *Building Code Requirements for Reinforced Concrete*, and shall be left in place until the slab attains 75% of its specified design strength and a minimum of seven (7) days.

E. Deck panels shall be placed on structural supports and adjusted to final position with ends aligned, and attached securely to the supports immediately after placement in order to form a safe working platform. All deck sheets shall have adequate bearing and fastening to all supports to prevent slip off during construction. Deck ends over supports shall be installed with a minimum end bearing of 1-1/2 inches (38 mm). Deck areas subject to heavy or repeated traffic, concentrated loads, impact loads, wheel loads, etc. shall be adequately protected by planking or other approved means to avoid overloading and/or damage.

***Commentary:*** Staggering deck ends is not a recommended practice. The deck capacity as a form and the load capacity of a non-composite deck/slab system are not increased by staggering end joints, yet layout and erection costs are increased.

F. Lapped or Butted Ends: Deck ends shall be either lapped or butted over supports. Gaps up to 1 inch (25 mm) shall be permitted at butted ends.

G. Deck units and accessories shall be cut and neatly fit around openings and other work projecting through or adjacent to the decking.

***Commentary:*** It is the responsibility of the designer to designate holes/openings to be decked over in compliance with applicable federal and state OSHA directives. Care should be taken to analyze spans between supports at openings when determining those holes/openings to be decked over.

When a framed opening span exceeds the maximum deck span limits for construction loads, the opening must be detailed around instead of decked over. (Minimum construction load 50 lbs./sq. ft. (2.4 kPa), unless specific requirements dictate otherwise). When a framed hole/opening in floor deck is shown and dimensioned on the structural design drawings, pour stop (screed) angle is required to top of slab. When specified, cell closure angles will be provided at the open ends of deck 1-1/2 inches (38 mm) deep or deeper, in standard 10 feet (3 m) lengths to be field sized, cut and installed. Typically, non-composite floor decks that are less than 1-1/2 inches (38 mm) deep do not require or use cell closure. Alternate means to dam concrete may be used in lieu of cell closure, at the discretion of the installer, if approved by the project engineer.

### 3.1 Installation/General:

When a hole/opening is not shown and dimensioned on the structural design drawings, no provisions for concrete retainage will be provided by the metal deck manufacturer/ supplier. Metal floor decking holes and openings to be cut after the concrete pour shall not be field cut until concrete has reached 75% of its design strength and a minimum seven (7) days.

H. Trades that subsequently cut unscheduled openings through the deck shall be responsible for reinforcing these openings based upon an approved engineered design.

### 3.2 Installation/Anchorage:

A. Form deck units shall be anchored to steel supporting members including perimeter support steel and/or bearing walls by arc spot puddle welds of the following diameter and spacing, fillet welds of equal strength, or mechanical fasteners.

1. All welding of deck shall be in accordance with ANSI/AWS D1.3, *Structural Welding Code - Sheet Steel.* Each welder shall demonstrate an ability to produce satisfactory welds using a procedure such as shown in the SDI *Manual of Construction with Steel Deck,* or as described in ANSI/AWS D1.3.

2. Welding washers shall be used on all deck units with metal thickness less than 0.028 inches (0.7 mm). Welding washers shall be a minimum thickness of 0.0598 inches (16 gage, 1.50 mm) and have a nominal 3/8 inch (10 mm) diameter hole.

3. Where welding washers are not used, a minimum visible 5/8 inch (15 mm) diameter arc puddle weld shall be used. Weld metal shall penetrate all layers of deck material at end laps and shall have good fusion to the supporting members.

4. Weld spacing: Fastening pattern shall allow slabs to be designed on a continuous basis.

5. When used, fillet welds shall be at least 1-1/2 inch (38 mm) long.

6. Mechanical fasteners, either powder actuated, pneumatically driven, or screws, shall be permitted in lieu of welding to fasten deck to supporting framing if fasteners meet all project service requirements. When the fasteners are powder actuated or pneumatically driven, the load value per fastener used to determine the maximum fastener spacing shall be based on a minimum structural support thickness of not less than 1/8 inch (3 mm) and on the fastener providing a minimum 5/16 inch (8 mm) diameter bearing surface (fastener head size). When the structural support thickness is less than 1/8 inch (3 mm), powder actuated or pneumatically driven fasteners shall not be used, but screws are acceptable.

***Commentary:*** Mechanical fasteners (powder actuated, screws, pneumatically driven fasteners, etc.) are recognized as viable anchoring methods, provided the type and spacing of the fastener satisfies the design criteria. Documentation in the form of test data, design calculations, or design charts should be submitted by the fastener manufacturer as the basis for obtaining approval.

7. For deck units with spans greater than five feet (1.5 m), side laps and perimeter edges of units between span supports shall be fastened at intervals not exceeding 36 inches (1 m) on center, using one of the following methods:
   a. #10 self drilling screws.
   b. Crimp or button punch.
   c. Arc puddle welds 5/8 inch (15 mm) minimum visible diameter, or minimum 1 inch (25 mm) long fillet weld.

***Commentary:*** The above side lap spacing is a minimum. Service loads or diaphragm design may require closer spacing or larger side lap welds. Good metal to metal contact is necessary for a good side lap weld. Burn holes are to be expected.

B. Accessory Attachment:

1. Pour Stop and Girder Fillers: Pour stops and girder fillers shall be fastened to supporting structure in accordance with the SDI *Standard Practice Details, and Attachment NC2.*

2. Floor Deck Closures: Column closures, cell closures, and Z closures shall be fastened to provide tight fitting closures at open ends of ribs and sides of decking. Fasten cell closures at changes of direction of floor deck units unless otherwise directed.

***Commentary:*** Cell closures are generally not used on form deck of 1-5/16 inch (33 mm) depth or less.

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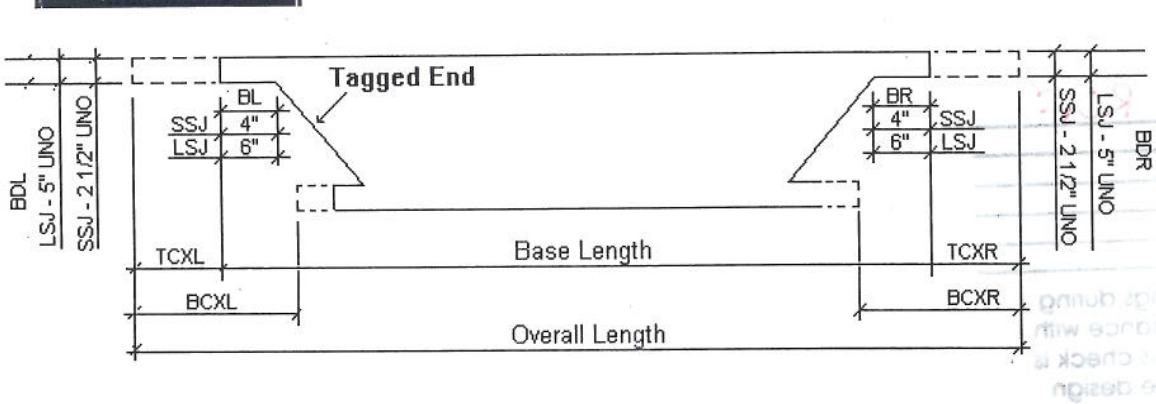


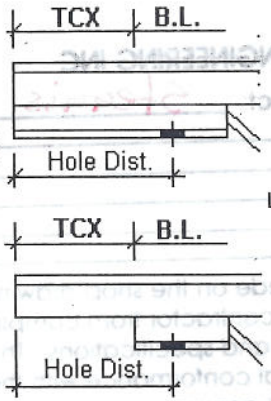


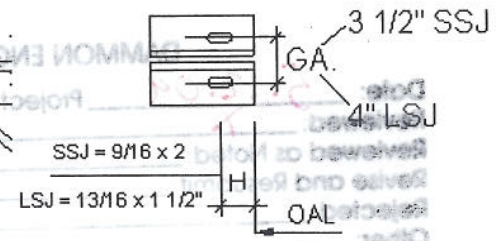


Short Span Joists: 178
Long Span Joists: 0
Girders: 0

## Joist Bill of Materials

| Mark | Qty | Joist Type | OAL (ft-in) | TCXL Length (ft-in) | TCXL Type | TCXR Length (ft-in) | TCXR Type | Base Length (ft-in) | Seat BDL (ft-in) | Seat BDR (ft-in) | BCXL Length (ft-in) | BCXL Type | BCXR Length (ft-in) | BCXR Type | Punch Seats HLE (ft-in) | Punch Seats HRE (ft-in) | Seat Ga(L) Ga(R) (ft-in) | Special | Reference Notes [Special] - (Loads) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| J1 | 2 | 14KS | 17'- 2 5/8" | | | | | 17'- 2 5/8" | 2 1/2" | 2 1/2" | | | | | | | | | |
| J2 | 94 | 14KS | 18'- 9 1/2" | 6" | R | | | 18'- 3 1/2" | 2 1/2" | 2 1/2" | | | | | | | | | |
| J3 | 10 | 14KS | 18'- 9 1/2" | 6" | R | | | 18'- 3 1/2" | 2 1/2" | 2 1/2" | | | | | | 1 1/4" | 3 1/2" | | [1] |
| J4 | 4 | 14KS | 18'- 3 1/8" | | | | | 18'- 3 1/8" | 2 1/2" | 2 1/2" | | | | | | 1 1/4" | 3 1/2" | | [1] |
| J5 | 5 | 14KS | 11'- 6 1/2" | 6" | R | | | 11'- 1/2" | 2 1/2" | 2 1/2" | | | | | | | | | |
| J6 | 2 | 14KS | 18'- 3 1/8" | | | | | 18'- 3 1/8" | 2 1/2" | 2 1/2" | | | | | | | | | |
| J7 | 2 | 14KS | 17'- 2" | | | | | 17'- 2" | 2 1/2" | 2 1/2" | | | | | | | | | |
| J8 | 2 | 14KS | 17'- 10 7/8" | | | | | 17'- 10 7/8" | 2 1/2" | 2 1/2" | | | | | | | | | |
| J9 | 47 | 14KS | 17'- 11 1/2" | | | | | 17'- 11 1/2" | 2 1/2" | 2 1/2" | | | | | | | | | |
| J10 | 6 | 14KS | 17'- 11 1/2" | | | | | 17'- 11 1/2" | 2 1/2" | 2 1/2" | | | | | 1 1/4" | 1 1/4" | 3 1/2" | | [1] |
| J11 | 1 | 14KS | 11'- 6 1/2" | 6" | R | | | 11'- 1/2" | 2 1/2" | 2 1/2" | | | | | | 1 1/4" | 3 1/2" | | [1] |
| J20 | 3 | 14KS | 18'- 9 1/2" | 6" | R | | | 18'- 3 1/2" | 2 1/2" | 2 1/2" | | | | | | | | | (1) |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 1 | Of: | 1 | Time: | Tue. 11:26 AM |

## BROADMOOR, L.L.C.

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

Robert Wilson 5.12.09

DQC Manager Date

QC Officer Date

**DAMMON ENGINEERING INC**

**Date:** 5.12.09 **Project:** Stennis ROF

**Reviewed:** X

**Reviewed as Noted:**

**Revise and Resubmit:**

**Rejected:**

**Other:**

**Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the** information given in the contract documents. This contractor is responsible for confirming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating his work with that of all other trades and performing all in a safe and satisfactory manner.

**Submittal Item:** Joists

**Comments**

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# Load Notes

| Load Note Number | Marks | Category | Chord | Type | Direction | Load1 (lbs, ft-lbs, plf, psf) | Dist1 (ft-in) | Load2 (lbs, ft-lbs, plf, psf) | Dist2 (ft-in) | Reference | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | J20 | DL | TC | Uni | GY | 100.0 | 5'- 0" | 100.0 | 13'- 7 1/2" | LOL | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 1 | Of: | 1 |

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Time: Tue. 11:26 AM

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# Shop Bill Notes

| Shopbill Note Number | Predefined Number | Joist Marks | Pre-Fab | Top Chord Cutout | Bottom Chord Cutout | Mid-Web Cutout | End Web Cutout | Rigging Table | Base Plates | Weld Plt | Paint | Deck | Recap Sheets | Inspect | Shop Bill Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [1] | 54 | J3 J4 J10 J11 | | | | | | | | | | | | X | Danger Tag Required |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 1 | Of: | 1 | Time: | Tue. 11:26 AM |

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# Design Notes

| Shopbill Note Number | Predefined Number | Joist Marks | Shop Bill Note |
|---|---|---|---|
| [1] | 54 | J3 J4 J10 J11 | Danger Tag Required |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
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# Bridging Groups

| Bridging Group Number | Master Mark | Minimum Total Rows | Minimum Rows X | X Clip Type | Reference Line | Slave Mark | Reference Offset (ft-in) | Panel Master | Fixed Location1 (ft-in) | Fixed Location2 (ft-in) | Fixed Location3 (ft-in) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | J1 | 2 | | | L | | | | | | |
| | | | | | L | J2 | | | | | |
| | | | | | L | J3 | | | | | |
| | | | | | L | J4 | | | | | |
| | | | | | L | J6 | | | | | |
| | | | | | L | J7 | | | | | |
| | | | | | L | J8 | | | | | |
| | | | | | L | J9 | | | | | |
| | | | | | L | J10 | | | | | |
| | | | | | L | J20 | | | | | |
| 2 | J5 | 1 | | | L | | | | | | |
| | | | | | L | J11 | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 |
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# Keypunch Parameters: Job-Level

### Units

U.S. SMI

### Minimum Crimp Depth

1'- 6"

### Minimum Material Size

| | Min Thick | Min Mat | Max Width |
|---|---|---|---|
| TC | | | |
| BC | | | |
| Brng. Seat | | | |
| Prim. Web | | | |
| Sec. Web | | | |
| Weight | | | |
| TC = BC? | No | | |

### Base Area Loads

| | Joists | Girders |
|---|---|---|
| DL | 50.0 | |
| CL | 5.0 | |
| LL | 100.0 | |
| SL | | |
| Gross Uplift | | |
| Wp | | |
| Spacing | 2'- 0" | |
| Self-Weight | No | No |
| LL Reduction | No | No |

### Seat Lengths

| | |
|---|---|
| Short Span | 4" |
| Long Span | 6" |
| Girder | 6" |

### Welds

SJI

### Top Chord Support

Yes

### Tag End

Left

### Girder Loads

| | |
|---|---|
| LL | |
| WL | |
| SL | |

### Deflection

| | Live | Total |
|---|---|---|
| Joist Span | 360.0 | 240.0 |
| Cantilever | 120.0 | 0.0 |
| TCX | 120.0 | 0.0 |

### Assign Same Name to Identical Bundles

No

### Joist Top Chord Holes

| | | |
|---|---|---|
| Size | n/a | |
| Spacing | n/a | K |
| Gauge | n/a | LH |
| Staggered | n/a | Girder |

### Hole Gauges

| | Seat Gauge | Slot Length | Slot Width |
|---|---|---|---|
| K | 3 1/2" | 2" | 9/16" |
| LH | 4" | 1 1/2" | 13/16" |
| Girder | 5" | 1 1/2" | 13/16" |

### Default Girder Hole Gauges

| Top Chord Angle Size | Half Gage |
|---|---|
| <= 2 1/2" | 2" |
| Between | 2 1/4" |
| >= 5" | 2 1/2" |

### Camber

Radius 3600'- 0"

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 1 | Of: | 1 | Time: | Tue. 11:26 AM |

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# Design Parameters: Job-Level

### Stress

| | |
|---|---|
| Stress Ratio | 1.01 |
| Yield Stress | 50.0 |
| Maximum Tensile Stress | 65.0 |
| Ultimate Tensile Stress | 65.0 |

### Standard Joist Bridging

| | |
|---|---|
| TC Standard | Yes |
| TC Optimized | No |
| BC Standard | Yes |
| BC Optimized | No |

### Design Constants

| | K | LH | Girder | KCS | H |
|---|---|---|---|---|---|
| Minimum Shear | 25.0 | 25.0 | 25.0 | 25.0 | 50.0 |
| Stress Reversal | 0.0 | 0.0 | 25.0 | 100.0 | 0.0 |
| Available Weld | 100.0 | 100.0 | 100.0 | 90.0 | 100.0 |
| Chord Shear | Yes | Yes | Yes | Yes | Yes |
| Chord Kx | 1.0 | 0.75 | 1.0 | 1.0 | 1.0 |
| TC End Panel Kx | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Chord Ky | 0.94 | 0.94 | 1.0 | 0.94 | 1.0 |
| Chord Kz | 1.0 | 0.75 | 1.0 | 1.0 | 1.0 |
| Web Kx | 1.0 | 0.75 | 1.0 | 1.0 | 1.0 |
| Web Ky | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| End Web Kx | 1.0 | 0.75 | 1.0 | 1.0 | 1.0 |
| First Web Kx | 1.0 | 1.2 | 1.2 | 1.0 | 1.0 |
| Web Kz | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| TC Bridge | 145.0 | 170.0 | 575.0 | 145.0 | 145.0 |
| TC Inter | 90.0 | 90.0 | 90.0 | 90.0 | 90.0 |
| TC End | 120.0 | 120.0 | 120.0 | 120.0 | 120.0 |
| Type Comp | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 |
| Type Tensile | 240.0 | 240.0 | 240.0 | 240.0 | 240.0 |
| TC Brace Force | 0.5 | 0.5 | 2.0 | 0.5 | 0.5 |
| TC Bend Panel | 2'- 0" | 0'- 0" | 0'- 0" | 2'- 0" | 2'- 0" |
| TC Bend | 550.0 | 0.0 | 0.0 | 550.0 | 550.0 |
| EP Reduction | 0.9 | 1.0 | 1.0 | 0.9 | 0.9 |

### Horizontal Seat Load

| | |
|---|---|
| Percentage Axial Load | 100.0 % |
| Load in KIPS | n/a |
| Percentage End Reaction | n/a |

### Chord Gap

| | |
|---|---|
| Angle Web | 1" |
| Rod Web | 1/2" |

### OSHA Column Joists

| | |
|---|---|
| Phi-Connect: NA | 0.0 |
| Phi-Connect: Zero BCXs | 1.0 |
| Phi-Connect: One BCX | 1.0 |
| Phi-Connect: Two BCXs | 1.0 |

### Design Codes

| | |
|---|---|
| Design Code Value | SJI |
| ASD-LRFD | ASD |

### Girder Horizontal Leg Bending

| | |
|---|---|
| Joist Reaction | 70.0 |
| Joist EOT | 1/4" |
| Joist Seat Width | 4 1/4" |

### Load Combination Building Codes

| | |
|---|---|
| Building Code | IBC2006 |
| ASD - LRFD | ASD |
| Roof - Floor | Roof |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 1 | Of: | 1 | Time: | Tue. 11:26 AM |

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# Design Loads

J1

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 17'- 2 5/8"

| Category | Chord | Type | Direction | Load1 (lbs, ft-lbs, plf, psf) | Distance1 (ft-in) | Load2 (lbs, ft-lbs, plf, psf) | Distance2 (ft-in) | Reference | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| CL | TC | Uni | GY | 10.0 | 2" | 10.0 | 17'- 5/8" | LOL | Standard load from designation |
| DL | TC | Uni | GY | 100.0 | 2" | 100.0 | 17'- 5/8" | LOL | Standard load from designation |
| LL | TC | Uni | PY | 200.0 | 2" | 200.0 | 17'- 5/8" | LOL | Standard load from designation |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 1 | Of: | 3 |

| | |
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# Design Load Combinations

J1

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 17'- 2 5/8"

| Load Combination | Stress Ratio | Top Chord Support | Deflection | Calculated Deflection | Camber | Multiplier - Category Formula | Remarks |
|---|---|---|---|---|---|---|---|
| 2 | 1.000 | Yes | TL | -0.55 | No | DL+LL+CL | Basecase - IBC2006, ASD, Roof |
| 29 | 1.000 | Yes | LL | -0.35 | No | LL | Deflection Case |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 2 | Of: | 3 | Time: | Tue. 11:26 AM |

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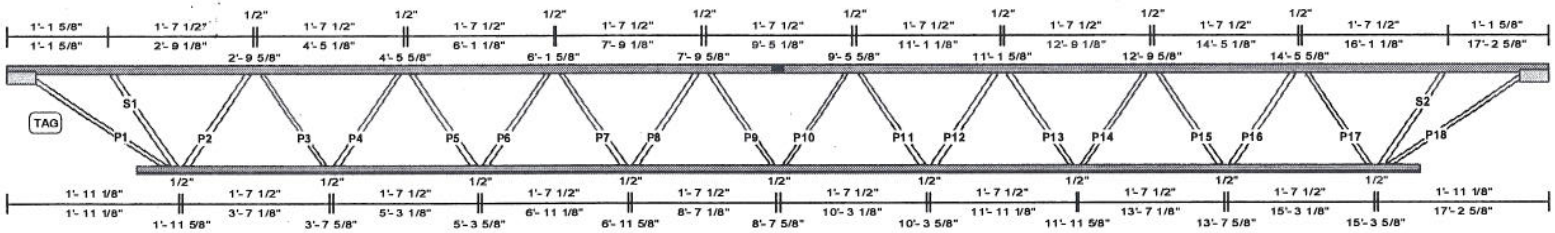
# Design Summary

J1




| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|
| Depth: 14.0 | | | | |
| Moment of Inertia: 41.19 | | | | |
| TC | 2 | L1-1/4X1-1/4X.109 | | 0.99 |
| BC | 2 | L1X1X.109 | | 0.79 |
| BPL | 2 | L1-1/2X1-1/2X.109 | | |
| BPR | 2 | L1-1/2X1-1/2X.109 | | |
| P1 | 1 | 1/2 RD | 2.3 | 0.87 |
| S1 | 1 | 9/16 RD | 0.2 | 0.14 |
| P2 | 1 | 9/16 RD | 1.1 | 0.78 |
| P3 | 1 | 9/16 RD | 0.8 | 0.25 |
| P4 | 1 | 9/16 RD | 0.8 | 0.56 |
| P5 | 1 | 1/2 RD | 0.6 | 0.21 |
| P6 | 1 | 1/2 RD | 0.6 | 0.60 |
| P7 | 1 | 1/2 RD | 0.4 | 0.13 |
| P8 | 1 | 1/2 RD | 0.4 | 0.38 |
| P9 | 1 | 1/2 RD | 0.4 | 0.13 |
| P10 | 1 | 1/2 RD | 0.4 | 0.13 |
| P11 | 1 | 1/2 RD | 0.4 | 0.38 |
| P12 | 1 | 1/2 RD | 0.4 | 0.13 |
| P13 | 1 | 1/2 RD | 0.6 | 0.60 |
| P14 | 1 | 1/2 RD | 0.6 | 0.21 |
| P15 | 1 | 9/16 RD | 0.8 | 0.56 |
| P16 | 1 | 9/16 RD | 0.8 | 0.25 |
| P17 | 1 | 9/16 RD | 1.1 | 0.78 |
| S2 | 1 | 9/16 RD | 0.2 | 0.14 |
| P18 | 1 | 1/2 RD | 2.3 | 0.87 |

| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 3 | Of: | 3 |

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# Design Loads

J2

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 18'- 3 1/2"

| Category | Chord | Type | Direction | Load1 (lbs, ft-lbs, plf, psf) | Distance1 (ft-in) | Load2 (lbs, ft-lbs, plf, psf) | Distance2 (ft-in) | Reference | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| CL | TC | Uni | GY | 10.0 | 8" | 10.0 | 18'- 7 1/2" | LOL | Standard load from design parameters - excluding TCO(s) |
| CL0 | TC | Uni | GY | 10.0 | 0" | 10.0 | 8" | LOL | Standard load from design parameters - left TCO |
| DL | TC | Uni | GY | 100.0 | 8" | 100.0 | 18'- 7 1/2" | LOL | Standard load from design parameters - excluding TCO(s) |
| DL0 | TC | Uni | GY | 100.0 | 0" | 100.0 | 8" | LOL | Standard load from design parameters - left TCO |
| LL | TC | Uni | PY | 200.0 | 8" | 200.0 | 18'- 7 1/2" | LOL | Standard load from design parameters - excluding TCO(s) |
| LL0 | TC | Uni | PY | 200.0 | 0" | 200.0 | 8" | LOL | Standard load from design parameters - left TCO |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: MAG | Designed: MAG | Paint: GRAY OXIDE | Mils: 1.5 | Date: Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: MAG | Shopbilled: MAG | Sheet: 1 | Of: 3 | Time: Tue. 11:26 AM |

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# Design Load Combinations

J2

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 18'- 3 1/2"

| Load Combination | Stress Ratio | Top Chord Support | Deflection | Calculated Deflection | Camber | Multiplier - Category Formula | Remarks |
|---|---|---|---|---|---|---|---|
| 2 | 1.000 | Yes | TL | -0.7 | No | DL+LL+CL | Basecase - IBC2006, ASD, Roof |
| 2.1 | 1.000 | Yes | | | No | DL+DL0+LL+LL0+CL+CL0 | |
| 29 | 1.000 | Yes | LL | -0.45 | No | LL | Deflection Case |
| 29.1 | 1.000 | Yes | LL | -0.45 | No | LL+LL0 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 2 | Of: | 3 | Time: | Tue, 11:26 AM |

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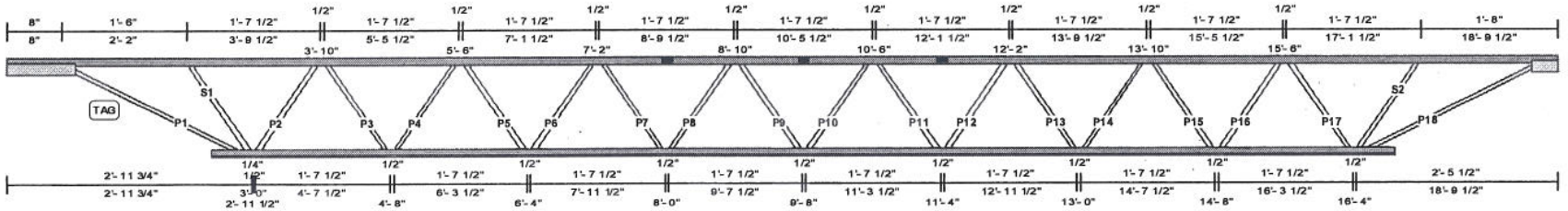
# Design Summary

J2




| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|
| Depth: 14.0 | | | | |
| Moment of Inertia: 41.19 | | | | |
| TC | 2 | L1-1/4X1-1/4X.109 | | 1.00 |
| BC | 2 | L1X1X.109 | | 0.90 |
| BPL | 2 | L1-1/2X1-1/2X.109 | | |
| BPR | 2 | L1-1/2X1-1/2X.109 | | |
| P1 | 1 | 9/16 RD | 2.6 | 0.88 |
| S1 | 1 | 9/16 RD | 0.3 | 0.20 |
| P2 | 1 | 9/16 RD | 1.1 | 0.78 |
| P3 | 1 | 9/16 RD | 0.8 | 0.25 |
| P4 | 1 | 9/16 RD | 0.8 | 0.57 |
| P5 | 1 | 1/2 RD | 0.6 | 0.22 |
| P6 | 1 | 1/2 RD | 0.6 | 0.60 |
| P7 | 1 | 1/2 RD | 0.5 | 0.15 |
| P8 | 1 | 1/2 RD | 0.5 | 0.43 |
| P9 | 1 | 1/2 RD | 0.5 | 0.15 |
| P10 | 1 | 1/2 RD | 0.5 | 0.43 |
| P11 | 1 | 1/2 RD | 0.5 | 0.43 |
| P12 | 1 | 1/2 RD | 0.5 | 0.15 |
| P13 | 1 | 1/2 RD | 0.6 | 0.60 |
| P14 | 1 | 1/2 RD | 0.6 | 0.21 |
| P15 | 1 | 9/16 RD | 0.8 | 0.57 |
| P16 | 1 | 9/16 RD | 0.8 | 0.25 |
| P17 | 1 | 9/16 RD | 1.1 | 0.77 |
| S2 | 1 | 9/16 RD | 0.3 | 0.20 |
| P18 | 1 | 9/16 RD | 2.6 | 0.88 |

| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 3 | Of: | 3 |

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# Design Loads

J3

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 18'- 3 1/2"

| Category | Chord | Type | Direction | Load1 (lbs, ft-lbs, plf, psf) | Distance1 (ft-in) | Load2 (lbs, ft-lbs, plf, psf) | Distance2 (ft-in) | Reference | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| CL | TC | Uni | GY | 10.0 | 8" | 10.0 | 18'- 7 1/2" | LOL | Standard load from design parameters - excluding TCO(s) |
| CL0 | TC | Uni | GY | 10.0 | 0" | 10.0 | 8" | LOL | Standard load from design parameters - left TCO |
| DL | TC | Uni | GY | 100.0 | 8" | 100.0 | 18'- 7 1/2" | LOL | Standard load from design parameters - excluding TCO(s) |
| DL0 | TC | Uni | GY | 100.0 | 0" | 100.0 | 8" | LOL | Standard load from design parameters - left TCO |
| LL | TC | Uni | PY | 200.0 | 8" | 200.0 | 18'- 7 1/2" | LOL | Standard load from design parameters - excluding TCO(s) |
| LL0 | TC | Uni | PY | 200.0 | 0" | 200.0 | 8" | LOL | Standard load from design parameters - left TCO |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 1 | Of: | 3 |

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# Design Load Combinations

J3

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 18'- 3 1/2"

| Load Combination | Stress Ratio | Top Chord Support | Deflection | Calculated Deflection | Camber | Multiplier - Category Formula | Remarks |
|---|---|---|---|---|---|---|---|
| 2 | 1.000 | Yes | TL | -0.7 | No | DL+LL+CL | Basecase - IBC2006, ASD, Roof |
| 2.1 | 1.000 | Yes | | | No | DL+DL0+LL+LL0+CL+CL0 | |
| 29 | 1.000 | Yes | LL | -0.45 | No | LL | Deflection Case |
| 29.1 | 1.000 | Yes | LL | -0.45 | No | LL+LL0 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 2 | Of: | 3 | Time: | Tue. 11:26 AM |

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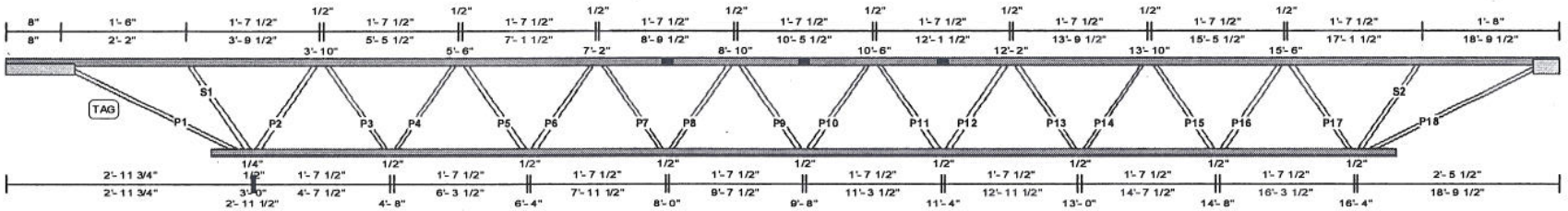
# Design Summary

J3




| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|
| Depth: 14.0 | | | | |
| Moment of Inertia: 41.19 | | | | |
| TC | 2 | L1-1/4X1-1/4X.109 | | 1.00 |
| BC | 2 | L1X1X.109 | | 0.90 |
| BPL | 2 | L1-1/2X1-1/2X.109 | | |
| BPR | 2 | L2X2X.163 | | |
| P1 | 1 | 9/16 RD | 2.6 | 0.88 |
| S1 | 1 | 9/16 RD | 0.3 | 0.20 |
| P2 | 1 | 9/16 RD | 1.1 | 0.78 |
| P3 | 1 | 9/16 RD | 0.8 | 0.25 |
| P4 | 1 | 9/16 RD | 0.8 | 0.57 |
| P5 | 1 | 1/2 RD | 0.6 | 0.22 |
| P6 | 1 | 1/2 RD | 0.6 | 0.60 |
| P7 | 1 | 1/2 RD | 0.5 | 0.15 |
| P8 | 1 | 1/2 RD | 0.5 | 0.43 |
| P9 | 1 | 1/2 RD | 0.5 | 0.15 |
| P10 | 1 | 1/2 RD | 0.5 | 0.43 |
| P11 | 1 | 1/2 RD | 0.5 | 0.43 |
| P12 | 1 | 1/2 RD | 0.5 | 0.15 |
| P13 | 1 | 1/2 RD | 0.6 | 0.60 |
| P14 | 1 | 1/2 RD | 0.6 | 0.21 |
| P15 | 1 | 9/16 RD | 0.8 | 0.57 |
| P16 | 1 | 9/16 RD | 0.8 | 0.25 |
| P17 | 1 | 9/16 RD | 1.1 | 0.77 |
| S2 | 1 | 9/16 RD | 0.3 | 0.20 |
| P18 | 1 | 9/16 RD | 2.6 | 0.88 |

| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 3 | Of: | 3 | Time: | Tue. 11:26 AM |

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# Design Loads

J4

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 18'- 3 1/8"

| Category | Chord | Type | Direction | Load1 (lbs, ft-lbs, plf, psf) | Distance1 (ft-in) | Load2 (lbs, ft-lbs, plf, psf) | Distance2 (ft-in) | Reference | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| CL | TC | Uni | GY | 10.0 | 2" | 10.0 | 18'- 1 1/8" | LOL | Standard load from designation |
| DL | TC | Uni | GY | 100.0 | 2" | 100.0 | 18'- 1 1/8" | LOL | Standard load from designation |
| LL | TC | Uni | PY | 200.0 | 2" | 200.0 | 18'- 1 1/8" | LOL | Standard load from designation |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: MAG | Designed: MAG | Paint: GRAY OXIDE | Mils: 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: MAG | Shopbilled: MAG | Sheet: 1 | Of: 3 | Time: | Tue. 11:26 AM |

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# Design Load Combinations

J4

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 18'- 3 1/8"

| Load Combination | Stress Ratio | Top Chord Support | Deflection | Calculated Deflection | Camber | Multiplier - Category Formula | Remarks |
|---|---|---|---|---|---|---|---|
| 2 | 1.000 | Yes | TL | -0.7 | No | DL+LL+CL | Basecase - IBC2006, ASD, Roof |
| 29 | 1.000 | Yes | LL | -0.45 | No | LL | Deflection Case |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 2 | Of: | 3 | Time: | Tue. 11:26 AM |

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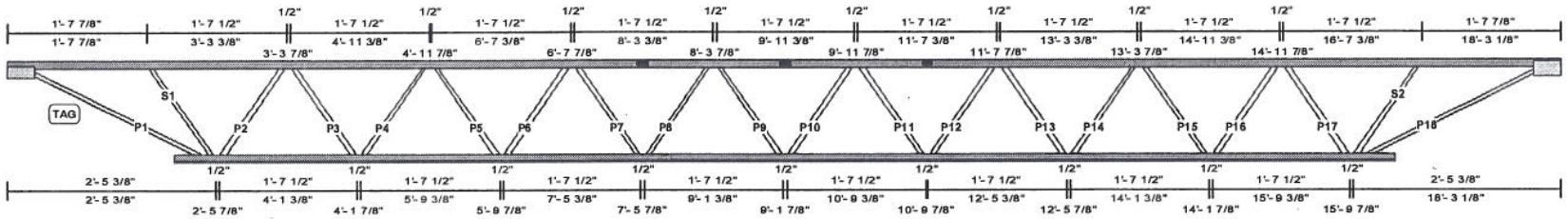
# Design Summary

J4




| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|
| Depth: 14.0 | | | | |
| Moment of Inertia: 41.19 | | | | |
| TC | 2 | L1-1/4X1-1/4X.109 | | 1.00 |
| BC | 2 | L1X1X.109 | | 0.89 |
| BPL | 2 | L1-1/2X1-1/2X.109 | | |
| BPR | 2 | L2X2X.163 | | |
| P1 | 1 | 9/16 RD | 2.6 | 0.87 |
| S1 | 1 | 9/16 RD | 0.3 | 0.20 |
| P2 | 1 | 9/16 RD | 1.1 | 0.77 |
| P3 | 1 | 9/16 RD | 0.8 | 0.25 |
| P4 | 1 | 9/16 RD | 0.8 | 0.57 |
| P5 | 1 | 1/2 RD | 0.6 | 0.21 |
| P6 | 1 | 1/2 RD | 0.6 | 0.60 |
| P7 | 1 | 1/2 RD | 0.4 | 0.14 |
| P8 | 1 | 1/2 RD | 0.4 | 0.40 |
| P9 | 1 | 1/2 RD | 0.4 | 0.14 |
| P10 | 1 | 1/2 RD | 0.4 | 0.14 |
| P11 | 1 | 1/2 RD | 0.4 | 0.40 |
| P12 | 1 | 1/2 RD | 0.4 | 0.14 |
| P13 | 1 | 1/2 RD | 0.6 | 0.60 |
| P14 | 1 | 1/2 RD | 0.6 | 0.21 |
| P15 | 1 | 9/16 RD | 0.8 | 0.57 |
| P16 | 1 | 9/16 RD | 0.8 | 0.25 |
| P17 | 1 | 9/16 RD | 1.1 | 0.77 |
| S2 | 1 | 9/16 RD | 0.3 | 0.20 |
| P18 | 1 | 9/16 RD | 2.6 | 0.87 |

| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 3 | Of: | 3 | Time: | Tue. 11:26 AM |

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# Design Loads

J5

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 11'- 1/2"

| Category | Chord | Type | Direction | Load1 (lbs, ft-lbs, plf, psf) | Distance1 (ft-in) | Load2 (lbs, ft-lbs, plf, psf) | Distance2 (ft-in) | Reference | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| CL | TC | Uni | GY | 10.0 | 8" | 10.0 | 11'- 4 1/2" | LOL | Standard load from design parameters - excluding TCO(s) |
| CL0 | TC | Uni | GY | 10.0 | 0" | 10.0 | 8" | LOL | Standard load from design parameters - left TCO |
| DL | TC | Uni | GY | 100.0 | 8" | 100.0 | 11'- 4 1/2" | LOL | Standard load from design parameters - excluding TCO(s) |
| DL0 | TC | Uni | GY | 100.0 | 0" | 100.0 | 8" | LOL | Standard load from design parameters - left TCO |
| LL | TC | Uni | PY | 200.0 | 8" | 200.0 | 11'- 4 1/2" | LOL | Standard load from design parameters - excluding TCO(s) |
| LL0 | TC | Uni | PY | 200.0 | 0" | 200.0 | 8" | LOL | Standard load from design parameters - left TCO |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: MAG | Designed: MAG | Paint: GRAY OXIDE | Mils: 1.5 | Date: Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: MAG | Shopbilled: MAG | Sheet: 1 | Of: 3 | Time: Tue. 11:26 AM |

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# Design Load Combinations

J5

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 11'- 1/2"

| Load Combination | Stress Ratio | Top Chord Support | Deflection | Calculated Deflection | Camber | Multiplier - Category Formula | Remarks |
|---|---|---|---|---|---|---|---|
| 2 | 1.000 | Yes | TL | -0.12 | No | DL+LL+CL | Basecase - IBC2006, ASD, Roof |
| 2.1 | 1.000 | Yes | | | No | DL+DL0+LL+LL0+CL+CL0 | |
| 29 | 1.000 | Yes | LL | -0.08 | No | LL | Deflection Case |
| 29.1 | 1.000 | Yes | LL | -0.08 | No | LL+LL0 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 2 | Of: | 3 |

| | |
|---|---|
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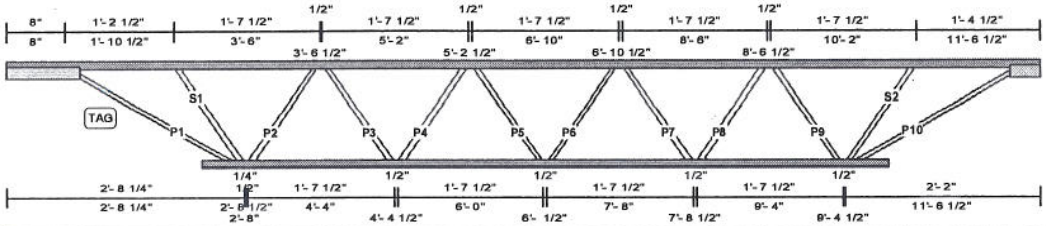
# Design Summary

J5




| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|
| Depth: 14.0 | | | | |
| Moment of Inertia: 41.19 | | | | |
| TC | 2 | L1-1/4X1-1/4X.109 | | 0.53 |
| BC | 2 | L1X1X.109 | | 0.31 |
| BPL | 2 | L1-1/2X1-1/2X.109 | | |
| BPR | 2 | L1-1/2X1-1/2X.109 | | |
| P1 | 1 | 1/2 RD | 1.6 | 0.58 |
| S1 | 1 | 1/2 RD | 0.3 | 0.28 |
| P2 | 1 | 1/2 RD | 0.6 | 0.63 |
| P3 | 1 | 1/2 RD | 0.3 | 0.10 |
| P4 | 1 | 1/2 RD | 0.3 | 0.29 |
| P5 | 1 | 1/2 RD | 0.3 | 0.09 |
| P6 | 1 | 1/2 RD | 0.3 | 0.27 |
| P7 | 1 | 1/2 RD | 0.3 | 0.29 |
| P8 | 1 | 1/2 RD | 0.3 | 0.10 |
| P9 | 1 | 1/2 RD | 0.6 | 0.62 |
| S2 | 1 | 1/2 RD | 0.3 | 0.28 |
| P10 | 1 | 1/2 RD | 1.6 | 0.58 |

| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 3 | Of: | 3 | Time: | Tue. 11:26 AM |

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# Design Loads

J6

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 18'- 3 1/8"

| Category | Chord | Type | Direction | Load1 (lbs, ft-lbs, plf, psf) | Distance1 (ft-in) | Load2 (lbs, ft-lbs, plf, psf) | Distance2 (ft-in) | Reference | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| CL | TC | Uni | GY | 10.0 | 2" | 10.0 | 18'- 1 1/8" | LOL | Standard load from designation |
| DL | TC | Uni | GY | 100.0 | 2" | 100.0 | 18'- 1 1/8" | LOL | Standard load from designation |
| LL | TC | Uni | PY | 200.0 | 2" | 200.0 | 18'- 1 1/8" | LOL | Standard load from designation |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: MAG | Designed: MAG | Paint: GRAY OXIDE | Mils: 1.5 | Date: Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: MAG | Shopbilled: MAG | Sheet: 1 | Of: 3 | Time: Tue. 11:26 AM |

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# Design Load Combinations

J6

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 18'- 3 1/8"

| Load Combination | Stress Ratio | Top Chord Support | Deflection | Calculated Deflection | Camber | Multiplier - Category Formula | Remarks |
|---|---|---|---|---|---|---|---|
| 2 | 1.000 | Yes | TL | -0.7 | No | DL+LL+CL | Basecase - IBC2006, ASD, Roof |
| 29 | 1.000 | Yes | LL | -0.45 | No | LL | Deflection Case |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 2 | Of: | 3 | Time: | Tue. 11:26 AM |

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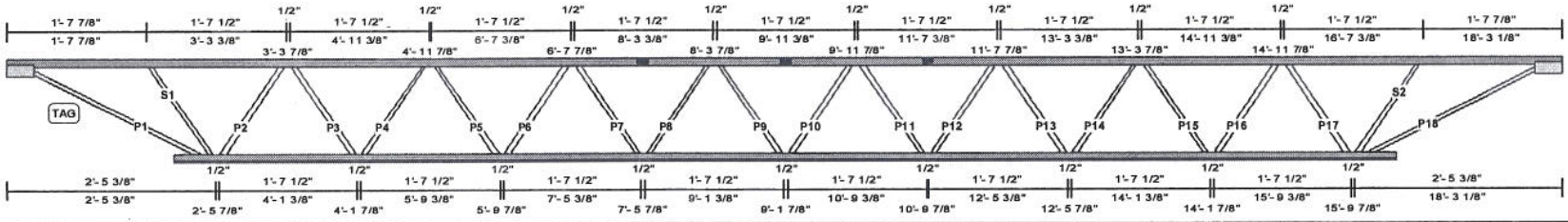
# Design Summary

J6




| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|
| Depth: 14.0 | | | | |
| Moment of Inertia: 41.19 | | | | |
| TC | 2 | L1-1/4X1-1/4X.109 | | 1.00 |
| BC | 2 | L1X1X.109 | | 0.89 |
| BPL | 2 | L1-1/2X1-1/2X.109 | | |
| BPR | 2 | L1-1/2X1-1/2X.109 | | |
| P1 | 1 | 9/16 RD | 2.6 | 0.87 |
| S1 | 1 | 9/16 RD | 0.3 | 0.20 |
| P2 | 1 | 9/16 RD | 1.1 | 0.77 |
| P3 | 1 | 9/16 RD | 0.8 | 0.25 |
| P4 | 1 | 9/16 RD | 0.8 | 0.57 |
| P5 | 1 | 1/2 RD | 0.6 | 0.21 |
| P6 | 1 | 1/2 RD | 0.6 | 0.60 |
| P7 | 1 | 1/2 RD | 0.4 | 0.14 |
| P8 | 1 | 1/2 RD | 0.4 | 0.40 |
| P9 | 1 | 1/2 RD | 0.4 | 0.14 |
| P10 | 1 | 1/2 RD | 0.4 | 0.14 |
| P11 | 1 | 1/2 RD | 0.4 | 0.40 |
| P12 | 1 | 1/2 RD | 0.4 | 0.14 |
| P13 | 1 | 1/2 RD | 0.6 | 0.60 |
| P14 | 1 | 1/2 RD | 0.6 | 0.21 |
| P15 | 1 | 9/16 RD | 0.8 | 0.57 |
| P16 | 1 | 9/16 RD | 0.8 | 0.25 |
| P17 | 1 | 9/16 RD | 1.1 | 0.77 |
| S2 | 1 | 9/16 RD | 0.3 | 0.20 |
| P18 | 1 | 9/16 RD | 2.6 | 0.87 |

| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 3 | Of: | 3 |

Date: Apr. 21, 2009
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# Design Loads

J7

## Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 17'- 2"

| Category | Chord | Type | Direction | Load1 (lbs, ft-lbs, plf, psf) | Distance1 (ft-in) | Load2 (lbs, ft-lbs, plf, psf) | Distance2 (ft-in) | Reference | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| CL | TC | Uni | GY | 10.0 | 2" | 10.0 | 17'- 0" | LOL | Standard load from designation |
| DL | TC | Uni | GY | 100.0 | 2" | 100.0 | 17'- 0" | LOL | Standard load from designation |
| LL | TC | Uni | PY | 200.0 | 2" | 200.0 | 17'- 0" | LOL | Standard load from designation |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: MAG | Designed: MAG | Paint: GRAY OXIDE | Mils: 1.5 | Date: Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: MAG | Shopbilled: MAG | Sheet: 1 | Of: 3 | Time: Tue. 11:26 AM |

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# Design Load Combinations

J7

Mark Type: 14KS Tributary Width: 2'- 0" Base Length: 17'- 2"

| Load Combination | Stress Ratio | Top Chord Support | Deflection | Calculated Deflection | Camber | Multiplier - Category Formula | Remarks |
|---|---|---|---|---|---|---|---|
| 2 | 1.000 | Yes | TL | -0.54 | No | DL+LL+CL | Basecase - IBC2006, ASD, Roof |
| 29 | 1.000 | Yes | LL | -0.35 | No | LL | Deflection Case |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 2 | Of: | 3 | Time: | Tue. 11:26 AM |

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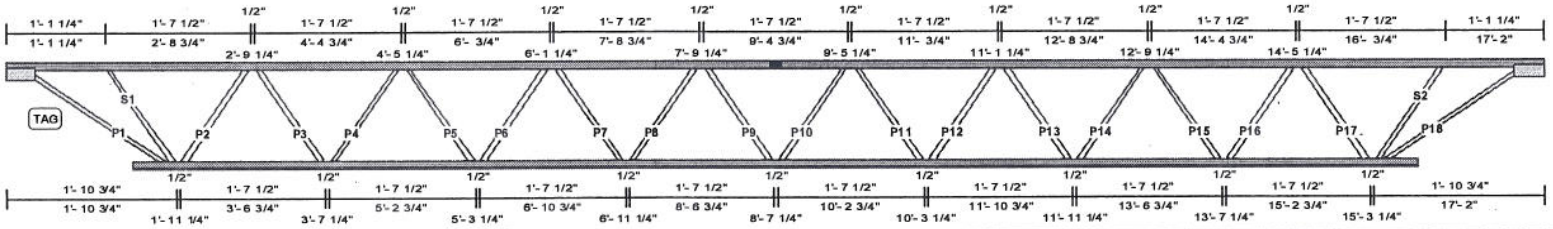
# Design Summary

J7




| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|
| Depth: 14.0 | | | | |
| Moment of Inertia: 41.19 | | | | |
| TC | 2 | L1-1/4X1-1/4X.109 | | 0.98 |
| BC | 2 | L1X1X.109 | | 0.79 |
| BPL | 2 | L1-1/2X1-1/2X.109 | | |
| BPR | 2 | L1-1/2X1-1/2X.109 | | |
| P1 | 1 | 1/2 RD | 2.3 | 0.86 |
| S1 | 1 | 9/16 RD | 0.2 | 0.14 |
| P2 | 1 | 9/16 RD | 1.1 | 0.78 |
| P3 | 1 | 9/16 RD | 0.8 | 0.25 |
| P4 | 1 | 9/16 RD | 0.8 | 0.56 |
| P5 | 1 | 1/2 RD | 0.6 | 0.21 |
| P6 | 1 | 1/2 RD | 0.6 | 0.60 |
| P7 | 1 | 1/2 RD | 0.4 | 0.13 |
| P8 | 1 | 1/2 RD | 0.4 | 0.38 |
| P9 | 1 | 1/2 RD | 0.4 | 0.13 |
| P10 | 1 | 1/2 RD | 0.4 | 0.13 |
| P11 | 1 | 1/2 RD | 0.4 | 0.38 |
| P12 | 1 | 1/2 RD | 0.4 | 0.13 |
| P13 | 1 | 1/2 RD | 0.6 | 0.60 |
| P14 | 1 | 1/2 RD | 0.6 | 0.21 |
| P15 | 1 | 9/16 RD | 0.8 | 0.56 |
| P16 | 1 | 9/16 RD | 0.8 | 0.25 |
| P17 | 1 | 9/16 RD | 1.1 | 0.78 |
| S2 | 1 | 9/16 RD | 0.2 | 0.14 |
| P18 | 1 | 1/2 RD | 2.3 | 0.86 |

| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 3 | Of: | 3 | Time: | Tue. 11:26 AM |

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# Design Loads

J8

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 17'- 10 7/8"

| Category | Chord | Type | Direction | Load1 (lbs, ft-lbs, plf, psf) | Distance1 (ft-in) | Load2 (lbs, ft-lbs, plf, psf) | Distance2 (ft-in) | Reference | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| CL | TC | Uni | GY | 10.0 | 2" | 10.0 | 17'- 8 7/8" | LOL | Standard load from designation |
| DL | TC | Uni | GY | 100.0 | 2" | 100.0 | 17'- 8 7/8" | LOL | Standard load from designation |
| LL | TC | Uni | PY | 200.0 | 2" | 200.0 | 17'- 8 7/8" | LOL | Standard load from designation |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: MAG | Designed: MAG | Paint: GRAY OXIDE | Mils: 1.5 | Date: Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: MAG | Shopbilled: MAG | Sheet: 1 | Of: 3 | Time: Tue. 11:26 AM |

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# Design Load Combinations

J8

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 17'- 10 7/8"

| Load Combination | Stress Ratio | Top Chord Support | Deflection | Calculated Deflection | Camber | Multiplier - Category Formula | Remarks |
|---|---|---|---|---|---|---|---|
| 2 | 1.000 | Yes | TL | -0.64 | No | DL+LL+CL | Basecase - IBC2006, ASD, Roof |
| 29 | 1.000 | Yes | LL | -0.41 | No | LL | Deflection Case |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 2 | Of: | 3 | Time: | Tue. 11:26 AM |

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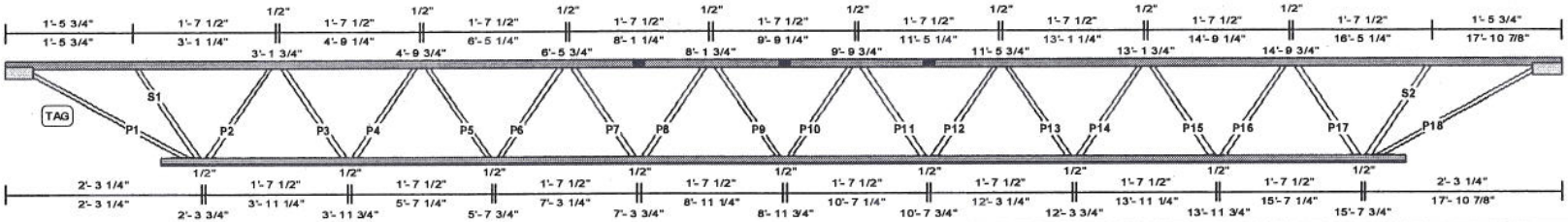
# Design Summary

J8




| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|
| Depth: 14.0 | | | | |
| Moment of Inertia: 41.19 | | | | |
| TC | 2 | L1-1/4X1-1/4X.109 | | 0.95 |
| BC | 2 | L1X1X.109 | | 0.86 |
| BPL | 2 | L1-1/2X1-1/2X.109 | | |
| BPR | 2 | L1-1/2X1-1/2X.109 | | |
| P1 | 1 | 9/16 RD | 2.4 | 0.81 |
| S1 | 1 | 9/16 RD | 0.3 | 0.18 |
| P2 | 1 | 9/16 RD | 1.1 | 0.78 |
| P3 | 1 | 9/16 RD | 0.8 | 0.25 |
| P4 | 1 | 9/16 RD | 0.8 | 0.57 |
| P5 | 1 | 1/2 RD | 0.6 | 0.21 |
| P6 | 1 | 1/2 RD | 0.6 | 0.60 |
| P7 | 1 | 1/2 RD | 0.4 | 0.14 |
| P8 | 1 | 1/2 RD | 0.4 | 0.39 |
| P9 | 1 | 1/2 RD | 0.4 | 0.14 |
| P10 | 1 | 1/2 RD | 0.4 | 0.14 |
| P11 | 1 | 1/2 RD | 0.4 | 0.39 |
| P12 | 1 | 1/2 RD | 0.4 | 0.14 |
| P13 | 1 | 1/2 RD | 0.6 | 0.60 |
| P14 | 1 | 1/2 RD | 0.6 | 0.21 |
| P15 | 1 | 9/16 RD | 0.8 | 0.57 |
| P16 | 1 | 9/16 RD | 0.8 | 0.25 |
| P17 | 1 | 9/16 RD | 1.1 | 0.78 |
| S2 | 1 | 9/16 RD | 0.3 | 0.18 |
| P18 | 1 | 9/16 RD | 2.4 | 0.81 |

| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 3 | Of: | 3 |

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|---|---|
| Date: | Apr. 21, 2009 |
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# Design Loads

J9

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 17'- 11 1/2"

| Category | Chord | Type | Direction | Load1 (lbs, ft-lbs, plf, psf) | Distance1 (ft-in) | Load2 (lbs, ft-lbs, plf, psf) | Distance2 (ft-in) | Reference | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| CL | TC | Uni | GY | 10.0 | 2" | 10.0 | 17'- 9 1/2" | LOL | Standard load from designation |
| DL | TC | Uni | GY | 100.0 | 2" | 100.0 | 17'- 9 1/2" | LOL | Standard load from designation |
| LL | TC | Uni | PY | 200.0 | 2" | 200.0 | 17'- 9 1/2" | LOL | Standard load from designation |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: MAG | Designed: MAG | Paint: GRAY OXIDE Mils: 1.5 | Date: Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: MAG | Shopbilled: MAG | Sheet: 1 Of: 3 | Time: Tue. 11:26 AM |

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# Design Load Combinations

J9

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 17'- 11 1/2"

| Load Combination | Stress Ratio | Top Chord Support | Deflection | Calculated Deflection | Camber | Multiplier - Category Formula | Remarks |
|---|---|---|---|---|---|---|---|
| 2 | 1.000 | Yes | TL | -0.65 | No | DL+LL+CL | Basecase - IBC2006, ASD, Roof |
| 29 | 1.000 | Yes | LL | -0.42 | No | LL | Deflection Case |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 2 | Of: | 3 |

| | |
|---|---|
| Date: | Apr. 21, 2009 |
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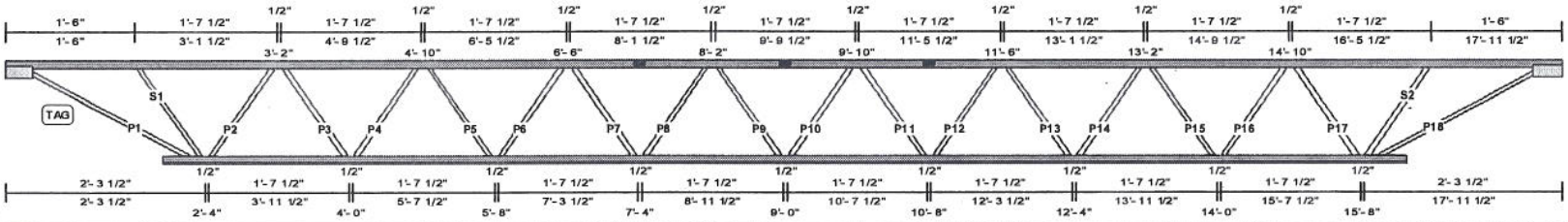
# Design Summary

J9




| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|
| Depth: 14.0 | | | | |
| Moment of Inertia: 41.19 | | | | |
| TC | 2 | L1-1/4X1-1/4X.109 | | 0.96 |
| BC | 2 | L1X1X.109 | | 0.86 |
| BPL | 2 | L1-1/2X1-1/2X.109 | | |
| BPR | 2 | L1-1/2X1-1/2X.109 | | |
| P1 | 1 | 9/16 RD | 2.4 | 0.82 |
| S1 | 1 | 9/16 RD | 0.3 | 0.18 |
| P2 | 1 | 9/16 RD | 1.1 | 0.78 |
| P3 | 1 | 9/16 RD | 0.8 | 0.25 |
| P4 | 1 | 9/16 RD | 0.8 | 0.57 |
| P5 | 1 | 1/2 RD | 0.6 | 0.21 |
| P6 | 1 | 1/2 RD | 0.6 | 0.60 |
| P7 | 1 | 1/2 RD | 0.4 | 0.14 |
| P8 | 1 | 1/2 RD | 0.4 | 0.39 |
| P9 | 1 | 1/2 RD | 0.4 | 0.14 |
| P10 | 1 | 1/2 RD | 0.4 | 0.14 |
| P11 | 1 | 1/2 RD | 0.4 | 0.39 |
| P12 | 1 | 1/2 RD | 0.4 | 0.14 |
| P13 | 1 | 1/2 RD | 0.6 | 0.60 |
| P14 | 1 | 1/2 RD | 0.6 | 0.21 |
| P15 | 1 | 9/16 RD | 0.8 | 0.57 |
| P16 | 1 | 9/16 RD | 0.8 | 0.25 |
| P17 | 1 | 9/16 RD | 1.1 | 0.78 |
| S2 | 1 | 9/16 RD | 0.3 | 0.18 |
| P18 | 1 | 9/16 RD | 2.4 | 0.82 |

| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 3 | Of: | 3 | Time: | Tue. 11:26 AM |

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# Design Loads

J10

## Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 17'- 11 1/2"

| Category | Chord | Type | Direction | Load1 (lbs, ft-lbs, plf, psf) | Distance1 (ft-in) | Load2 (lbs, ft-lbs, plf, psf) | Distance2 (ft-in) | Reference | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| CL | TC | Uni | GY | 10.0 | 2" | 10.0 | 17'- 9 1/2" | LOL | Standard load from designation |
| DL | TC | Uni | GY | 100.0 | 2" | 100.0 | 17'- 9 1/2" | LOL | Standard load from designation |
| LL | TC | Uni | PY | 200.0 | 2" | 200.0 | 17'- 9 1/2" | LOL | Standard load from designation |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: MAG | Designed: MAG | Paint: GRAY OXIDE Mils: 1.5 | Date: Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: MAG | Shopbilled: MAG | Sheet: 1 Of: 3 | Time: Tue. 11:26 AM |

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# Design Load Combinations

J10

Mark Type: 14KS Tributary Width: 2'- 0" Base Length: 17'- 11 1/2"

| Load Combination | Stress Ratio | Top Chord Support | Deflection | Calculated Deflection | Camber | Multiplier - Category Formula | Remarks |
|---|---|---|---|---|---|---|---|
| 2 | 1.000 | Yes | TL | -0.65 | No | DL+LL+CL | Basecase - IBC2006, ASD, Roof |
| 29 | 1.000 | Yes | LL | -0.42 | No | LL | Deflection Case |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 2 | Of: | 3 | Time: | Tue. 11:26 AM |

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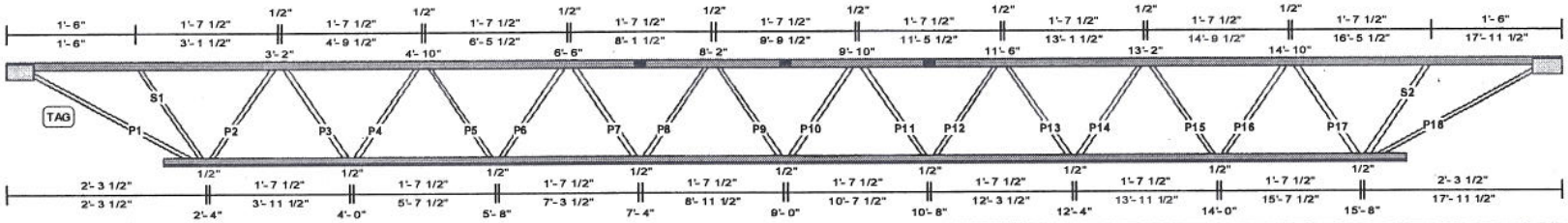
# Design Summary

J10




| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|
| Depth: 14.0 | | | | |
| Moment of Inertia: 41.19 | | | | |
| TC | 2 | L1-1/4X1-1/4X.109 | | 0.96 |
| BC | 2 | L1X1X.109 | | 0.86 |
| BPL | 2 | L2X2X.163 | | |
| BPR | 2 | L2X2X.163 | | |
| P1 | 1 | 9/16 RD | 2.4 | 0.82 |
| S1 | 1 | 9/16 RD | 0.3 | 0.18 |
| P2 | 1 | 9/16 RD | 1.1 | 0.78 |
| P3 | 1 | 9/16 RD | 0.8 | 0.25 |
| P4 | 1 | 9/16 RD | 0.8 | 0.57 |
| P5 | 1 | 1/2 RD | 0.6 | 0.21 |
| P6 | 1 | 1/2 RD | 0.6 | 0.60 |
| P7 | 1 | 1/2 RD | 0.4 | 0.14 |
| P8 | 1 | 1/2 RD | 0.4 | 0.39 |
| P9 | 1 | 1/2 RD | 0.4 | 0.14 |
| P10 | 1 | 1/2 RD | 0.4 | 0.14 |
| P11 | 1 | 1/2 RD | 0.4 | 0.39 |
| P12 | 1 | 1/2 RD | 0.4 | 0.14 |
| P13 | 1 | 1/2 RD | 0.6 | 0.60 |
| P14 | 1 | 1/2 RD | 0.6 | 0.21 |
| P15 | 1 | 9/16 RD | 0.8 | 0.57 |
| P16 | 1 | 9/16 RD | 0.8 | 0.25 |
| P17 | 1 | 9/16 RD | 1.1 | 0.78 |
| S2 | 1 | 9/16 RD | 0.3 | 0.18 |
| P18 | 1 | 9/16 RD | 2.4 | 0.82 |

| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 3 | Of: | 3 | Time: | Tue. 11:26 AM |

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# Design Loads

J11

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 11'- 1/2"

| Category | Chord | Type | Direction | Load1 (lbs, ft-lbs, plf, psf) | Distance1 (ft-in) | Load2 (lbs, ft-lbs, plf, psf) | Distance2 (ft-in) | Reference | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| CL | TC | Uni | GY | 10.0 | 8" | 10.0 | 11'- 4 1/2" | LOL | Standard load from design parameters - excluding TCO(s) |
| CL0 | TC | Uni | GY | 10.0 | 0" | 10.0 | 8" | LOL | Standard load from design parameters - left TCO |
| DL | TC | Uni | GY | 100.0 | 8" | 100.0 | 11'- 4 1/2" | LOL | Standard load from design parameters - excluding TCO(s) |
| DL0 | TC | Uni | GY | 100.0 | 0" | 100.0 | 8" | LOL | Standard load from design parameters - left TCO |
| LL | TC | Uni | PY | 200.0 | 8" | 200.0 | 11'- 4 1/2" | LOL | Standard load from design parameters - excluding TCO(s) |
| LL0 | TC | Uni | PY | 200.0 | 0" | 200.0 | 8" | LOL | Standard load from design parameters - left TCO |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 1 | Of: | 3 |

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# Design Load Combinations

J11

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 11'- 1/2"

| Load Combination | Stress Ratio | Top Chord Support | Deflection | Calculated Deflection | Camber | Multiplier - Category Formula | Remarks |
|---|---|---|---|---|---|---|---|
| 2 | 1.000 | Yes | TL | -0.12 | No | DL+LL+CL | Basecase - IBC2006, ASD, Roof |
| 2.1 | 1.000 | Yes | | | No | DL+DL0+LL+LL0+CL+CL0 | |
| 29 | 1.000 | Yes | LL | -0.08 | No | LL | Deflection Case |
| 29.1 | 1.000 | Yes | LL | -0.08 | No | LL+LL0 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 2 | Of: | 3 | Time: | Tue. 11:26 AM |

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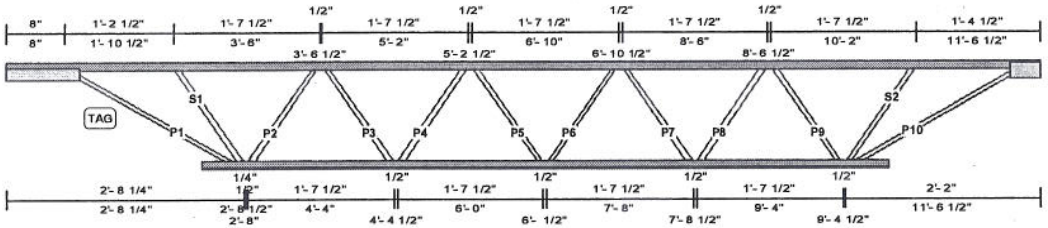
# Design Summary

J11




| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|
| Depth: 14.0 | | | | |
| Moment of Inertia: 41.19 | | | | |
| TC | 2 | L1-1/4X1-1/4X.109 | | 0.53 |
| BC | 2 | L1X1X.109 | | 0.31 |
| BPL | 2 | L1-1/2X1-1/2X.109 | | |
| BPR | 2 | L2X2X.163 | | |
| P1 | 1 | 1/2 RD | 1.6 | 0.58 |
| S1 | 1 | 1/2 RD | 0.3 | 0.28 |
| P2 | 1 | 1/2 RD | 0.6 | 0.63 |
| P3 | 1 | 1/2 RD | 0.3 | 0.10 |
| P4 | 1 | 1/2 RD | 0.3 | 0.29 |
| P5 | 1 | 1/2 RD | 0.3 | 0.09 |
| P6 | 1 | 1/2 RD | 0.3 | 0.27 |
| P7 | 1 | 1/2 RD | 0.3 | 0.29 |
| P8 | 1 | 1/2 RD | 0.3 | 0.10 |
| P9 | 1 | 1/2 RD | 0.6 | 0.62 |
| S2 | 1 | 1/2 RD | 0.3 | 0.28 |
| P10 | 1 | 1/2 RD | 1.6 | 0.58 |

| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 3 | Of: | 3 |

Date: Apr. 21, 2009
Time: Tue. 11:26 AM

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# Design Loads

J20

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 18'- 3 1/2"

| Category | Chord | Type | Direction | Load1 (lbs, ft-lbs, plf, psf) | Distance1 (ft-in) | Load2 (lbs, ft-lbs, plf, psf) | Distance2 (ft-in) | Reference | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| CL | TC | Uni | GY | 10.0 | 8" | 10.0 | 18'- 7 1/2" | LOL | Standard load from design parameters - excluding TCO(s) |
| CL0 | TC | Uni | GY | 10.0 | 0" | 10.0 | 8" | LOL | Standard load from design parameters - left TCO |
| DL | TC | Uni | GY | 100.0 | 8" | 100.0 | 18'- 7 1/2" | LOL | Standard load from design parameters - excluding TCO(s) |
| DL0 | TC | Uni | GY | 100.0 | 0" | 100.0 | 8" | LOL | Standard load from design parameters - left TCO |
| LL | TC | Uni | PY | 200.0 | 8" | 200.0 | 18'- 7 1/2" | LOL | Standard load from design parameters - excluding TCO(s) |
| LL0 | TC | Uni | PY | 200.0 | 0" | 200.0 | 8" | LOL | Standard load from design parameters - left TCO |
| DL | TC | Uni | GY | 100.0 | 5'- 0" | 100.0 | 13'- 7 1/2" | LOL | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: MAG | Designed: MAG | Paint: GRAY OXIDE | Mils: 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: MAG | Shopbilled: MAG | Sheet: 1 | Of: 3 | Time: | Tue. 11:26 AM |

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# Design Load Combinations

J20

Mark Type: 14KS  Tributary Width: 2'- 0"  Base Length: 18'- 3 1/2"

| Load Combination | Stress Ratio | Top Chord Support | Deflection | Calculated Deflection | Camber | Multiplier - Category Formula | Remarks |
|---|---|---|---|---|---|---|---|
| 2 | 1.000 | Yes | TL | -0.75 | No | DL+LL+CL | Basecase - IBC2006, ASD, Roof |
| 2.1 | 1.000 | Yes | | | No | DL+DL0+LL+LL0+CL+CL0 | |
| 29 | 1.000 | Yes | LL | -0.4 | No | LL | Deflection Case |
| 29.1 | 1.000 | Yes | LL | -0.4 | No | LL+LL0 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 2 | Of: | 3 | Time: | Tue. 11:26 AM |

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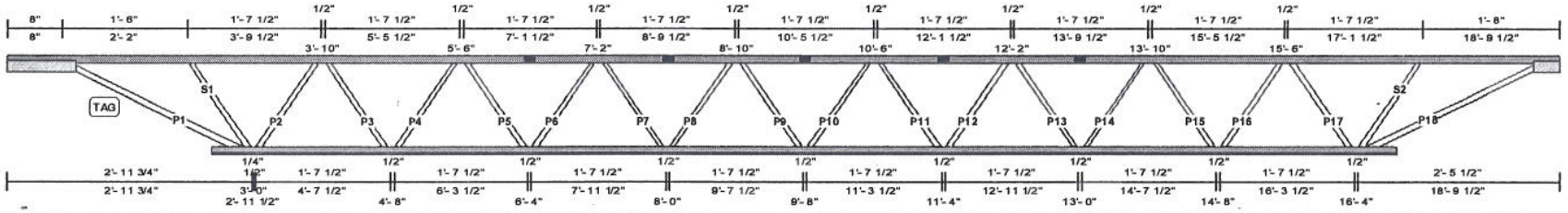
# Design Summary

J20




| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|
| Depth: 14.0 | | | | |
| Moment of Inertia: 46.79 | | | | |
| TC | 2 | L1-1/4X1-1/4X.125 | | 0.94 |
| BC | 2 | L1X1X.125 | | 0.98 |
| BPL | 2 | L1-1/2X1-1/2X.109 | | |
| BPR | 2 | L1-1/2X1-1/2X.109 | | |
| P1 | 1 | 5/8 RD | 2.7 | 0.83 |
| S1 | 1 | 5/8 RD | 0.3 | 0.14 |
| P2 | 1 | 5/8 RD | 1.2 | 0.66 |
| P3 | 1 | 5/8 RD | 0.9 | 0.26 |
| P4 | 1 | 5/8 RD | 0.9 | 0.51 |
| P5 | 1 | 1/2 RD | 0.8 | 0.28 |
| P6 | 1 | 1/2 RD | 0.8 | 0.79 |
| P7 | 1 | 1/2 RD | 0.5 | 0.18 |
| P8 | 1 | 1/2 RD | 0.5 | 0.50 |
| P9 | 1 | 1/2 RD | 0.5 | 0.50 |
| P10 | 1 | 1/2 RD | 0.5 | 0.28 |
| P11 | 1 | 1/2 RD | 0.5 | 0.50 |
| P12 | 1 | 1/2 RD | 0.5 | 0.18 |
| P13 | 1 | 1/2 RD | 0.8 | 0.80 |
| P14 | 1 | 1/2 RD | 0.8 | 0.29 |
| P15 | 1 | 5/8 RD | 0.9 | 0.50 |
| P16 | 1 | 5/8 RD | 0.9 | 0.26 |
| P17 | 1 | 5/8 RD | 1.1 | 0.65 |
| S2 | 1 | 5/8 RD | 0.3 | 0.14 |
| P18 | 1 | 5/8 RD | 2.7 | 0.82 |

| Member | Piece Qty | Material | Weld Length | Max Stress Ratio |
|---|---|---|---|---|

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Job Name: | 8028914 | Job Number: | 49-09-0482-01 | Detailed: | MAG | Designed: | MAG | Paint: | GRAY OXIDE | Mils: | 1.5 | Date: | Apr. 21, 2009 |
| Location: | Biloxi, MS US | Description: | FOR FAB | Checked: | MAG | Shopbilled: | MAG | Sheet: | 3 | Of: | 3 | Time: | Tue, 11:26 AM |

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE
**02/09**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

| | |
|---|---|
| AHRI 1010 | (2002) Self-Contained, Mechanically Refrigerated Drinking-Water Coolers |

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

| | |
|---|---|
| ASHRAE 90.1 - IP | (2007) Energy Standard for Buildings Except Low-Rise Residential Buildings, I-P Edition |

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

| | |
|---|---|
| ASSE 1001 | (2008) Atmospheric Type Vacuum Breakers |
| ASSE 1005 | (1999) Water Heater Drain Valves 3/4 Inch Size |
| ASSE 1010 | (2004) Water Hammer Arresters |
| ASSE 1011 | (2004; Errata 2004) Hose Connection Vacuum Breakers |
| ASSE 1012 | (2002) Backflow Preventer with Intermediate Atmospheric Vent |
| ASSE 1013 | (2005) Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers |
| ASSE 1018 | (2001) Trap Seal Primer Valves - Potable, Water Supplied |
| ASSE 1019 | (2004; Errata 2005) Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type |
| ASSE 1020 | (2004; Errata 2004; Errata 2004) Pressure Vacuum Breaker Assembly |
| ASSE 1037 | (1990) Performance Requirements for Pressurized Flushing Devices (Flushometer) for Plumbing Fixtures |

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|---|---|
| AWWA 10084 | (2005) Standard Methods for the Examination of Water and Wastewater |
| AWWA B300 | (2004) Hypochlorites |
| AWWA B301 | (2004) Liquid Chlorine |
| AWWA C203 | (2002) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied |
| AWWA C606 | (2006) Grooved and Shouldered Joints |
| AWWA C651 | (2005; Errata 2005) Standard for Disinfecting Water Mains |
| AWWA C652 | (2002) Disinfection of Water-Storage Facilities |
| AWWA C700 | (2002; Errata 2008) Standard for Cold Water Meters - Displacement Type, Bronze Main Case |
| AWWA C701 | (2007) Standard for Cold-Water Meters - Turbine Type for Customer Service |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS A5.8/A5.8M | (2004; Errata 2004) Specification for Filler Metals for Brazing and Braze Welding |
| AWS B2.2 | (1991) Brazing Procedure and Performance Qualification |

ASME INTERNATIONAL (ASME)

| | |
|---|---|
| ASME A112.1.2 | (2004) Standard for Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors) |
| ASME A112.14.1 | (2003; R 2008) Backwater Valves |
| ASME A112.19.2 | (2008) Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals |
| ASME A112.19.5 | (2005) Trim for Water-Closet Bowls, Tanks and Urinals |
| ASME A112.36.2M | (1991; R 2008) Cleanouts |
| ASME A112.6.1M | (1997; R 2008) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use |
| ASME A112.6.3 | (2001; R 2007) Standard for Floor and |

| | |
|---|---|
| | Trench Drains |
| ASME B1.20.1 | (1983; R 2006) Pipe Threads, General Purpose (Inch) |
| ASME B16.12 | (1998; R 2006) Cast Iron Threaded Drainage Fittings |
| ASME B16.15 | (2006) Cast Bronze Threaded Fittings Classes 125 and 250 |
| ASME B16.18 | (2001; R 2005) Cast Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.21 | (2005) Nonmetallic Flat Gaskets for Pipe Flanges |
| ASME B16.22 | (2001; R 2005) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.23 | (2002; Errata 2003; R 2006) Cast Copper Alloy Solder Joint Drainage Fittings - DWV |
| ASME B16.24 | (2006) Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500, and 2500 |
| ASME B16.29 | (2007) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV |
| ASME B16.3 | (2006) Malleable Iron Threaded Fittings, Classes 150 and 300 |
| ASME B16.34 | (2004) Valves - Flanged, Threaded and Welding End |
| ASME B16.39 | (1998; R 2006) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300 |
| ASME B16.4 | (2006) Standard for Gray Iron Threaded Fittings; Classes 125 and 250 |
| ASME B16.5 | (2003) Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 |
| ASME B31.1 | (2007; Addenda 2008) Power Piping |
| ASME B31.5 | (2006) Refrigeration Piping and Heat Transfer Components |
| ASME B40.100 | (2005) Pressure Gauges and Gauge Attachments |
| ASME BPVC SEC IX | (2007; Addenda 2008) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications |

| | |
|---|---|
| ASME BPVC SEC VIII D1 | (2007; Addenda 2008) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage |
| ASME CSD-1 | (2006) Control and Safety Devices for Automatically Fired Boilers |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 105/A 105M | (2005) Standard Specification for Carbon Steel Forgings for Piping Applications |
| ASTM A 183 | (2003) Standard Specification for Carbon Steel Track Bolts and Nuts |
| ASTM A 193/A 193M | (2008b) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service |
| ASTM A 47/A 47M | (1999; R 2004) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process |
| ASTM A 515/A 515M | (2003; R 2007) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service |
| ASTM A 516/A 516M | (2006) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service |
| ASTM A 518/A 518M | (1999; R 2008) Standard Specification for Corrosion-Resistant High-Silicon Iron Castings |
| ASTM A 53/A 53M | (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A 536 | (1984e1; R 2004) Standard Specification for Ductile Iron Castings |
| ASTM A 733 | (2003) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples |
| ASTM A 74 | (2008a) Standard Specification for Cast Iron Soil Pipe and Fittings |
| ASTM A 888 | (2008) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications |
| ASTM B 117 | (2007a) Standing Practice for Operating Salt Spray (Fog) Apparatus |
| ASTM B 152/B 152M | (2006ae1) Standard Specification for |

| | |
|---|---|
| | Copper Sheet, Strip, Plate, and Rolled Bar |
| ASTM B 306 | (2002) Standard Specification for Copper Drainage Tube (DWV) |
| ASTM B 32 | (2008) Standard Specification for Solder Metal |
| ASTM B 370 | (2003) Standard Specification for Copper Sheet and Strip for Building Construction |
| ASTM B 42 | (2002e1) Standard Specification for Seamless Copper Pipe, Standard Sizes |
| ASTM B 43 | (1998; R 2004) Standard Specification for Seamless Red Brass Pipe, Standard Sizes |
| ASTM B 584 | (2008a) Standard Specification for Copper Alloy Sand Castings for General Applications |
| ASTM B 75 | (2002) Standard Specification for Seamless Copper Tube |
| ASTM B 813 | (2000e1) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube |
| ASTM B 828 | (2002) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings |
| ASTM B 88 | (2003) Standard Specification for Seamless Copper Water Tube |
| ASTM B 88M | (2005) Standard Specification for Seamless Copper Water Tube (Metric) |
| ASTM C 1053 | (2000; R 2005) Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications |
| ASTM C 564 | (2008) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings |
| ASTM C 920 | (2008) Standard Specification for Elastomeric Joint Sealants |
| ASTM D 1004 | (2008) Initial Tear Resistance of Plastic Film and Sheeting |
| ASTM D 1248 | (2005) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable |
| ASTM D 1785 | (2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120 |

| | |
|---|---|
| ASTM D 2000 | (2008) Standard Classification System for Rubber Products in Automotive Applications |
| ASTM D 2235 | (2004) Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings |
| ASTM D 2239 | (2003) Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter |
| ASTM D 2241 | (2005) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) |
| ASTM D 2464 | (2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM D 2466 | (2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 |
| ASTM D 2467 | (2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM D 2564 | (2004e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems |
| ASTM D 2665 | (2008b) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings |
| ASTM D 2672 | (1996a; R 2003) Joints for IPS PVC Pipe Using Solvent Cement |
| ASTM D 2683 | (2004) Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing |
| ASTM D 2822 | (2005) Asphalt Roof Cement |
| ASTM D 2846/D 2846M | (2006) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems |
| ASTM D 2855 | (1996; R 2002) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings |
| ASTM D 2996 | (2001; R 2007e1) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe |

| | |
|---|---|
| ASTM D 3122 | (1995; R 2002) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings |
| ASTM D 3138 | (2004) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components |
| ASTM D 3139 | (1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals |
| ASTM D 3212 | (2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals |
| ASTM D 3261 | (2003) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing |
| ASTM D 3311 | (2008) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns |
| ASTM D 4101 | (2008) Standard Specification for Polypropylene Injection and Extrusion Materials |
| ASTM D 4551 | (1996e1; R 2008) Poly(Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane |
| ASTM D 638 | (2008) Standard Test Method for Tensile Properties of Plastics |
| ASTM E 1 | (2007) Standard Specification for ASTM Liquid-in-Glass Thermometers |
| ASTM E 96/E 96M | (2005) Standard Test Methods for Water Vapor Transmission of Materials |
| ASTM F 1760 | (2001; R 2005e1) Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content |
| ASTM F 409 | (2002) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings |
| ASTM F 437 | (2006) Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM F 438 | (2004) Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40 |

| | |
|---|---|
| ASTM F 439 | (2006) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM F 441/F 441M | (2002) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80 |
| ASTM F 442/F 442M | (1999; R 2005e1) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR) |
| ASTM F 477 | (2008) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| ASTM F 493 | (2004) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings |
| ASTM F 628 | (2008) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core |
| ASTM F 877 | (2007) Crosslinked Polyethylene (PEX) Plastic Hot- and Cold- Water Distribution Systems |
| ASTM F 891 | (2007) Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core |

CAST IRON SOIL PIPE INSTITUTE (CISPI)

| | |
|---|---|
| CISPI 301 | (2004) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications |
| CISPI 310 | (2004) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications |

COPPER DEVELOPMENT ASSOCIATION (CDA)

| | |
|---|---|
| CDA A4015 | (1994; R 1995) Copper Tube Handbook |

CSA AMERICA, INC. (CSA/AM)

| | |
|---|---|
| CSA/AM Z21.22 | (1999; Addenda A 2000, Addenda B 2001; R 2004) Relief Valves for Hot Water Supply Systems |

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

| | |
|---|---|
| FCCCHR Manual | (1988e9) Manual of Cross-Connection Control |

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

| | |
|---|---|
| IAPMO PS 117 | (2005) Press Type Or Plain End Rub Gsktd W/ Nail CU & CU Alloy Fittings for Install On CU Tubing |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|---|---|
| ICC A117.1 | (2003; R 2004) Standard for Accessible and Usable Buildings and Facilities |
| ICC IPC | (2006; Supplement 2007) International Plumbing Code |

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

| | |
|---|---|
| ISEA Z358.1 | (2004) Emergency Eyewash and Shower Equipment |

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

| | |
|---|---|
| MSS SP-110 | (1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends |
| MSS SP-25 | (2008) Standard Marking System for Valves, Fittings, Flanges and Unions |
| MSS SP-44 | (2006) Steel Pipeline Flanges |
| MSS SP-58 | (2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture |
| MSS SP-67 | (2002a; R 2004) Standard for Butterfly Valves |
| MSS SP-69 | (2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application |
| MSS SP-70 | (2006) Standard for Cast Iron Gate Valves, Flanged and Threaded Ends |
| MSS SP-71 | (2005) Standard for Gray Iron Swing Check Valves, Flanged and Threaded Ends |
| MSS SP-72 | (1999) Standard for Ball Valves with Flanged or Butt-Welding Ends for General Service |
| MSS SP-73 | (2003) Brazing Joints for Copper and Copper Alloy Pressure Fittings |
| MSS SP-78 | (2005a) Cast Iron Plug Valves, Flanged and Threaded Ends |
| MSS SP-80 | (2008) Bronze Gate, Globe, Angle and Check |

Valves

MSS SP-83 (2006) Standard for Class 3000 Steel Pipe Unions Socket Welding and Threaded

MSS SP-85 (2002) Standard for Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2003) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (2008) Standard for the Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF 14 (2008) Plastics Piping System Components and Related Materials

NSF 61 (2008) Drinking Water System Components - Health Effects

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA-01 (1998) Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201 (2006) Water Hammer Arresters Standard

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508 (1997) Hose Clamp Specifications

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star (1992; R 2006) Energy Star Energy Efficiency Labeling System

PL 93-523 (1974; A 1999) Safe Drinking Water Act

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 430 Energy Conservation Program for Consumer Products

40 CFR 50.12 National Primary and Secondary Ambient Air

| | |
|---|---|
| | Quality Standards for Lead |
| PL 109-58 | Energy Policy Act of 2005 (EPAct05) |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 174 | (2004; Rev thru Sep 2008) Household Electric Storage Tank Water Heaters |
| UL 1951 | (1994; Rev thru Oct 2008) Standard for Electric Plumbing Accessories |
| UL 430 | (2004; Rev thru Nov 2007) Waste Disposers |
| UL 499 | (2005; Rev thru Aug 2008) Electric Heating Appliances |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fixtures; (LEED)

List of installed fixtures with manufacturer, model, and flow rate.

Flush valve water closets

Flush valve urinals

Wall hung lavatories

Kitchen sinks

Service sinks

Drinking-water coolers

Water heaters

Pumps

Backflow prevention assemblies; G

Shower Faucets

Welding

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Plumbing System

Diagrams, instructions, and other sheets proposed for posting.

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Test of Backflow Prevention Assemblies; G.

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

SD-10 Operation and Maintenance Data

Plumbing System; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

[Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and

welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with Section 05 05 23 WELDING, STRUCTURAL.

1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC. Energy consuming products and systems shall be in accordance with PL 109-58 and ASHRAE 90.1 - IP

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.9 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal

"NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Solder containing lead shall not be used with copper pipe. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A 74, AWWA C606. For hubless type: CISPI 310

b. Coupling for Steel Pipe: AWWA C606.

c. Couplings for Grooved Pipe: [Ductile Iron ASTM A 536 (Grade 65-45-12)] [Malleable Iron ASTM A 47/A 47M, Grade 32510]. [Copper ASTM A 536].

d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

e. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.

f. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.

g. Solder Material: Solder metal shall conform to ASTM B 32.

h. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.

i. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.

j. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.

k. Rubber Gaskets for Grooved Pipe: ASTM D 2000, maximum temperature

230 degrees F.

l. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.

m. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A 183.

n. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D 3138.

o. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D 2235.

p. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855.

q. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F 493.

r. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105/A 105M. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.

s. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D 3122.

t. Press fittings for Copper Pipe and Tube: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for copper press fittings shall be EPDM, FKM or HNBR. Sealing elements shall be factory installed or an alternative supplied fitting manufacturer. Sealing element shall be selected based on manufacturer's approved application guidelines.

u. Copper tubing shall conform to ASTM B 88, Type K, L or M.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201. [Water hammer arrester shall be [diaphragm][ or ][piston] type.]

b. Copper, Sheet and Strip for Building Construction: ASTM B 370.

c. Asphalt Roof Cement: ASTM D 2822.

d. Hose Clamps: SAE J1508.

e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

f. Metallic Cleanouts: ASME A112.36.2M.

g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be

nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.

i. Hypochlorites: AWWA B300.

j. Liquid Chlorine: AWWA B301.

k. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.

l. Thermometers: ASTM E 1. Mercury shall not be used in thermometers.

### 2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

## 2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

## 2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

| Description | Standard |
|---|---|
| Butterfly Valves | MSS SP-67 |
| Cast-Iron Gate Valves, Flanged and Threaded Ends | MSS SP-70 |
| Cast-Iron Swing Check Valves, Flanged and Threaded Ends | MSS SP-71 |
| Ball Valves with Flanged Butt-Welding Ends for General Service | MSS SP-72 |
| Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends | MSS SP-110 |
| Cast-Iron Plug Valves, Flanged and Threaded Ends | MSS SP-78 |
| Bronze Gate, Globe, Angle, and Check Valves | MSS SP-80 |
| Steel Valves, Socket Welding and Threaded Ends | ASME B16.34 |
| Cast-Iron Globe and Angle Valves, Flanged and | MSS SP-85 |

| Description<br>Threaded Ends | Standard |
|---|---|
| Backwater Valves | ASME A112.14.1 |
| Vacuum Relief Valves | CSA/AM Z21.22 |
| Water Heater Drain Valves | ASSE 1005 |
| Trap Seal Primer Valves | ASSE 1018 |
| Temperature and Pressure Relief Valves for Hot Water Supply Systems | CSA/AM Z21.22 |
| Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers | ASME CSD-1<br>Safety Code No., Part CW, Article 5 |

2.3.1 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

2.3.2 Wall Hydrants (Frostproof)

ASSE 1019 with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

2.3.3 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to CSA/AM Z21.22. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh shall have 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh shall have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.3.4 Thermostatic Mixing Valves

Provide thermostatic mixing valve for lavatory faucets. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and

pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 5 degrees F of any setting.

## 2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with ICC IPC. Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years or shall be copper alloy with all visible surfaces chrome plated. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature.]

### 2.4.1 Automatic Controls

Provide automatic, sensor operated faucets and flush valves to comply with ASSE 1037 and UL 1951 for lavatory faucets, urinals, and water closets. Flushing and faucet systems shall consist of solenoid-activated valves with light beam sensors. Flush valve for water closet shall include an override pushbutton. Flushing devices shall be provided as described in paragraph FIXTURES AND FIXTURE TRIMMINGS.

### 2.4.2 Flush Valve Water Closets

ASME A112.19.2, white vitreous china, siphon jet, elongated bowl, floor-mounted, floor outlet or wall mounted, wall outlet, based on application. Top of toilet seat height above floor shall be 14 to 15 inches, except 17 to 19 inches for wheelchair water closets. Provide wax bowl ring including plastic sleeve. Water flushing volume of the water closet and flush valve combination shall not exceed 1.6 gallons per flush. Provide white solid plastic elongated open-front seat. Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Mounted height of flush valve shall not interfere with the hand

rail in ADA stalls. Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.

### 2.4.3 Flush Valve Urinals

ASME A112.19.2, white vitreous china, wall-mounted, wall outlet, siphon jet, integral trap, and extended side shields. Provide urinal with the rim 17 inches above the floor. Water flushing volume of the urinal and flush valve combination shall not exceed 1.0 gallons per flush. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports. Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.

### 2.4.4 Wheelchair Flush Valve Type Urinals

ASME A112.19.2, white vitreous china, wall-mounted, wall outlet, blowout action, integral trap, elongated projecting bowl, 20 inches long from wall to front of flare, and ASME A112.19.5 trim. Provide large diaphragm (not less than 2.625 inches upper chamber inside diameter at the point where the diaphragm is sealed between the upper and lower chambers), nonhold-open flush valve of chrome plated cast brass conforming to ASTM B 584, including vacuum breaker and angle control-stop valve with back check. The water flushing volume of the flush valve and urinal combination shall not exceed 1.0 gallon per flush. Furnish urinal manufacturer's certification of conformance. Provide ASME A112.6.1M concealed chair carriers. Mount urinal with front rim a maximum of 17 inches above floor and flush valve handle a maximum of 44 inches above floor for use by handicapped on wheelchair. Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.

### 2.4.5 Wall Hung Lavatories

ASME A112.19.2, white vitreous china, straight back type, minimum dimensions of 19 inches, wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets, and openings for concealed arm carrier installation. Provide aerator with faucet. Water flow rate shall not exceed 1.0 gpm when measured at a flowing water pressure of 60 psi. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports and concealed arms for the lavatory. Mount lavatory with the front rim 34 inches above floor and with 29 inches minimum clearance from bottom of the front rim to floor. Provide top-mounted solenoid-activated lavatory faucets including electrical-operated light-beam-sensor to energize the solenoid.

### 2.4.6 Kitchen Sinks

ASME A112.19.3, 20 gage stainless steel with integral mounting rim for flush installation, minimum dimensions of 33 inches wide by 21 inches front to rear, two compartments, with undersides fully sound deadened, with supply openings for use with top mounted washerless sink faucets with hose spray, and with 3.5 inch drain outlet. Provide aerator with faucet. Water flow rate shall not exceed 1.5 gpm when measured at a flowing water pressure of 60 psi. Provide stainless steel drain outlets and stainless steel cup strainers. Provide separate 1.5 inch P-trap and drain piping to vertical vent piping from each compartment. Provide top mounted washerless

sink faucets with hose spray. Provide UL 430 waste disposer in right compartment.

### 2.4.7 Service Sinks

ASME A112.19.2, white vitreous china with integral back and wall hanger supports, minimum dimensions of 22 inches wide by 20 inches front to rear, with two supply openings in 10 inch high back. Provide floor supported wall outlet cast iron P-trap and stainless steel rim guards as recommended by service sink manufacturer. Provide back mounted washerless service sink faucets with vacuum breaker and 0.75 inch external hose threads.

### 2.4.8 Drinking-Water Coolers

AHRI 1010 with more than a single thickness of metal between the potable water and the refrigerant in the heat exchanger, wall-hung, bubbler style, air-cooled condensing unit, 4.75 gph minimum capacity, stainless steel splash receptor and basin, and stainless steel cabinet. Bubblers shall be controlled by push levers or push bars, front mounted or side mounted near the front edge of the cabinet. Bubbler spouts shall be mounted at maximum of 36 inches above floor and at front of unit basin. Spouts shall direct water flow at least 4 inches above unit basin and trajectory parallel or nearly parallel to the front of unit. Provide ASME A112.6.1M concealed steel pipe chair carriers.

### 2.4.9 Wheelchair Drinking Water cooler

AHRI 1010, wall-mounted bubbler style with ASME A112.6.1M concealed chair carrier, air-cooled condensing unit, 4.75 gph minimum capacity, stainless steel splash receptor, and all stainless steel cabinet, with 27 inch minimum knee clearance from front bottom of unit to floor and 36 inch maximum spout height above floor. Bubblers shall also be controlled by push levers, by push bars, or touch pads one on each side or one on front and both sides of the cabinet.

### 2.4.10 Precast Terrazzo Mop Sinks

Terrazzo shall be made of marble chips cast in white portland cement to produce 3000 psi minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers.

### 2.4.11 Emergency Eyewash and Shower

ISEA Z358.1, floor supported free standing unit. Provide deluge shower head, stay-open ball valve operated by pull rod and ring or triangular handle. Provide eyewash and stay-open ball valve operated by foot treadle or push handle.

## 2.5 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR Manual. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied

atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

## 2.6 DRAINS

### 2.6.1 Floor and Shower Drains

Floor and shower drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.6.3. [Provide drain with trap primer connection, trap primer, and connection piping. Primer shall meet ASSE 1018.]

#### 2.6.1.1 Metallic Shower Pan Drains

Where metallic shower pan membrane is installed, polyethylene drain with corrosion-resistant screws securing the clamping device shall be provided. Polyethylene drains shall have fittings to adapt drain to waste piping. Polyethylene for floor drains shall conform to ASTM D 1248. Drains shall have separate cast-iron "P" trap, circular body, seepage pan, and strainer, unless otherwise indicated.

#### 2.6.1.2 Drains and Backwater Valves

Drains and backwater valves installed in connection with waterproofed floors or shower pans shall be equipped with bolted-type device to securely clamp flashing.

### 2.6.2 Bathtub and Shower Faucets and Drain Fittings

Provide single control pressure equalizing bathtub and shower faucets with body mounted from behind the wall with threaded connections. Provide ball joint self-cleaning shower heads. Provide shower heads which deliver a maximum of 2.2 GPM at 80 PSI per Energy Star requirements. Provide tubing mounted from behind the wall between bathtub faucets and shower heads and bathtub diverter spouts. Provide separate globe valves or angle valves with union connections in each supply to faucet.

### 2.6.3 Area Drains

Area drains shall be plain pattern with polished stainless steel perforated or slotted grate and bottom outlet. The drain shall be circular or square with a 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Drains shall be cast iron with manufacturer's standard coating. Grate shall be easily lifted out for cleaning. Outlet shall be suitable for inside caulked connection to drain pipe. Drains shall conform to ASME A112.6.3.

### 2.6.4 Floor Sinks

Floor sinks shall be square, with 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body, and perforated grate of cast iron in industrial areas and stainless steel in finished areas. The outlet pipe size shall be as indicated or of the same size as the connecting pipe.

### 2.6.5 Sight Drains

Sight drains shall consist of body, integral seepage pan, and adjustable strainer with perforated or slotted grate and funnel extension. The strainer shall have a threaded collar to permit adjustment to floor thickness. Drains shall be of double drainage pattern suitable for embedding in the floor construction. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided for other than concrete construction. Drains shall have a galvanized heavy cast-iron body and seepage pan and chromium-plated bronze, nickel-bronze, or nickel-brass strainer and funnel combination. Drains shall be provided with threaded connection and with a separate cast-iron "P" trap, unless otherwise indicated. Drains shall be circular, unless otherwise indicated. The funnel shall be securely mounted over an opening in the center of the strainer. Minimum dimensions shall be as follows:

| | |
|---|---|
| Area of strainer and collar | 36 square inches |
| Height of funnel | 3-3/4 inches |
| Diameter of lower portion of funnel | 2 inches |
| Diameter of upper portion of funnel | 4 inches |

## 2.7 SHOWER PAN

Shower pan may be copper, or nonmetallic material.

### 2.7.1 Sheet Copper

Sheet copper shall be 16 ounce weight.

### 2.7.2 Plasticized Polyvinyl Chloride Shower Pan Material

Material shall be sheet form. The material shall be 0.040 inch minimum thickness of plasticized polyvinyl chloride or chlorinated polyethylene and shall be in accordance with ASTM D 4551.

### 2.7.3 Nonplasticized Polyvinyl Chloride (PVC) Shower Pan Material

Material shall consist of a plastic waterproofing membrane in sheet form. The material shall be 0.040 inch minimum thickness of nonplasticized PVC and shall have the following minimum properties:

a. or ASTM D 638:

Ultimate Tensile Strength: 2600 psi
Ultimate Elongation: 398 percent
100 Percent Modulus: 445 psi

b. ASTM D 1004:

Tear Strength: 300 pounds per inch

c. ASTM E 96/E 96M:

Permeance: 0.008 perms

d. Other Properties:

Specific Gravity: 1.29
PVC Solvent: Weldable
Cold Crack: minus -53 degrees F
Dimensional stability, 212 degrees F minus 2.5 percent
Hardness, Shore A: 89

## 2.8 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F 409 or copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Provide traps with removable access panels for easy clean-out at sinks and lavatories. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

## 2.9 INTERCEPTORS

### 2.9.1 Oil Interceptor

Cast iron or welded steel, coated inside and outside with white acid resistant epoxy, with internal air relief bypass, bronze cleanout plug, double wall trap seal, removable combination pressure equalizing and flow diffusing baffle and sediment bucket, horizontal baffle, adjustable oil draw-off and vent connections on either side, gas and watertight gasketed nonskid cover, and flow control fitting.

## 2.10 WATER HEATERS

Water heater types and capacities shall be as indicated. Each water heater

shall have replaceable anodes. Each primary water heater shall have controls with an adjustable range that includes 90 to 160 degrees F. Each gas-fired water heater and booster water heater shall have controls with an adjustable range that includes 120 to 180 degrees F. Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and standby heat losses shall conform to TABLE III for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 500 gallons storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 200 degrees F water temperature and 150 psi working pressure. The expansion tank size and acceptance volume shall be as indicated.

2.10.1 Automatic Storage Type

Heaters shall be complete with control system, and shall have ASME rated combination pressure and temperature relief valve.

2.10.1.1 Electric Type

Electric type water heaters shall conform to UL 174 with dual heating elements. Each element shall be 4.5 KW. The elements shall be wired so that only one element can operate at a time.

2.10.2 Electric Instantaneous Water Heaters (Tankless)

UL 499 and UL listed flow switch activated, tankless electric instantaneous water heater for wall mounting below sink or lavatory.

2.11 PUMPS

2.11.1 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump and motor shall be supported by the piping on which it is installed. The shaft shall be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze.

Motor shall be totally enclosed, fan-cooled and shall have sufficient horsepower for the service required. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover.

2.12 COMPRESSED AIR SYSTEM

2.12.1 Air Compressors

Air compressor unit shall be a factory-packaged assembly, including motor controls, switches, wiring, accessories, and motor controllers, in a NEMA 250, Type 1 or 4 enclosure. Tank-mounted air compressors shall be manufactured to comply with UL listing requirements. Air compressors shall have manufacturer's name and address, together with trade name, and catalog number on a nameplate securely attached to the equipment. Each compressor shall start and stop automatically at upper and lower pressure limits of the system. Guards shall shield exposed moving parts. An intake air

filter and silencer shall be provided with each compressor. Aftercooler and moisture separator shall be installed between compressors and air receiver to remove moisture and oil condensate before the air enters the receiver. Aftercoolers shall be either air- or water-cooled, as indicated. The air shall pass through a sufficient number of tubes to affect cooling. Tubes shall be sized to give maximum heat transfer. Water to unit shall be controlled by a solenoid or pneumatic valve, which opens when the compressors start and closes when the compressors shut down. Cooling capacity of the aftercooler shall be sized for the total capacity of the compressors. Means shall be provided for draining condensed moisture from the receiver by an automatic float type trap. Capacities of air compressors and receivers shall be as indicated.

### 2.12.2 Air Receivers

Receivers shall be designed for 200 psi working pressure. Receivers shall be factory air tested to 1-1/2 times the working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges and automatic and manual drains. The outside of air receivers may be galvanized or supplied with commercial enamel finish. Receivers shall be designed and constructed in accordance with ASME BPVC SEC VIII D1 and shall have the design working pressures specified herein. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided.

### 2.12.3 Intake Air Supply Filter

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 microns. Filter body and media shall withstand a maximum 125 psi, capacity as indicated.

### 2.12.4 Pressure Regulators

The air system shall be provided with the necessary regulator valves to maintain the desired pressure for the installed equipment. Regulators shall be designed for a maximum inlet pressure of 125 psi and a maximum temperature of 200 degrees F. Regulators shall be single-seated, pilot-operated with valve plug, bronze body and trim or equal, and threaded connections. The regulator valve shall include a pressure gauge and shall be provided with an adjustment screw for adjusting the pressure differential from 0 to 125 psi. Regulator shall be sized as indicated.

## 2.13 DOMESTIC WATER SERVICE METER

Cold water meters 2 inches and smaller shall be positive displacement type conforming to AWWA C700. Cold water meters 2-1/2 inches and larger shall be turbine type conforming to AWWA C701. Meter register may be round or straight reading type, as provided by the local utility. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

## 2.14 ELECTRICAL WORK

Provide electrical motor driven equipment specified complete with motors, motor starters, and controls as specified herein and in Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide [high efficiency type, ]single-phase, fractional-horsepower alternating-current

motors, including motors that are part of a system, corresponding to the applications in accordance with NEMA MG 11. [In addition to the requirements of Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM, provide polyphase, squirrel-cage medium induction motors with continuous ratings, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. ] Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

Controllers and contactors shall have auxiliary contacts for use with the controls provided. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers, including the required monitors and timed restart.

Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

## 2.15 MISCELLANEOUS PIPING ITEMS

### 2.15.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

### 2.15.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where [supply] drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

#### 2.15.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

#### 2.15.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.15.3 Pipe Hangers (Supports)

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.15.4 Nameplates

Provide 0.125 inch thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 0.25 inch high normal block lettering into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

2.15.5 Labels

Provide labels for sensor operators at flush valves and faucets. Include the following information on each label:

a. Identification of the sensor and its operation with [graphic] [written] [Braille] description.

b. Range of the sensor.

c. Battery replacement schedule.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A gate valve or full port ball valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the finish grade or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

### 3.1.1 Water Pipe, Fittings, and Connections

#### 3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

#### 3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

#### 3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

#### 3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

#### 3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and full port ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the

supply piping at the fixture is an acceptable drain.

#### 3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

#### 3.1.1.7 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 4 inches in diameter or larger shall be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

#### 3.1.1.8 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

### 3.1.2 Compressed Air Piping (Non-Oil Free)

Compressed air piping shall be installed as specified for water piping and suitable for 125 psig working pressure. Compressed air piping shall have supply lines and discharge terminals legibly and permanently marked at both ends with the name of the system and the direction of flow.

### 3.1.3 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be

made up with fittings of compatible material and made for the specific purpose intended.

3.1.3.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.3.2 Mechanical Couplings

Mechanical couplings may be used in conjunction with grooved pipe for aboveground, ferrous or non-ferrous, domestic hot and cold water systems, in lieu of unions, brazed, soldered, welded, flanged, or threaded joints.

Mechanical couplings are permitted in accessible locations including behind access plates. Flexible grooved joints will not be permitted, except as vibration isolators adjacent to mechanical equipment. Rigid grooved joints shall incorporate an angle bolt pad design which maintains metal-to-metal contact with equal amount of pad offset of housings upon installation to ensure positive rigid clamping of the pipe.

Designs which can only clamp on the bottom of the groove or which utilize gripping teeth or jaws, or which use misaligned housing bolt holes, or which require a torque wrench or torque specifications will not be permitted.

Rigid grooved pipe couplings shall be for use with grooved end pipes, fittings, valves and strainers. Rigid couplings shall be designed for not less than 125 psi service and appropriate for static head plus the pumping head, and shall provide a watertight joint.

Grooved fittings and couplings, and grooving tools shall be provided from the same manufacturer. Segmentally welded elbows shall not be used. Grooves shall be prepared in accordance with the coupling manufacturer's latest published standards. Grooving shall be performed by qualified grooving operators having demonstrated proper grooving procedures in accordance with the tool manufacturer's recommendations.

The Contracting Officer shall be notified 24 hours in advance of test to demonstrate operator's capability, and the test shall be performed at the work site, if practical, or at a site agreed upon. The operator shall demonstrate the ability to properly adjust the grooving tool, groove the pipe, and to verify the groove dimensions in accordance with the coupling manufacturer's specifications.

3.1.3.3 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.3.4 Grooved Mechanical Joints

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter

of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.1.3.5 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.3.6 Copper Tube and Pipe

a. Brazed. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA A4015 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air compressor and the receiver.

c. Copper Tube Extracted Joint. Mechanically extracted joints shall be made in accordance with ICC IPC.

d. Press connection. Copper press connections shall be made in **strict** accordance with the manufacturer's installation instructions for manufactured rated size. The joints shall be pressed using the tool(s) approved by the manufacturer **of that joint**. Minimum distance between fittings shall be in accordance with the manufacturer's requirements.

3.1.3.7 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

3.1.3.8 Other Joint Methods

3.1.4 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed

to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.5 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.5.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor.

Unless otherwise indicated, sleeves shall be of a size to provide a minimum of one inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic.

Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated.

3.1.5.2 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be

suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.5.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.5.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

a. A standard roof coupling for threaded pipe up to 6 inches in diameter.

b. A tack-welded or banded-metal rain shield around the pipe.

3.1.5.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07 92 00 JOINT SEALANTS.

3.1.5.6 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.6 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07 84 00 FIRESTOPPING.

3.1.7 Supports

3.1.7.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.7.2 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.

h. Type 40 shields shall:

(1) Be used on insulated pipe less than 4 inches.

(2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.

(3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 8 pcf or greater.

i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:

(1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.

(2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

(3) On pipe 4 inches and larger carrying medium less that 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

n. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.7.3 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.8 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.9 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be [cast iron] [or] [plastic].

## 3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

### 3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 6 inches above the top of the tank or water heater.

### 3.2.2 Heat Traps

Piping to and from each water heater and hot water storage tank shall be routed horizontally and downward a minimum of 2 feet before turning in an upward direction.

### 3.2.3 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

### 3.2.4 Expansion Tank

A pre-charged expansion tank shall be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor shall adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

## 3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

### 3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. [Flushometer valves for water closets shall be installed 39 inches above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 30 inches above the floor and arranged to avoid interference with grab bars.

3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC A117.1.

3.3.4 Shower Bath Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

3.3.5 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.5.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.3.5.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.3.5.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.5.4 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished

shall be as recommended by the chair-carrier manufacturer.

### 3.3.6 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with [ICC IPC] at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

### 3.3.7 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in[ Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS][ Section 05 51 33 METAL LADDERS][ Section 05 52 00 METAL RAILINGS][ Section 05 51 00 METAL STAIRS].

### 3.3.8 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 2 inches above the flood rim of the funnel to provide an acceptable air gap.

### 3.3.9 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311. Traps for acid-resisting waste shall be of the same material as the pipe.

### 3.3.10 Shower Pans

Before installing shower pan, subfloor shall be free of projections such as nail heads or rough edges of aggregate. Drain shall be a bolt-down, clamping-ring type with weepholes, installed so the lip of the subdrain is flush with subfloor.

#### 3.3.10.1 General

The floor of each individual shower, the shower-area portion of combination shower and drying room, and the entire shower and drying room where the two are not separated by curb or partition, shall be made watertight with a shower pan fabricated in place. The shower pan material shall be cut to size and shape of the area indicated, in one piece to the maximum extent practicable, allowing a minimum of 6 inches for turnup on walls or

partitions, and shall be folded over the curb with an approximate return of 1/4 of curb height. The upstands shall be placed behind any wall or partition finish. Subflooring shall be smooth and clean, with nailheads driven flush with surface, and shall be sloped to drain. Shower pans shall be clamped to drains with the drain clamping ring.

3.3.10.2 Metal Shower Pans

When a shower pan of required size cannot be furnished in one piece, metal pieces shall be joined with a flintlock seam and soldered or burned. The corners shall be folded, not cut, and the corner seam shall be soldered or burned. Pans, including upstands, shall be coated on all surfaces with one brush coat of asphalt. Asphalt shall be applied evenly at not less than 1 gallon per 50 square feet. A layer of felt covered with building paper shall be placed between shower pans and wood floors. The joining surfaces of metal pan and drain shall be given a brush coat of asphalt after the pan is connected to the drain.

3.3.10.3 Nonplasticized Chlorinated Polyethylene Shower Pans

Corners of nonplasticized chlorinated polyethylene shower pans shall be folded against the upstand by making a pig-ear fold. Hot-air gun or heat lamp shall be used in making corner folds. Each pig-ear corner fold shall be nailed or stapled 1/2 inch from the upper edge to hold it in place. Nails shall be galvanized large-head roofing nails. On metal framing or studs, approved duct tape shall be used to secure pig-ear fold and membrane. Where no backing is provided between the studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding 1/2 inch from upper edge. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it will be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Surfaces to be solvent-welded shall be clean. Surfaces to be joined with xylene shall be initially sprayed and vigorously cleaned with a cotton cloth, followed by final coating of xylene and the joining of the surfaces by roller or equivalent means. If ambient or membrane temperatures are below 40 degrees F the membrane and the joint shall be heated prior to application of xylene. Heat may be applied with hot-air gun or heat lamp, taking precautions not to scorch the membrane. Adequate ventilation and wearing of gloves are required when working with xylene. Membrane shall be pressed into position on the drain body, and shall be cut and fit to match so that membrane can be properly clamped and an effective gasket-type seal provided. On wood subflooring, two layers of 15 pound dry felt shall be installed prior to installation of shower pan to ensure a smooth surface for installation.

3.3.10.4 Nonplasticized Polyvinyl Chloride (PVC) Shower Pans

Nonplasticized PVC shall be turned up behind walls or wall surfaces a distance of not less than 6 inches in room areas and 3 inches above curb level in curbed spaces with sufficient material to fold over and fasten to outside face of curb. Corners shall be pig-ear type and folded between pan and studs. Only top 1 inch of upstand shall be nailed to hold in place. Nails shall be galvanized large-head roofing type. Approved duct tape shall be used on metal framing or studs to secure pig-ear fold and membrane. Where no backing is provided between studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding at top inch of upstand. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it is to be applied shall be coated

with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Trim for drain shall be exactly the size of drain opening. Bolt holes shall be pierced to accommodate bolts with a tight fit. Adhesive shall be used between pan and subdrain. Clamping ring shall be bolted firmly. A small amount of gravel or porous materials shall be placed at weepholes so that holes remain clear when setting bed is poured. Membrane shall be solvent welded with PVC solvent cement. Surfaces to be solvent welded shall be clean (free of grease and grime). Sheets shall be laid on a flat surface with an overlap of about 2 inches. Top edge shall be folded back and surface primed with a PVC primer. PVC cement shall be applied and surfaces immediately placed together, while still wet. Joint shall be lightly rolled with a paint roller, then as the joint sets shall be rolled firmly but not so hard as to distort the material. In long lengths, about 2 or 3 feet at a time shall be welded. On wood subflooring, two layers of 15 pound felt shall be installed prior to installation of shower pan to ensure a smooth surface installation.

## 3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors.

### 3.4.1 Tank- or Skid-Mounted Compressors

Floor attachment shall be as recommended by compressor manufacturer.

## 3.5 WATER METER REMOTE READOUT REGISTER

The remote readout register shall be mounted at the location indicated or as directed by the Contracting Officer.

## 3.6 IDENTIFICATION SYSTEMS

### 3.6.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

### 3.6.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

### 3.6.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished

space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 3/8 inch in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 3 foot width, 30 inches height, and 1/2 inch thickness. The board shall be made of wood fiberboard and framed under glass or 1/16 inch transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. The color code board shall be mounted and located in the mechanical or equipment room. The color code system shall be as indicated below:

| Color | System | Item | Location |
|---|---|---|---|
| [_____] | [_____] | [_____] | [_____] |

## 3.7 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

## 3.8 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

### 3.8.1 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

#### 3.8.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B 117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use

on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.8.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

3.9 TESTS, FLUSHING AND DISINFECTION

3.9.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with [ICC IPC], except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure to the Contracting Officer for approval.

a. Drainage and Vent Systems Test. The final test shall include a smoke test.

b. Building Sewers Tests.

c. Water Supply Systems Tests.

3.9.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection

(Manual M-14). Report form for each assembly shall include, as a minimum, the following:

| Data on Device | Data on Testing Firm |
|---|---|
| Type of Assembly | Name |
| Manufacturer | Address |
| Model Number | Certified Tester |
| Serial Number | Certified Tester No. |
| Size | Date of Test |
| Location | |
| Test Pressure Readings | Serial Number and Test Data of Gauges |

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.9.1.2 Shower Pans

After installation of the pan and finished floor, the drain shall be temporarily plugged below the weep holes. The floor area shall be flooded with water to a minimum depth of 1 inch for a period of 24 hours. Any drop in the water level during test, except for evaporation, will be reason for rejection, repair, and retest.

3.9.1.3 Compressed Air Piping (Nonoil-Free)

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to 150 psig and hold this pressure for 2 hours with no drop in pressure.

3.9.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.9.3 System Flushing

3.9.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with [hot] potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

3.9.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Comply with ASHRAE 90.1 - IP for minimum efficiency requirements. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 50.12 Part 141.80(c)(1). The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.9.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

e. Pump suction and discharge pressures.

f. Temperature of each domestic hot-water supply.

g. Operation of each floor and roof drain by flooding with water.

h. Operation of each vacuum breaker and backflow preventer.

i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

j. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in quadruplicate. The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

3.9.5 Disinfection

After operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. System shall be flushed as specified, before introducing chlorinating material. The

chlorinating material shall be hypochlorites or liquid chlorine. Except as herein specified, water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump, shall be used. If after the 24 hour and 6 hour holding periods, the residual solution contains less than 25 ppm and 50 ppm chlorine respectively, flush the piping and tank with potable water, and repeat the above procedures until the required residual chlorine levels are satisfied. The system including the tanks shall then be flushed with clean water until the residual chlorine level is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. Samples of water in disinfected containers shall be obtained from several locations selected by the Contracting Officer.

The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method used shall be EPA approved for drinking water systems and shall comply with applicable local and state requirements.

Disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

## 3.10 WASTE MANAGEMENT

Place materials defined as hazardous or toxic waste in designated containers. Return solvent and oil soaked rags for contaminant recovery and laundering or for proper disposal. Close and seal tightly partly used sealant and adhesive containers and store in protected, well-ventilated, fire-safe area at moderate temperature. Place used sealant and adhesive tubes and containers in areas designated for hazardous waste. Separate copper and ferrous pipe waste in accordance with the Waste Management Plan and place in designated areas for reuse.

## 3.11 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

## 3.12 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, minimum overall efficiency.

ET = Minimum thermal efficiency with 70 degrees F delta T.

SL = Standby loss is maximum (Btu/h) based on a 70 degrees F temperature difference between stored water and ambient requirements.

V = Rated volume in gallons

Q = Nameplate input rate in kW (Btu/h)

3.12.1 Storage Water Heaters

3.12.1.1 Electric

a. Storage capacity of 60 gallons shall have a minimum energy factor (EF) of 0.93 or higher per FEMP requirements.

b. Storage capacity of 60 gallons or more shall have a minimum energy factor (EF) of 0.91 or higher per FEMP requirements.

3.13 TABLES

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

| | | SERVICE | | | | | |
|---|---|---|---|---|---|---|---|
| Item # | Pipe and Fitting Materials | A | B | C | D | E | F |
| 1 | Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark. | X | X | X | X | X | |
| 2 | Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A 888. Pipe and fittings shall be marked with the CISPI trademark. | | X | X | X | X | |
| 3 | Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10 | X | | X | X | | |
| 4 | Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10 | | | | X | X | |
| 5 | Grooved pipe couplings, ferrous and non-ferrous pipe ASTM A 536 and ASTM A 47/A 47M | X | X | | X | X | |
| 6 | Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47/A 47M for use with Item 5 | X | X | | X | X | |
| 7 | Bronze sand casting grooved joint pressure fittings for non-ferrous pipe | X | X | | X | X | |

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

| Item # | Pipe and Fitting Materials | SERVICE A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| | ASTM B 584, for use with Item 5 | | | | | | |
| 8 | Wrought copper grooved joint pressure pressure fittings for non-ferrous pipe ASTM B 75 C12200, ASTM B 152/B 152M, C11000, ASME B16.22 ASME B16.22 for use with Item 5 | X | X | | | | |
| 9 | Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10 | | | | X | X | |
| 10 | Steel pipe, seamless galvanized, ASTM A 53/A 53M, Type S, Grade B | X | | | X | X | |
| 11 | Seamless red brass pipe, ASTM B 43 | | X | X | | | |
| 12 | Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14 | | | | X | X | |
| 13 | Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14 | | | | X | X | |
| 14 | Seamless copper pipe, ASTM B 42 | | | | X | | |
| 15 | Cast bronze threaded fittings, ASME B16.15 | | | | X | X | |
| 16 | Copper drainage tube, (DWV), ASTM B 306 | X* | X | X* | X | X | |
| 17 | Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29 | X | X | X | X | X | |
| 18 | Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23 | X | X | X | X | X | |
| 19 | Acrylonitrile-Butadiene-Styrene (ABS) plastic drain, waste, and vent pipe and fittings ASTM D 2661, ASTM F 628 | X | X | X | X | X | X |
| 20 | Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D 2665, | X | X | X | X | X | X |

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

| | | SERVICE | | | | | |
|---|---|---|---|---|---|---|---|
| Item # | Pipe and Fitting Materials | A | B | C | D | E | F |
| | ASTM F 891, (Sch 40)<br>ASTM F 1760 | | | | | | |
| 21 | Process glass pipe and fittings,<br>ASTM C 1053 | | | | | | X |
| 22 | High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint),<br>ASTM A 518/A 518M | | X | | | X | X |
| 23 | Polypropylene (PP) waste pipe and fittings, ASTM D 4101 | | | | | | X |
| 24 | Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996 | | | | | | X |

SERVICE:

A - Underground Building Soil, Waste and Storm Drain
B - Aboveground Soil, Waste, Drain In Buildings
C - Underground Vent
D - Aboveground Vent
E - Interior Rainwater Conductors Aboveground
F - Corrosive Waste And Vent Above And Belowground
* - Hard Temper

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

| | | SERVICE | | | |
|---|---|---|---|---|---|
| Item No. | Pipe and Fitting Materials | A | B | C | D |
| 1 | Malleable-iron threaded fittings,<br>a. Galvanized, ASME B16.3<br>for use with Item 4a | X | X | X | X |
| | b. Same as "a" but not galvanized<br>for use with Item 4b | | | X | |
| 2 | Grooved pipe couplings, ferrous pipe<br>ASTM A 536 and<br>ASTM A 47/A 47M, non-ferrous<br>pipe, ASTM A 536<br>and ASTM A 47/A 47M, | X | X | X | |
| 3 | Ductile iron grooved joint fittings<br>for ferrous pipe ASTM A 536 | X | X | X | |

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

| Item No. | Pipe and Fitting Materials | SERVICE A | B | C | D |
|---|---|---|---|---|---|
| | and ASTM A 47/A 47M, for use with Item 2 | | | | |
| 4 | Steel pipe: a. Seamless, galvanized, ASTM A 53/A 53M, Type S, Grade B | X | X | X | X |
| | b. Seamless, black, ASTM A 53/A 53M, Type S, Grade B | | | X | |
| 5 | Seamless red brass pipe, ASTM B 43 | X | X | | X |
| 6 | Bronze flanged fittings, ASME B16.24 for use with Items 5 and 7 | X | X | | X |
| 7 | Seamless copper pipe, ASTM B 42 | X | X | | X |
| 8 | Seamless copper water tube, ASTM B 88, ASTM B 88M | X** | X** | X** | X*** |
| 9 | Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7 | X | X | | X |
| 10 | Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 5, 7 and 8 | X | X | X | X |
| 11 | Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Item 8 | X | X | X | X |
| 12 | Bronze and sand castings grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 2 | X | X | X | |
| 13 | Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter ASTM D 2447 | X | | | X |
| 14 | Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, | X | | | X |

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

| Item No. | Pipe and Fitting Materials | SERVICE A | B | C | D |
|---|---|---|---|---|---|
| | ASTM D 3035 | | | | |
| 15 | Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, ASTM D 2239 | X | | | X |
| 16 | Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D 3261 for use with Items 14, 15, and 16 | X | | | X |
| 17 | Socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe, ASTM D 2683 for use with Item 15 | X | | | X |
| 18 | Polyethylene (PE) plastic tubing, ASTM D 2737 | X | | | X |
| 19 | Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D 2846/D 2846M | X | X | | X |
| 20 | Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, ASTM F 441/F 441M | X | X | | X |
| 21 | Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F 442/F 442M | X | X | | X |
| 22 | Threaded chlorinated polyvinyl chloride (chloride CPVC) plastic pipe fittings, Schedule 80, ASTM F 437, for use with Items 20, and 21 | X | X | | X |
| 23 | Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F 438 for use with Items 20, 21, and 22 | X | X | | X |
| 24 | Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F 439 for use with Items 20, 21, and 22 | X | X | | X |
| 25 | Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, | X | | | X |

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

| Item No. | Pipe and Fitting Materials | SERVICE A | B | C | D |
|---|---|---|---|---|---|
| | ASTM D 1785 | | | | |
| 26 | Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D 2241 | X | | | X |
| 27 | Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D 2466 | X | | | X |
| 28 | Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2467 for use with Items 26 and 27 | X | | | X |
| 29 | Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2464 | X | | | X |
| 30 | Joints for IPS pvs pipe using solvent cement, ASTM D 2672 | X | | | X |
| 31 | Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996 | X | X | | |
| 32 | Steel pipeline flanges, MSS SP-44 | X | X | | |
| 33 | Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B 828 | X | X | | |
| 34 | Carbon steel pipe unions, socket-welding and threaded, MSS SP-83 | X | X | X | |
| 35 | Malleable-iron threaded pipe unions ASME B16.39 | X | X | | |
| 36 | Nipples, pipe threaded ASTM A 733 | X | X | X | |
| 37 | Crosslinked Polyethylene (PEX) Plastic Pipe ASTM F 877. | X | X | | X |
| 38 | Press Fittings | X | X | | |

A - Cold Water Service Aboveground
B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

| | | SERVICE | | | |
|---|---|---|---|---|---|
| Item No. | Pipe and Fitting Materials | A | B | C | D |

C - Compressed Air Lubricated
D - Cold Water Service Belowground
Indicated types are minimum wall thicknesses.
** - Type L - Hard
*** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors
**** - In or under slab floors only brazed joints

TABLE III
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT (I-P)

A. STORAGE WATER HEATERS

| FUEL | STORAGE CAPACITY GALLONS | INPUT RATING | TEST PROCEDURE | REQUIRED PERFORMANCE |
|---|---|---|---|---|
| Elect. | 60 max. | | 10 CFR 430 | EF = 0.93 |
| Elect. | 60 min. | | 10 CFR 430 | EF = 0.91 |
| Elect. | 20 min. | 12 kW max. | 10 CFR 430 | EF = 0.93-0.00132V min. |
| Elect. | 20 min. | 12 kW min. | CSA/AM Z21.10.3 | SL = 20+35x(V^^1/2)max. |

TERMS:

EF = Energy factor, minimum overall efficiency.
ET = Minimum thermal efficiency with 70 degrees F delta T.
SL = Standby loss is maximum Btu/h based on a 70 degree F temperature difference between stored water and ambient requirements.
V = Rated storage volume in gallons
Q = Nameplate input rate in Btu/h

-- End of Section --

# ELKAY SPECIFICATIONS

## Pacemaker® Double Bowl Sink
## 20 Gauge – Type 304 – Self-Rim
## Model PSR Series

### GENERAL
Fine quality Pacemaker double bowl hospitality sink seamlessly drawn of #20 gauge, type 304 (18-8) nickel bearing stainless steel. Self-rimming.

### DESIGN FEATURES
Bowl Depths: 7-1/4" (PSR3319 and PSR4322), 7-1/2" (PSR3321).

Coved Corners: 1-3/4".

Bowl and Faucet Deck Recess: 3/16" drop ledge.

Finish: Exposed surfaces are polished to a lustrous, highlighted bright satin finish.

Underside: Fully undercoated to prevent condensation and deaden sound. PSR3321 underside is fully protected by heavy duty Sound Guard® undercoating.

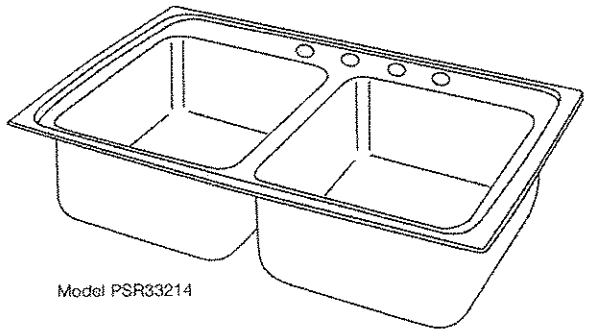
### OTHER
Drain Openings: 3-1/2".

Faucet Holes: Available with 0, 1, 2, MR2, 3, 4 or 5, 1-1/2" diameter faucet holes 4" centers.

NOTE: Unless otherwise specified, sink is furnished with 4 faucet holes.

These sinks comply with ANSI Standard A112.19.3M.

These sinks are listed by the International Association of Plumbing and Mechanical Officials as meeting the requirements of the Uniform Plumbing Code.

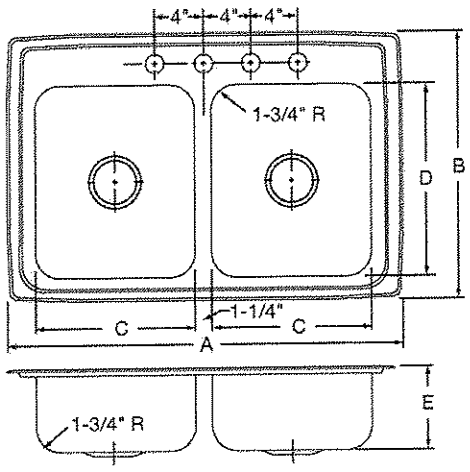


Model PSR33214

### SINK DIMENSIONS (INCHES)*

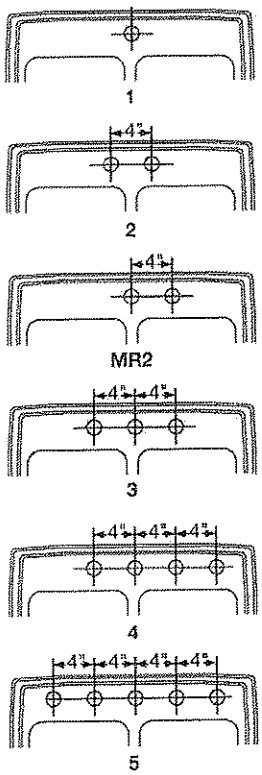
| Model Number | Overall L A | Overall W B | Inside Each Bowl L C | Inside Each Bowl W D | Inside Each Bowl D E | Cutout in Countertop (1½" Radius Corners) L | Cutout in Countertop (1½" Radius Corners) W | No. of 1½" Dia. Faucet Holes 4" Center | Minimum Cabinet Size | Ship. Wt. Lbs. |
|---|---|---|---|---|---|---|---|---|---|---|
| PSR3319 | 33 | 19½ | 14 | 14 | 7¼ | 32⅜ | 18⅞ | 1, 2, MR2, 3, 4 or 5 | 36 | 16 |
| PSR3321 | 33 | 21¼ | 13½ | 16 | 7½ | 32⅜ | 20⅝ | 1, 2, MR2, 3, 4 or 5 | 36 | 17 |
| PSR4322 | 43 | 22 | 19 | 16 | 7¼ | 42⅜ | 21⅜ | 1, 2, MR2, 3, 4 or 5 | 48 | 20 |

*Length is left to right. Width is front to back..




Model PSR33214 Illustrated

### HOLE DRILLING CONFIGURATIONS




ALL DIMENSIONS IN INCHES, TO CONVERT TO MILLIMETERS MULTIPLY BY 25.4.

*In keeping with our policy of continuing product improvement, Elkay reserves the right to change product specifications without notice.*

*This specification describes an Elkay product with design, quality and functional benefits to the user. When making a comparison of other producers' offerings, be certain these features are not overlooked.*


Elkay
www.elkayusa.com

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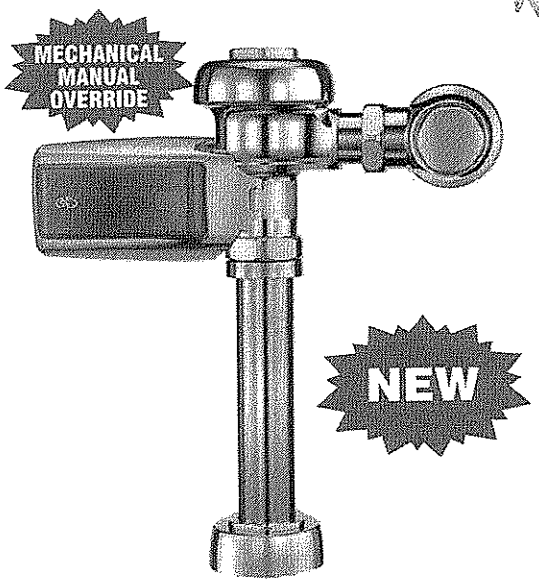
(Rev. 10/03) 1-75D

SLOAN®
OPTIMA SYSTEMS
Battery Powered Flushometers

# SLOAN
## Optima® SMOOTH™
**Side-Mount-Operator-Over-The-Handle**

**Model 110/111**




### Description
Exposed, Battery Powered, Sensor Activated, Sloan® Optima® SMOOTH™ Water Closet Flushometer for floor mounted or wall hung top spud bowls.

### Flush Cycle
☐ Model 110 Water Saver (3.5 gpf/13.2 Lpf)
☒ Model 111 Low Consumption (1.6 gpf/6.0 Lpf)

### Specifications
Quiet, Exposed, Diaphragm Type, Chrome Plated Closet Flushometer with the following features:

**Flushometer**
- High Chloramine Resistant PERMEX™ Synthetic Rubber Diaphragm with Linear Filtered Bypass and Vortex Cleansing Action™
- ADA Compliant Metal Oscillating Non-Hold-Open Handle with Triple Seal Handle Packing
- 1" I.P.S. Screwdriver Bak-Chek™ Angle Stop
- Vandal Resistant Stop Cap
- Adjustable Tailpiece
- Vacuum Breaker with Flush Connection
- Spud Coupling and Spud Flange for 1½" Top Spud
- Sweat Solder Adapter with Cover Tube and Cast Wall Flange
- High Copper, Low Zinc Brass Castings for Dezincification Resistance
- Non-Hold-Open Handle and No External Volume Adjustment to Ensure Water Conservation
- Low Consumption flush accuracy
- Handle Packing, Stop Seat and Vacuum Breaker Molded from PERMEX™ Rubber Compound for Chloramine Resistance

**Optima SMOOTH Unit**
- ADA Compliant OPTIMA® SMOOTH™ Battery Powered Infrared Sensor for automatic "Hands-free" operation
- Sensor with Automatic Range Adjustment
- Chrome Plated Metal Sensor Housing
- Mechanical Manual Override Flush Handle
- Four (4) Size C Batteries included
- "Low Battery" Flashing LED
- "User in View" Flashing LED
- 25 to 80 psi Operating Range

Valve Body, Cover, Tailpiece and Control Stop shall be in conformance with ASTM Alloy Classification for Semi-Red Brass. Valve shall be in compliance to the applicable sections of ASSE 1037, ANSI/ASME A 12.19.2, and Military Specification V-29193.

### Variations
☐ TP Trap Primer
☐ DFB Dual Filtered Fixed Bypass Diaphragm
☐ YG Extended Bumper on Angle Stop (for seat with cover)

This space for Architect/Engineer approval

Job Name _____ Date _____

Model Specified _____ Quantity _____

Variations Specified _____

Customer/Wholesaler _____

Contractor _____

Architect _____

### ADA Compliant

### Automatic
Sloan SMOOTH™ equipped Flushometers provide the ultimate in sanitary protection and automatic operation. There is no need for AC hookups or wall alterations. The Flushometer operates by means of a battery powered infrared sensor. Once the user enters the sensor's effective range and then steps away, the SMOOTH™ Unit initiates the flushing cycle to flush the fixture. State-of-the-art Technology enables activation of a manual override without "double flushing" occurring as the user departs (locks out sensor for approximately 10 seconds).

### Hygienic
The Sloan® Optima® SMOOTH™ Flushometer is the next advancement in hygiene. It uses sensor technology to transform manual installations into electronic, hands-free operation. User makes no physical contact with the Flushometer surface except to initiate the Override Handle when required. Helps control the spread of infectious diseases.

### Economical
Automatic operation provides water usage savings over other flushing devices. Reduces maintenance and operation costs. Installation and battery replacement does not require turning off water to the valve.

### Warranty
3 year (limited)

The information contained in this document is subject to change without notice.

Model

# 110/111

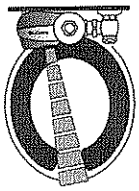
- **Description**
  Exposed, Battery Powered, Sensor Activated, Sloan® Optima® SMOOTH™ Water Closet Flushometer for floor mounted or wall hung top spud bowls.
- **Flush Cycle**
  - ☐ Model 110 Water Saver (3.5 gpf/13.2 Lpf)
  - ☐ Model 111 Low Consumption (1.6 gpf/6.0 Lpf)

## ELECTRICAL SPECIFICATIONS

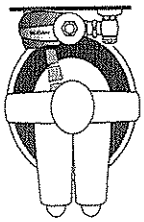
- **Control Circuit**
  6 VDC Input
- **OPTIMA Sensor Type**
  Active Infrared with Automatic Adjustment
- **OPTIMA Sensor Range**
  Normal Range:
  26" - 32" (660 mm-813 mm)
  Reduced Range:
  20" - 26" (508 mm-660 mm)
- **Battery Type**
  (4) Size C Alkaline
- **Battery Life**
  2 Years @ 4,000 Flushes/Month
- **Indicator Lights**
  User in View/Low Battery
- **Operating Pressure**
  25-80 psi (172-552 kPa)

## OPERATION

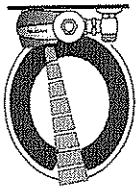
1. A continuous, invisible light beam is emitted from the SMOOTH unit's Infrared Sensor.



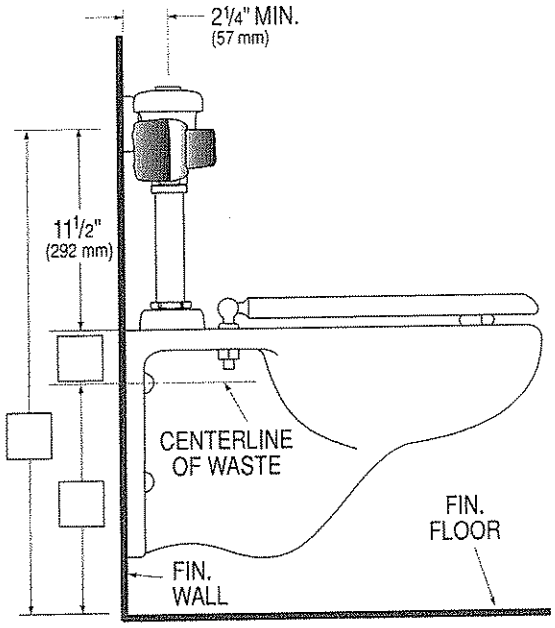
2. When the user enters the sensor's effective range, the Red LED light in the sensor window flashes for eight seconds. After eight seconds of sensing the user, the light will stop flashing and the unit waits for the user to step away before initiating a flush cycle.



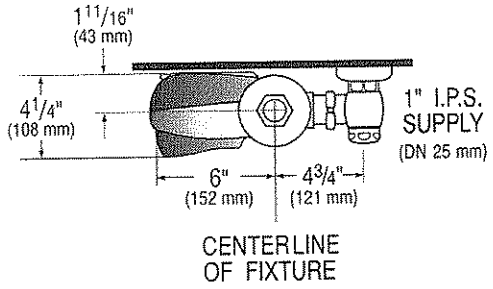
3. When the user steps away, the unit initiates a flush cycle. The unit then automatically resets and is ready for the next user.



## DIMENSIONS




Side View




Top View

**SLOAN VALVE COMPANY • 10500 SEYMOUR AVENUE • FRANKLIN PARK, IL 60131**
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Sloan Optima SMOOTH 110/111 S.S. — Rev. 0 (12/05)

SLOAN®

OPTIMA SYSTEMS

Battery Powered Flushometers

# SLOAN Optima® SMOOTH™ Model 186

**Side-Mount-Operator-Over-The-Handle**

## Description

Exposed, Battery Powered, Sensor Activated, Sloan® Optima® SMOOTH™ Urinal Flushometer for ¾" top spud urinals.

## Flush Cycle

☐ Model 186 Water Saver (1.5 gpf/5.7 Lpf)
☒ Model 186-1.0 Low Consumption (1.0 gpf/3.8 Lpf)
☐ Model 186-0.5 (0.5 gpf/1.9 Lpf)

## Specifications

Quiet, Exposed, Diaphragm Type, Chrome Plated Urinal Flushometer with the following features:

### Flushometer

- High Chloramine Resistant PERMEX™ Synthetic Rubber Diaphragm with Linear Filtered Bypass and Vortex Cleansing Action™
- ADA Compliant Metal Oscillating Non-Hold-Open Handle with Triple Seal Handle Packing
- ¾" I.P.S. Screwdriver Bak-Chek™ Angle Stop
- Vandal Resistant Stop Cap
- Adjustable Tailpiece
- Vacuum Breaker with Flush Connection
- Spud Coupling and Spud Flange for ¾" Top Spud
- Sweat Solder Adapter with Cover Tube and Cast Wall Flange
- High Copper, Low Zinc Brass Castings for Dezincification Resistance
- Non-Hold-Open Handle and No External Volume Adjustment to Ensure Water Conservation
- Low Consumption flush accuracy
- Handle Packing, Stop Seat and Vacuum Breaker Molded from PERMEX™ Rubber Compound for Chloramine Resistance

### Optima SMOOTH Unit

- ADA Compliant OPTIMA® SMOOTH™ Battery Powered Infrared Sensor for automatic "Hands-free" operation
- Sensor with Automatic Range Adjustment
- Chrome Plated Metal Sensor Housing
- Mechanical Manual Override Flush Handle
- Four (4) Size C Batteries included
- "Low Battery" Flashing LED
- "User in View" Flashing LED
- 25 to 80 psi Operating Range

Valve Body, Cover, Tailpiece and Control Stop shall be in conformance with ASTM Alloy Classification for Semi-Red Brass. Valve shall be in compliance to the applicable sections of ASSE 1037, ANSI/ASME A112.19.2, and Military Specification V-29193.

## Variations

☐ DFB Dual Filtered Fixed Bypass Diaphragm

## ADA Compliant

## Automatic

Sloan SMOOTH™ equipped Flushometers provide the ultimate in sanitary protection and automatic operation. There is no need for AC hookups or wall alterations. The Flushometer operates by means of a battery powered infrared sensor. Once the user enters the sensor's effective range and then steps away, the SMOOTH™ Unit initiates the flushing cycle to flush the fixture. State-of-the-art Technology enables activation of a manual override without "double flushing" occurring as the user departs (locks out sensor for approximately 10 seconds).

## Hygienic

The Sloan® Optima® SMOOTH™ Flushometer is the next advancement in hygiene. It uses sensor technology to transform manual installations into electronic, hands-free operation. User makes no physical contact with the Flushometer surface except to initiate the Override Handle when required. Helps control the spread of infectious diseases.

## Economical

Automatic operation provides water usage savings over other flushing devices. Reduces maintenance and operation costs. Installation and battery replacement does not require turning off water to the valve.

## Warranty

3 year (limited)

This space for Architect/Engineer approval

Job Name _____ Date _____

Model Specified _____ Quantity _____

Variations Specified _____

Customer/Wholesaler _____

Contractor _____

Architect _____

The information contained in this document is subject to change without notice.

Model

# 186

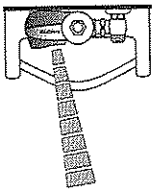
- **Description**
  Exposed, Battery Powered, Sensor Activated, Sloan® Optima® SMOOTH™ Urinal Flushometer for ¾" top spud urinals.
- **Flush Cycle**
  - ☐ Model 186 Water Saver (1.5 gpf/5.7 Lpf)
  - ☐ Model 186-1.0 Low Consumption (1.0 gpf/3.8 Lpf)
  - ☐ Model 186-0.5 (0.5 gpf/1.9 Lpf)

## ELECTRICAL SPECIFICATIONS

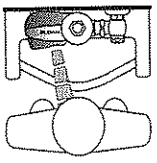
- **Control Circuit**
  6 VDC Input
- **OPTIMA Sensor Type**
  Active Infrared with Automatic Adjustment
- **OPTIMA Sensor Range**
  Normal Range:
  26" - 32" (660 mm-813 mm)
  Reduced Range:
  20" - 26" (508 mm-660 mm)
- **Battery Type**
  (4) Size C Alkaline
- **Battery Life**
  2 Years @ 4,000 Flushes/Month
- **Indicator Lights**
  User in View/Low Battery
- **Operating Pressure**
  25-80 psi (172-552 kPa)

## OPERATION

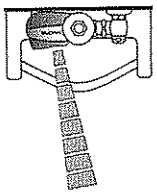
1. A continuous, invisible light beam is emitted from the SMOOTH unit's Infrared Sensor.



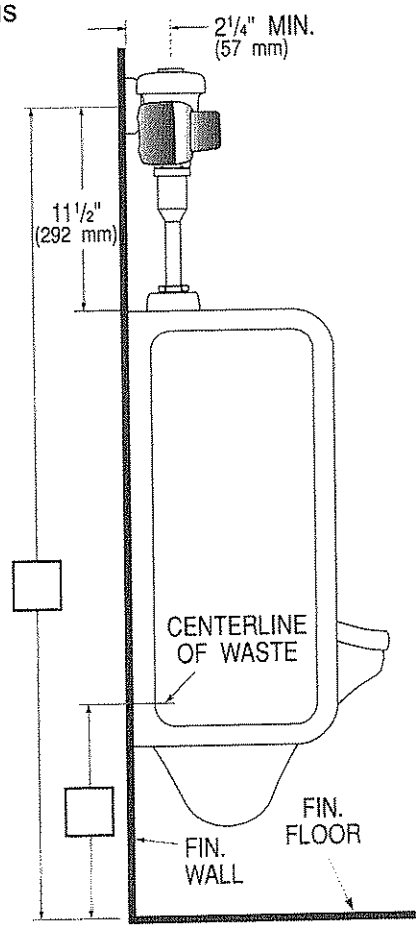
2. When the user enters the sensor's effective range, the Red LED light in the sensor window flashes for eight seconds. After eight seconds of sensing the user, the light will stop flashing and the unit waits for the user to step away before initiating a flush cycle.



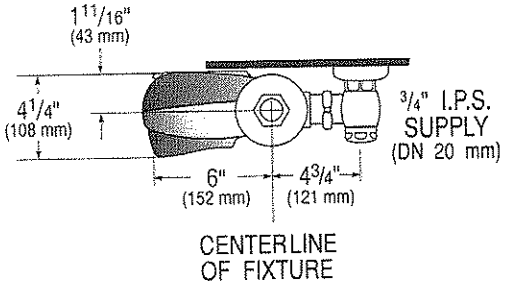
3. When the user steps away, the unit initiates a flush cycle. The unit then automatically resets and is ready for the next user.



## DIMENSIONS




Side View




Top View

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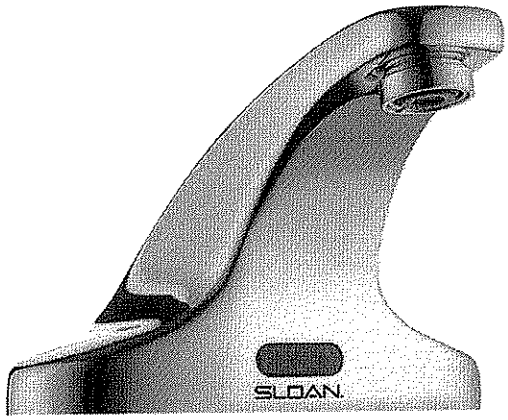
Sloan Optima SMOOTH 186 S.S. — Rev. 0 (12/05)

SLOAN®
Faucets

Sensor Activated
**Electronic Handwashing Faucet**

# SF-2300
# SF-2350




▶ **Description**
Sensor Activated, Electronic, 4 inch Centerset Hand Washing Faucet for tempered or hot/cold water operation.

▶ **Models**
☐ SF-2300 Series 6 VDC Plug-in Transformer Powered with Battery Backup
☒ SF-2350 Series Battery Powered

▶ **Flow Rate**
☐ 0.5 gpm/1.9 Lpm Max Flow Spray Head

▶ **Specifications**
ADA Compliant, Sensor Activated, 6 VDC, Chrome Plated Brass, Hand Washing Faucet with the following features:
- Splash-proof Circuit Control Module
- Adjustable Infrared Sensor Range
- 36" (914 mm) Long Sensor Cable
- 24" (610 mm) Long Flex Hose
- Filtered Solenoid Valve with serviceable Strainer Filter
- Bak-Chek® Tee for Hot/Cold Supply
- 6 VDC Plug-in Transformer (Model SF-2300 only)
- Aerator Spray Head
- Includes Four (4) AA-size Batteries
- Includes appropriate Mounting Hardware

▶ **Variations** (add suffix to Model Number for inclusion with Faucet)
- **Temperature Mixing Valves**
  ☒ BDM MIX-60-A Below Deck Mechanical Mixing Valve

▶ **Accessories** (specify separately)
- **Standard Outlet**
  - ☐ SFP-13 0.5 gpm/1.9 Lpm Spray Head
  - ☐ SFP-23 2.2 gpm/8.3 Lpm Aerator
- **Vandal Resistant Outlet**
  - ☐ EAF-15 0.5 gpm/1.9 Lpm Vandal Resistant Spray Head
  - ☐ SFP-24 2.2 gpm/8.3 Lpm Vandal Resistant Aerator
- **Transformers**
  - ☐ SFP-6 120 VAC/6 VDC Plug-in Transformer
  - ☐ SFP-20 240 VAC/6 VDC Type G Rectangular (UK) Plug-in Transformer
  - ☐ SFP-25 240 VAC/6 VDC Type C Round Pin (Euro) Plug-in Transformer
  - ☐ SFP-26 240 VAC/6 VDC Type A Flat Blade (Asia) Plug-in Transformer
  - ☐ SFP-35-A Gang Transformer Kit, includes 1 Plug-in Gang Transformer, 5 Splitter Cables and 1 Extension Cable
  - ☐ SFP-36 71" (1800 mm) 120 VAC/6 VDC Plug-in Gang Transformer
  - ☐ SFP-38 51" (1300 mm) Splitter Cable
  - ☐ SFP-37 51" (1300 mm) Extension Cable

▶ **ADA Compliant**

▶ **Automatic**
The Sloan SF-2300 and SF-2350 Electronic Hand Washing Faucets operate by means of an infrared sensor. When the user enters the sensor's effective range, the Solenoid activates the water flow. Tempered water flows from the Faucet until the user steps away. The Faucet then automatically shuts off.

▶ **Hygienic**
The ultimate in sanitary protection — there are no handles to turn or buttons to push. Helps to control the spread of infectious diseases.

▶ **Economical**
Automatic operation provides water usage savings over other faucet devices. Reduces maintenance and operation costs.

▶ **Warranty**
1 year (limited)

▶ **Compliant to:**
ASME A112.18.1 and CSA B125.1

Listed by I.A.P.M.O. ® Certified

This space for Architect/Engineer approval

Job Name ..... Date .....

Model Specified ..... Quantity .....

Variations Specified .....

Customer/Wholesaler .....

Contractor .....

Architect .....



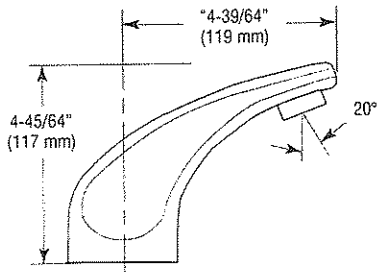
The information contained in this document is subject to change without notice.

# SF-2300
# SF-2350

**Description**
Sensor Activated, Electronic, 4 inch Centerset Hand Washing Faucet for tempered or hot/cold water operation.

**Models**
- ☐ SF-2300 Series — 6 VDC Plug-in Transformer Powered with Battery Backup
- ☐ SF-2350 Series — Battery Powered

**Flow Rate**
- ☐ 0.5 gpm/1.9 Lpm Max Flow Spray Head




## ELECTRICAL SPECIFICATIONS

**Control Circuit**
6 VDC Input/Output

**Transformer**
6 VDC Plug-in (Model 2300 only)

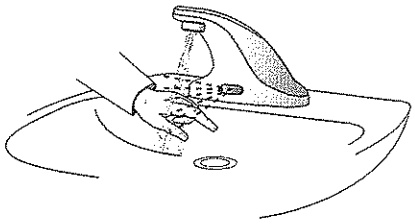
**Battery Life**
Four (4) Alkaline AA Batteries
2 years at 8,000 cycles/month

**Solenoid Valve**
6 VDC,
Serviceable Strainer,
3/8" Compression Inlet,
1/2" NPSM Outlet

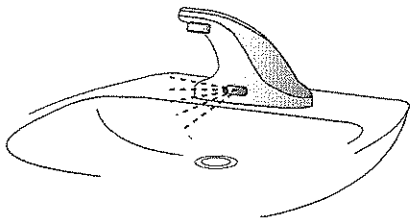
**Sensor Range**
Nominal:
4" - 7" (102 mm - 178 mm)

## OPERATION

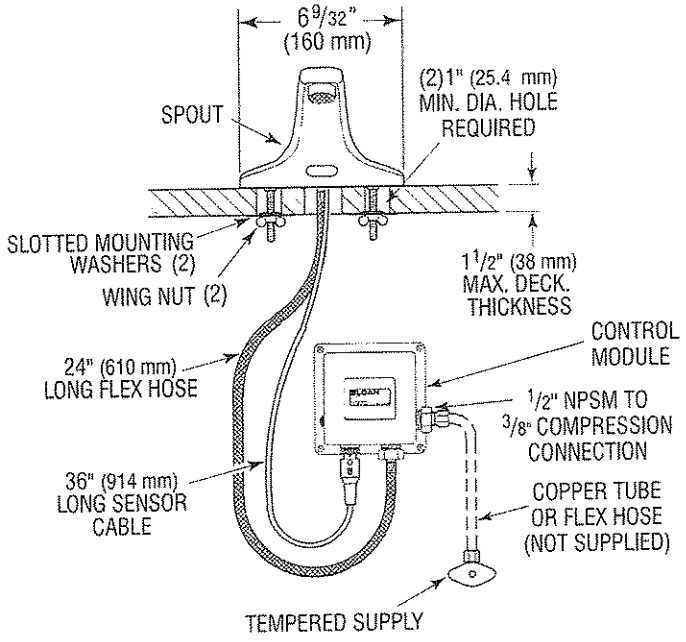
1. When a user's hands enter the sensing range, water flows from the spout.



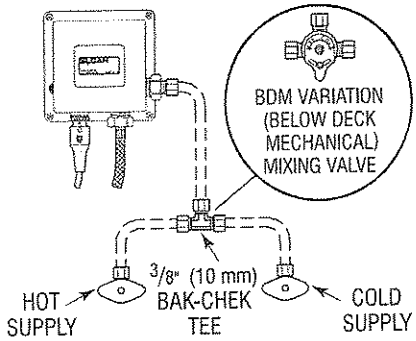
2. When hands are removed, the water flow stops.



## ROUGH-IN DIMENSIONS




**HOT AND COLD WATER SUPPLY APPLICATIONS**
(SPECIFY IN MODEL VARIATION)

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# ELKAY®
## SPECIFICATIONS

# Two Station Wall Mount Water Coolers Barrier-Free Access (Adult and Child) NSF/ANSI 61 Compliant – Models EZTL8C, EZSTL8C, EZTLDDC and EZSTLDDC

### GENERAL

Self-contained, wall hung electric refrigerated water cooler. Chilling capacity of 50°F drinking water, based upon 80°F inlet water and 90°F ambient.

**Model EZSTL8C** has self-closing Easy-Touch Controls on front, left and right of each unit.

**Model EZTL8C** has self-closing Easy-Touch Controls on the front of each unit.

**Model EZSTLDDC** non-refrigerated. Same as EZSTL8C without cooling system. (Requires outlet for power cord.)

All models have a hooded stream projector with Easy-Touch Controls that require less than 3 pounds of force to activate commercial-grade solenoid based flow control. Patented* valve with built-in flow regulator provide constant stream from 20 to 105 psi water pressure. Bubbler orifice fully protected to meet all sanitary codes.

NOTE: Minimum 40 psi supply line pressure required in special circumstances where both sides of bi-level are in use simultaneously to ensure adequate stream height. Does not apply to non-refrigerated units.

This model cooler consists of a refrigerated lower unit which requires a water supply, drain outlet and electrical supply.

### ADA COMPLIANT

These Water Coolers comply with the requirements of A.D.A. (Americans with Disabilities Act) when properly installed. Unit is compliant if installed in an alcove and is also compliant when mounted on an exposed wall if a wing wall is located on the left side or if LKAPREZL apron is installed under upper unit. Also meets the guidelines for children's environments providing the floor to orifice height is 30" or less on the lower unit and proper clear floor space is provided for parallel approach. (Based on Architectural and Transportation Barriers Compliance Board final ruling.) Check Local and State Codes.

### NO LEAD DESIGN

These Water Coolers are certified to be lead-free as defined by the Safe Drinking Water Act. Elkay Water Coolers are manufactured with a waterway system utilizing copper components and completely lead-free materials. These waterways have no lead because all lead materials, such as leaded brass, have been removed. All joints are brazed using silver solder only. No lead solder is permitted. A strainer with an easily cleanable screen is provided to allow trapping and convenient removal of waterborne particulate of 140 microns and larger prior to their entry into the water cooler.

These water coolers are certified to **NSF/ANSI 61**.

### CAPACITIES CHART

| Model Number | Base Rate | **GPH of 50°F Drinking Water Room Temperature °F 70°F | 80°F | 90°F | Rated Watts | Full Load Amps | Glass† Filler Option | Ship. Wt. Lbs. |
|---|---|---|---|---|---|---|---|---|
| EZSTL8C | 8.0 | 9.7 | 8.8 | 8.0 | 370 | 4.0 | Yes | 89 |
| EZTL8C | 8.0 | 9.7 | 8.8 | 8.0 | 370 | 4.0 | Yes | 89 |
| EZTLDDC | – | – | – | – | – | – | Yes | 66 |
| EZSTLDDC | – | – | – | – | – | – | Yes | 66 |

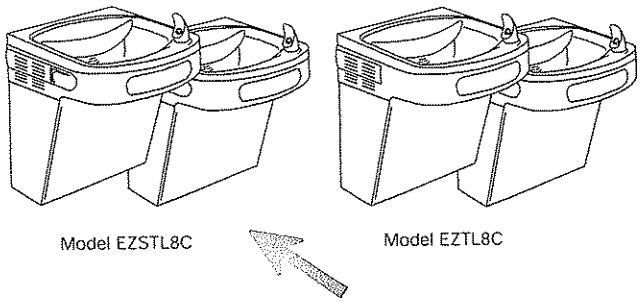
**Based on 80°F inlet water temperature. †Glass filler available at extra cost. Requires factory preparation to receive glass filler. Upper unit only.

Rated watts shown are based on operational (run) time, in compliance with A.R.I. Standard 1010 conditions. Specific applications will determine the actual watts consumed per hour. Watts consumed will be based on number of people served per hour (usage), ambient temperatures, and inlet water temperature.

### COOLING SYSTEM

**Motor Compressor:** Hermetically sealed, reciprocating type, 115VAC, 60Hz single phase. Sealed-in lifetime oil supply. Equipped with electric cord and three prong molded rubber plug (domestic models).

*In keeping with our policy of continuing product improvement, Elkay reserves the right to change product specifications without notice.*



Model EZSTL8C  Model EZTL8C

**Condenser:** Fan cooled, copper tube with aluminum fins. Fan motor is permanently lubricated.

**Cooling Unit:** Combination tube-tank type. Tube portion is continuous coil of copper tubing. Tank is stainless steel. Fully insulated with EPS foam which meets Underwriters Laboratories Inc. requirements for self-extinguishing material.

**Refrigerant Control:** Refrigerant HFC-134a is controlled by accurately calibrated capillary tube for positively trouble-free operation.

**Temperature Control:** Enclosed adjustable thermostat is factory preset. Requires no adjustment other than for altitude requirements. Easily accessible.

### CONSTRUCTION

**Frame:** Galvanized structural steel chassis supports refrigeration system and fastens to wall. Provides increased structural integrity and rigidity to cooler.

**Stainless Steel Basin:** Type 304, one piece polished to a uniform Elkay bright luster finish. Basin has integral drain grid, embossed bubbler pad. No exposed fasteners.

**Exclusive Flexi-Guard® Safety Bubbler*:** Innovative design utilizes an infused anti-microbial pliable polyester elastomer to prevent accidental mouth injuries. Flexes on impact, then returns to original position. Strong. Abrasion-resistant. Anti-sweat. Keyed in location to prevent rotation.

**Upper Shroud:** Contoured shock-absorbing, provides additional protection against accidental injury. No exposed fasteners.

**Lower Shroud:** One piece easy to remove and replace. Allows access to internal components from three sides.

**Cabinet:** Cabinet design allows for flush to wall mounting. No recess space is required.

**Color Selection:** Unless otherwise specified cabinet is two-tone gray upper shroud with textured gray lower shroud. Stainless Steel lower shrouds available at extra cost.

**5 YEAR LIMITED WARRANTY** on the refrigeration system of the unit. Electrical components and water system are warranted for 12 months from date of installation. Sample Certificate available on request.

Elkay Pressure-Type Water Coolers are designed to operate on 20 psi to 105 psi supply line pressure. If inlet pressure is above 105 psi, a pressure regulator must be installed in the supply line. Any damage caused by reason of connecting this product to supply line pressures lower than 20 psi or higher than 105 psi is not covered by the warranty.

### STANDARDS

c UL us Elkay Electric Air Cooled Water Coolers meet the requirements of NSF/ANSI 61. Unit complies with A.R.I. Standard 1010.

* Patent #4,481,971

*This specification describes an Elkay product with design, quality and functional benefits to the user. When making a comparison of other producers' offerings, be certain these features are not overlooked.*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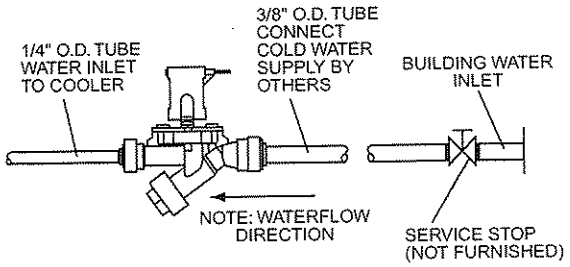
# Two Station Wall Mount Water Coolers Barrier-Free Access (Adult and Child) NSF/ANSI 61 Compliant – Models EZTL8C, EZSTL8C, EZTLDDC and EZSTLDDC

ELKAY®

## ROUGH-IN DIMENSIONS




**IMPORTANT!**

**INSTALLER PLEASE NOTE:**

This water cooler has been designed and built to provide water to the user which has not been altered by materials in the cooler waterways.

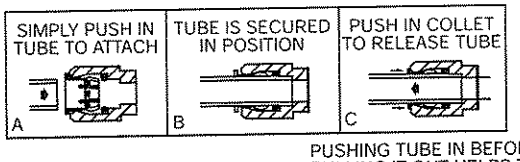
The grounding of electrical equipment such as telephone, computers, etc., to water lines is a common procedure. This grounding may be in the building but may also occur away from the building. This grounding can cause electrical feedback into a water cooler creating an electrolysis which creates a metallic taste or causes an increase in the metal content of the water. This condition is avoidable by installing the cooler using the proper materials as shown below.

**NOTICE**

This water cooler must be connected to the water supply using a dielectric coupling. The cooler is furnished with a non-metallic strainer which meets this requirement.

The drain trap which is provided by the installer should also be plastic to completely isolate the cooler from the building plumbing system.

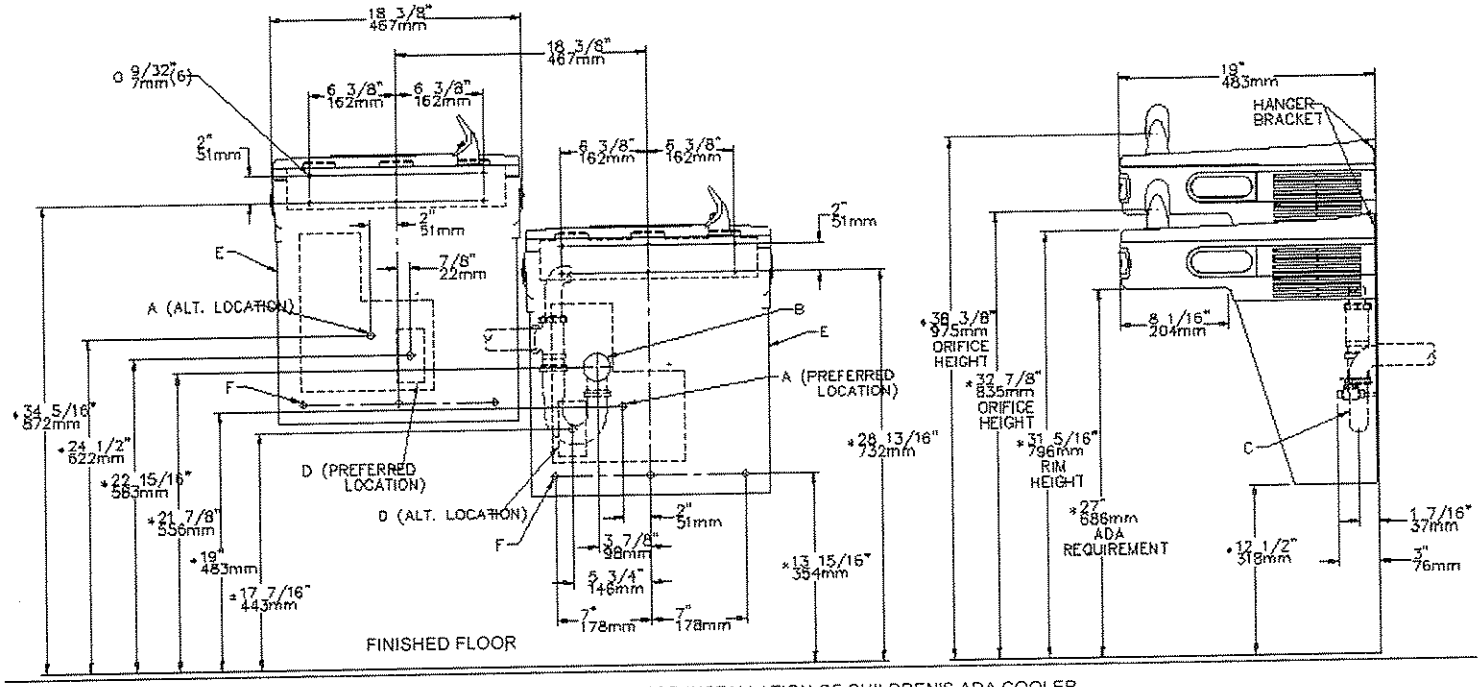
OPERATION OF QUICK CONNECT FITTINGS




PUSHING TUBE IN BEFORE PULLING IT OUT HELPS TO RELEASE TUBE

FRONT VIEW

SIDE VIEW




*REDUCE HEIGHT BY 3 INCHES FOR INSTALLATION OF CHILDREN'S ADA COOLER

**LEGEND**

A = RECOMMENDED WATER SUPPLY LOCATION 3/8 O.D. UNPLATED COPPER TUBE CONNECT STUB WITH SHUT OFF (BY OTHERS) 3 IN. (76mm) MAXIMUM OUT FROM WALL

B = RECOMMENDED LOCATION FOR WASTE OUTLET TO ACCOMODATE 1-1/2" NOMINAL DRAIN. DRAIN STUB 2 IN. OUT FROM WALL

C = 1-1/2 TRAP NOT FURNISHED

D = ELECTRICAL SUPPLY (3) WIRE RECESSED BOX DUPLEX OUTLET

F = 7/16 BOLT HOLES FOR FASTENING UNIT TO WALL

INSURE PROPER VENTILATION BY MAINTAINING 6" (152mm) MINIMUM CLEARANCE FROM CABINET LOUVERS TO WALL.


Elkay

12-24E (Rev. 2/09)

2222 Camden Court
Oak Brook, IL 60523

elkayusa.com



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# ELKAY®
## SPECIFICATIONS

# Wall Mount Water Coolers
# Barrier-Free Access (Adult & Child)
# NSF/ANSI 61 Compliant
# Models EZ4, EZ8, EZS4, EZS8, EZSD and EZD

### GENERAL
Self-contained, wall hung electric refrigerated water cooler. Chilling capacity of 50°F drinking water, based upon 80°F inlet water and 90°F ambient.

**Models EZS4 and EZS8** have self-closing Easy-Touch Controls on front and both right and left sides.

**Models EZ4 and EZ8** each have self-closing Easy-Touch Controls on the front only.

**Model EZSD** is non-refrigerated. Same as EZS8 without cooling system. (Requires outlet for power cord.)

All models have a hooded stream projector with Easy-Touch Controls that require less than 3 pounds of force to activate. Patented* valve with built-in flow regulator provide constant stream from 20 to 105 psi, water pressure. Bubbler orifice fully protected to meet all sanitary codes.

Non-pressurized stainless steel cooling tank is standard. Non-pressurized water tank is located after bubbler valve, so that tank is subject to line pressure only when Easy-Touch Control is pressed.

### ADA COMPLIANT
These Water Coolers comply with the requirements of A.D.A. (Americans with Disabilities Act) when properly installed. Also meets the guidelines for children's environments providing the floor to orifice height is 30" or less and proper clear floor space is provided for parallel approach. (Based on Architectural and Transportation Barriers Compliance Board final ruling.) Check Local and State Codes.

### NO LEAD DESIGN
These Water Coolers are certified to be lead-free as defined by the Safe Drinking Water Act. Elkay Water Coolers are manufactured with a waterway system utilizing copper components and completely lead-free materials. These waterways have no lead because all lead materials, such as leaded brass, have been removed. All joints are brazed using silver solder only. No lead solder is permitted. A strainer with an easily cleanable screen is provided to allow trapping and convenient removal of waterborne particulate of 140 microns and larger prior to their entry into the water cooler.

These water coolers are certified to **NSF/ANSI 61**.

### CAPACITIES CHART

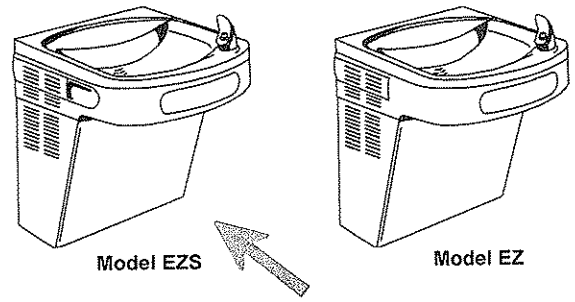
| Model Number | Base Rate | **GPH of 50°F Drinking Water Room Temperature °F 70°F | 80°F | 90°F | Rated Watts | Full Load Amps | Glass† Filler Option | Ship. Wt. Lbs. |
|---|---|---|---|---|---|---|---|---|
| EZS4 | 4.0 | 5.0 | 4.4 | 4.0 | 370 | 4.0 | Yes | 56 |
| EZS8 | 8.0 | 9.7 | 8.8 | 8.0 | 370 | 4.0 | Yes | 56 |
| EZ4 | 4.0 | 5.0 | 4.4 | 4.0 | 370 | 4.0 | Yes | 56 |
| EZ8 | 8.0 | 9.7 | 8.8 | 8.0 | 370 | 4.0 | Yes | 56 |
| EZSD | – | – | – | – | – | – | Yes | 18 |
| EZD | – | – | – | – | – | – | Yes | 18 |

**Based on 80°F inlet water temperature. †Glass filler available at extra cost. Requires factory preparation to receive glass filler.

Rated watts shown are based on operational (run) time, in compliance with A.R.I. Standard 1010 conditions. Specific applications will determine the actual watts consumed per hour. Watts consumed will be based on number of people served per hour (usage), ambient temperatures, and inlet water temperature.

### COOLING SYSTEM
**Motor Compressor:** Hermetically sealed, reciprocating type, 115V, 60 Hz single phase. Sealed-in lifetime oil supply. Equipped with electric cord and three prong molded rubber plug (domestic models).

**Condenser:** Fan cooled, copper tube with aluminum fins. Fan motor is permanently lubricated.




**Cooling Unit:** Combination tube-tank type. Self cleansing. Tube portion is continuous coil of copper tubing. Tank is stainless steel. Fully insulated with EPS foam which meets Underwriters Laboratories Inc. requirements for self-extinguishing material.

**Refrigerant Control:** Refrigerant HFC-134a is controlled by accurately calibrated capillary tube for positively trouble-free operation.

**Temperature Control:** Enclosed adjustable thermostat is factory pre-set. Requires no adjustment other than for altitude requirements. Easily accessible.

### CONSTRUCTION
**Frame:** Galvanized structural steel chassis supports refrigeration system and fastens to wall. Provides increased structural integrity and rigidity to cooler.

**Stainless Steel Basin:** One piece polished to a uniform Elkay bright luster finish. Basin has integral drain grid, embossed bubbler pad. No exposed fasteners.

**Exclusive Flexi-Guard® Safety Bubbler*:** Innovative design utilizes an infused anti-microbial pliable polyester elastomer to prevent accidental mouth injuries. Flexes on impact, then returns to original position. Strong. Abrasion-resistant. Anti-sweat. Keyed in location to prevent rotation.

**Upper Shroud:** Contoured shock-absorbing, provides additional protection against accidental injury. No exposed fasteners.

**Lower Shroud:** One piece easy to remove and replace. Allows access to internal components from three sides.

**Cabinet:** Cabinet design allows for flush to wall mounting. No recess space is required.

**Color Selection:** Unless otherwise specified cabinet is two-tone gray on upper shroud with textured gray lower shroud. Stainless Steel lower shroud available at extra cost.

**5 YEAR LIMITED WARRANTY** on the refrigeration system of the unit. Electrical components and water system are warranted for 12 months from date of installation. Sample Certificate available on request.

Elkay Pressure-Type Water Coolers are designed to operate on 20 psi to 105 psi supply line pressure. If inlet pressure is above 105 psi, a pressure regulator must be installed in the supply line. Any damage caused by reason of connecting this product to supply line pressures lower than 20 psi or higher than 105 psi is not covered by the warranty.

### STANDARDS
c UL us Elkay Electric Air Cooled Water Coolers meet the requirements of NSF/ANSI 61. Unit complies with A.R.I. Standard 1010.

* Patent #4,481,971

*In keeping with our policy of continuing product improvement, Elkay reserves the right to change product specifications without notice.*

*This specification describes an Elkay product with design, quality and functional benefits to the user. When making a comparison of other producers' offerings, be certain these features are not overlooked.*

Elkay
elkayusa.com
2222 Camden Court
Oak Brook, IL 60523
Printed in U.S.A.
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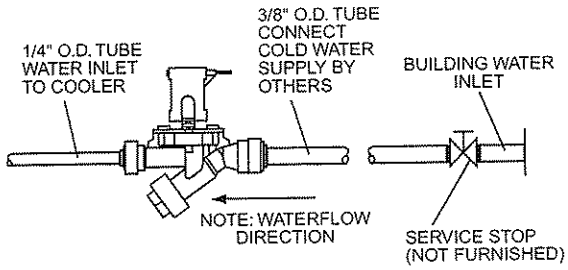
(Rev. 9/06) 12-23C

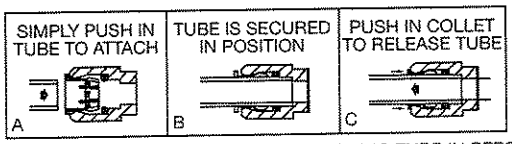
# Wall Mount Water Coolers
# Barrier-Free Access (Adult & Child)
# NSF/ANSI 61 Compliant
# Models EZ4, EZ8, EZS4, EZS8, EZSD and EZD

ELKAY®

## ROUGH-IN DIMENSIONS




OPERATION OF QUICK CONNECT FITTINGS




PUSHING TUBE IN BEFORE
PULLING IT OUT HELPS TO
RELEASE TUBE

Open space rough-in design permits new installation or replacement of existing fountains and coolers with this Elkay cooler when rough-in is within the outline shown. When the cooler is mounted as shown the location available is from 15" to 21-11/16" from floor and 1-1/16" to 7-1/4" from the left of centerline. Space is also available from 21-11/16" to 24-5/8" from floor and 2-3/4" to 7-1/4" from the left of centerline. Additional space is also available from 24-5/8" to 26-11/16" from floor and 3-3/4" to 7-1/4" from the left of centerline. Connections approaching the limits of these areas may be restricted and should only be considered for use until after an examination of the cooler has been made.

**IMPORTANT!**

**INSTALLER PLEASE NOTE:**

This water cooler has been designed and built to provide water to the user which has not been altered by materials in the cooler waterways.

The grounding of electrical equipment such as telephone, computers, etc., to water lines is a common procedure. This grounding may be in the building but may also occur away from the building. This grounding can cause electrical feedback into a water cooler creating an electrolysis which creates a metallic taste or causes an increase in the metal content of the water. This condition is avoidable by installing the cooler using the proper materials as shown below.

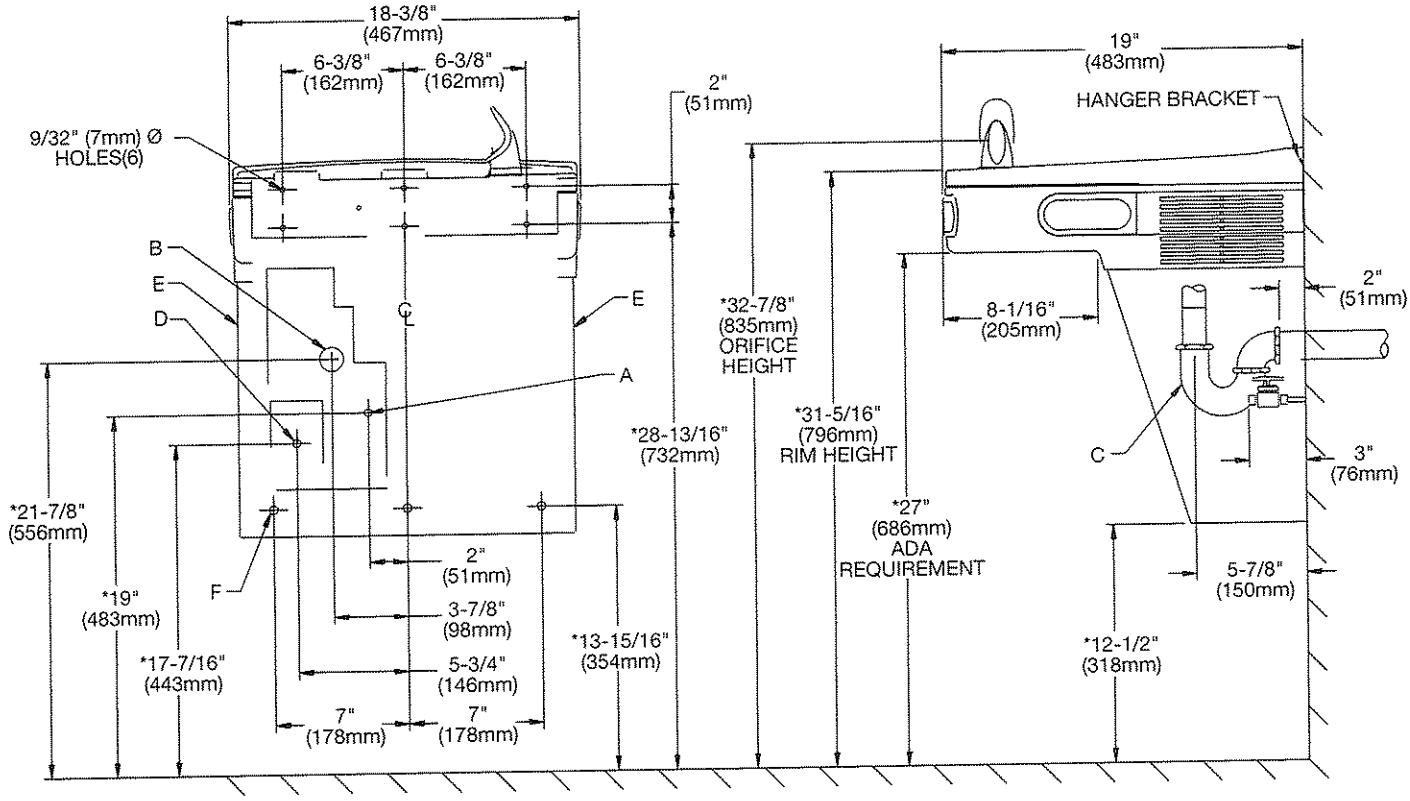
**NOTICE**

This water cooler must be connected to the water supply using a dielectric coupling. The cooler is furnished with a non-metallic strainer which meets this requirement.

The drain trap which is provided by the installer should also be plastic to completely isolate the cooler from the building plumbing system.

## FRONT VIEW

## SIDE VIEW




**LEGEND**

A = RECOMMENDED WATER SUPPLY LOCATION 3/8" O.D. UNPLATED COPPER TUBE CONNECT STUB WITH SHUT OFF (BY OTHERS) 3 IN. (76mm) MAXIMUM OUT FROM WALL.

B = RECOMMENDED LOCATION FOR WASTE OUTLET 1-1/4" O.D. DRAIN STUB 2 IN. (51mm) OUT FROM WALL.

C = 1-1/4" TRAP NOT FURNISHED.

D = ELECTRICAL SUPPLY (3) WIRE RECESSED BOX.

E = INSURE PROPER VENTILATION BY MAINTAINING 6" (152mm) (MIN.) CLEARANCE FROM CABINET LOUVERS TO WALL.

F = 7/16" BOLT HOLES FOR FASTENING UNIT TO WALL.

*REDUCE HEIGHT BY 3 INCHES FOR INSTALLATION OF CHILDRENS ADA COOLER.

Elkay

2222 Camden Court
Oak Brook, IL 60523

elkayusa.com

Printed in U.S.A.
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# S19-310AC, S19-310SBFW, S19-310TT
## Combination Drench Shower and Eye/Face Wash Unit

- Complies with American National Standard Z358.1-2004
- Galvanized Steel Protected with BRADTECT™ Safety Yellow Coating
- Universal Identification Sign and Inspection Tag Included
- Full, One-Year Warranty
- Patent Pending

CERTIFIED MODEL Z358.1-2004

## Specifications

Combination Drench Shower and Eye/Face Wash Unit saves space and fits easily into any work environment. Shower valve operates quickly by a pull rod with a triangular handle. Shower provides a superior washdown with a more even spray pattern. Eye/face wash operated by a large, highly visible push handle. Safe, steady water flow under varying water supply conditions from 30–90 PSI is assured by integral flow control in the sprayhead assembly. NOTE: The ANSI Z358.1 standard requires an uninterruptable supply of flushing fluid at a minimum 30 PSI flowing pressure.

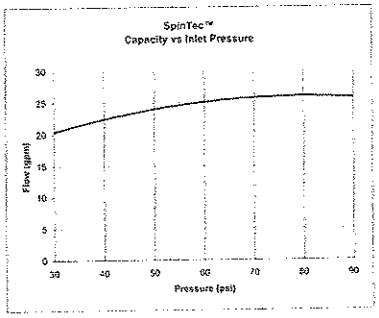
### cUPC Approved:

S19-310AC, S19-310SBFW and S19-310TT are certified to comply with the requirements of the Uniform Plumbing Code and the National Plumbing Code of Canada by the International Association of Plumbing and Mechanical Officials (IAPMO).

## Standard Equipment

### SpinTec™ Showerhead

3.1" (78.7mm) diameter highly visible yellow impact-resistant plastic. Model S19-310TT includes a 10-3/4" (273mm) diameter corrosion-resistant stainless steel shroud. SpinTec drench showerhead features integral 23 GPM flow control, conserving water and helping to accurately size your tepid water system.




### Eyewash Bowl

10" (254mm) diameter yellow impact-resistant plastic or 10-3/4" (273mm) diameter corrosion-resistant stainless steel.

### Standard Sprayhead Assembly

Twin perforated-disc eye/face wash heads with protective pop-off sprayhead covers, operated by a large, highly visible push handle or a foot treadle (S19-310AC only). Safe, steady water flow under varying water supply conditions from 30–90 PSI is assured by integral flow control in the sprayhead assembly. NOTE: The ANSI Z358.1 standard requires an uninterruptable supply of flushing fluid at a minimum 30 PSI flowing pressure.

### Shower Valve

Chrome-plated brass 1" NPT stay-open ball valve. Operated by a stainless steel pull rod with triangular handle.

### Eyewash Valve

Chrome-plated brass 1/2" NPT stay-open ball valve. Hand operated by highly visible safety yellow PVC push handle (S19-310SBFW and S19-310TT) or stainless steel push handle (S19-310AC).

### Pipe and Fittings

1-1/4" galvanized steel with BRADTECT™ safety yellow coating.

### Water Supply

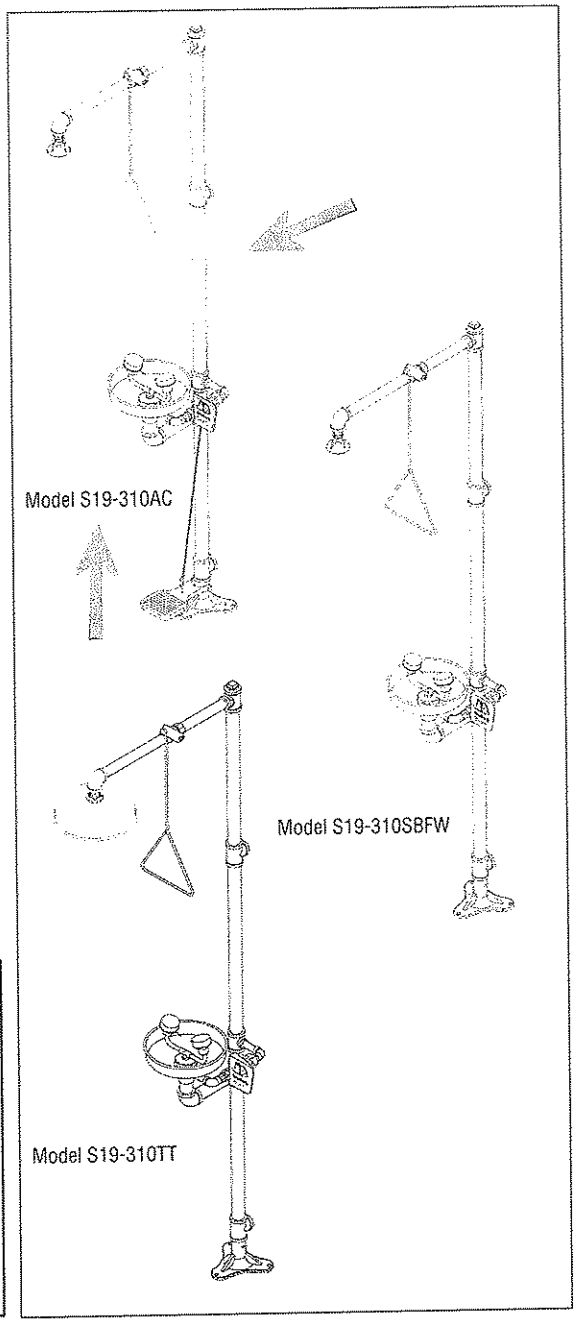
1-1/4" NPT.

### Recommended Option:

Navigator S19-2100 EFX25
Emergency Thermostatic Mixing Valve

NAVIGATOR

Satisfies ANSI Z358.1-2004 tepid water requirements.

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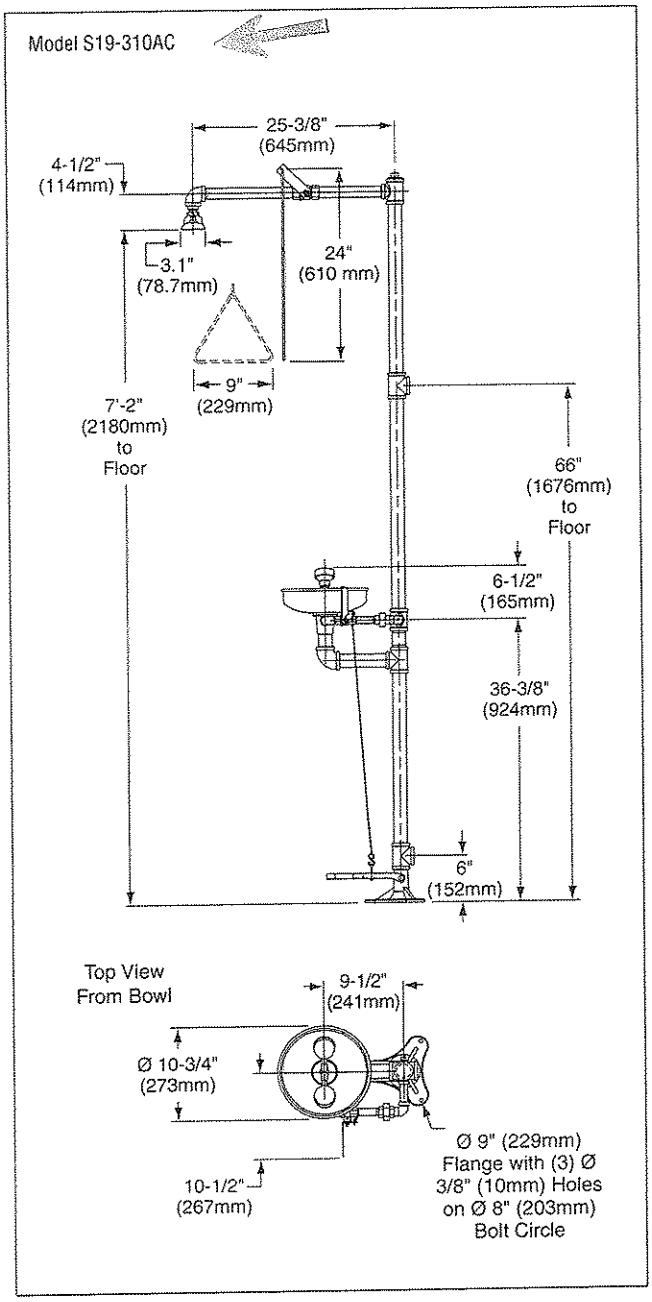
P.O. Box 309, Menomonee Falls, WI 53052-0309
Phone: 800.BRADLEY (800.272.3539) Fax: 262.253.4161
bradleycorp.com

# S19-310AC, S19-310SBFW, S19-310TT
## Combination Drench Shower/Eye/Face Wash Unit

| Model | Description |
|---|---|
| ☐ S19-310AC | Drench Shower/Eyewash - **Plastic Showerhead and Stainless Steel Bowl with Foot Treadle Operation** |
| ☐ S19-310SBFW | Drench Shower/Eyewash - **Plastic Showerhead and Stainless Steel Bowl** |
| ☐ S19-310TT | Drench Shower/Eyewash - **Stainless Steel Showerhead and Stainless Steel Bowl** |
| ☐ S19-2100 | Navigator EFX25 - Emergency Thermostatic Mixing Valve |

*Local codes may require the installation of a backflow prevention valve to complete proper installation. Compliance with local codes is the responsibility of the installer. Valve must be tested annually to verify that it is functioning properly. Backflow prevention valves are not included with the fixture and may be supplied by the contractor or purchased from Bradley Corporation.*




*All dimensions assume standard thread engagement. Variations in manufacturing allow for +/- 1/8" (3mm) per threaded joint. To find the tolerance of a dimension, add the number of thread joints in between a dimension and multiply it by 1/8" (3mm).*

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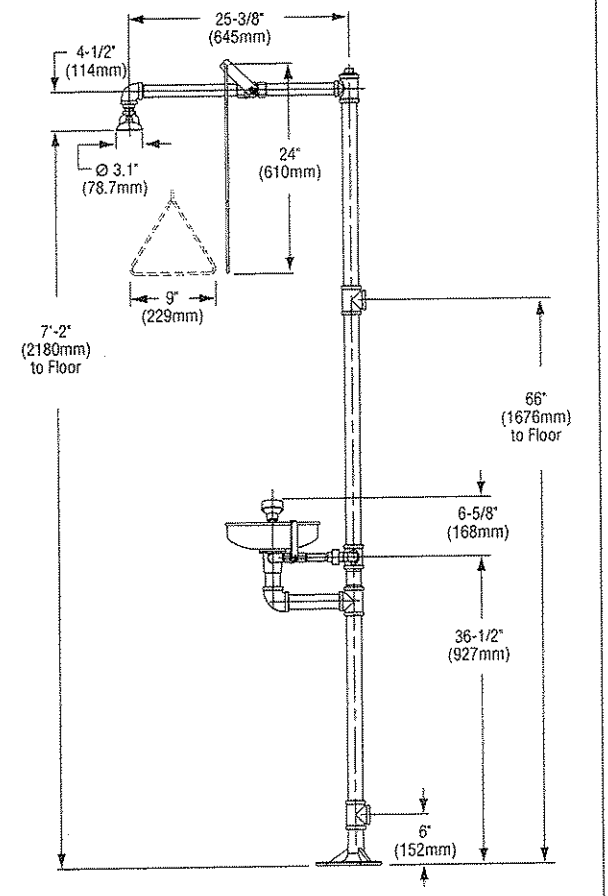
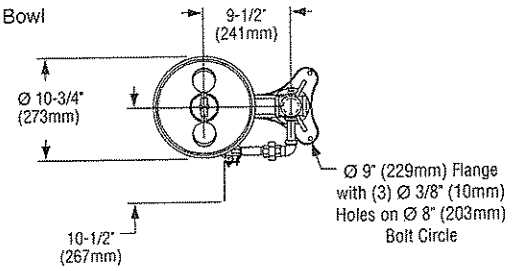
Phone: 800.BRADLEY (800.272.3539) Fax: 262.253.4161
bradleycorp.com

# S19-310AC, S19-310SBFW, S19-310TT
## Combination Drench Shower/Eye/Face Wash Unit

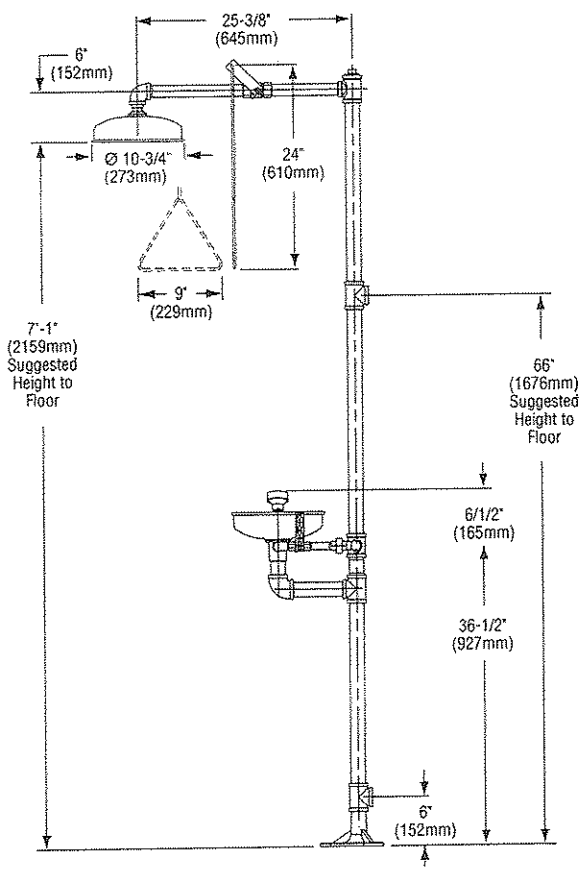
Model S19-310SBFW



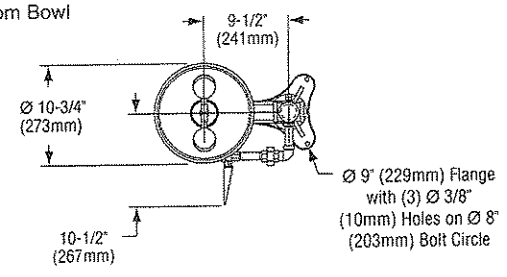

Top View
From Bowl




Model S19-310TT




Top View
From Bowl




*All dimensions assume standard thread engagement. Variations in manufacturing allow for +/- 1/8" (3mm) per threaded joint. To find the tolerance of a dimension, add the number of thread joints in between a dimension and multiply it by 1/8" (3mm).*

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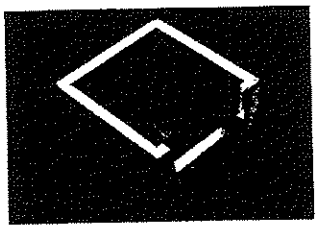
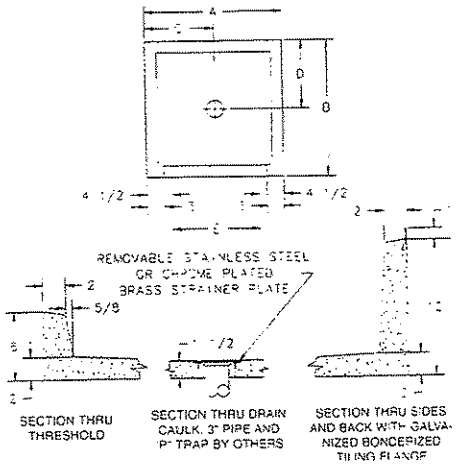
## **SERIES TSB-3000** (Square and Rectangular - 6" dropped front with 12" high side and back walls)

Models TSB-3000, TSB-3001, TSB-3002 and TSB-3003 shall be supplied with continuous stainless steel caps on all curbs (See Table II)



**MODEL TSB-3010 SHOWN**
Models TSB-3010, TSB-3011, TSB -3012 and TSB -3013 shall be supplied with stainless steel cap on dropped threshold curb only (See Table III)




SECTION THRU THRESHOLD | SECTION THRU DRAIN CAULK. 3" PIPE AND "P" TRAP BY OTHERS | SECTION THRU SIDES AND BACK WITH GALVANIZED BONDERIZED TILING FLANGE

TABLE II - Series TSB-3000
With Stainless Steel Caps On All Curbs

| MODEL | SIZE | A | B | C | D | E |
|---|---|---|---|---|---|---|
| TSB-3000 | 24x24x12 | 24 | 24 | 12 | 12 | 15 |
| TSB-3001 | 32x32x12 | 32 | 32 | 16 | 16 | 23 |
| TSB-3002 | 36x36x12 | 36 | 36 | 18 | 18 | 27 |
| TSB-3003 | 36x24x12 | 36 | 24 | 18 | 12 | 27 |

TABLE III -- Series TSB-3000
With Stainless Steel Threshold Only

| MODEL | SIZE | A | B | C | D | E |
|---|---|---|---|---|---|---|
| TSB-3010 | 24x24x12 | 24 | 24 | 12 | 12 | 15 |
| TSB-3011 | 32x32x12 | 32 | 32 | 16 | 16 | 23 |
| TSB-3012 | 36x36x12 | 36 | 36 | 18 | 18 | 27 |
| TSB-3013 | 36x24x12 | 36 | 24 | 18 | 12 | 27 |

KOHLER®

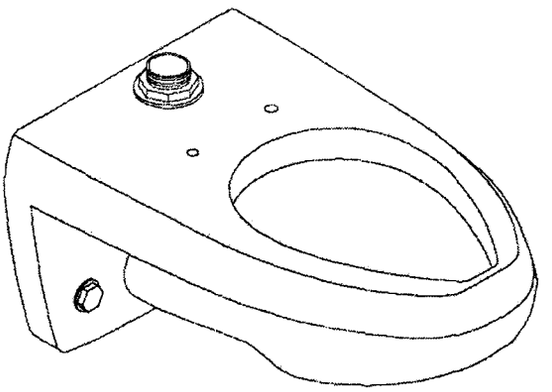
# KINGSTON™

BOWL
**K-4330**

**ADA**

## Features

- *1-1/2" top spud*
- *Vitreous china*
- *Elongated bowl*
- *Wall-mount*
- *1.6 gpf (6 lpf)*
- *ADA compliant when installed at required height of 17"-19" from floor to top of seat*
- *With bedpan lugs (-L)*
- *Siphon jet*
- *12-3/8" (31.4 cm) x 11-3/8" (28.9 cm) water area*



## Codes/Standards Applicable

Specified model meets or exceeds the following:

- *ADA*
- *ASME A112.19.2*
- *ASME A112.19.6*
- *ICC/ANSI A117.2*
- *Energy Policy Act of 1992 (EPACT)*
- *IAPMO/UPC*
- *CSA B125*

## Colors/Finishes

- 0: White
- Other: Refer to Price Book for additional colors/finishes

**Accessories**

- 0: White
- Other: Refer to Price Book for additional colors/finishes

## Specified Model

| Model | Description | Colors/Finishes | |
|---|---|---|---|
| K-4330 | Elongated bowl toilet | ☒ 0 White | ☐ Other_____ |
| K-4330-L | Elongated bowl toilet with bedpan lugs | ☐ 0 White | ☐ Other_____ |
| **Recommended Accessories** | | | |
| K-4670-C | Lustra™ open front seat | ☐ 0 White | ☐ Other_____ |
| K-4670-CA | Lustra™ open front seat (with anti-microbial agent) | ☐ 0 White | |

## Product Specification:

The elongated bowl shall be wall-mount with a 1-1/2" top spud. Bowl shall be made of vitreous china. Bowl shall have 12-3/8" (31.4 cm) x 11-3/8" (28.9 cm) water area. Bowl shall be 1.6 gpf (6 lpf). Bowl shall be ADA compliant when installed at required height of 17" (43.2 cm) - 19" (48.3 cm) from the floor to the top of the seat. Bowl shall have bedpan lugs (-L). Bowl shall have siphon jet. Bowl shall be Kohler Model K-4330-_____



USA: 1-800-4-KOHLER
Canada: 1-800-964-5590
kohler.com

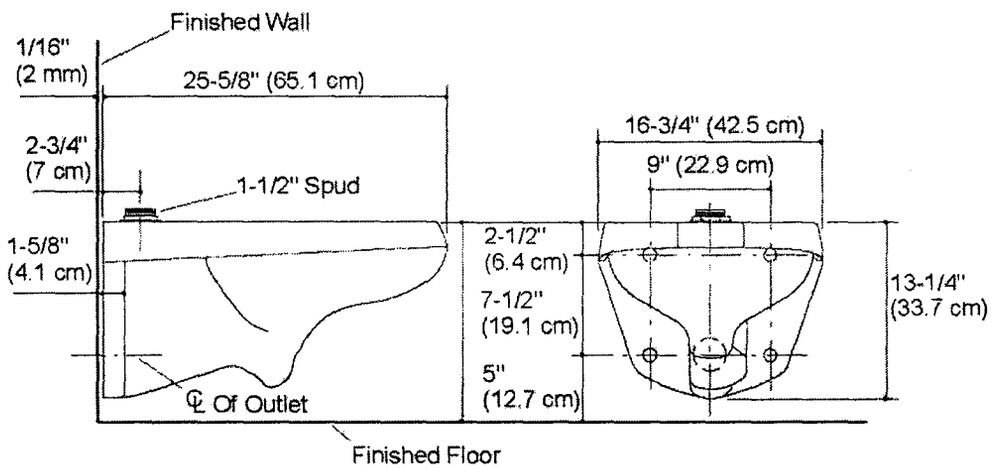
# KINGSTON™

## Technical Information

| | |
|---|---|
| ADA compliant | |
| Fixture: | |
| Configuration | top spud, elongated |
| Water per flush | 1.6 gallons (6 L)* |
| Spud size | 1-1/2" |
| Passageway | 2-1/4" (5.7 cm) |
| Water area | 12-3/8" (31.4 cm) x 11-3/8" (28.9 cm) |
| Water depth from rim | 5-1/4" (13.3 cm) |
| Seat post hole centers | 5-1/2" (14 cm) |
| * Designed to flush with 1.6 (6 L) gallons of water when installed with a 1.6 (6 L) gpf flush valve. | |
| Included components: | |
| Spud | 18357 |
| Flush valve requirements: Refer to manufacturer and local codes. | |

## Installation Notes

Install this product according to the installation guide.




## Product Diagram



THE BOLD LOOK OF KOHLER.

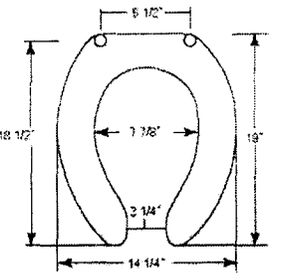
COMMERCIAL PLASTIC SEATS

Church.

# MODEL 295C

- ELONGATED SEAT OPEN FRONT LESS COVER
- SOLID PLASTIC
- EXTERNAL 300 SERIES STAINLESS STEEL CHECK HINGES

Seats shall be No. _____ as manufactured by Church Seats. Seats shall be heavy weight and injection molded of solid plastic. Seats shall be open front less cover for elongated bowl and feature large molded-in bumpers. External check hinges to feature 300 Series stainless steel posts that stop seat 11 degrees beyond vertical. Uses 300 Series stainless steel hardware. Color to be _____. (specify white or fixture manufacturer's color.) Hinges shall be_____.

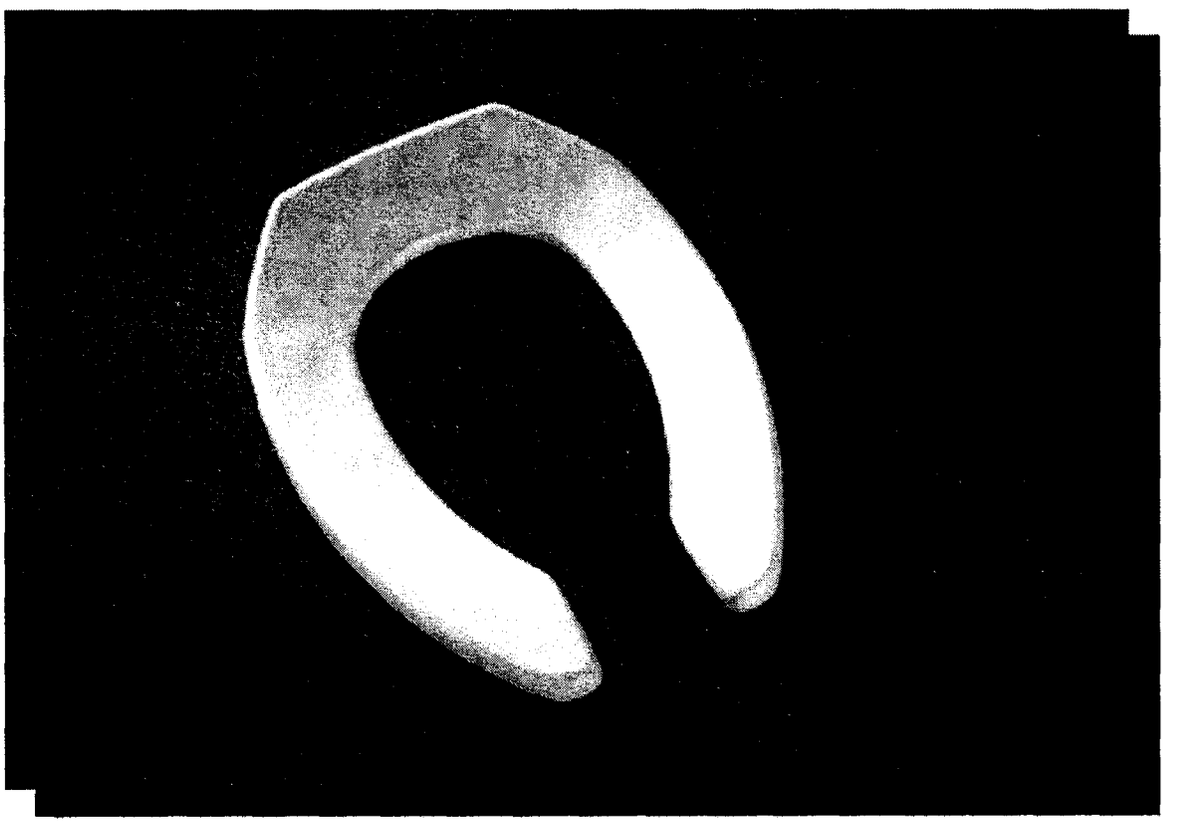



300 Series Stainless Steel

❑ 295C Open front seat less cover/external check hinge stops seat 11° beyond vertical.

❑ 295SSC Open front seat less cover/stainless steel, self-sustaining and external check hinge holds seat in any raised position up to 11° beyond vertical.

Ring thickness is 13/16"
Ring thickness including the bumper is 1"
Height of the seat is 2-1/4

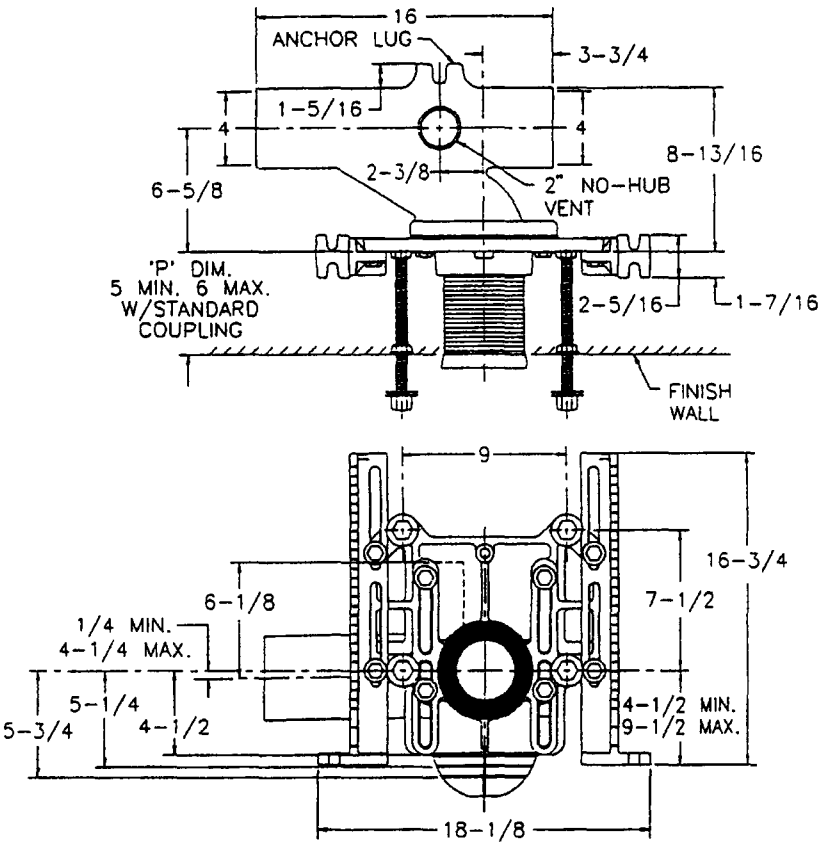


**Church Seats, Sheboygan Falls, WI 53085 Phone: 920-467-2664 or 800-233-7328 Fax: 920-467-8573**
**www.churchseats.com**

# Z-1203-N ADJUSTABLE HORIZONTAL SIPHON JET- No-Hub

TAG _____

Dimensions Subject to Manufacturing Tolerances




| Product No. | Approx. Wt. Lbs. |
|---|---|
| Z-1203-NL4 | 67 |
| Z-1203-NR4 | |

Note:
1. Min. 'P' Dim. Obtainable = 1-3/4"
2. Feet bolted to floor using min. 1/2 dia. bolts and back slots on carrier feet.
3. Back anchor foot required for secure installation.

**ENGINEERING SPECIFICATION:** ZURN Z-1203-N( ) Adjustable, horizontal siphon jet water closet "Rigid System" with 4" No-Hub connections. Complete with Dura-Coated cast iron right hand or left hand main fitting, with 2" vent, adjustable gasketed face plate, universal floor mounted foot supports, corrosion resistant adjustable ABS coupling with integral test cap, fixture bolts, trim, and stud protectors. Rear anchor tie down and bonded "Neo-Seal" gasket.

**PRODUCT/DEFINITION**

_____ Z-1203-NR4 4" No-Hub Right Hand Inlet with Flow to Left
_____ Z-1203-NL4 4" No-Hub Left Hand Inlet with Flow to Right

**PREFIXES**

_____ Z- D.C.C.I. System with Zurn "ZZ" Adjustable Coupling*
_____ ZQ- D.C.C.I. System with Non-Adjustable Coupling

**SUFFIXES**

_____ -A Auxiliary Support Assembly (For P-Dim. greater than 18")
_____ -B Blowout Type Fixture Support
_____ -BC Back Cleanout
_____ -CC Cast Iron Coupling 6" Long
_____ -CL Coupling Length Greater than 12" (Specify length if greater than 6")
_____ -F Floor Mounted Back Outlet, Fixture Support
_____ -G Galvanized Cast Iron
_____ -M Auxiliary Foot Support (For P-Dim. 10"-18")
_____ -T Threaded Stack Connection (Available on Restricted Basis Only)
_____ -VP Vandal Proof Trim
_____ -W Adapter for Womens Urinal
_____ -29 Mechanical Test Cap Assembly (Previously Z-1210-29)
_____ -45 Finishing Frame for Siphon Jet System (For Blowout System specify -45-B) (Previously Z-1210-45)
_____ -50 Flush Valve Supply Support for W.C. (Previously Z-1210-50)
_____ -61 "ZZ" Coupling Wrench

*REGULARLY FURNISHED UNLESS OTHERWISE SPECIFIED

REV. A DATE: 9/20/91 C.N. NO. 67825
DRAWING NO. 54353 PRODUCT NO. Z-1203-N

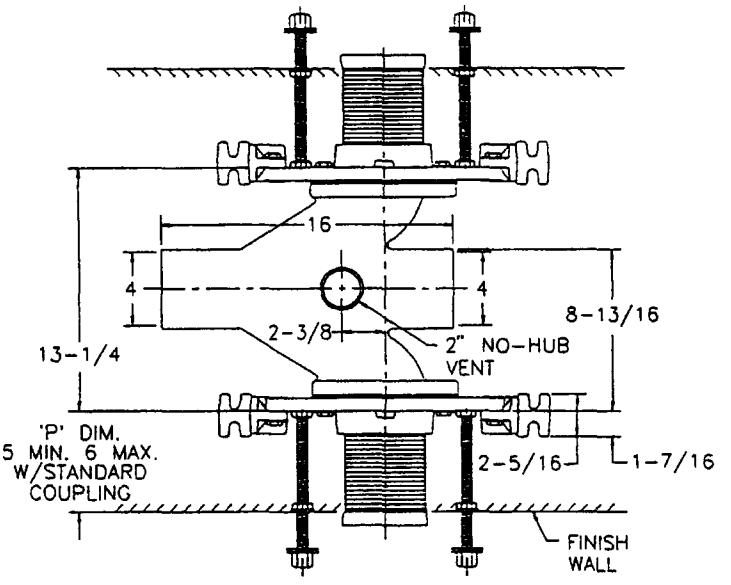
ZURN INDUSTRIES, INC., HYDROMECHANICS DIV., 1801 Pittsburgh Ave., Erie, PA 16514 Phone: 814/455-0921 Fax: 814/454-7929

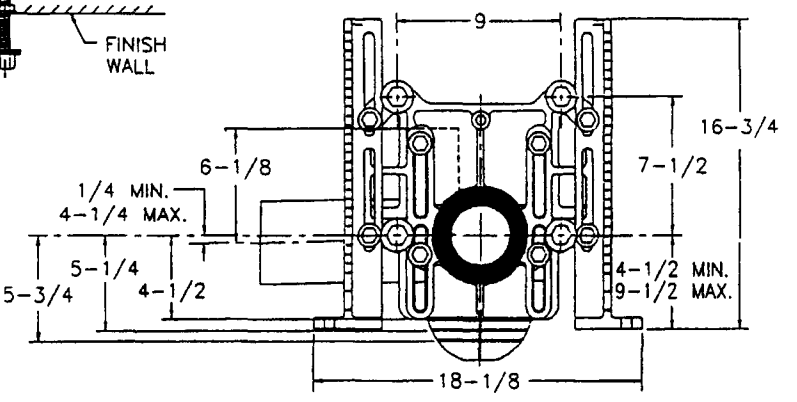
# Z-1203-ND ADJUSTABLE HORIZONTAL BACK TO BACK SIPHON JET- No-Hub

TAG _____

Dimensions Subject to Manufacturing Tolerances

| Product No. | Approx. Wt. Lbs. |
|---|---|
| Z-1203-ND4 | 120 |




Note:
1. Min. 'P' Dim. Obtainable = 1-3/4"
2. Feet bolted to floor using min. 1/2 dia. bolts and back slots on carrier feet.

**ENGINEERING SPECIFICATION:** ZURN Z-1203-ND4 Adjustable, horizontal siphon jet water closet "Rigid System" with 4" No-Hub connections. Complete with Dura-Coated cast iron fitting, with 2" vent, adjustable gasketed face plates, universal floor mounted foot supports, corrosion resistant adjustable ABS couplings with integral test cap, fixture bolts, trim, and stud protectors. Rear anchor tie down and bonded "Neo-Seal" gaskets.

**PRODUCT/DEFINITION**

_____ Z-1203-ND4 4" No-Hub Back to Back Inlet (Double)

**PREFIXES**

_____ Z- D.C.C.I. System with Zurn "ZZ" Adjustable Coupling*
_____ ZQ- D.C.C.I. System with Non-Adjustable Coupling

**SUFFIXES**

_____ -A Auxiliary Support Assembly (For P-Dim. greater than 18")
_____ -B Blowout Type Fixture Support
_____ -BC Back Cleanout
_____ -CC Cast Iron Coupling 6" Long
_____ -CL Coupling Length Greater than 12" (Specify length if greater than 6")
_____ -F Floor Mounted Back Outlet, Fixture Support
_____ -G Galvanized Cast Iron
_____ -M Auxiliary Foot Support (For P-Dim. 10"-18")
_____ -T Threaded Stack Connection (Available on Restricted Basis Only)
_____ -VP Vandal Proof Trim
_____ -W Adapter for Womens Urinal
_____ -29 Mechanical Test Cap Assembly (Previously Z-1210-29)
_____ -45 Finishing Frame for Siphon Jet System (For Blowout System specify -45-B) (Previously Z-1210-45)
_____ -50 Flush Valve Supply Support for W.C. (Previously Z-1210-50)
_____ -61 "ZZ" Coupling Wrench

*REGULARLY FURNISHED UNLESS OTHERWISE SPECIFIED

REV. A DATE: 9/20/91 C.N. NO. 67825
DRAWING NO. 54354 PRODUCT NO. Z-1203-ND

ZURN INDUSTRIES, INC., HYDROMECHANICS DIV., 1801 Pittsburgh Ave., Erie, PA 16514 Phone: 814/455-0921 Fax: 814/454-7929

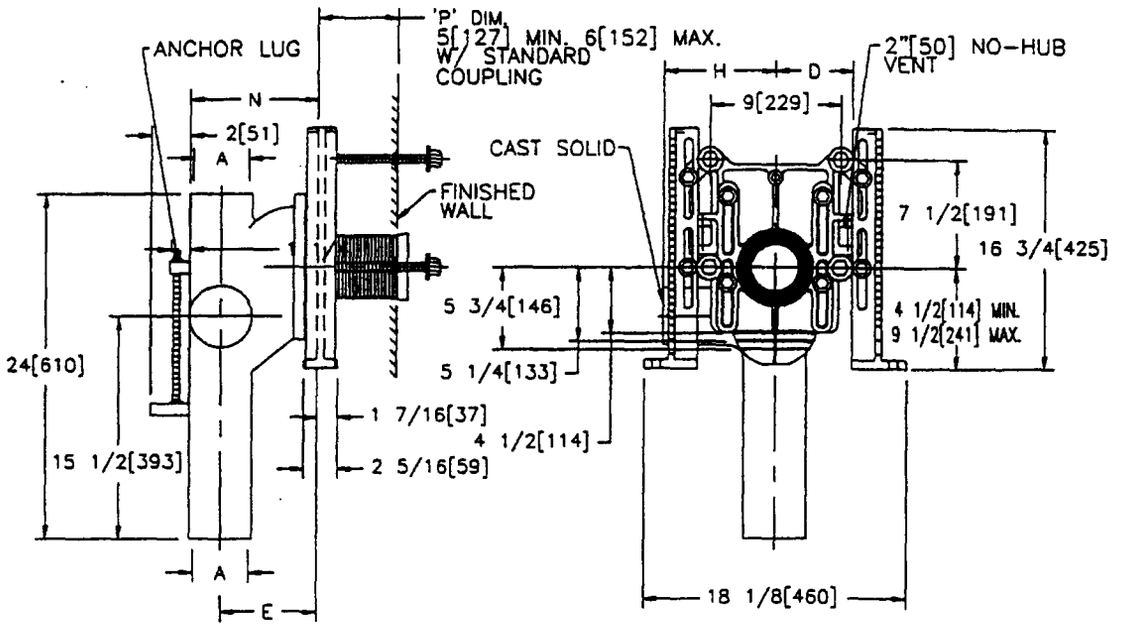
# Z-1204-N

## ADJUSTABLE VERTICAL SIPHON JET-NO-HUB

SPECIFICATION SHEET

TAG _____

Dimensional Data (inches and [ mm ]) are Subject to Manufacturing Tolerances and Change Without Notice




**Note:**

1. Min. 'P' Dim. Obtainable=2 [51]
2. 2 No-Hub vent connection regularly furnished on right hand side. Left hand available when specified (Suffix- VL)
3. Auxiliary inlet available right (-JR) or left (-JL) or both sides (-JJ) when specified.
4. Feet bolted to floor using min. 1/2 [13] dia. bolts and back slots on carrier feet.
5. Back anchor foot required for secure installation.

| Product No. | Dimensions In Inches | | | | | Approx. Wt.Lbs. [kg] |
|---|---|---|---|---|---|---|
| | A | D | E | H | N | |
| Z-1204-N4 | 4 [102] | 5 [127] | 6 5/8 [168] | 5 1/2 [140] | 8 7/8 [225] | 80 [36] |
| Z-1204-N5 | 5 [127] | 5 1/2 [140] | 6 5/8 [168] | 6 1/2 [165] | 9 3/8 [238] | 85 [39] |
| Z-1204-N6 | 6 [152] | 6 [152] | 7 1/8 [181] | 6 1/2 [165] | 10 3/8 [264] | 95 [43] |

**ENGINEERING SPECIFICATION:**
ZURN Z-1204-N( ) Adjustable, vertical siphon jet water closet "Rigid System" with ( ) size No-Hub connections and ( ) side inlets. Complete with Dura-Coated cast iron left hand fitting, with 2 [51] vent, adjustable gasketed face plate, universal floor mounted foot supports, corrosion resistant adjustable ABS coupling with integral test cap, fixture bolts, trim, and stud protectors. Rear anchor tie down, and bonded "Neo-Seal" gasket.

**PRODUCT/DEFINITION**

_____ Z-1204-N No-Hub Stack, Single Inlet, 2 [51] Right Hand Vent

**PREFIXES**

_____ Z- D.C.C.I. System with Zurn "ZZ" Adjustable Coupling
_____ ZQ- D.C.C.I. System with NPT Face Plate, Non-Adjustable Coupling

**SUFFIXES**

_____ -A Auxiliary Support Assembly (For P-Dim. greater than 18 [457])
_____ -B Blowout Type Fixture SupporT
_____ -BC Back Cleanout
_____ -CC Corrosion Resistant 6 [152] Long Cast Iron Coupling
_____ -CL Coupling Length Greater than 12 [305] (Specify length if greater than 6 [152])
_____ -F Floor Mounted Back Outlet, Closet Connection
_____ -G Galvanized Cast Iron
_____ -JJ Two 2 [51] Auxiliary Inlet
_____ -JL 2 [51] Left Hand Auxiliary Inlet
_____ -JR 2 [51] Right Hand Auxiliary Inlet
_____ -M Auxiliary Foot Support (For P-Dim. 10 [254] to 18 [457])
_____ -T Threaded Stack Connection
_____ -VL Left Hand Vent Connection
_____ -VP Vandal Proof Trim
_____ -W Adapter Assembly for Womens Urinal
_____ -29 Mechanical Test Cap Assembly (Previously Z-1210-29)
_____ -45 Finishing Frame for Siphon Jet Closet (For Blowout System specift -45-B)
_____ -50 Flush Valve Supply Support for W.C. (Previously Z-1210-50)
_____ -61 Adjusting Wrench for "ZZ" Coupling

*REGULARLY FURNISHED UNLESS OTHERWISE SPECIFIED

REV. DATE: 03/21/95 C.N. NO. 71120

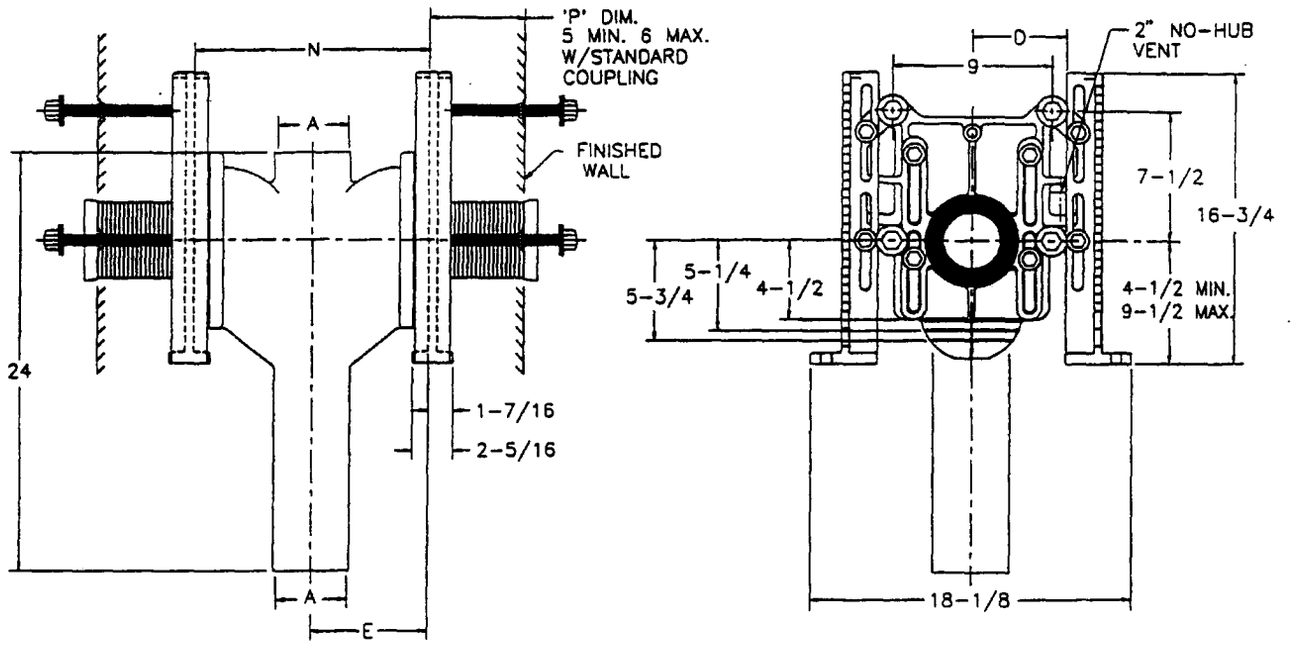
DWG. NO. 58842 PRODUCT NO. Z-1204-N

ZURN INDUSTRIES, INC. • HYDROMECHANICS DIV., • 1801 Pittsburgh Ave. • Erie, PA 16514 • Phone: 814/455-0921 Fax: 814/454-7929
In Canada: ZURN INDUSTRIES LIMITED • 6540 Gottardo Court • Mississauga, Ontario L5T 2A2 • Phone: 905/795-8844 Fax: 905/795-8850

# Z-1204-ND ADJUSTABLE VERTICAL SIPHON JET-No-Hub

TAG _____

Dimensions Subject to Manufacturing Tolerances




| Product No. | Dimensions In Inches | | | | | Approx. Wt. Lbs. |
|---|---|---|---|---|---|---|
| | A | D | E | H | N | |
| Z-1204-ND4 | 4 | 5 | 6-5/8 | 5-1/2 | 13-1/4 | 139 |
| Z-1204-ND5 | 5 | 5-1/2 | 6-5/8 | 6-1/2 | 13-1/4 | 140 |
| Z-1204-ND6 | 6 | 6 | 7-1/8 | 6-1/2 | 14-1/4 | 145 |

**Note:**
1. Min. 'P' Dim. Obtainable=2"
2. Two 4" or 5" side inlets as indicated.
3. Feet bolted to floor using min. 1/2 dia. bolts and back slots on carrier feet.

**ENGINEERING SPECIFICATION:** ZURN Z-1204-ND( ) Adjustable, vertical siphon jet water closet "Rigid System" with ( ) size No-Hub connections and ( ) side inlets. Complete with Dura-Coated cast iron right and left hand fitting, with 2" vent, adjustable gasketed face plate, universal floor mounted foot supports, corrosion resistant adjustable ABS coupling with integral test cap, fixture bolts, trim, and stud protectors. Rear anchor tie down, and bonded "Neo-Seal" gasket.

**PRODUCT/DEFINITION**

_____ **Z-1204-ND** No-Hub Stack, Double Inlets, 2" Vent.

**PREFIXES**

_____ Z- D.C.C.I. System with Zurn "ZZ" Adjustable Coupling
_____ ZQ- D.C.C.I. System with NPT Face Plate, Non Adjustable Coupling

**SUFFIXES**

_____ -A Auxiliary Support Assembly (For P-Dim. greater than 18")
_____ -B Blowout Type Fixture Support
_____ -BC Back Cleanout
_____ -CC Cast Iron Coupling 6" Long
_____ -CL Coupling Length Greater than 12" (Specify length if greater than 6")
_____ -F Floor Mounted Back Outlet, Fixture Support
_____ -G Galvanized Cast Iron
_____ -JJ 2" Auxiliary Inlet
_____ -JL 2" Left Hand Auxiliary Inlet
_____ -JR 2" Right Hand Auxiliary Inlet
_____ -M Auxiliary Foot Support (For P-Dim. 10"-18")
_____ -T Threaded Stack Connection
_____ -VL Left Hand Vent Connection
_____ -VP Vandal Proof Trim
_____ -W Adapter for Womens Urinal
_____ -29 Mechanical Test Cap Assembly (Previously Z-1210-29)
_____ -45 Finishing Frame for Siphon Jet System (For Blowout System specify -45-B) (Previously Z-1210-45)
_____ -50 Flush Valve Supply Support for W.C. (Previously Z-1210-50)
_____ -61 "ZZ" Coupling Wrench

*REGULARLY FURNISHED UNLESS OTHERWISE SPECIFIED

REV. A DATE: 8/9/94 C.N. NO. 69939
DRAWING NO. 56985 PRODUCT NO. Z-1204-ND

ZURN INDUSTRIES, INC., HYDROMECHANICS DIV., 1801 Pittsburgh Ave., Erie, PA 16514 Phone: 814/455-0921 Fax: 814/454-7929

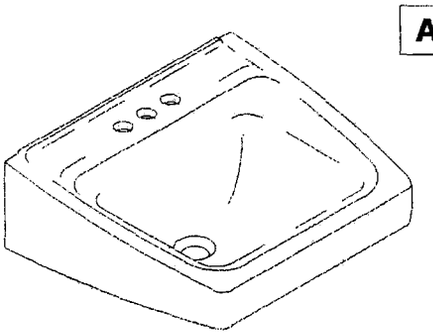
KOHLER®

# CHESAPEAKE™

## WALL-MOUNT LAVATORY

# K-1722, K-1724, K-1728

ADA



## FEATURES

- *19-1/4"(48.9cm) x 17-1/4"(43.8cm)*
- *Vitreous china*
- *Ledge-back*
- *8"(20.3cm) centers (K-1724), 4"(10.2cm) centers (K-1728) or single-hole (K-1722)*
- *With overflow*
- *ADA compliant*
- *With hanger*
- *Drilled for concealed arm carrier*

## CODES/STANDARDS APPLICABLE

Specified model meets or exceeds the following:

- *ADA*
- *ASME/ANSI A112.19.2M*
- *CABO/ANSI A117.1*
- *IAPMO/UPC*
- *State of Massachusetts*

## COLORS/FINISHES

- 0 White
- Other Refer to Fixtures Price Book for additional colors

**Accessories:**

- CP Polished Chrome
- Other Refer to Faucets Price Book for additional finishes

## SPECIFIED MODEL:

| Model | Description | Colors/Finishes | |
|---|---|---|---|
| K-1724 | 8" (20.3cm) centers lavatory | ☐0 White | ☐Other_____ |
| K-1728 | 4" (10.2cm) centers lavatory | ☒0 White | ☐Other_____ |
| K-1722 | Single-hole lavatory | ☐0 White | ☐Other_____ |
| **Recommended Accessories** | | | |
| K-8998 | Trap | ☐CP | ☐Other_____ |

## PRODUCT SPECIFICATION:

The lavatory shall be 19-1/4" (48.9cm) in length, and 17-1/4" (43.8cm) in width. Lavatory shall be made of vitreous china. Lavatory shall be ledge-back with hanger. Lavatory shall have 8" (20.2cm) centers (K-1724), 4" (10.2cm) centers (K-1728), or single-hole (K-1722) drilling. Lavatory shall be drilled for concealed arm carrier. Lavatory shall have overflow. Lavatory shall be ADA compliant. Lavatory shall be Kohler Model K-_____-_____-_____.

*We reserve the right to make revisions without notice in the design of fixtures or in packaging unless this right has specifically been waived at the time the order is accepted.*

# CHESAPEAKE™

## PRODUCT INFORMATION

| **ADA** compliant. | | | |
|---|---|---|---|
| Fixture*: | | basin area | water depth |
| Lavatory | | 14" (35.6cm) x 11" (27.9cm) | 4-7/8" (12.4cm) |
| Drain hole | 1-3/4" D. (4.4cm) | | |
| * Approximate measurements for comparison only. | | | |

| Holes | K-1724 | K-1728 | K-1722 |
|---|---|---|---|
| Spout | 1-3/8" D. (3.5cm) | 1-1/4" D. (3.2cm) | 1-3/8" D. (3.5cm) |
| Faucet | 1-3/8" D. (3.5cm) | 1-1/4" D. (3.2cm) | |

| Soap dispenser | 1-1/4" D. (3.2cm) |
|---|---|

| Included Components: | |
|---|---|
| Hanger | 64839 |

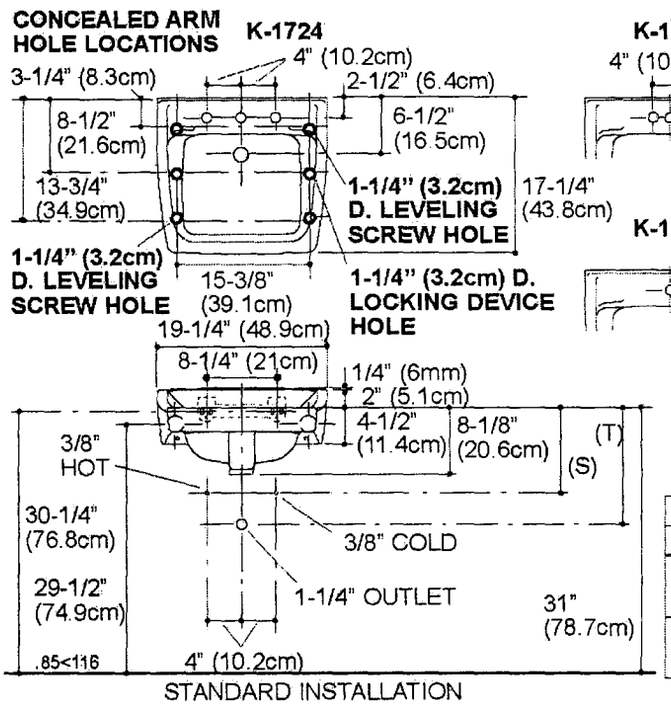
## INSTALLATION NOTES

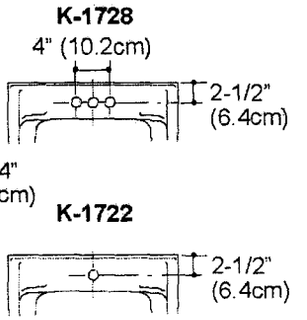
Install this product according to the installation guide.

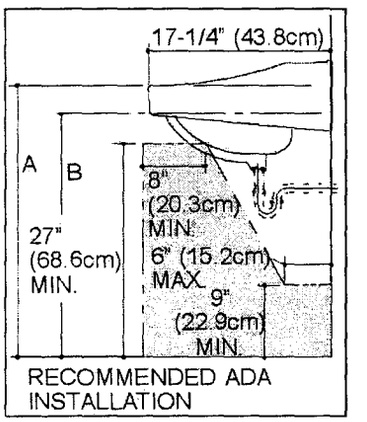
Fixture dimensions are nominal and conform to tolerances in ASME Standard A112.19.2M.

Concealed arm carrier required, **NOT** supplied by Kohler Co.

Supplied hanger not used with concealed arm carrier.




| ADA rim height = A | ADA arm carrier height = B |
|---|---|
| 34" (86.4cm) Max. | 33" (81.9cm) Max. |
| (T) Pop-up drain 13-3/4" (34.9cm), grid drain 12-7/8" (32.7cm). | |
| (S) 10" (25.4cm) (Based on 12" (30.5cm) riser which may require cutting). | |

## PRODUCT DIAGRAM



THE BOLD LOOK OF KOHLER®

QUALITY DESIGNED McGUIRE PRODUCTS

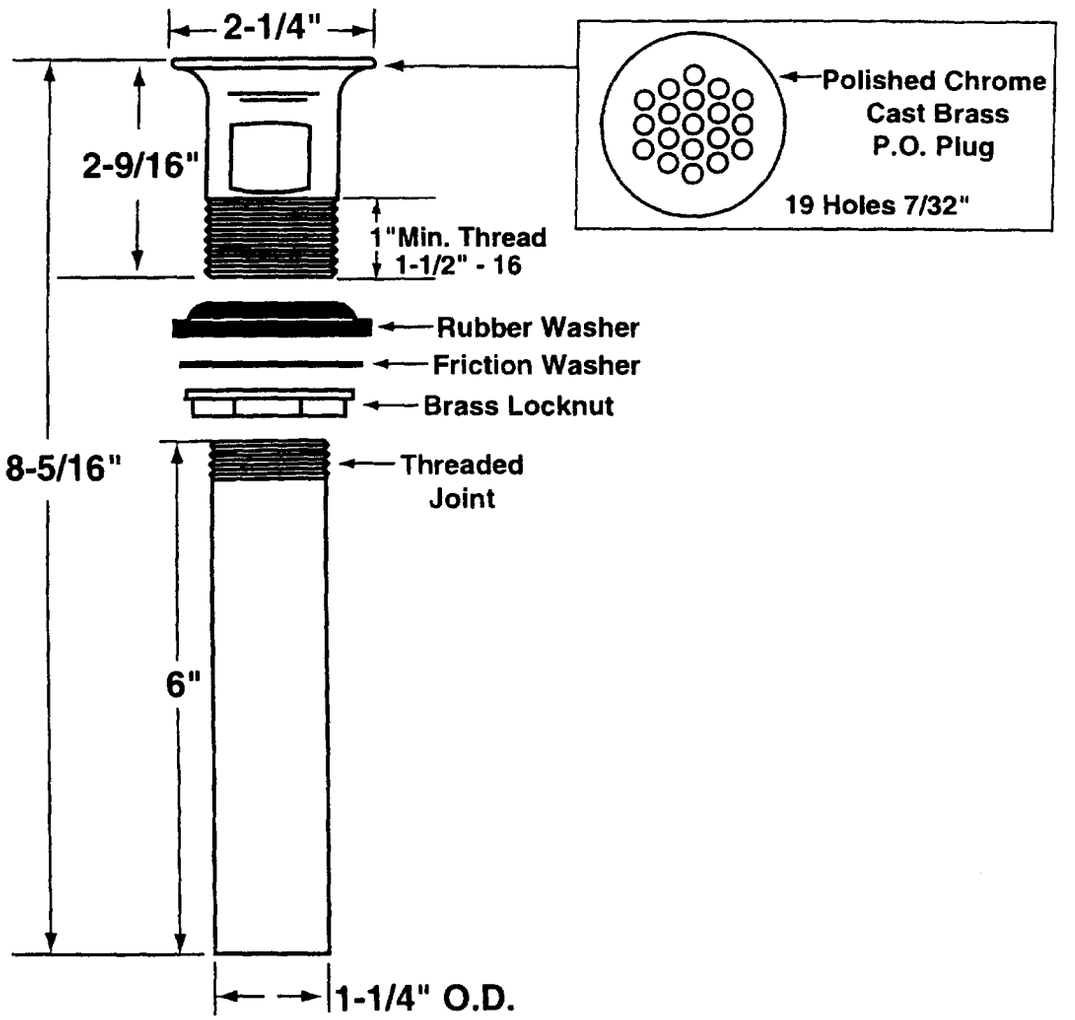
**McGUIRE MFG. CO., INC.**
60 Grandview Court
P.O. Box 746 ♣ Cheshire, CT 06410
203-699-1801 ♣ Fax 203-699-1813

# Product Specification

**Part No.** 155A

Open Grid P.O. Plug

**Job Name:** **Submittal Number:**




***Available with 1 1/2" O.D. brass tailpiece, specify Part # 155A2**

CSA Certified

See accessories section for details on product variations.

## Specifications:

Cast Brass Chrome Plated Open Grid P.O. Plug with 17 gauge 1-1/4" x 6" seamless brass tailpiece, brass locknut, heavy rubber basin washer and fiber friction washer. P.O. plug shall be in compliance with CSA or other recognized testing authority and bear both manufacturer and testing mark.

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KOHLER® FAUCETS

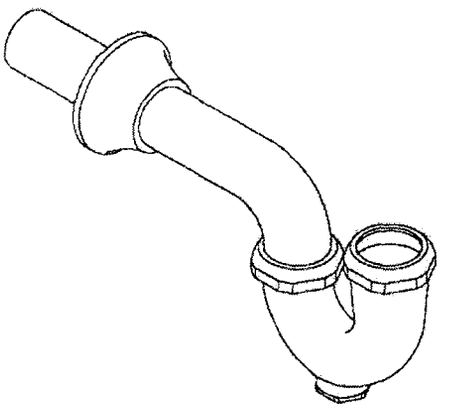
P-TRAP

# K-8998

## ALSO K-8999, K-9000

## FEATURES

- *Cast brass construction*
- *Adjustable rotation on tube outlet*
- *Slip-joint inlet*
- *Cleanout plug*
- *Flange*



## CODES/STANDARDS APPLICABLE

Specified model meets or exceeds the following:

- *ASME/ANSI A112.18.1M*
- *IAPMO/UPC*

## COLORS/FINISHES

- CP Polished Chrome
- Other Refer to Faucets Price Book for additional finishes

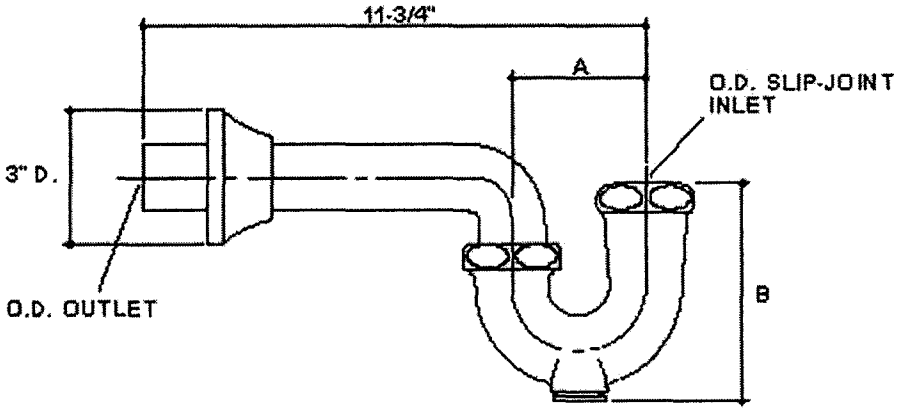
## SPECIFIED MODEL:

| Model | Description | | |
|---|---|---|---|
| K-8998 | With 1-1/4" O.D. Inlet and 1-1/4" O.D. Outlet | ☐CP | ☐Other____ |
| K-8999 | With 1-1/4" O.D. Inlet and 1-1/2" O.D. Outlet | ☒CP | |
| K-9000 | With 1-1/2" O.D. Inlet and 1-1/2" O.D. Outlet | ☐CP | |

## PRODUCT SPECIFICATION:

P-trap shall be of cast brass construction. Adjustable P-trap shall include cleanout plug, and flange. Optional features shall be 1-1/4" or 1-1/2" O.D. slip-joint inlet and 1-1/4" or 1-1/2" O.D. outlet. Product shall be Kohler Model K-_____-_____.

[redacted]




| Roughing-In Notes | | | | |
|---|---|---|---|---|
| | A | B | O.D. OUTLET | O.D. INLET |
| K-8998 | 2-3/4" | 4-3/8" | 1-1/4" | 1-1/4" |
| K-8999 | 3" | 4-7/8" | 1-1/2" | 1-1/4" |
| K-9000 | 3" | 4-7/8" | 1-1/2" | 1-1/2" |

14

## PRODUCT DIAGRAM

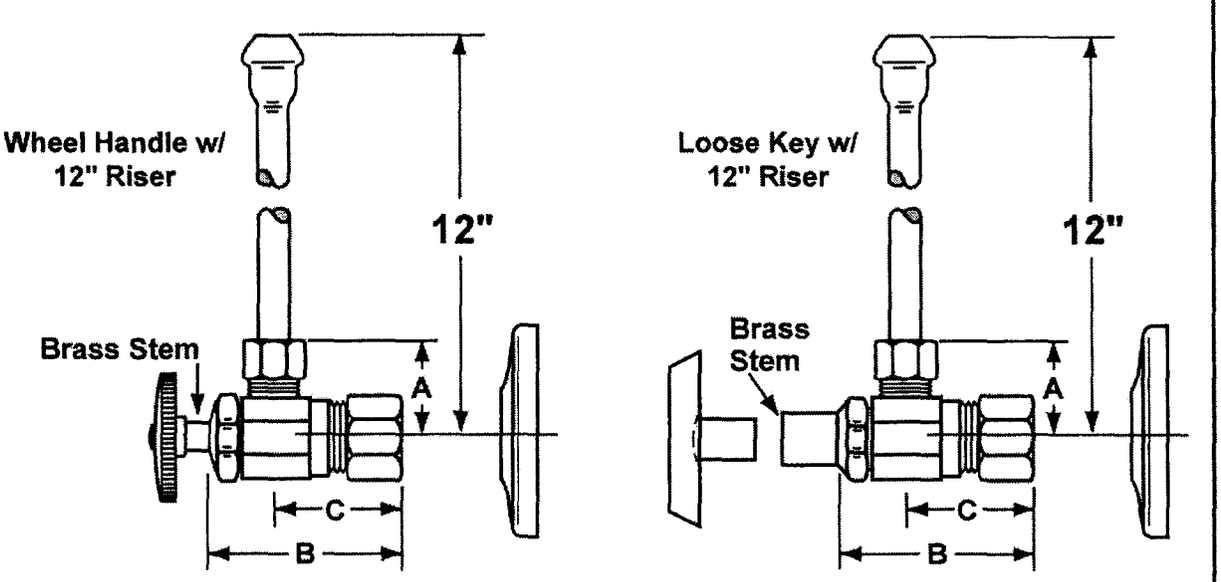
McGUIRE MFG. CO., INC.
60 Grandview Court
P.O. Box 746 ♣ Cheshire, CT 06410
203-699-1801 ♣ Fax 203-699-1813
www.mcguiremfg.com

# Product Specification

**Part No.**
2165CC, 2165CCLK,
2167CC, 2167CCLK

Compression x Compression
Lavatory Supply

Job Name: Submittal Number:




| NO. | ROUGHING MEASUREMENTS | A | B | C |
|---|---|---|---|---|
| 2165CC | 1/2" Nominal x 3/8" O.D. | 1" | 1-1/2" | 3/4" |
| 2165CCLK | 1/2" Nominal x 3/8" O.D. | 1" | 2-1/4" | 3/4" |
| 2167CC | 1/2" Nominal x 1/2" O.D. | 1" | 1-1/2" | 3/4" |
| 2167CCLK | 1/2" Nominal x 1/2" O.D. | 1" | 2-1/4" | 3/4" |

**LK** designates *Loose Key*

CSA Certified

See options and accessories section for details on product variations.

## Specifications:

Supply kit shall include chrome plated brass stops with full turn brass stem, no plastic, (12, 15, 20) inch chrome plated copper risers and (shallow, deep, bell) (steel, brass) or (forged brass with set screw) flange. Inlet shall be (3/8, 1/2) inch (IPS, sweat, compression). Outlet shall be (3/8, 1/2) inch (IPS, compression). Supply kit shall be McGuire _____. Supply kit shall be certified by CSA or other recognized testing authority and bear manufacturer and testing mark. Stop to be certified to 200 psi line pressure.

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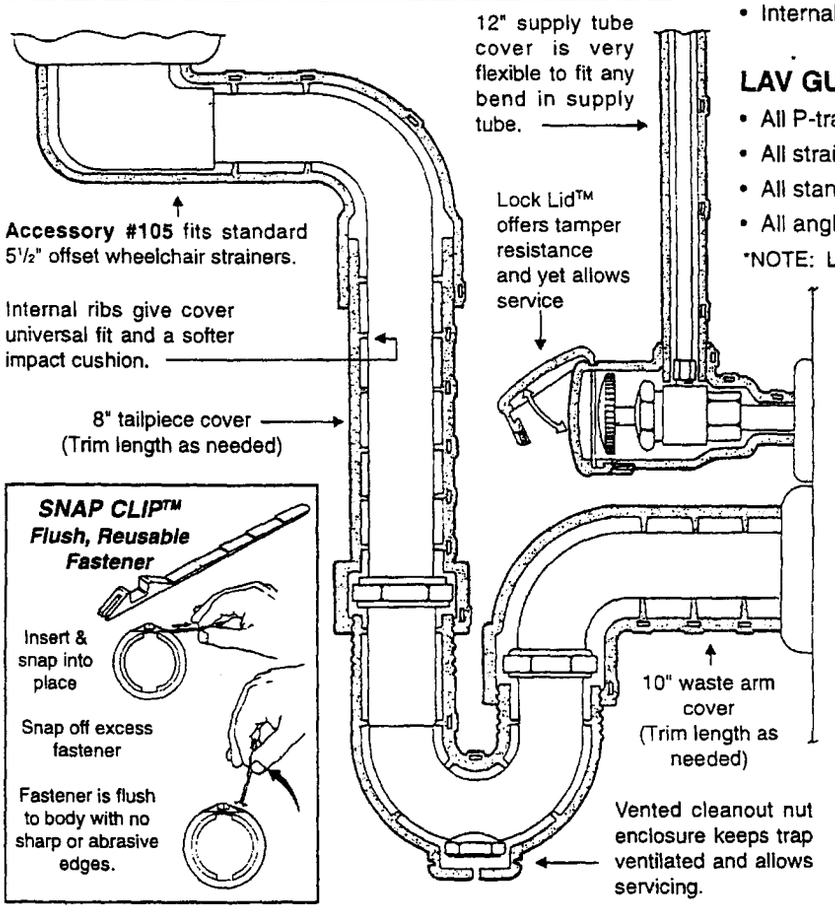
# SUBMITTAL SHEET

**PRODUCT DESCRIPTION**

LAV GUARD waste and supply piping covers satisfy all ADA compliance requirements with its unique and universal design, allowing for easy installation over virtually all tubular and cast brass P-p assemblies, as well as angle valve and supply tube assemblies, regardless of their geometry or rotational offset. Smooth, flush Snap Clip™ fasteners firmly secure piping covers in place.

**SAMPLE SPECIFICATIONS**

Handicap lavatory P-trap and angle valve assemblies shall be covered with the soft, antimicrobial, **LAV GUARD**, piping cover manufactured by **TRUEBRO, Inc.** Model #_____, Accessory #_____, color_____(white or grey). Piping cover shall be secured with Snap Clip™ flush mounted fasteners. Angle stop valve shall be secured with locking lid access cover. Cover shall be non-yellowing and fire retardant.







| | |
|---|---|
| MATERIAL: | MOLDED CLOSED CELL VINYL |
| NOM. WALL: | 1/8 INCH CONSTANT |
| DUROMETER: | 55 - 65 - SHORE A |
| UV PROTECTION: | WILL NOT FADE OR DISCOLOR |
| DURABILITY: | VIRTUALLY INDESTRUCTIBLE |
| FASTENERS: | SNAP-CLIP™, FLUSH, REUSABLE |
| COLOR: | LIGHT GREY OR WHITE |
| PAINTABILITY: | APPLY ACRYLIC ENAMEL |
| BURNING CHARACTERISTICS ASTM D 635: | SELF-EXTINGUISHED 5 SEC (ATB) 10 MM (AEB) |
| THERMAL CONDUCTIVITY ASTM C 177: | BTU - IN/HR - FT² - °F K VALUE = 1.17 |
| BACTERIA/FUNGUS RESIST: | ANTIMICROBIAL VINYL FORMULA |
| MAINTENANCE: | USE COMMON DETERGENTS |

# LAV GUARD™

UNDERSINK PROTECTIVE PIPE COVERS

## DESIGN FEATURES

- Universal design fits virtually all lavatory applications
- Antimicrobial vinyl maintains sanitary conditions
- Lock Lid™ on valve stops tampering & allows service
- Cleanout nut cap allows service on trap without disassembly
- Snap-Clip™ fastener is flush, nonabrasive & reusable
- Internal ribs enhance K value & soften impact cushioning

## LAV GUARD Kits Fit:

- All P-trap assemblies, cast brass or tubular - 1¼" or 1½".
- All straight tail piece assemblies - 1¼" or 1½".
- All standard 5½" offset wheelchair strainers. (Acc. #105)
- All angle stop valves - handled or keyed type ⅜" or ½".

*NOTE: LAV GUARD Kits will not fit Schedule 40 plastic P-traps.

## Models Available: White or Grey

Select model and color.

___ **Model #99** ❑ **white** ❑ **grey**
One angle valve and supply cover only.

___ **Model #100** ❑ **white** ❑ **grey**
One P-trap cover only.

___ **Model #101** ❑ **white** ❑ **grey**
One P-trap cover, one angle valve and supply cover.

___ **Model #102** ❑ **white** ❑ **grey**
One P-trap cover, two angle valve and supply covers.

___ **Model #103** ❑ **white** ❑ **grey**
One P-trap cover, two angle valve and supply covers, one offset tailpiece wheelchair strainer cover. (Acc. #105)

___ **Accessory #105** ❑ **white** ❑ **grey**
One offset tailpiece wheelchair strainer cover only.

Approved By:

TRUEBRO
MAKING AMERICA ACCESSIBLE

TRUEBRO, Inc.
7 Main Street • Ellington, CT 06029
(203) 875-2868 • 1-800-340-5969
Fax: (203) 872-0300

4/95

ZURN

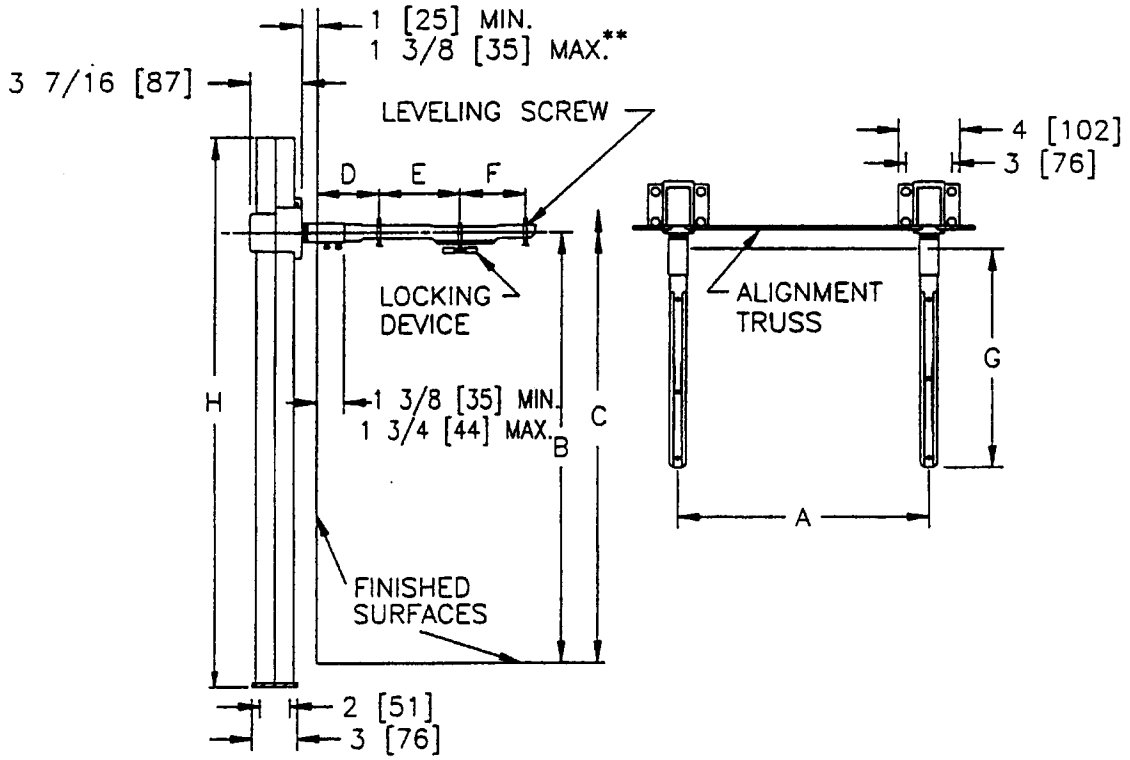
# Z-1231

## CONCEALED ARM SYSTEM WALL LAVATORIES

SPECIFICATION SHEET

TAG _____

Dimensional Data (inches and [ mm ]) are Subject to Manufacturing Tolerances and Change Without Notice




** WITH STANDARD SLEEVE LENGTH OF 3 1/4 [83].

| Product No. | Approx. Wt. Lbs. [kg] |
|---|---|
| Z-1231 | 45 [20] |

**ENGINEERING SPECIFICATION:** ZURN Z-1231 Lavatory support system with concealed arms. Complete with Dura-Coated rectangular steel uprights with welded feet, cast iron adjustable headers, concealed arms, steel sleeves, alignment truss, and mounting fasteners.

**OPTIONS** (Check/specify appropriate options)

**PREFIXES**

_____ Z- Dura-Coated System with Support Plate*

**SUFFIXES**

_____ -AL Adapter Lug
_____ -CU Floor to Ceiling Upright (Specify Height Required)
_____ -D Back to Back System
_____ -E2 Concealed Arm Escutcheons 2 [51] Long
_____ -E4 Concealed Arm Escutcheons 4 [102] Long
_____ -E6 Concealed Arm Escutcheons 6 [152] Long
_____ -SL Stud Lenght Over 3 1/4 [82] (Specify Length)
_____ -WS Wall Support Valve Plate (Specify Valve Name and Number)
_____ -79 Paraplegic Rough-in

*REGULARLY FURNISHED UNLESS OTHERWISE SPECIFIED

REV. DATE: 03/21/95 C.N. NO. 71133

DWG. NO. 58855 PRODUCT NO. Z-1231

ZURN INDUSTRIES, INC. • HYDROMECHANICS DIV., • 1801 Pittsburgh Ave. • Erie, PA 16514 • Phone: 814/455-0921 Fax: 814/454-7929
In Canada: ZURN INDUSTRIES LIMITED • 6540 Gottardo Court • Mississauga, Ontario L5T 2A2 • Phone: 905/795-8844 Fax: 905/795-8850

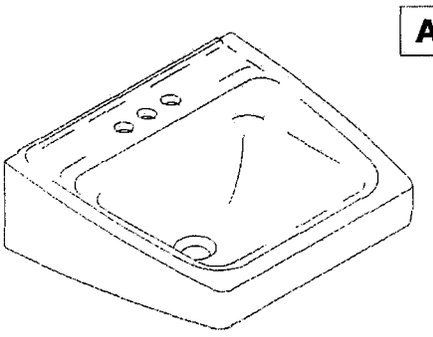
KOHLER®

# CHESAPEAKE™

## WALL-MOUNT LAVATORY

# K-1722, K-1724, K-1728

ADA



## FEATURES

- *19-1/4"(48.9cm) x 17-1/4"(43.8cm)*
- *Vitreous china*
- *Ledge-back*
- *8"(20.3cm) centers (K-1724), 4"(10.2cm) centers (K-1728) or single-hole (K-1722)*
- *With overflow*
- *ADA compliant*
- *With hanger*
- *Drilled for concealed arm carrier*

## CODES/STANDARDS APPLICABLE

Specified model meets or exceeds the following:

- *ADA*
- *ASME/ANSI A112.19.2M*
- *CABO/ANSI A117.1*
- *IAPMO/UPC*
- *State of Massachusetts*

## COLORS/FINISHES

- 0 White
- Other Refer to Fixtures Price Book for additional colors

**Accessories:**

- CP Polished Chrome
- Other Refer to Faucets Price Book for additional finishes

## SPECIFIED MODEL:

| Model | Description | Colors/Finishes | |
|---|---|---|---|
| K-1724 | 8" (20.3cm) centers lavatory | ☐0 White | ☐Other_____ |
| K-1728 | 4" (10.2cm) centers lavatory | ☒0 White | ☐Other_____ |
| K-1722 | Single-hole lavatory | ☐0 White | ☐Other_____ |
| **Recommended Accessories** | | | |
| K-8998 | Trap | ☐CP | ☐Other_____ |

## PRODUCT SPECIFICATION:

The lavatory shall be 19-1/4" (48.9cm) in length, and 17-1/4" (43.8cm) in width. Lavatory shall be made of vitreous china. Lavatory shall be ledge-back with hanger. Lavatory shall have 8" (20.2cm) centers (K-1724), 4" (10.2cm) centers (K-1728), or single-hole (K-1722) drilling. Lavatory shall be drilled for concealed arm carrier. Lavatory shall have overflow. Lavatory shall be ADA compliant. Lavatory shall be Kohler Model K-_____-_____-_____.

*We reserve the right to make revisions without notice in the design of fixtures or in packaging unless this right has specifically been waived at the time the order is accepted.*

# CHESAPEAKE™

## PRODUCT INFORMATION

| **ADA** compliant. | | | |
|---|---|---|---|
| Fixture*: | | basin area | water depth |
| Lavatory | | 14" (35.6cm) x 11" (27.9cm) | 4-7/8" (12.4cm) |
| Drain hole | 1-3/4" D. (4.4cm) | | |
| * Approximate measurements for comparison only. | | | |

| Holes | K-1724 | K-1728 | K-1722 |
|---|---|---|---|
| Spout | 1-3/8" D. (3.5cm) | 1-1/4" D. (3.2cm) | 1-3/8" D. (3.5cm) |
| Faucet | 1-3/8" D. (3.5cm) | 1-1/4" D. (3.2cm) | |

| | |
|---|---|
| Soap dispenser | 1-1/4" D. (3.2cm) |

| Included Components: | |
|---|---|
| Hanger | 64839 |

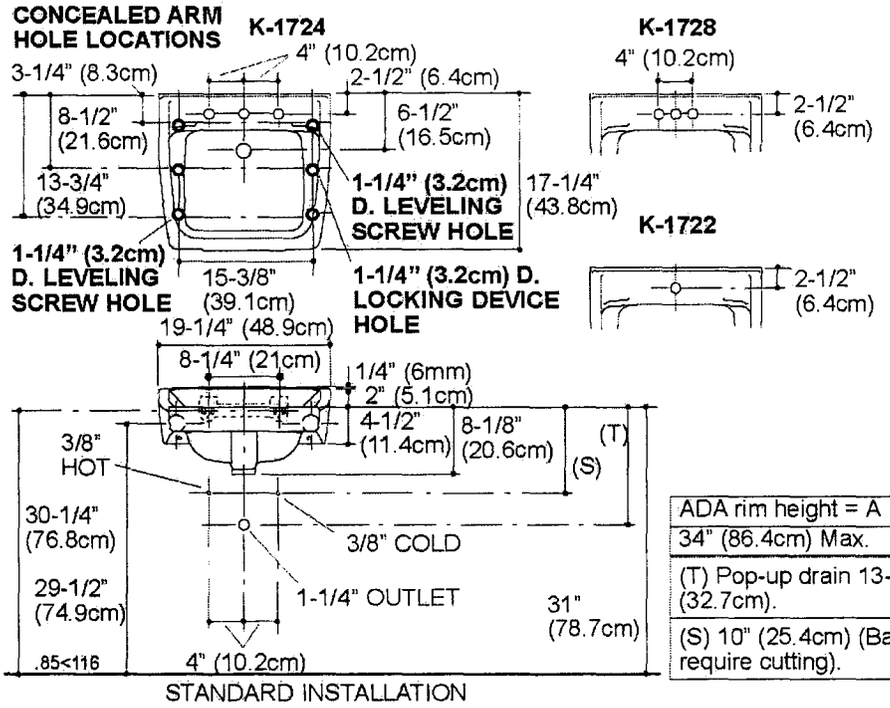
## INSTALLATION NOTES

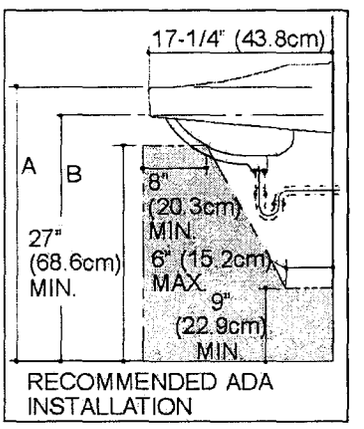
Install this product according to the installation guide.

Fixture dimensions are nominal and conform to tolerances in ASME Standard A112.19.2M.

Concealed arm carrier required, **NOT** supplied by Kohler Co.

Supplied hanger not used with concealed arm carrier.




| ADA rim height = A | ADA arm carrier height = B |
|---|---|
| 34" (86.4cm) Max. | 33" (81.9cm) Max. |
| (T) Pop-up drain 13-3/4" (34.9cm), grid drain 12-7/8" (32.7cm). | |
| (S) 10" (25.4cm) (Based on 12" (30.5cm) riser which may require cutting). | |

## PRODUCT DIAGRAM



THE BOLD LOOK OF KOHLER.

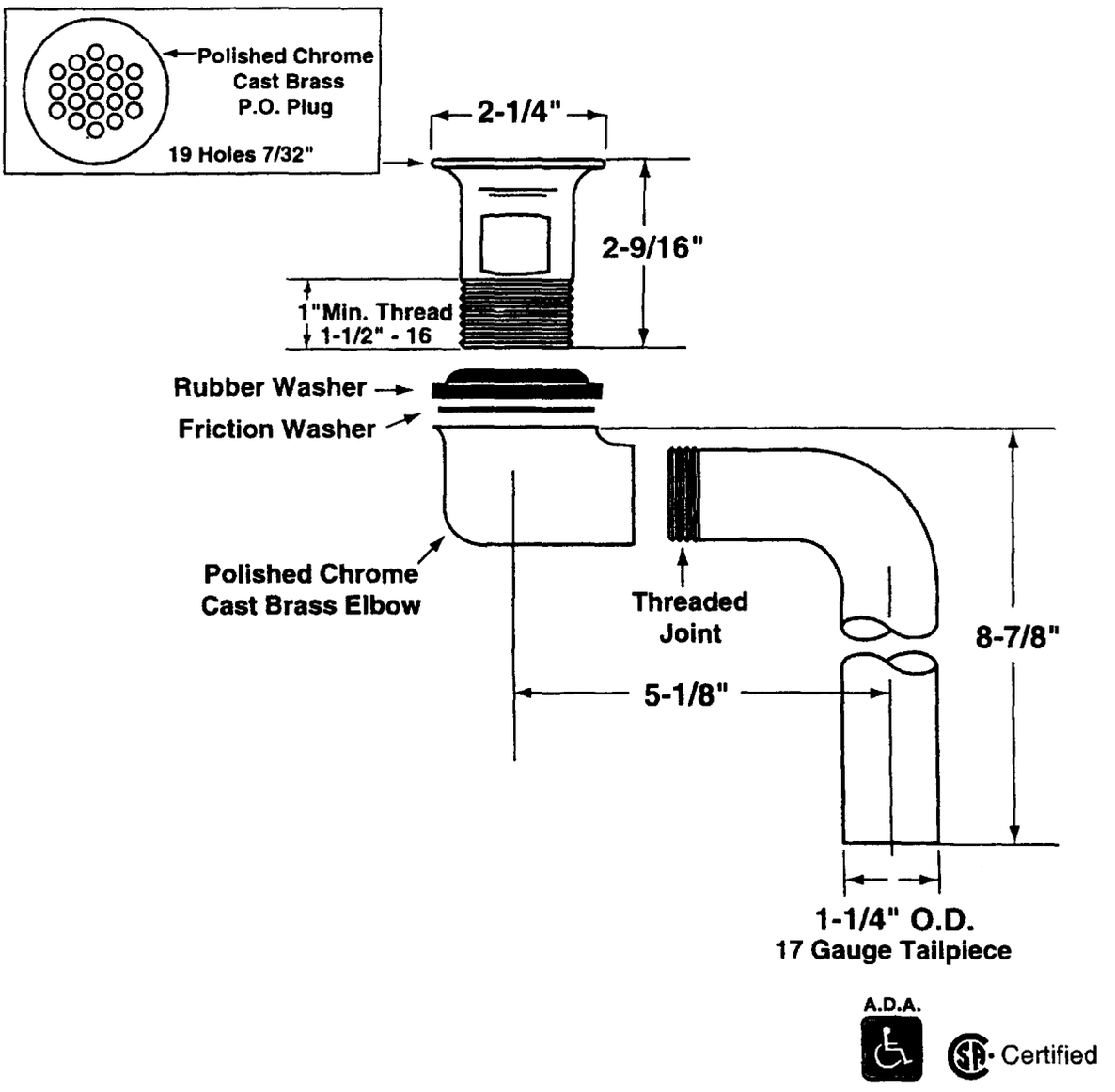
QUALITY DESIGNED McGUIRE PRODUCTS

**McGUIRE MFG. CO., INC.**
60 Grandview Court
P.O. Box 746 ♣ Cheshire, CT 06410
203-699-1801 ♣ Fax 203-699-1813

# Product Specification

**Part No.**
155WC
Offset Lavatory
Grid Strainer

**Job Name:** **Submittal Number:**




A.D.A.

Certified

See accessories section for details on product variations.

## Specifications:

Cast Brass Chrome Plated Offset Wheelchair Strainer with polished chrome cast brass elbow, 17 gauge 1-1/4 inch seamless brass offset tailpiece, heavy rubber basin washer and fiber friction washer. Offset lavatory strainer shall be in compliance with CSA or other recognized testing authority and bear both manufacturer and testing mark.

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KOHLER® FAUCETS

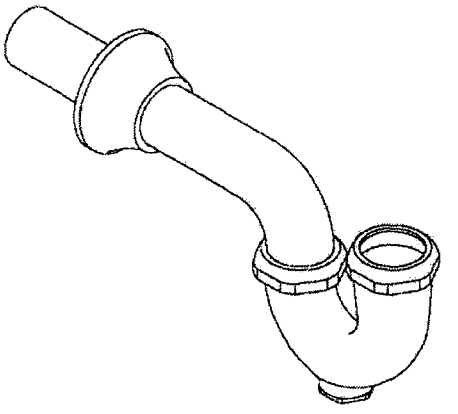
P-TRAP

# K-8998

ALSO K-8999, K-9000

## FEATURES

- *Cast brass construction*
- *Adjustable rotation on tube outlet*
- *Slip-joint inlet*
- *Cleanout plug*
- *Flange*



## CODES/STANDARDS APPLICABLE

Specified model meets or exceeds the following:

- *ASME/ANSI A112.18.1M*
- *IAPMO/UPC*

## COLORS/FINISHES

- CP Polished Chrome
- Other Refer to Faucets Price Book for additional finishes

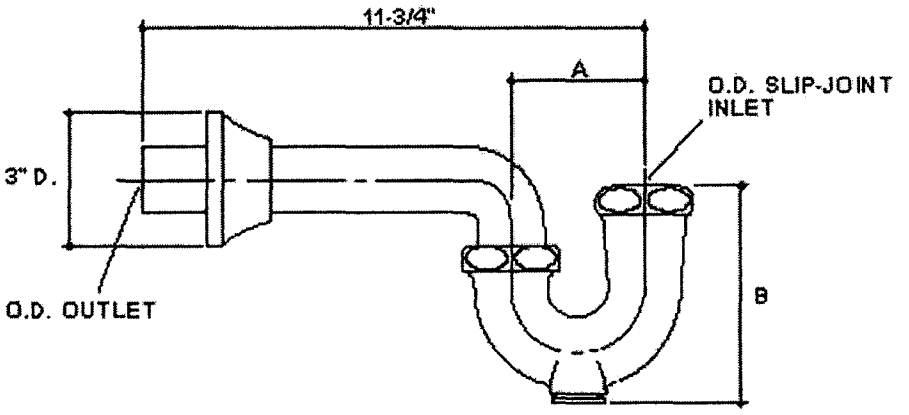
## SPECIFIED MODEL:

| Model | Description | | |
|---|---|---|---|
| K-8998 | With 1-1/4" O.D. Inlet and 1-1/4" O.D. Outlet | ☐CP | ☐Other____ |
| K-8999 | With 1-1/4" O.D. Inlet and 1-1/2" O.D. Outlet | ☒CP | |
| K-9000 | With 1-1/2" O.D. Inlet and 1-1/2" O.D. Outlet | ☐CP | |

## PRODUCT SPECIFICATION:

P-trap shall be of cast brass construction. Adjustable P-trap shall include cleanout plug, and flange. Optional features shall be 1-1/4" or 1-1/2" O.D. slip-joint inlet and 1-1/4" or 1-1/2" O.D. outlet. Product shall be Kohler Model K-_____-_____.

[redacted]




| Roughing-In Notes | | | | |
|---|---|---|---|---|
| | A | B | O.D. OUTLET | O.D. INLET |
| K-8998 | 2-3/4" | 4-3/8" | 1-1/4" | 1-1/4" |
| K-8999 | 3" | 4-7/8" | 1-1/2" | 1-1/4" |
| K-9000 | 3" | 4-7/8" | 1-1/2" | 1-1/2" |

14

## PRODUCT DIAGRAM

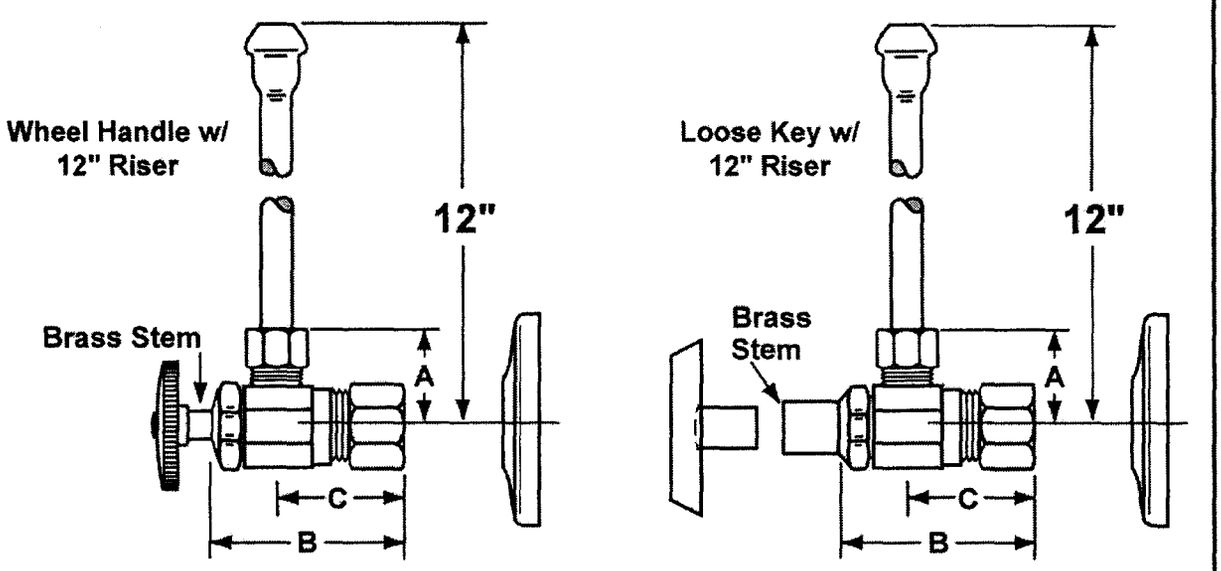
McGUIRE MFG. CO., INC.
60 Grandview Court
P.O. Box 746 ♣ Cheshire, CT 06410
203-699-1801 ♣ Fax 203-699-1813
www.mcguiremfg.com

# Product Specification

**Part No.**
2165CC, 2165CCLK,
2167CC, 2167CCLK

Compression x Compression
Lavatory Supply

Job Name: Submittal Number:




| NO. | ROUGHING MEASUREMENTS | A | B | C |
|---|---|---|---|---|
| 2165CC | 1/2" Nominal x 3/8" O.D. | 1" | 1-1/2" | 3/4" |
| 2165CCLK | 1/2" Nominal x 3/8" O.D. | 1" | 2-1/4" | 3/4" |
| 2167CC | 1/2" Nominal x 1/2" O.D. | 1" | 1-1/2" | 3/4" |
| 2167CCLK | 1/2" Nominal x 1/2" O.D. | 1" | 2-1/4" | 3/4" |

**LK** designates *Loose Key*

CSA Certified

See options and accessories section for details on product variations.

## Specifications:

Supply kit shall include chrome plated brass stops with full turn brass stem, no plastic, (12, 15, 20) inch chrome plated copper risers and (shallow, deep, bell) (steel, brass) or (forged brass with set screw) flange. Inlet shall be (3/8, 1/2) inch (IPS, sweat, compression). Outlet shall be (3/8, 1/2) inch (IPS, compression). Supply kit shall be McGuire _____. Supply kit shall be certified by CSA or other recognized testing authority and bear manufacturer and testing mark. Stop to be certified to 200 psi line pressure.

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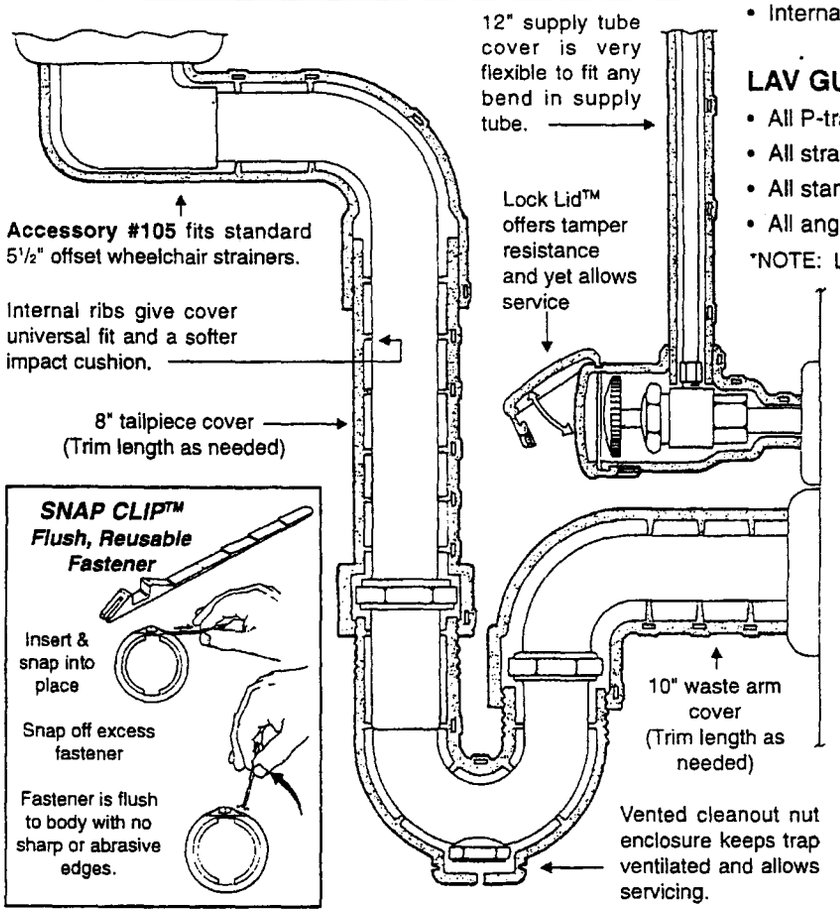
# SUBMITTAL SHEET

**PRODUCT DESCRIPTION**

LAV GUARD waste and supply piping covers satisfy all ADA compliance requirements with its unique and universal design, allowing for easy installation over virtually all tubular and cast brass P-p assemblies, as well as angle valve and supply tube assemblies, regardless of their geometry or rotational offset. Smooth, flush Snap Clip™ fasteners firmly secure piping covers in place.

**SAMPLE SPECIFICATIONS**

Handicap lavatory P-trap and angle valve assemblies shall be covered with the soft, antimicrobial, **LAV GUARD**, piping cover manufactured by **TRUEBRO, Inc.** Model #_____, Accessory #_____, color_____(white or grey). Piping cover shall be secured with Snap Clip™ flush mounted fasteners. Angle stop valve shall be secured with locking lid access cover. Cover shall be non-yellowing and fire retardant.







| | |
|---|---|
| MATERIAL: | MOLDED CLOSED CELL VINYL |
| NOM. WALL: | 1/8 INCH CONSTANT |
| DUROMETER: | 55 - 65 - SHORE A |
| UV PROTECTION: | WILL NOT FADE OR DISCOLOR |
| DURABILITY: | VIRTUALLY INDESTRUCTIBLE |
| FASTENERS: | SNAP-CLIP™, FLUSH, REUSABLE |
| COLOR: | LIGHT GREY OR WHITE |
| PAINTABILITY: | APPLY ACRYLIC ENAMEL |
| BURNING CHARACTERISTICS ASTM D 635: | SELF-EXTINGUISHED 5 SEC (ATB) 10 MM (AEB) |
| THERMAL CONDUCTIVITY ASTM C 177: | BTU - IN/HR - FT² - °F K VALUE = 1.17 |
| BACTERIA/FUNGUS RESIST: | ANTIMICROBIAL VINYL FORMULA |
| MAINTENANCE: | USE COMMON DETERGENTS |

# LAV GUARD™

UNDERSINK PROTECTIVE PIPE COVERS

## DESIGN FEATURES

- Universal design fits virtually all lavatory applications
- Antimicrobial vinyl maintains sanitary conditions
- Lock Lid™ on valve stops tampering & allows service
- Cleanout nut cap allows service on trap without disassembly
- Snap-Clip™ fastener is flush, nonabrasive & reusable
- Internal ribs enhance K value & soften impact cushioning

## LAV GUARD Kits Fit:

- All P-trap assemblies, cast brass or tubular - 1¼" or 1½".
- All straight tail piece assemblies - 1¼" or 1½".
- All standard 5½" offset wheelchair strainers. (Acc. #105)
- All angle stop valves - handled or keyed type ⅜" or ½".

*NOTE: LAV GUARD Kits will not fit Schedule 40 plastic P-traps.

## Models Available: White or Grey

Select model and color.

___ **Model #99** ❑ white ❑ grey
One angle valve and supply cover only.

___ **Model #100** ❑ white ❑ grey
One P-trap cover only.

___ **Model #101** ❑ white ❑ grey
One P-trap cover, one angle valve and supply cover.

___ **Model #102** ☒ white ❑ grey
One P-trap cover, two angle valve and supply covers.

___ **Model #103** ❑ white ❑ grey
One P-trap cover, two angle valve and supply covers, one offset tailpiece wheelchair strainer cover. (Acc. #105)

___ **Accessory #105** ☒ white ❑ grey
One offset tailpiece wheelchair strainer cover only.

Approved By:

TRUEBRO
MAKING AMERICA ACCESSIBLE

TRUEBRO, Inc.
7 Main Street • Ellington, CT 06029
(203) 875-2868 • 1-800-340-5969
Fax: (203) 872-0300

4/95

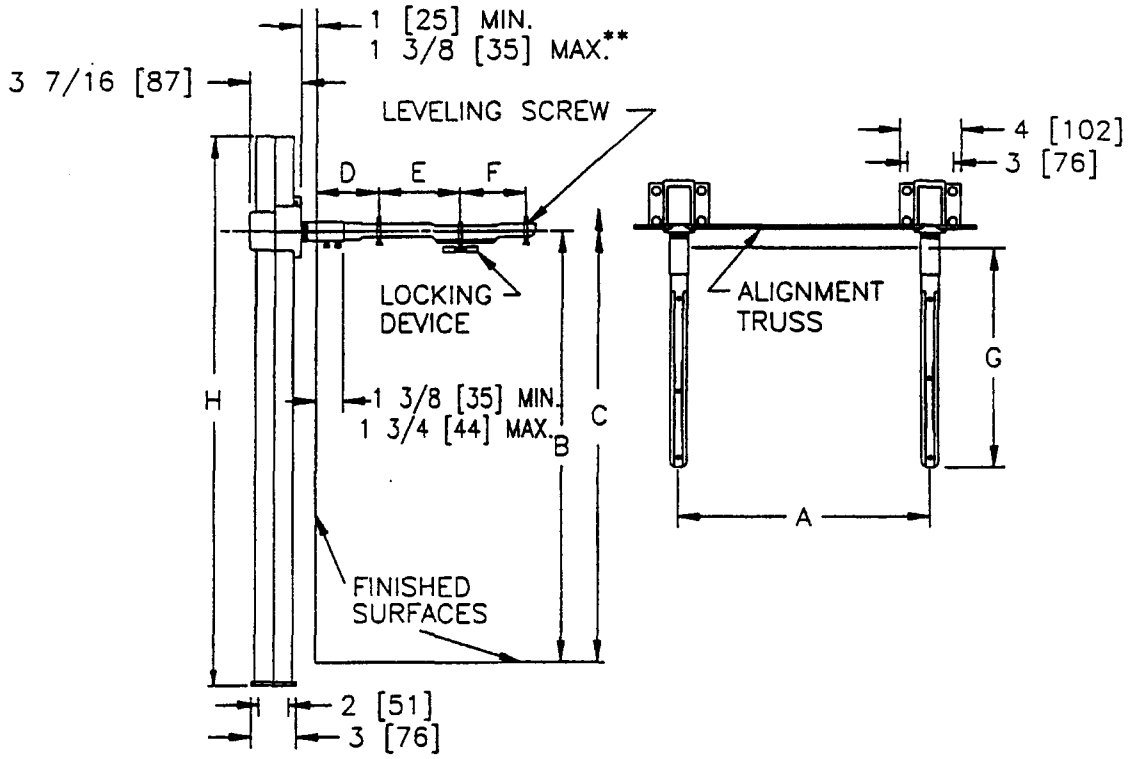
ZURN

# Z-1231
## CONCEALED ARM SYSTEM
## WALL LAVATORIES

SPECIFICATION SHEET

TAG _____

Dimensional Data (inches and [ mm ]) are Subject to Manufacturing Tolerances and Change Without Notice




** WITH STANDARD SLEEVE LENGTH OF 3 1/4 [83].

| Product No. | Approx. Wt. Lbs. [kg] |
|---|---|
| Z-1231 | 45 [20] |

**ENGINEERING SPECIFICATION:** ZURN Z-1231 Lavatory support system with concealed arms. Complete with Dura-Coated rectangular steel uprights with welded feet, cast iron adjustable headers, concealed arms, steel sleeves, alignment truss, and mounting fasteners.

**OPTIONS** (Check/specify appropriate options)

**PREFIXES**

_____ Z- Dura-Coated System with Support Plate*

**SUFFIXES**

_____ -AL Adapter Lug
_____ -CU Floor to Ceiling Upright (Specify Height Required)
_____ -D Back to Back System
_____ -E2 Concealed Arm Escutcheons 2 [51] Long
_____ -E4 Concealed Arm Escutcheons 4 [102] Long
_____ -E6 Concealed Arm Escutcheons 6 [152] Long
_____ -SL Stud Lenght Over 3 1/4 [82] (Specify Length)
_____ -WS Wall Support Valve Plate
(Specify Valve Name and Number)
_____ -79 Paraplegic Rough-in

*REGULARLY FURNISHED UNLESS OTHERWISE SPECIFIED

| REV. | DATE: 03/21/95 | C.N. NO. 71133 |
|---|---|---|
| DWG. NO. 58855 | PRODUCT NO. Z-1231 | |

ZURN INDUSTRIES, INC. • HYDROMECHANICS DIV., • 1801 Pittsburgh Ave. • Erie, PA 16514 • Phone: 814/455-0921 Fax: 814/454-7929
In Canada: ZURN INDUSTRIES LIMITED • 6540 Gottardo Court • Mississauga, Ontario L5T 2A2 • Phone: 905/795-8844 Fax: 905/795-8850

KOHLER®

# DEXTER™

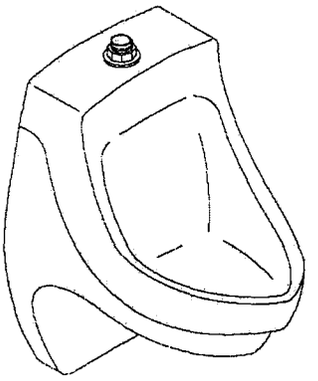
URINAL

# K-5016-ET

ADA

## FEATURES

- *Vitreous china*
- *Siphon jet*
- *3/4" top spud*
- *14-1/2" (36.8cm) extended rim*
- *Includes inlet & outlet spuds and hangers*
- *Includes anti-backsplash wall*
- *1.0 gallon (3.78L) or less flush*
- *ADA compliant when rim is mounted no higher than 17" (43.2cm) from finished floor*



## CODES/STANDARDS APPLICABLE

Specified model meets or exceeds the following:

- *ADA when rim is mounted no higher than 17" (43.2cm) from finished floor*
- *ASME/ANSI A112.19.2M*
- *ASME/ANSI A112.19.6M*
- *CABO/ANSI A117.1*
- *IAPMO/UPC*
- *Energy Policy Act of 1992 (EPACT)*
- *States of Massachusetts, New York, & Texas*
- *City of Los Angeles, CA*

## COLORS/FINISHES

- 0 White
- Other Refer to Fixtures Price Book for additional colors

## SPECIFIED MODEL:

| Model | Description | Colors/Finishes | |
|---|---|---|---|
| K-5016-ET | 3/4" top spud urinal | ☒0 White | ☐Other_____ |

## PRODUCT SPECIFICATION:

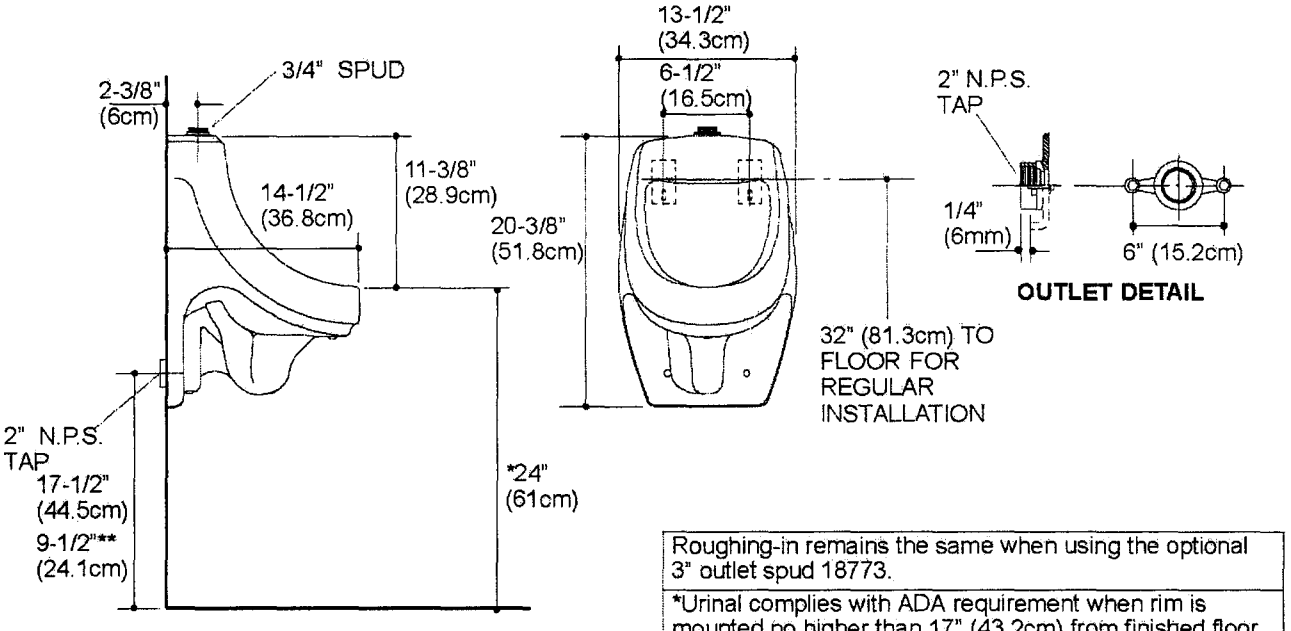
The siphon jet urinal shall be made of vitreous china with a 3/4" top spud. Urinal shall have 14-1/2" (36.8cm) extended rim. Urinal shall include inlet & outlet spuds and hangers. Urinal shall include anti-backsplash wall. Urinal shall be 1.0 gallon (3.78L) or less flush. Urinal shall be ADA compliant when rim is mounted no higher than 17" (43.2cm) from finished floor. Urinal shall be Kohler Model K-5016-ET-_____.

*We reserve the right to make revisions without notice in the design of fixtures or in packaging unless this right has specifically been waived at the time the order is accepted.*

# DEXTER™

## PRODUCT INFORMATION

| | |
|---|---|
| **ADA** compliant. | |
| Fixture: | |
| Configuration | Top spud |
| Spud inlet size | 3/4" |
| Gallons per flush | < 1 gallon* (3.78L) |
| *Designed to flush with less than one gallon (3.78L) of water when installed with a water saving flush valve. | |
| Included Components: | |
| 3/4" inlet spud | 18376 |
| 2" outlet spud | 18766 |
| Hanger (2 required) | 64512 |
| Flush valve requirements: Refer to manufacturer's instructions and local codes. | |




1.25>116

| |
|---|
| Roughing-in remains the same when using the optional 3" outlet spud 18773. |
| *Urinal complies with ADA requirement when rim is mounted no higher than 17" (43.2cm) from finished floor. |
| **Outlet height for ADA compliance. |

## PRODUCT DIAGRAM

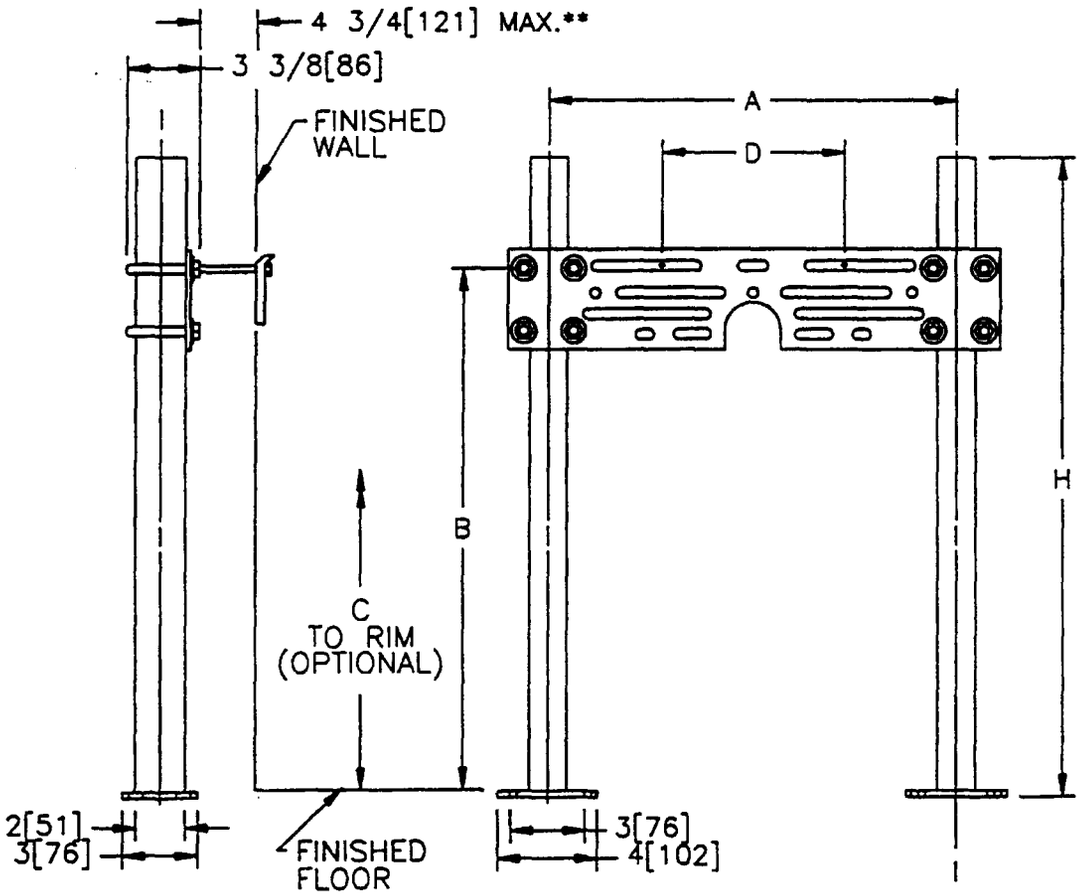
SPECIFICATION SHEET

# Z-1221

## PLATE TYPE SYSTEM WALL URINALS

TAG _____

Dimensional Data (inches and [ mm ]) are Subject to Manufacturing Tolerances and Change Without Notice




** WITH STANDARD STUD LENGTH OF 6[152]

| Product No. | Approx. Wt. Lbs. [kg] |
|---|---|
| Z-1221 | 50 [23] |

**ENGINEERING SPECIFICATION:** ZURN Z-1221 Wall urinal support system with top support plate. Complete with Dura-Coated rectangular steel uprights with welded feet, adjustable support plate, and mounting fasteners.

**OPTIONS** (Check/specify appropriate options)

**PREFIXES**

_____ Z- Dura-Coated System with Universal Plate*

**SUFFIXES**

_____ -CU Floor to Ceiling Upright
_____ -D Back to Back System
_____ -SL Stud Length Greater Than 6 [152] (Specify Length)
_____ -58 Flush Valve Supply Support for Urinals

*REGULARLY FURNISHED UNLESS OTHERWISE SPECIFIED

REV. DATE: 03/21/95 C.N. NO. 71127

DWG. NO. 58849 PRODUCT NO. Z-1221

ZURN INDUSTRIES, INC. • HYDROMECHANICS DIV., • 1801 Pittsburgh Ave. • Erie, PA 16514 • Phone: 814/455-0921 Fax: 814/454-7929
In Canada: ZURN INDUSTRIES LIMITED • 6540 Gottardo Court • Mississauga, Ontario L5T 2A2 • Phone: 905/795-8844 Fax: 905/795-8850

ADVANCE TABCO®
SMART FABRICATION™

*STAINLESS STEEL*
*SQUARE CORNER SCULLERY*

# BUDGET SINKS

*"400" Series "600" Series*

***Item #:*** _____ ***Qty #:*** _____

***Model #:*** _____

***Project #:*** _____

**ONE COMPARTMENT**

**THREE COMPARTMENT**

**TWO COMPARTMENT**

**FOUR COMPARTMENT**

## MATERIAL:

"400" Series is 16 gauge type 430 Series.

"600" Series is 16 gauge type 304 Series.

Galvanized tubular legs.

1" adjustable plastic bullet feet.

## CONSTRUCTION:

All heli-arc welded.

Welded areas blended to match adjacent surfaces and to a satin finish.

## MECHANICAL:

Supply is 1/2" hot & cold.

Faucet holes on 8" O.C.

Waste drains are 1 1/2" IPS basket type and are included.

Faucets are not included (see accessories).

Four compartment units require two faucets.

Three compartment units with 24" sink bowls require two faucets.

**DETACHABLE DRAINBOARDS**

| Model # | Qty |
|---|---|
| N-5-818 | |
| N-5-18 | |
| N-5-24 | |
| N-5-30 | |
| N-5-36 | |
| N-5-48 | |
| N-54-24 | |
| N-54-36 | |
| N-54-48 | |

Drainboards 36" and 48" are supplied with legs for support.


ADVANCE TABCO®
SMART FABRICATION™
www.advancetabco.com

**NEW YORK**
(800) 645-3166
Fax: (631) 242-6900

**GEORGIA**
(800) 832-1218
Fax: (770) 775-5625

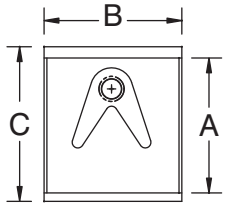
**TEXAS**
(800) 527-0353
Fax: (972) 932-4795

**NEVADA**
(800) 446-8684
Fax: (775) 972-1578

# DIMENSIONS and SPECIFICATIONS

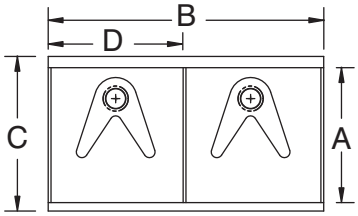
TOL Overall: ± .500" Interior: ± .250"

ALL DIMENSIONS ARE TYPICAL



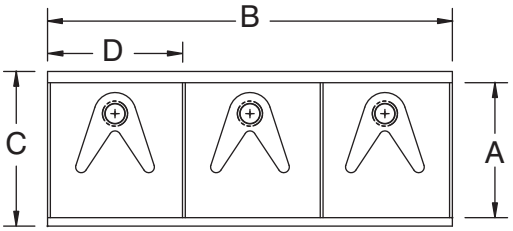

**ONE COMPARTMENT**

| A | B | C | "400" Series 16 Ga. S/S "430" | "600" Series 16 Ga. S/S "300" | Ship Weight |
|---|---|---|---|---|---|
| 18" | 18" | 21 1/2" | **4-81-18** | **6-81-18** | 45 lbs. |
| 21" | 18" | 24 1/2" | **4-1-18** | **6-1-18** | 47 lbs. |
| 21" | 24" | 24 1/2" | **4-1-24** | **6-1-24** | 53 lbs. |
| 21" | 36" | 24 1/2" | **4-1-36** | **6-1-36** | 66 lbs. |
| 24" | 24" | 27 1/2" | **4-41-24** | **6-41-24** | 53 lbs. |
| 24" | 36" | 27 1/2" | **4-41-36** | **6-41-36** | 69 lbs. |



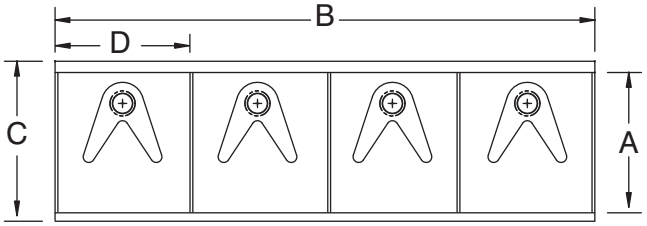

**TWO COMPARTMENTS**

| A | B | C | D | "400" Series 16 Ga. S/S "430" | "600" Series 16 Ga. S/S "300" | Ship Weight |
|---|---|---|---|---|---|---|
| 21" | 36" | 24 1/2" | 18" | **4-2-36** | **6-2-36** | 73 lbs. |
| 21" | 48" | 24 1/2" | 24" | **4-2-48** | **6-2-48** | 86 lbs. |
| 21" | 60" | 24 1/2" | 30" | **4-2-60** | **6-2-60** | 100 lbs. |
| 24" | 48" | 27 1/2" | 24" | **4-42-48** | **6-42-48** | 88 lbs. |
| 24" | 60" | 27 1/2" | 30" | **4-42-60** | **6-42-60** | 108 lbs. |




**THREE COMPARTMENTS**

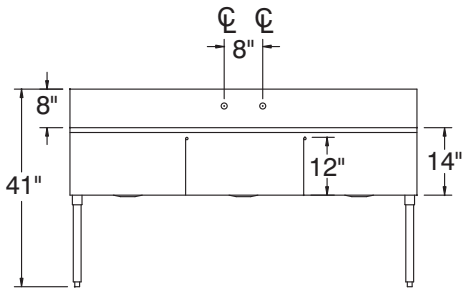
| A | B | C | D | "400" Series 16 Ga. S/S "430" | "600" Series 16 Ga. S/S "300" | Ship Weight |
|---|---|---|---|---|---|---|
| 21" | 36" | 24 1/2" | 12" | **4-3-36** | **6-3-36** | 78 lbs. |
| 21" | 48" | 24 1/2" | 16" | **4-3-48** | **6-3-48** | 91 lbs. |
| 21" | 54" | 24 1/2" | 18" | **4-3-54** | **6-3-54** | 98 lbs. |
| 21" | 72" | 24 1/2" | 24" | **4-3-72** | **6-3-72** | 115 lbs. |
| 24" | 60" | 27 1/2" | 20" | **4-43-60** | **6-43-60** | 105 lbs. |
| 24" | 72" | 27 1/2" | 24" | **4-43-72** | **6-43-72** | 120 lbs. |



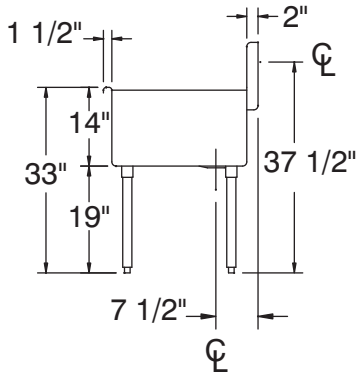

**FOUR COMPARTMENTS**

| A | B | C | D | "400" Series 16 Ga. S/S "430" | "600" Series 16 Ga. S/S "300" | Ship Weight |
|---|---|---|---|---|---|---|
| 21" | 48" | 24 1/2" | 12" | **4-4-48** | **6-4-48** | 96 lbs. |
| 21" | 60" | 24 1/2" | 15" | **4-4-60** | **6-4-60** | 115 lbs. |
| 21" | 72" | 24 1/2" | 18" | **4-4-72** | **6-4-72** | 120 lbs. |

## FRONT VIEW




## PLUMBING ROUGH-IN




## DETACHABLE DRAINBOARDS

| Size | 18 Ga. S/S "430" | Ship Weight |
|---|---|---|
| 18 x 18 | **N-5-818** | 10 lbs. |
| 21 x 18 | **N-5-18** | 11 lbs. |
| 21 x 24 | **N-5-24** | 12 lbs. |
| 21 x 30 | **N-5-30** | 22 lbs. |
| 21 x 36 | **N-5-36** | 25 lbs. |
| 21 x 48 | **N-5-48** | 28 lbs. |
| 24 x 24 | **N-54-24** | 18 lbs. |
| 24 x 36 | **N-54-36** | 32 lbs. |
| 24 x 48 | **N-54-48** | 36 lbs. |

ADVANCE TABCO
SMART FABRICATION™

ADVANCE TABCO is constantly engaged in a program of improving our products. Therefore, we reserve the right to change specifications without prior notice.



200 Heartland Boulevard, Edgewood, NY 11717-8380

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KOHLER® FAUCETS®

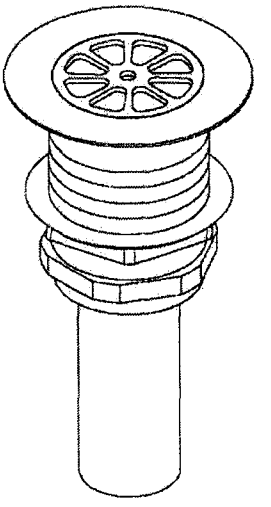
SINK STRAINER

# K-9115

ALSO K-9118

## FEATURES

- *Brass construction*
- *Intended for sink installations with 2" outlet*
- *Perforated strainer*
- *Brass tailpiece*



## CODES/STANDARDS APPLICABLE

Specified model meets or exceeds the following:

- *ASME/ANSI A112.18.1M*

## COLORS/FINISHES

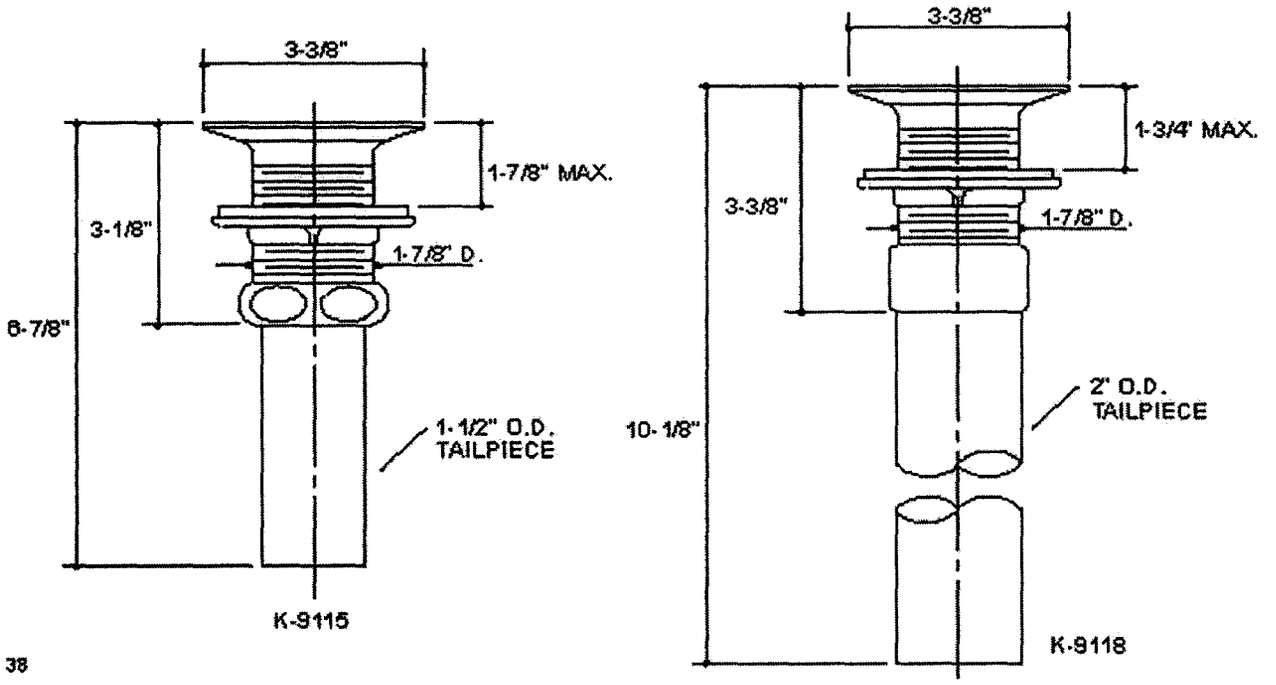
- CP Polished Chrome

## SPECIFIED MODEL:

| Model | Description | |
|---|---|---|
| K-9115 | With 1-1/2" O.D. Tailpiece | ☒CP |
| K-9118 | With 2" O.D. Tailpiece | ☐CP |

## PRODUCT SPECIFICATION:

Sink strainer shall be of brass construction. Product shall feature perforated strainer, cast brass body, and brass tailpiece. Product is intended for sink installations with 2" outlet. Optional feature shall be 1-1/2" O.D. or 2" O.D. tailpiece. Strainer shall be Kohler Model K-_____-CP.




## PRODUCT DIAGRAM

KOHLER® FAUCETS

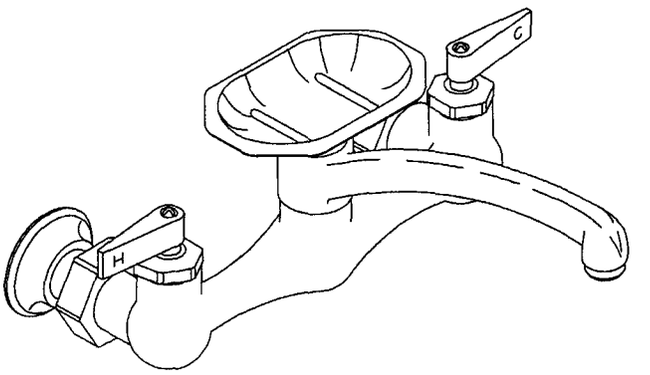
# CLEARWATER®

## SINK SUPPLY FAUCET
# K-7853
## ALSO K-7855, K-7856

ADA

## Features

- *Brass construction*
- *Brass valve bodies*
- *Valvet® valves*
- *Rotating spout*
- *For 8″ (20.3 cm) centers*
- *Cross and lever handles are ADA compliant*
- *Optional soap dish*
- *Inside threaded couplings*
- *Available with 8″ (20.3 cm) or 12″ (30.5 cm) spout reach*
- *Available with ADA compliant cross or lever handles*
- *2.2 gpm (8.3 lpm) maximum flow rate*




## Codes/Standards Applicable

Specified model meets or exceeds the following at date of manufacture:

- *ADA*
- *ASME A112.18.1/CSA B125.1*
- *ICC/ANSI A117.1*
- *NSF 61*
- *Energy Policy Act of 1992*
- *All applicable US Federal and State material regulations*

## Colors/Finishes

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

## Specified Model

| Model | Description | ADA | | ADA | |
|---|---|---|---|---|---|
| K-7853 | Sink supply faucet – 8″ (20.3 cm) spout reach and lever handles, less soap dish | ❑ CP | | | |
| K-7855-3 | Sink supply faucet – 8″ (20.3 cm) spout reach and cross handles, with soap dish | | | ❑ CP | ❑ Other____ |
| K-7855-4 | Sink supply faucet – 8″ (20.3 cm) spout reach and lever handles, with soap dish | ☒ CP | ❑ Other____ | | |
| K-7856-3 | Sink supply faucet – 12″ (30.5 cm) spout reach and cross handles, with soap dish | | | ❑ CP | ❑ Other____ |
| K-7856-4 | Sink supply faucet – 12″ (30.5 cm) spout reach and lever handles, with soap dish | ❑ CP | ❑ Other____ | | |

## Product Specification

The two-handle sink supply faucet shall be of brass construction and brass valve bodies. Product shall feature Valvet valves, inside threaded couplings, and a rotating spout. Product shall be for 8″ (20.3 cm) centers. Product shall be available with a 8″ (20.3 cm) or 12″ (30.5 cm) spout reach. Product shall be available with cross handles or lever handles which are ADA compliant. Product shall have optional soap dish. Faucet shall be Kohler Model K-____-____-____.

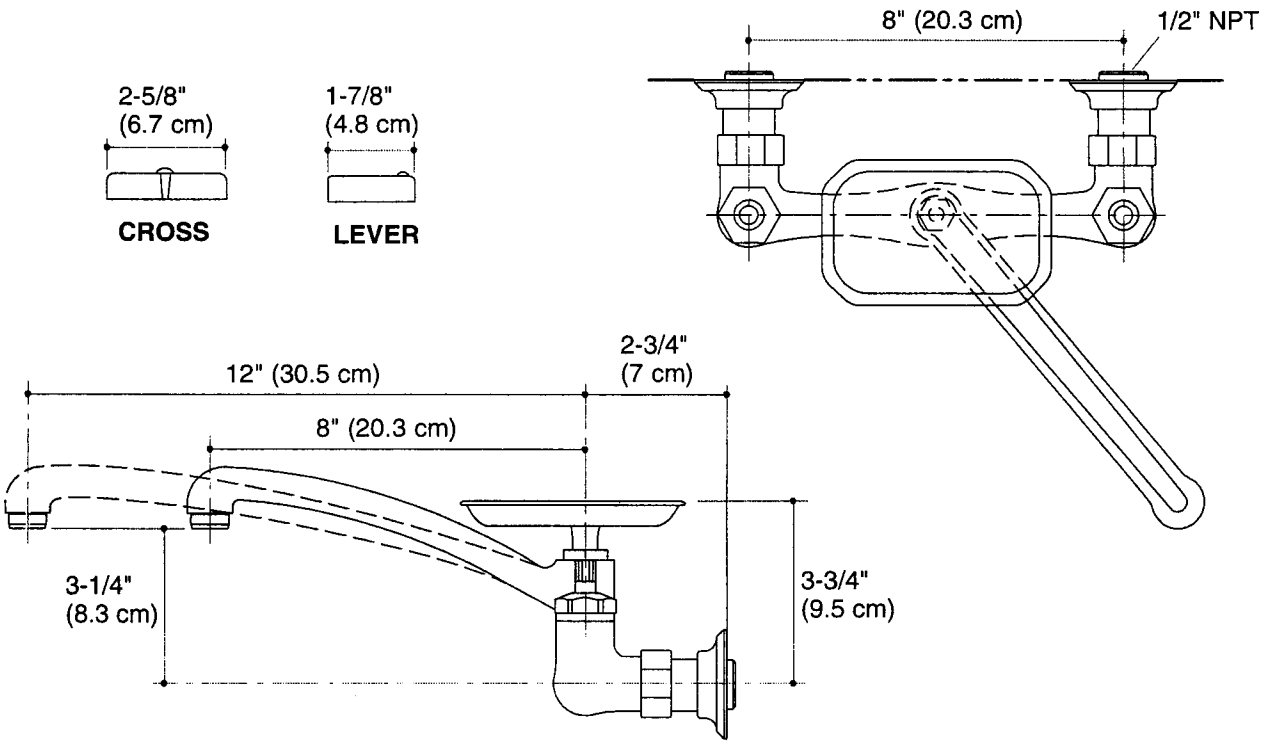


USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

# CLEARWATER®

## Installation Notes

Install this product according to the installation guide.




**Product Diagram**



THE BOLD LOOK OF KOHLER®

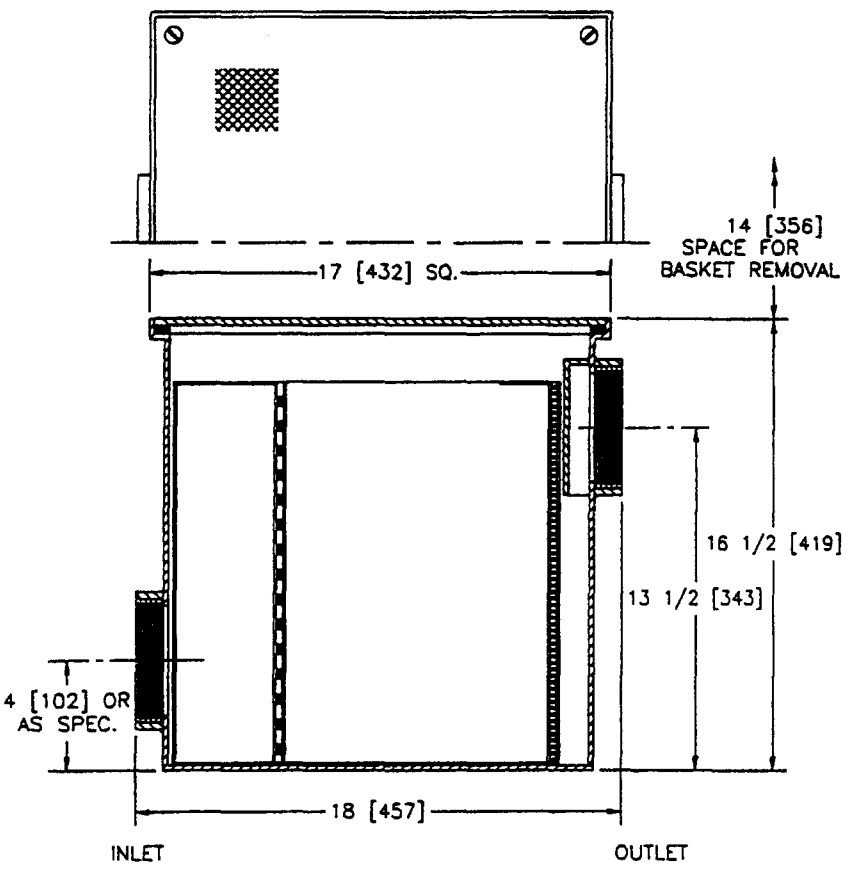
ZURN

# Z-1181 ←
## SOLIDS INTERCEPTOR

SPECIFICATION SHEET

TAG _____

Dimensional Data (inches and [ mm ]) are Subject to Manufacturing Tolerances and Change Without Notice




| Inlet/Outlet Inches | Flow Rate GPM [L] | Approx. Wt. Lbs. [kg] |
|---|---|---|
| 1-1/2, 2** [38, 50] | 30 [113] | 40 [18] |

**ENGINEERING SPECIFICATION:** ZURN Z-1181 Large capacity Acid Resistant Coated fabricated steel solids interceptor, in lieu of fixture 'P' trap, for on-floor or flush with floor installation, with removable primary and secondary flow diffusing/ intercepting screens, and sediment bucket, with gasketed non-skid cover. Regularly furnished with 2 [50] low inlet and high outlet.**

**OPTIONS** (Check/specify appropriate options)

**PREFIXES**

_____ Z- Acid Resistant Coated Fabricated Steel*
_____ ZS- All Fabricated Type 304 Stainless Steel

**SUFFIXES**

_____ -SS Custom Stainless Mesh Screen for Bucket (Specify opening size)
_____ -YR Replacement Basket Assembly

*REGULARLY FURNISHED UNLESS OTHERWISE SPECIFIED

**REV. DATE: 03/21/95 C.N. NO. 71196**
**DWG. NO. 58913 PRODUCT NO. Z-1181**

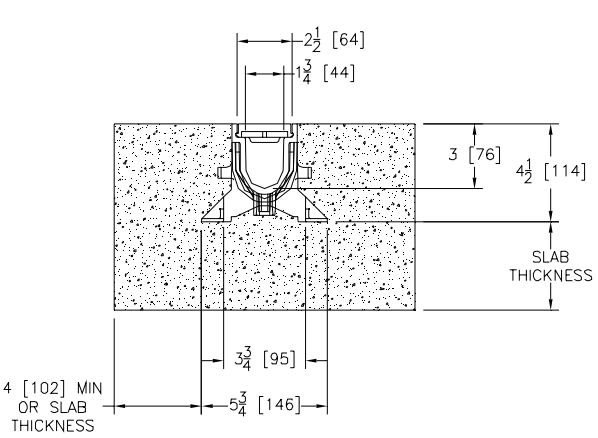
ZURN INDUSTRIES, INC. • HYDROMECHANICS DIV., • 1801 Pittsburgh Ave. • Erie, PA 16514 • Phone: 814/455-0921 Fax: 814/454-7929
In Canada: ZURN INDUSTRIES LIMITED • 6540 Gottardo Court • Mississauga, Ontario L5T 2A2 • Phone: 905/795-8844 Fax: 905/795-8850

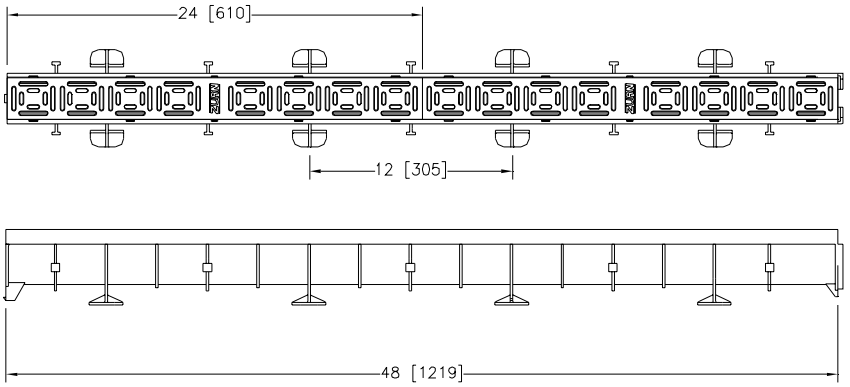
# Z880 2 1/2 [64] WIDE TRENCH DRAIN SYSTEM

**SPECIFICATION SHEET**

TAG _____

Dimensional Data (inches and [ mm ]) are Subject to Manufacturing Tolerances and Change Without Notice




## ENGINEERING SPECIFICATION

**Zurn Z880** 2 1/2 [64] Wide Trench Drain System shall be 48 [1220] long and 2 1/2 [63.5] wide. Drain shall be 3 [76] deep. Drain shall be made of (HDPE) High Density Polyethylene, and is UV-10 stabilized. Drain shall have bedding feet and/or bedding feet shall be used for positioning and anchoring purposes. Drain shall have tongue and groove snap fit connection. Drain shall be Flo-Thru Z880. 24 [610] long high-density polyethylene decorative grate (-POG) provided as standard.

## PREFIX OPTIONS

**Z*-** 48 [1219] linear high density polyethylene modular drain channel with high-density polyethylene decorative grate.

## OPTIONS

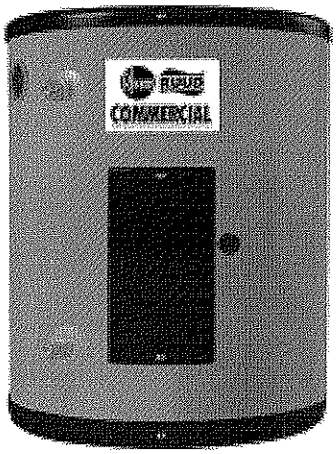
| | |
|---|---|
| **-E1** | End Cap |
| **-E1.5** | 1-1/2 [38] No Hub End Outlet |
| **-U1.5** | 1-1/2 [38] No Hub Bottom Outlet |
| **-C45** | 45 Degree Channel |
| **-C90** | 90 Degree Channel |
| **-G45** | 45Degree Plastic Pool Grate |
| **-G90** | 90 Degree Plastic Pool Grate |
| **-BZ** | Bronze Decorative Grate |
| **-POG** | Heel-Proof Polyethylene Grate |
| **-SOG** | Stainless Steel Decorative Grate |

*Regularly Furnished Unless Otherwise Specified

| | | |
|---|---|---|
| **REV. C** | **DATE: 07/19/06** | **C.N. NO. 109009** |
| **DWG.NO. 64442** | **PRODUCT NO. Z880** | |


**ZURN INDUSTRIES, INC., FLO-THRU DIV., 2640 South Work Street, Falconer, NY 14733**
**Phone: 716/665-1132, Fax: 716/665-1135, World Wide Web: www.zurn.com**
**In Canada: ZURN INDUSTRIES LIMITED, 3544 Nashua Drive, Mississauga, Ontario L4V1L2, Phone: 905\405-8272 Fax: 905\405-1292**
**In UK: Zurn Industries Ltd, Riverside Rd, Pottington Business Park, Barnstaple, Devon EX31 1QN, Phone 01271-340350 Fax 01271-344660**

# Point-Of-Use Electric Commercial Water Heaters




**120, 208, 240, 277 and 480 voltages**

## Available in Sizes Ranging From 2-1/2 – 30 Gallon Tank-Type Models

▶ **1440 Watts thru 6000 Watts**

Rheem-Ruud point-of-use electric commercial water heaters are designed to provide hot water at the consumption point, eliminating costly temperature loss in long piping runs. Well suited for a wide variety of applications, point-of-use heaters are small enough for installation in limited spaces under counters, mop sinks, cabinets, or any remote area where modest quantities of hot water are required. They are ideally suited for applications in retail stores, public restrooms, office washrooms, kitchen and mop or bar sinks.

## Construction Features:

- **Long life tank design –** proprietary steel formulation with a unique coat of high temperature porcelain enamel to maximize corrosion resistance resulting in a superior tank design. A patented R-Tech anode rod provides advanced technology; equalizing aggressive water action while prolonging the effective life of the anode rod and in turn the life of the tank.
- **Long life heating elements –** Our patented resistor elements are designed with a specially treated, double layer of magnesium oxide and copper to resist corrosion.
- **Efficient design –** Rigid polyurethane foam insulation provides superior insulating qualities resulting in reduced operating costs.
- **Optional wall mounting kit –** The wall mounting kit provides an easy way to mount the unit off the floor, out of the way for more useable floor space in a small area. Each kit is designed to be used on walls with 16" stud centers. All necessary parts are included in this easy to install kit. (Note: The 2-1/2 gallon model comes standard with a wall mounting kit.)
- **Automatic temperature control –** A surface mounted thermostat automatically cycles on and off to maintain the water temperature at a desired preset level.
- **Temperature limiting control –** Automatically and safely cuts off the power in the unlikely event that the water temperature exceeds 190°F.
- **Temperature and pressure relief valve –** AGA/ASME rated and factory installed.

## Certifications and Ratings:

- **Efficiency –** these models meet or exceed thermal efficiency and standby loss requirements of current ASHRAE standards. (Part of the Federally mandated Energy Policy Act (EPact)). Also exceeds energy efficiency codes of all states including California Energy Commission (CEC).
- **Safety and construction –** these products are design certified by Underwriters Laboratories (UL) to meet UL standard 174 as electric storage tank water heaters. All models are North Carolina Code compliant. **CERTIFIED FOR A 150 PSI MAXIMUM WORKING PRESSURE.**

*Continued on reverse.*

## DIMENSIONAL INFORMATION (All dimensions shown in English and Metric)

| MODEL NUMBER | MIN WATTS | MAX WATTS | TANK CAPACITY GALLONS | TANK CAPACITY LITERS | A inches | A mm | B inches | B mm | C inches | C mm | D inches | D mm | E inches | E mm | APPROXIMATE SHIPPING WEIGHT LBS. | APPROXIMATE SHIPPING WEIGHT KGS. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EGSP2 | 1,440 | 1,500 | 2.5 | *9* | 14 | *356* | 9-3/4 | *248* | — | — | — | — | — | — | 18 | *8* |
| EGSP6 | 1,500 | 6,000 | 6 | *23* | 15-1/8 | *384* | 15-3/4 | *400* | 12-5/8 | *321* | 11-5/8 | *295* | 4-1/4 | *108* | 41 | *19* |
| EGSP10 | 1,500 | 6,000 | 10 | *38* | 22-7/8 | *581* | 15-3/4 | *400* | 20-3/8 | *518* | 19-3/8 | *492* | 4-1/4 | *108* | 53 | *24* |
| EGSP15 | 1,500 | 6,000 | 15 | *57* | 24-1/4 | *616* | 17-3/4 | *451* | 21-7/8 | *556* | 19-3/8 | *492* | 4-5/8 | *117* | 65 | *29* |
| EGSP20 | 1,500 | 6,000 | 19.9 | *75* | 25-1/8 | *638* | 19-3/4 | *502* | 22-5/8 | *575* | 19-3/8 | *492* | 5-1/8 | *130* | 76 | *34* |
| EGSP30 | 1,500 | 6,000 | 30 | *114* | 30 | *762* | 21-3/4 | *533* | 23 | *584* | 23 | *584* | 2-3/4 | *70* | 115 | *52* |

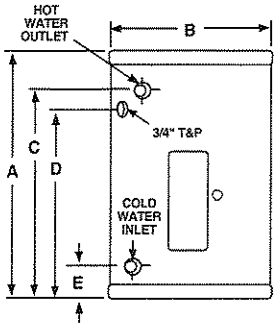
| Water Temperature Ratings: | Thermostat Type: Surface Mounted | Minimum Temperature: 110°F *(43.3°C)* | Maximum Temperature: 170°F *(76.7°C)* | High Temperature Limit: 190°F *(87.8°C)* |
|---|---|---|---|---|

**NOTE:** Basic model numbers are listed. When ordering, specify electrical input and kW to determine specific model number.

## MODELS:

**EGSP6**
**EGSP10**
**EGSP15**
**EGSP20**
**EGSP30**

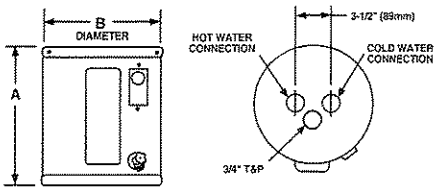
Water Connections 3/4" NPT




## MODEL:

**EGSP2**

Water Connections 1/2" NPT




## Recommended Specifications:

Water heater(s) shall be model _____, manufactured by RHEEM-RUUD, having electrical input of _____ kW and a recovery rate of _____ GPH at a 100°F temperature rise. Water heater(s) shall have a storage capacity of _____ gallons. Water heater(s) shall have the UL seal of certification and be factory equipped with an AGA/ASME rated temperature and pressure relief valve. Tank(s) interior shall be coated with a high temperature porcelain enamel and furnished with an R-Tech resistored magnesium anode rod rigidly supported. Water heater(s) shall meet or exceed the energy factor requirements of ASHRAE. Tanks shall have a working pressure rating of 150 psi, and shall be completely assembled. Water heater(s) shall be equipped with a copper, resistored, "screw-in" type element. Tank shall be insulated with rigid polyurethane foam insulation. Water heater(s) shall be equipped with a surface mounted thermostat with an integral, manual reset, high limit control. Water heater(s) shall be covered by a three year limited warranty against tank leaks.

## Limited Warranty:

This product features a three year limited warranty against tank leaks. Please refer to Commercial Warranty Information brochure for complete warranty information.

## PRODUCT AVAILABILITY

| ELEMENT WATTAGE | SINGLE PHASE OPERATION ONLY 120 V | 208 V | 240 V | 277 V | 480 V |
|---|---|---|---|---|---|
| 1,440 | Y** | NA | NA | NA | NA |
| 1,500 | Y | Y | Y** | N/A | N/A |
| 2,000 | Y | Y | Y | Y | Y |
| 2,500 | Y | Y | Y | NA | NA |
| 3,000 | Y | Y | Y | Y | Y |
| 4,500 | NA | Y | Y* | Y* | Y* |
| 6,000 | NA | Y | Y | Y | Y |

*Not available in EGSP6 & EGSP10
**EGSP2 available only in these configurations

## ELECTRICAL CHARACTERISTICS

| ELEMENT WATTAGE | SINGLE PHASE OPERATION ONLY – AMPS 120 V | 208 V | 240 V | 277 V | 480 V |
|---|---|---|---|---|---|
| 1,440 | 12.0 | NA | NA | NA | NA |
| 1,500 | 12.5 | 7.2 | 6.3 | N/A | N/A |
| 2,000 | 16.7 | 9.6 | 8.3 | 7.2 | 4.2 |
| 2,500 | 20.8 | 12.0 | 10.4 | NA | NA |
| 3,000 | 25.0 | 14.4 | 12.5 | 10.8 | 6.3 |
| 4,500 | NA | 21.6 | 18.8 | 16.2 | 9.4 |
| 6,000 | NA | 28.8 | 25.0 | 21.7 | 12.5 |

All models employ 1 heating element resulting in a 2-wire outlet (single phase) electrical configuration.

## RECOVERY CAPACITIES

Recovery in U.S. Gallons/Hr. (GPH) and Liters/Hr. (LPH) at Various Temperature Rises

| ELEMENT WATTAGE | 40°F *(22°C)* GPH | LPH | 60°F *(33°C)* GPH | LPH | 80°F *(45°C)* GPH | LPH | 100°F *(56°C)* GPH | LPH | 120°F *(67°C)* GPH | LPH |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,440 | 15 | *55* | 10 | *37* | 7 | *28* | 6 | *22* | 5 | *18* |
| 1,500 | 15 | *58* | 10 | *38* | 8 | *29* | 6 | *23* | 5 | *19* |
| 2,000 | 20 | *77* | 14 | *51* | 10 | *38* | 8 | *31* | 7 | *26* |
| 2,500 | 25 | *96* | 17 | *64* | 13 | *48* | 10 | *38* | 8 | *32* |
| 3,000 | 30 | *115* | 20 | *77* | 15 | *58* | 12 | *46* | 10 | *38* |
| 4,500 | 46 | *173* | 30 | *115* | 23 | *86* | 18 | *69* | 15 | *58* |
| 6,000 | 61 | *230* | 41 | *153* | 30 | *115* | 24 | *92* | 20 | *77* |

Rheem RUUD

COMMERCIAL WATER HEATERS

*In keeping with its policy of continuous progress and product improvement, Rheem-Ruud reserves the right to make changes without notice.*

**Rheem Water Heating** • 101 Bell Road, Montgomery, Alabama 36117-4305 • www.rheem.com
**Rheem Canada Ltd./Ltée**,128 Barton Street West, Hamilton, Ontario L8N 3P3

PRINTED IN U.S.A 08/08 WP FORM NO. RR102CE-4 Rev. 10

# RECOMMENDED PRODUCT SPECIFICATION

CHARLOTTE PIPE AND FOUNDRY COMPANY



## Suggested Specification

**System:** **PVC Schedule 40 Pressure Pipe and Fitting System**

**Scope:** This specification covers PVC Schedule 40 pipe and fittings for pressure applications. This system is intended for pressure applications where the operating temperature will not exceed 140°F.

**Specification:** Pipe and fittings shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a Cell Class of 12454 as identified in ASTM D 1784.

PVC Schedule 40 pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 1785. PVC Schedule 40 fittings shall conform to ASTM D 2466. Pipe and fittings shall be manufactured as a system and be the product of one manufacturer. All pipe and fittings shall be manufactured in the United States. Pipe and fittings shall conform to National Sanitation Foundation (NSF) Standard 61 or the health effects portion of NSF Standard 14.

Installation shall comply with the latest installation instructions published by Charlotte Pipe and Foundry and shall conform to all local plumbing, building, and fire code requirements. Solvent cement joints shall be made in a two step process with primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM D 2564. The system shall be protected from chemical agents, fire stopping materials, thread sealant, plasticized vinyl products, or other aggressive chemical agents not compatible with PVC compounds. Systems shall be hydrostatically tested after installation. Testing with compressed air or gas is not recommended.

**Referenced Standards:**

| | |
|---|---|
| ASTM D 1784 | Rigid Vinyl Compounds |
| ASTM D 1785 | PVC Plastic Pipe, Schedule 40 |
| ASTM D 2466 | PVC Plastic Fittings, Schedule 40 |
| ASTM D 2564 | Solvent Cements for PVC Pipe and Fittings |
| NSF Standard 14 | Plastic Piping Components and Related Materials |
| NSF Standard 61 | Drinking Water System Components - Health Effects |

Note: Latest revision of each standard applies.

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**Short Specification**:

Pipe and fittings shall be manufactured from PVC compound with a cell class of 12454 per ASTM D 1784 and conform with National Sanitation Foundation (NSF) standards 14 and 61. Pipe shall be iron pipe size (IPS) conforming to ASTM D 1785. Fittings shall conform to ASTM D 2466.

All pipe and fittings to be produced by a single manufacturer and to be installed in accordance with manufacturer's recommendations and local code requirements. Solvent cements shall conform to ASTM D 2564, primer shall conform to ASTM F 656. The system to be manufactured by Charlotte Pipe and Foundry Company and is intended for pressure applications where the temperature will not exceed 140°F.

# RECOMMENDED PRODUCT SPECIFICATION

CHARLOTTE PIPE AND FOUNDRY COMPANY



## Suggested Specification

**System:** **PVC Schedule 40 Solid Wall Pipe and PVC DWV Fitting System**

**Scope:** This specification covers PVC Schedule 40 solid wall pipe and PVC DWV fittings used in sanitary drain, waste, and vent (DWV), sewer, and storm drainage applications. This system is intended for use in non-pressure applications where the operating temperature will not exceed 140°F.

**Specification:** Pipe and fittings shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a Cell Class of 12454 as identified in ASTM D 1784.

PVC Schedule 40 pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 1785 and ASTM D 2665. PVC DWV fittings shall conform to ASTM D 2665. Pipe and fittings shall be manufactured as a system and be the product of one manufacturer. All pipe and fittings shall be manufactured in the United States. All systems shall utilize a separate waste and vent system. Pipe and fittings shall conform to National Sanitation Foundation Standard 14.

Installation shall comply with the latest installation instructions published by Charlotte Pipe and Foundry and shall conform to all local plumbing, building, and fire code requirements. Solvent cement joints shall be made in a two step process with primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM D 2564. The system shall be protected from chemical agents, fire stopping materials, thread sealant, plasticized vinyl products, or other aggressive chemical agents not compatible with PVC compounds. Systems shall be hydrostatically tested after installation. Testing with compressed air or gas is not recommended.

**Referenced Standards:**

| | |
|---|---|
| ASTM D 1784 | Rigid Vinyl Compounds |
| ASTM D 1785 | PVC Plastic Pipe, Schedule 40 |
| ASTM D 2665 | PVC Drain, Waste, and Vent Pipe & Fittings |
| ASTM D 2564 | Solvent Cements for PVC Pipe and Fittings |
| NSF Standard 14 | Plastic Piping Components and Related Materials |

Note: Latest revision of each standard applies.

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**Short Specification:**

Pipe and fittings shall be manufactured from PVC compound with a cell class of 12454 per ASTM D 1784 and conform with National Sanitation Foundation (NSF) standard 14. Pipe shall be iron pipe size (IPS) conforming to ASTM D 1785 and ASTM D 2665. Fittings shall conform to ASTM D 2665.

All pipe and fittings to be produced by a single manufacturer and to be installed in accordance with manufacturer's recommendations and local code requirements. Solvent cements shall conform to ASTM D 2564, primer shall conform to ASTM F 656. The system to be manufactured by Charlotte Pipe and Foundry Company and is intended for non-pressure drainage applications where the temperature will not exceed 140°F.

# PHYSICAL PROPERTIES OF ABS AND PVC MATERIALS



| PROPERTY | UNITS | ABS | ASTM NO. | PVC | ASTM NO. |
|---|---|---|---|---|---|
| Specific Gravity | g/cc | 1.05 | D 792 | 1.40 | D 792 |
| Tensile Strength (73°F) Minimum | Psi | 4,500 | D 638 | 7,000 | D 638 |
| Modulus of Elasticity in Tension (73°F) Minimum | Psi | 240,000 | D 638 | 400,000 | D 638 |
| Flexural Strength (73°F) | Psi | 10,585 | D 790 | 14,000 | D 790 |
| Izod Impact (notched at 73°F) Minimum | ft lb/ in. | 6.00 | D 256 | 0.65 | D 256 |
| Hardness (Durometer D) | | 70 | D 2240 | 80 ± 3 | D 2240 |
| Hardness (Rockwell R) | | 100 | D 785 | 110 - 120 | D 785 |
| Compressive Strength (73°F) | Psi | 7,000 | D 695 | 9,600 | D 695 |
| Hydrostatic Design Stress | Psi | N/A | | 2,000 | D 1598 |
| Coefficient of Linear Expansion | in./ in./ °F | $5.5 \times 10^{-5}$ | D 696 | $3.0 \times 10^{-5}$ | D 696 |
| Heat Distortion Temperature at 264 psi Minimum | degrees F | 180 | D 648 | 160 | D 648 |
| Coefficient of Thermal Conductivity | BTU/ hr/sq ft/ °F/ in. | 1.1 | C 177 | 1.2 | C 177 |
| Specific Heat | BTU/ °F/lb | 0.35 | D 2766 | 0.25 | D 2766 |
| Water Absorption (24 hrs at 73°F) | % weight gain | 0.40 | D 570 | .05 | D 570 |
| Cell Classification - Pipe | | 42222 | D 3965 | 12454 | D 1784 |
| Cell Classification - Fittings | | 32222 | D 3965 | 12454 | D 1784 |

Above data is based upon information provided by the raw material manufacturers. It should be used only as a recommendation and not as a guarantee of performance.

## ABS and PVC Standards

| TYPE PIPE / FITTING | STANDARD SPECIFICATIONS | |
|---|---|---|
| | MATERIAL | DIMENSIONS |
| **ABS DWV** | | |
| Schedule 40 DWV Foam Core Pipe | ASTM D 3965 | ASTM F 628 |
| Schedule 40 DWV Fittings | ASTM D 3965 | ASTM D 2661 |
| **PVC DWV** | | |
| Schedule 40 DWV Pipe | ASTM D 1784 | ASTM D 2665 & ASTM D 1785 |
| Schedule 40 DWV Foam Core Pipe | ASTM D 4396 | ASTM F 891 |
| Schedule 40 DWV Fittings | ASTM D 1784 | ASTM D 2665 |
| **PVC Pressure** | | |
| Schedule 40 Plain End Pipe | ASTM D 1784 | ASTM D 1785 |
| Schedule 40 Bell End Pipe | ASTM D 1784 | ASTM D 1785 |
| Schedule 40 Bell End Well Casing | ASTM D 1784 | ASTM D 1785 & ASTM F 480 |
| SDR 21 (PR 200) Bell End Pipe | ASTM D 1784 | ASTM D 2241 |
| SDR 26 (PR 160) Bell End Pipe | ASTM D 1784 | ASTM D 2241 |
| Schedule 40 Fittings | ASTM D 1784 | ASTM D 2466 |
| Schedule 80 Plain End Pipe | ASTM D 1784 | ASTM D 1785 |
| Schedule 80 Fittings | ASTM D 1784 | ASTM D 2464 & ASTM D 2467 |

# PVC Pipe: Schedule 40

NSF

## >> PVC Schedule 40 Pipe - Plain End

| PVC SCHEDULE 40 (WHITE) | | PLAIN END | | PVC 1120 | | ASTM D 1785 |
|---|---|---|---|---|---|---|
| PART NO. | NOM. SIZE | UPC # 611942- | AVG. OD (IN.) | MIN. WALL (IN.) | MAX WORK PRESSURE AT 23° C OR 73° F | WT. PER 100 FT. (LBS.) |
| PVC 4005 | 1/2"x10' | 06658 | .840 | .109 | 600 PSI | 15.9 |
| PVC 4005 | 1/2"x20' | 03922 | .840 | .109 | 600 PSI | 15.9 |
| PVC 4007 | 3/4"x10' | 06661 | 1.050 | .113 | 480 PSI | 21.1 |
| PVC 4007 | 3/4"x20' | 03925 | 1.050 | .113 | 480 PSI | 21.1 |
| PVC 4010 | 1"x10' | 06664 | 1.315 | .133 | 450 PSI | 31.3 |
| PVC 4010 | 1"x20' | 03928 | 1.315 | .133 | 450 PSI | 31.3 |
| PVC 7100* | 1 1/4"x10' | 03945 | 1.660 | .140 | 370 PSI | 42.4 |
| PVC 7100* | 1 1/4"x20' | 03946 | 1.660 | .140 | 370 PSI | 42.4 |
| PVC 7112* | 1 1/2"x10' | 03947 | 1.900 | .145 | 330 PSI | 50.7 |
| PVC 7112* | 1 1/2"x20' | 03948 | 1.900 | .145 | 330 PSI | 50.7 |
| PVC 7200* | 2"x10' | 03949 | 2.375 | .154 | 280 PSI | 68.1 |
| PVC 7200* | 2"x20' | 03950 | 2.375 | .154 | 280 PSI | 68.1 |
| PVC 4025* | 2 1/2"x20' | 04205 | 2.875 | .203 | 300 PSI | 108.0 |
| PVC 7300* | 3"x10' | 03951 | 3.500 | .216 | 260 PSI | 141.2 |
| PVC 7300* | 3"x20' | 03952 | 3.500 | .216 | 260 PSI | 141.2 |
| PVC 7400* | 4"x10' | 03953 | 4.500 | .237 | 220 PSI | 201.2 |
| PVC 7400* | 4"x20' | 03954 | 4.500 | .237 | 220 PSI | 201.2 |
| PVC 7500* | 5"x20' | 04837 | 5.563 | .258 | 190 PSI | 272.5 |
| PVC 7600* | 6"x10' | 03955 | 6.625 | .280 | 180 PSI | 353.7 |
| PVC 7600* | 6"x20' | 03956 | 6.625 | .280 | 180 PSI | 353.7 |
| PVC 7800* | 8"x20' | 03958 | 8.625 | .322 | 160 PSI | 532.3 |
| PVC 7910* | 10"x20' | 03959 | 10.750 | .365 | 140 PSI | 754.7 |
| PVC 7912* | 12"x20' | 03961 | 12.750 | .406 | 130 PSI | 997.9 |
| PVC 7914* | 14"x20' | 04862 | 14.000 | .437 | 130 PSI | 1180.1 |
| PVC 7916* | 16"x20' | 04918 | 16.000 | .500 | 130 PSI | 1543.1 |

*** Dual marked ASTM D 1785 and ASTM D 2665.**

**NOTE: When ordering, please specify plain end or bell end.**

**NSF Listed. Meets All Requirements of ASTM D 1784 and ASTM D 1785.**

PVC piping products are not recommended for use with compressed air or gases.

All Charlotte Pipe and Foundry Company Products are made in U.S.A.

You can't beat the system.®

# OUTSIDE DIAMETER AND THICKNESS

## PVC Schedule 40 Pipe - Bell End*

| PVC SCHEDULE 40 (WHITE) | | | BELL END | | PVC 1120 | | ASTM D 1785 |
|---|---|---|---|---|---|---|---|
| PART NO. | NOM. SIZE | UPC # 611942- | AVG. OD (IN.) | MIN. WALL (IN.) | MAX WORK PRESSURE AT 23° C OR 73° F | BELL DEPTH (IN.) | WT. PER 100 FT. (LBS.) |
| PVC 4005B** | ½"x10' | 04986 | .840 | .109 | 600 PSI | 2.00 | 15.9 |
| PVC 4005B** | ½"x20' | 03923 | .840 | .109 | 600 PSI | 2.00 | 15.9 |
| PVC 4007B** | ¾"x10' | 04987 | 1.050 | .113 | 480 PSI | 2.25 | 21.1 |
| PVC 4007B** | ¾"x20' | 03926 | 1.050 | .113 | 480 PSI | 2.25 | 21.1 |
| PVC 4010B** | 1"x10' | 04988 | 1.315 | .133 | 450 PSI | 2.50 | 31.3 |
| PVC 4010B** | 1"x20' | 03929 | 1.315 | .133 | 450 PSI | 2.50 | 31.1 |
| PVC 4012B§ | 1¼"x10' | 04989 | 1.660 | .140 | 370 PSI | 2.75 | 42.4 |
| PVC 4012B§ | 1¼"x20' | 03930 | 1.660 | .140 | 370 PSI | 2.75 | 42.4 |
| PVC 4015B§ | 1½"x10' | 04990 | 1.900 | .145 | 330 PSI | 3.00 | 50.7 |
| PVC 4015B§ | 1½"x20' | 03931 | 1.900 | .145 | 330 PSI | 3.00 | 50.7 |
| PVC 4020B† | 2"x10' | 04991 | 2.375 | .154 | 280 PSI | 4.00 | 69.2 |
| PVC 4020B† | 2"x20' | 03932 | 2.375 | .154 | 280 PSI | 4.00 | 69.2 |
| PVC 4025B‡ | 2½"x10' | 04992 | 2.875 | .203 | 300 PSI | 4.00 | 110.0 |
| PVC 4025B‡ | 2½"x20' | 04206 | 2.875 | .203 | 300 PSI | 4.00 | 110.0 |
| PVC 7300B§ | 3"x10' | 04853 | 3.500 | .216 | 260 PSI | 4.00 | 145.1 |
| PVC 4030B† | 3"x20' | 03933 | 3.500 | .216 | 260 PSI | 4.00 | 144.5 |
| PVC 7400B§ | 4"x10' | 04835 | 4.500 | .237 | 220 PSI | 4.00 | 207.9 |
| PVC 9400B† | 4"x20' | 03964 | 4.500 | .237 | 220 PSI | 5.00 | 206.2 |
| PVC 7600B§ | 6"x10' | 04850 | 6.625 | .280 | 180 PSI | 6.50 | 371.4 |
| PVC 9600B† | 6"x20' | 03965 | 6.625 | .280 | 180 PSI | 6.50 | 365.5 |
| PVC 7800B† | 8"x10' | 09903 | 8.625 | .322 | 160 PSI | 7.00 | 556.9 |
| PVC 9800B† | 8"x20' | 03967 | 8.625 | .322 | 160 PSI | 7.00 | 552.3 |
| PVC 7910B† | 10"x10' | 00990 | 10.750 | .365 | 140 PSI | 9.00 | 791.9 |
| PVC 7910B† | 10"x20' | 03960 | 10.750 | .365 | 140 PSI | 9.00 | 785.4 |
| PVC 7912B† | 12"x20' | 03962 | 12.750 | .406 | 130 PSI | 10.00 | 1046.7 |
| PVC 7914B† | 14"x20' | 04863 | 14.000 | .437 | 130 PSI | 10.00 | 1180.1 |
| PVC 7916B† | 16"x20' | 04929 | 16.000 | .500 | 130 PSI | 10.00 | 1543.1 |

* Bell dimensions meet either ASTM D 2672 or ASTM F 480, depending upon pipe diameter

** ASTM D 1785

§ Dual Marked ASTM D 1785 & ASTM D 2665

† Triple Marked ASTM D 1785 & ASTM D 2665 & ASTM F 480

‡ Dual Marked ASTM D 1785 & ASTM F 480

PVC piping products are not recommended for use with compressed air or gases.

# Eemax®

# "SINGLE POINT"

## CODE COMPLIANT HANDWASHING HEATERS

### Instant Comfort...Endless Savings

# ELECTRIC TANKLESS WATER HEATERS

9/06

## MODELS:

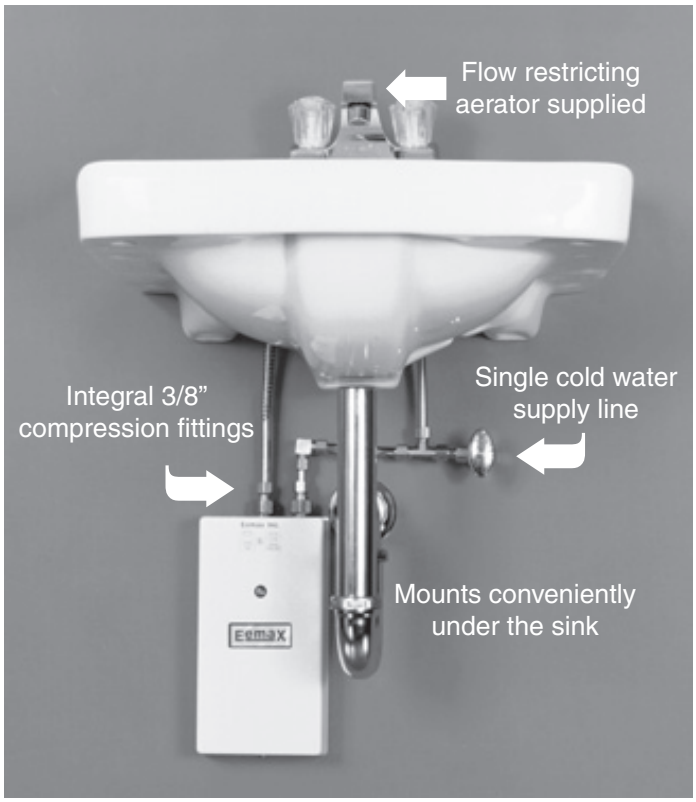
| | Volts | kW | Amps |
|---|---|---|---|
| SP2412 | 120V | 2.4kW | 20A |
| SP3012 | 120V | 3.0kW | 25A |
| SP3512 | 120V | 3.5kW | 29A |
| SP3208 | 208V | 3.0kW | 14.4A |
| SP4208 | 208V | 4.1kW | 19.7A |
| SP35 | 240V | 3.5kW | 14.6A |
| SP48 | 240V | 4.8kW | 20A |
| SP55 | 240V | 5.5kW | 22.9A |
| SP3277 | 277V | 3.0kW | 10.8A |
| SP4277 | 277V | 4.1kW | 14.8A |

## SPECIFICATION OPTIONS

☐ FC = Flex Connector braided-stainless steel water connections available. (EX176, EX177)
Example: SP3512FC

## APPLICATIONS:

- Shopping Malls
- Office and Tenant Spaces
- Commercial Buildings (restaurants, etc.)
- Modular Buildings/Modular Offices
- Public Hand Washing
- Service Stations
- Schools
- Concessions Stands, Stadiums




Designed to comply with .5 GPM handwashing code target outlet temperature 105° - 110°.

**ADVANCED TECHNOLOGY • HIGHEST EFFICIENCY**
**DESIGNED FOR DURABILITY**

**MADE IN USA**

## QUALITY FEATURES

- **On Demand Hot Water** - no delay.
- **Cut Energy Waste** - flow switch activates heater only on demand (no standby heat loss). **99% efficient**
- **Continuous Hot Water** - no storage capacity to run out.
- **Reduces Installation Cost** - no T & P relief valve needed (check local codes).
- **Easy Installation** - only one cold water line need be brought to lavatory - integral ⅜" compression fittings on top (no sweat connections). Mounts on wall at point-of use.
- **Integral Flow Restrictor** - Built in to ensure proper temperature rise. Complies with U.S. Federal regulations.
- **Faucet Aerator** - with excellent spray pattern supplied with unit.
- **Hands Free**, sensor and metering faucet compatible
- **Prevents Legionella Bacteria Growth**
- **Reduces Liming, Calcification and Sedimentation.**
- **Complies with Handicap Requirements**
- **Ni Chrome Element** - a unique, patented flow path ensures optimum heat transfer and extended element life.
- **Compact Size** - dimensions 10.75" x 5.25" x 2.875"; weight 3 lbs.
- **Field Serviceable Element** - replaceable cartridge element (1 year warranty).
- **Warranty** - Full Factory Warranty - Heaters are guaranteed against failure due to leaks of "Heater Body/Element Assembly" for a period of FIVE YEARS.
- **High Temperature Limit Switch** - protects against element burn out, with reset button.

## SUGGESTED SPECIFICATION

Tankless Water Heater shall be an Eemax Model _____ (model #) with , _____ (kW rating) vac, _____ (voltage) to heat 0.5 GPM @ a temperature rise of _____ (amperage) degrees F. Unit shall have ABS-UL 94Vo rated cover. Element shall be replaceable cartridge insert. Unit shall have a replaceable filter in the inlet connector and a flow regulator in the outlet connector. Element shall be iron free, nickel chrome material. Heater shall be fitted with ⅜" compression nuts and sleeves to eliminate need for soldering. Heater shall be installed upright with water connections on top only. Hot water storage tanks prohibited. Unit shall be Eemax or approved equal.
NOTE: Refer to rating chart for product information.

NOTE: Flow Activated 0.5 GPM

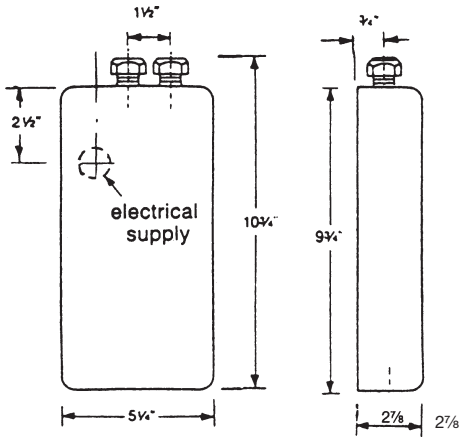
| OPERATING PRESSURE | |
|---|---|
| Min. | Max. |
| 25 PSI | 150 PSI |

**OPTIONAL FLEX CONNECTOR ACCESSORY (FC)**

Stainless steel braid reinforced flexible water connector.
☐ 3/8" C x 1/2" FIP - 16" faucet supply (EX176)
or
☐ 3/8" C x 3/8" C - 16" faucet supply (EX177)

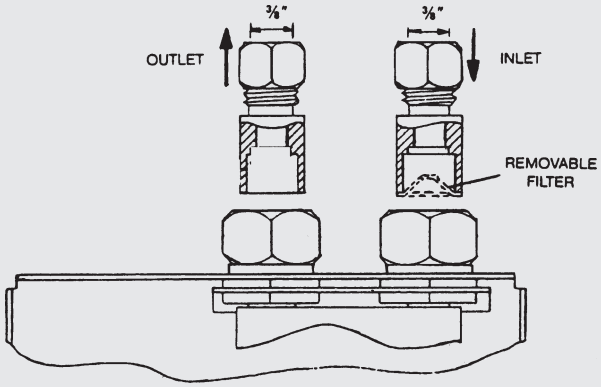
## RATINGS OF SINGLE POINT UNITS { Cold water feed only }

| MODEL | VOLTS | kW | AMPS | RISE AT 0.5 GPM | RECOMMENDED WIRE SIZE |
|---|---|---|---|---|---|
| SP2412 | 120V | 2.4kW | 20A | 33° | 10AWG |
| SP3012 | 120V | 3.0kW | 25A | 41° | 10AWG |
| SP3512 | 120V | 3.5kW | 29A | 48° | 10AWG |
| SP3208 | 208V | 3.0kW | 14.4A | 41° | 14AWG |
| SP4208 | 208V | 4.1kW | 19.7A | 56° | 12AWG |
| SP35 | 240V | 3.5kW | 14.6A | 48° | 14AWG |
| SP48 | 240V | 4.8kW | 20A | 65° | 12AWG |
| SP55 | 240V | 5.5kW | 22.9A | 75° | 10AWG |
| SP3277 | 277V | 3.0kW | 10.8A | 40° | 14AWG |
| SP4277 | 277V | 4.1kW | 14.8A | 56° | 14AWG |




### SPECIFICATIONS:

Dimensions: 10.75" x 5.25" x 2.875"
Weight: 3 lbs.
Materials:
Cover: ABS UL rated 94Vo.
Color: White
Element: Replaceable cartridge insert
Pipe-Fittings: 3/8" compression at top of unit
UL Listed: E86887 (M)
U.S. Patent #'s: 4,762,980 and 4,960,976

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**SPECIAL DESIGN SERVICE**

INQUIRIES FOR UNITS FOR UNIQUE APPLICATIONS ARE WELCOME. CALL OUR TECHNICAL SERVICE DEPT. 1-800-543-6163

### EEMAX SUBMITTAL

Engineer/Architect: _____
Job Name/Customer: _____
Location: _____
Contractor: _____
Representative: _____
HEATER SPECIFICATIONS:

| | Option | Quantity | kW | Voltage | AMPS | GPM |
|---|---|---|---|---|---|---|
| Single Point Model # SP_____ | _____ | _____ | _____ | _____ | _____ | ____ |

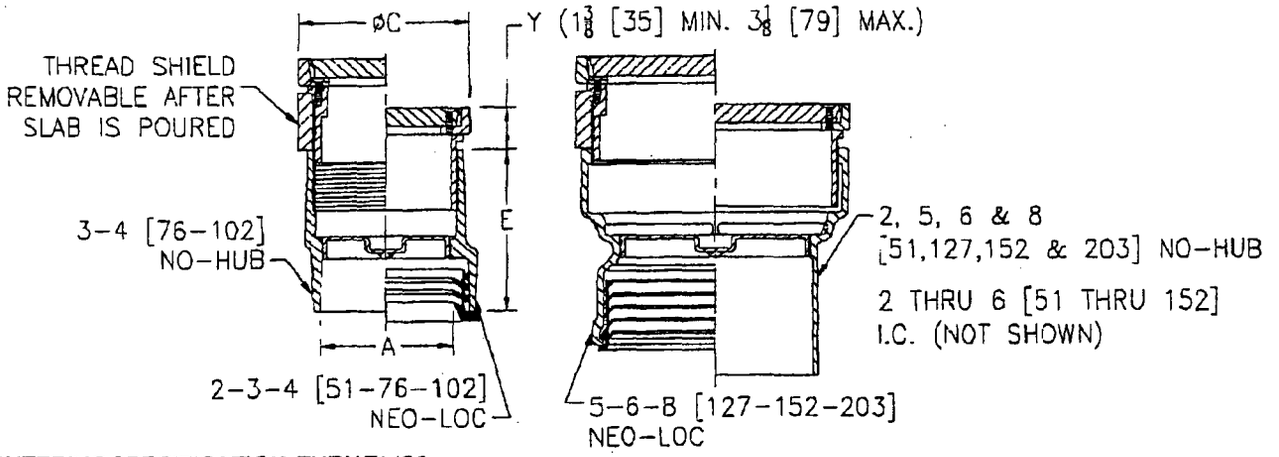

**Eemax® Inc.**
353 Christian Street, Oxford, CT 06478
www.eemax.com
Telephone: (203)267-7890
TOLL FREE: 1-800-543-6163
FAX: (203) 267-7975

# Z1400
## "LEVEL-TROL"
## ADJUSTABLE FLOOR CLEANOUT

SPECIFICATION SHEET

TAG _____

Dimensional Data (inches and [ mm ]) are Subject to Manufacturing Tolerances and Change Without Notice




**ENGINEERING SPECIFICATION:** ZURN Z1400
"Level-Trol" Adjustable floor cleanout, Dura-Coated cast iron body, with gas and watertight ABS tapered thread plug, and round scoriated secured top (Specify finish Z, ZB, ZN, ZS) adjustable to finished floor.

| A-Pipe Size | Dimension In Inches C | E | Approx. Wt. Lbs. [kg.] |
|---|---|---|---|
| Inside Caulk | | | |
| 2 [51] | 6 1/8 [156] | 6 7/8 [175] | 13.8 [6.3] |
| 3 [76] | 6 1/8 [156] | 6 7/8 [175] | 14 [6.4] |
| 4 [102] | 7 1/4 [184] | 6 7/8 [175] | 18.3 [8.3] |
| 5 [127] | 8 1/4 [210] | 6 7/8 [175] | 22.6 [10.3] |
| 6 [152] | 9 1/4 [235] | 6 7/8 [175] | 32.2 [14.6] |
| No-Hub | | | |
| 2 [51] | 4 1/8 [105] | 7 1/2 [191] | 7 [3] |
| 3 [76] | 4 1/8 [105] | 5 3/8 [137] | 7.7 [3.5] |
| 4 [102] | 5 1/8 [130] | 5 3/8 [137] | 10.3 [4.7] |
| 5 [127] | 7 1/4 [184] | 7 1/2 [191] | 17.6 [8] |
| 6 [152] | 8 1/4 [210] | 7 1/2 [191] | 22.2 [10.1] |
| 8 [203] | 9 1/4 [235] | 7 1/2 [191] | 29.9 [13.6] |
| Neo-Loc | | | |
| 2 [51] | 4 1/8 [105] | 5 3/8 [137] | 7.9 [3.6] |
| 3 [76] | 5 1/8 [130] | 5 3/8 [137] | 10.6 [4.8] |
| 4 [102] | 5 1/8 [130] | 5 3/8 [137] | 11.9 [5.4] |
| 5 [127] | 7 1/4 [184] | 6 1/2 [165] | 18.7 [8.5] |
| 6 [152] | 8 1/4 [210] | 6 1/2 [165] | 21.9 [9.9] |
| 8 [203] | 9 1/4 [235] | 6 1/2 [165] | 23.5 [10.7] |

**OPTIONS** (Check/specify appropriate options)

**PREFIXES**

- ____ Z — Dura Coated Cast Iron*
- ____ ZB — D.C.C.I. w/ Polished Bronze Top (Deduct 1/2 [13] from 'Y' Dim.)
- ✓ ZN — D.C.C.I. w/ Polished Nickel Bronze Top (Deduct 1/2 [13] from 'Y' Dim.)
- ____ ZS — D.C.C.I. w/ Polished Stainless Steel Top

**SUFFIXES**

- ____ -AR — Acid Resisting Epoxy Coated Finish
- ____ -BP — Bronze Plug
- ____ -CF — Carpet Flange Cover (ZB and ZN only)
- ____ -CM — Carpet Marker
- ____ -DC — Duresist Cover
- ____ -DX — Round ZB or ZN Top with Dex-o-tex Flange (2 thru 4 [51 thru 102] Sizes only)
- ____ -G — Galvanized Cast Iron
- ____ -HD — Heavy-Duty Top (Add 1/8 [3] to 'Y' Dim.) (ZB and ZN only)
- ____ -SG — Solid Gasketed Cover
- ____ -SM — Special Marking Stamped on Top
- ____ -T — Square Top
- ____ -TX — Square Top Recessed for 1/8 [3] Tile (ZB and ZN only)
- ____ -VP — Vandal-Proof Screws
- ____ -X — Round Top Recessed for 1/8 [3] Tile (ZB or ZN only)
- ____ -Z — Round Top Recessed for 1 1/4 [32] Terrazzo (ZB or ZN only)

**PIPE SIZE**

| | (Specify size/type) OUTLET | 'E' BODY HT. DIM. |
|---|---|---|
| 2 thru 6 [51 thru 152] | ____ IC Inside Caulk | See Chart |
| 2 thru 6-8 [51 thru 152-203] | ____ NH No-Hub | See Chart |
| 2 thru 6-8 [51 thru 152-203] | ✓ NL Neo-Loc | See Chart |

*REGULARLY FURNISHED UNLESS OTHERWISE SPECIFIED

REV. K DATE: 10/19/05 C.N. NO. 93985

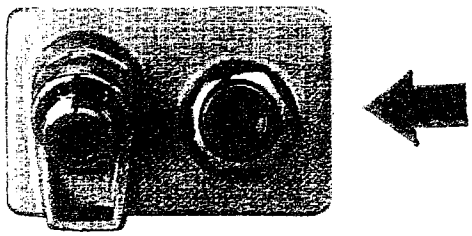
DWG. NO. 58757 PRODUCT NO. Z1400


ZURN INDUSTRIES, INC. • SPECIFICATION DRAINAGE OPERATION • 1801 Pittsburgh Ave. • Erie, PA 16514
Phone: 814\455-0921 • Fax: 814\454-7929 • World Wide Web: www.zurn.com
In Canada: ZURN INDUSTRIES LIMITED • 3544 Nashua Drive • Mississauga, Ontario L4V1L2 • Phone: 905\405-8272 Fax: 905\405-1292

WOODFORD

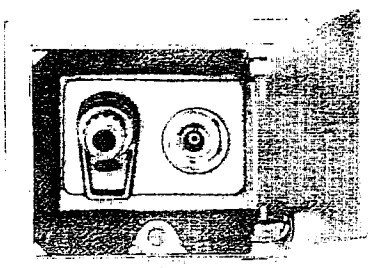
# *Anti-Siphon*
# Freezeless Wall Hydrants
# Model 65/B65

The Model 65 and B65 are automatic draining, freezeless wall hydrants with anti-siphon vacuum breakers. The Model B65 is enclosed in a flush mounted wall box. Both models are designed to blend in with modern architecture for installation on restaurants, schools, office buildings, churches, apartments, motels, stores, shopping centers and industrial buildings.



MODEL 65

**Exterior Finish:**
Standard - Chrome (CH)
Optional - Brass (BR) Polished Brass (PB)



MODEL B65

**Exterior Finish: Box & Door**
Standard - Chrome (CH)
Optional - Brass (BR) Polished Brass (PB)
Other Options: Anodized or Powder Coated Aluminum Box

## SPECIFICATIONS:

**MODEL 65/B65** – Approved under ASSE Standard 1019-B and listed by IAPMO®. Meets Government Specification WW-P-541b Type 205.

**VACUUM BREAKER – ANTI-SIPHON** - NIDEL® Model 34HA with ¾ inch male hose thread, approved under ASSE Standard 1011, Canadian Standards Association and listed by IAPMO®.

**VALVE SEAT** – Permanent type brass valve body with hemispherical seating surface.

**VALVE** – One piece valve plunger accurately controls both flow and drainage with a minimum number of turns and without need for adjustments.

**DRAIN** – Under nozzle away from hands of operator and with a lip to divert water away from building.

**CASING** – Copper tubes.

**NO LEAD SOLDER** - All solder joints.

**STEM** – Hardened stainless steel stem resists damage.

**TEE KEY** – Loose key operates hydrant.

**OPERATING ROD** – 3/8" solid brass operating rod.

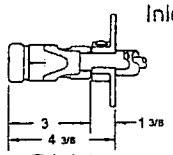
**INLETS** – As shown.

**WALL CLAMP** – Furnished on all 65 series except close coupled.

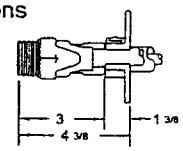
**MAX PRESSURE** – 125 p.s.i.

**MAX TEMPERATURE** - 120° F

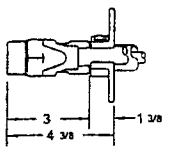
Inlet Descriptions



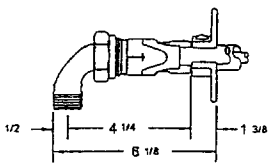

P Inlet
3/4" FEMALE PIPE THREAD




P1 Inlet
1" MALE PIPE THREAD




C Inlet
3/4" COPPER WATER TUBE




EP Inlet
UNION ELBOW WITH 3/4" MALE PIPE THREAD

**Specify as follows:**
Wall hydrant shall be Woodford Model (65-exposed type) or (B65-concealed box type), automatic draining with anti-siphon vacuum breaker. ASSE Standard 1019-B approved. ¾" inlet and outlet (specify type of inlet). Hardened stainless steel operating stem and one-piece valve plunger to control both flow and drain functions. Exterior finish to be Chrome Plated (options: Polished Brass or Rough Brass). Loose tee key to be furnished with each hydrant. Wall thickness to be _____ inches.

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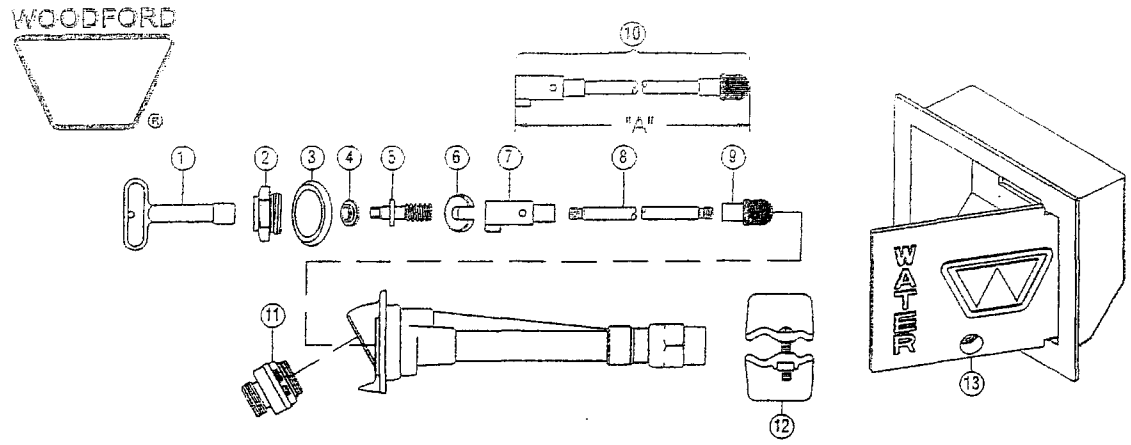
Rev. 06/99 Form No. 65.102

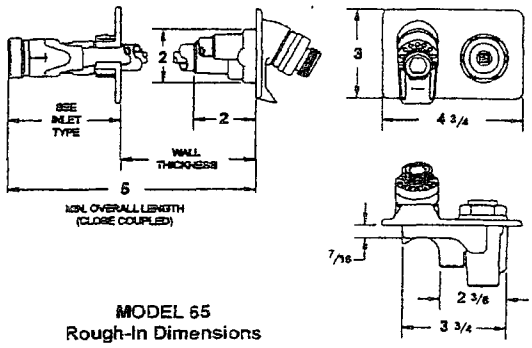



## MODEL 65/B65 PARTS LIST

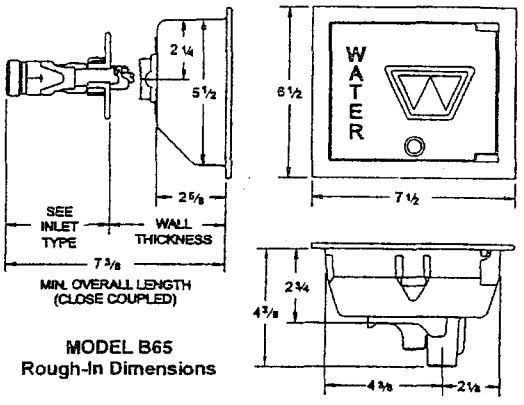
| ITEM | PART # | DESCRIPTION |
|---|---|---|
| 1 | 50009 | Tee Key |
| | 50010 | Long Tee Key (Box Models) |
| 2 | 50264 | Head Nut – chrome |
| | 50265 | Head Nut – brass |
| 3 | 50583 | I.D. RING |
| 4 | 50252 | Stem Washer |
| 5 | 55062 | Stem Screw |
| 6 | 50251 | "C" washer |
| 7 | 51014 | Yoke Nut |
| 8 | | Operating Rod (Sold With Item 10 Only) |
| 9 | 50250 | Plunger |
| 10 | 554XX | Operating Rod Assembly (Includes Items 7,8,9) (Select required assembled length from table below) |
| 11 | 55058 | Vacuum Breaker – chrome |
| | 55057 | Vacuum Breaker – brass |
| 12 | 55063 | Wall Clamp Assembly |
| 13 | 55070 | Box/Door Assembly – brass |
| | 55071 | Box/Door Assembly – polished brass |
| | 55072 | Box/Door Assembly – chrome |
| | 55431 | Box/Door Assembly – Anodized Aluminum |
| | 55432 | Box/Door Assembly – Powder Coated Aluminum |
| | RK-65 | Chrome Repair Kit (Includes Items 1-7 & 9) |

| Operating Rod Assy. "A" | | | |
|---|---|---|---|
| Wall Thickness | | Length | Part No. |
| 65 | B65 | | |
| CC | CC | 3 1/2" | 55401 |
| N/A | 4 | 4 1/2" | 55402 |
| 4 | 6 | 6 1/2" | 55404 |
| 6 | 8 | 8 1/2" | 55406 |
| 8 | 10 | 10 1/2" | 55408 |
| 10 | 12 | 12 1/2" | 55410 |
| 12 | 14 | 14 1/2" | 55412 |
| 14 | 16 | 16 1/2" | 55414 |
| 16 | 18 | 18 1/2" | 55416 |
| 18 | 20 | 20 1/2" | 55418 |
| 20 | 22 | 22 1/2" | 55420 |
| 22 | 24 | 24 1/2" | 55422 |
| 24 | N/A | 26 1/2" | 55424 |

Manufactured under one or more of the following patents:
U.S. Patents:
3,414,001
4,178,956
4,316,481
4,532,954
D216,790
D216,791
D277,365
D277,366
Canada Patents:
852,529
865,995
1,146,438




**MODEL 65**
**Rough-In Dimensions**




**MODEL B65**
**Rough-In Dimensions**

| Wall Thickness (In) | CC | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Overall Length* | 5 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 |
| Shipping Wt. (Lbs)** | 3.8 | 4.4 | 4.8 | 5.2 | 5.6 | 6 | 6.4 | 6.8 | 7.2 | 7.6 | 8 | 8.4 |

** Add 7.4 Lbs for brass box models.
** Add 2.5 Lbs for Aluminum box models.
*Add 3/8 " for all box hydrants except CC units add 2 3/8".

NOTE: Close Coupled Models are not recommended for use in freezing climates and cannot use wall clamp


WOODFORD MANUFACTURING COMPANY

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*To view our complete product line visit:* ***www.woodfordmfg.com***

FOR NON-FREEZING AREAS ONLY

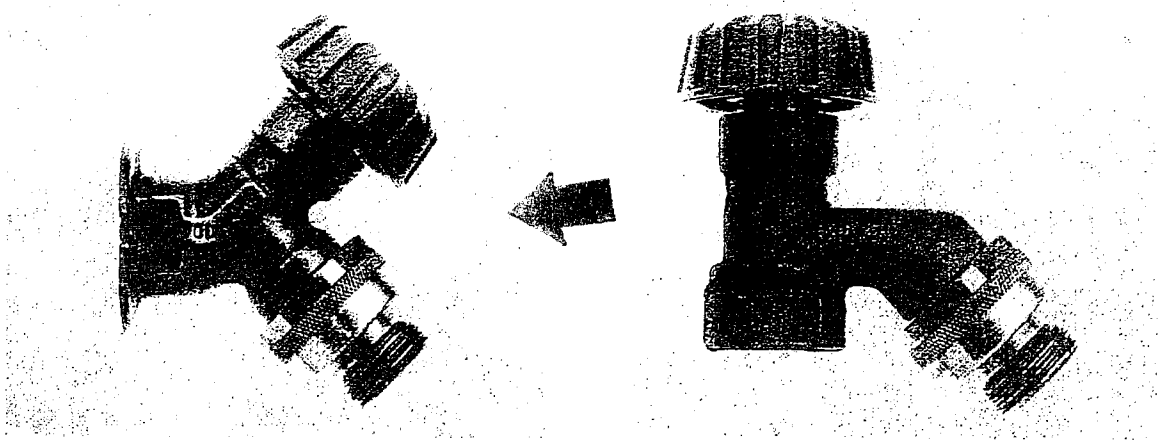
WOODFORD

For maximum protection, vacuum breaker replacement every three to five years is strongly recommended.

# Anti-Contamination Wall and Lawn Faucets

WALL FAUCET MODEL 24

LAWN FAUCET MODEL Y24

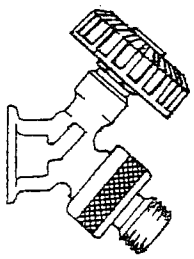


**24P - ½**

INLET - ½" FPT

INLET - ¾" FPT

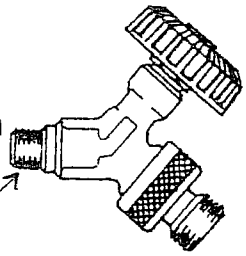
**24P - ¾**



**24CP**

INLET - ½" COPPER TUBE INSIDE

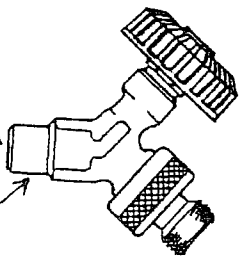
½" MPT OUTSIDE



**24C**

INLET - ½" COPPER TUBE INSIDE

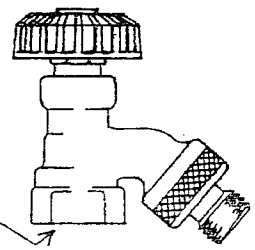
¾" COPPER COUPLING OUTSIDE



Model 24 is an anti-siphon vacuum breaker protected wall faucet for use in mild climate areas on homes, service stations, churches, motels, drive-in restaurants, etc.

**Y24**

INLET - ¾" NPT FEMALE THREAD



Model Y24 is an anti-siphon vacuum breaker protected lawn faucet for use in garden, lawn and other water systems in mild climate areas.

**SPECIFICATIONS:** 24P-½, 24P-¾, 24CP, 24C and Y24

**ANTI-SIPHON VACUUM BREAKER** — NIDEL® Model 34HF with ¾ inch male hose thread, approved under ASSE Standard 1011, Canadian Standards Association, listed by IAPMO® and accepted by U.S. Department of Health.

**EXTERIOR FINISH** — Brass. Optional polished chrome, polished brass or chrome plated casting with chrome plated vacuum breaker.

**OPERATING HANDLE** — Wheel handle. Polycarbonate. Optional loose tee key. Polished chrome standard loose tee key. Optional wheel handle.

**TAMPER PROOF LOCK SHIELD**

**BRASS CONSTRUCTION** — Adjustable packing nut with deep stem guard. Teflon impregnated packing and standard "O" size washer.

**SHIPPING WEIGHT** — 10 lbs. (approximate weight per master carton of ten units.)

*When ordering specify model number, inlet and finish.*

© 1975 Woodford Mfg. Co.

Rev. 11/93 FORM No. 53.111

WOODFORD MFG. CO. 11/93 15P VALVES

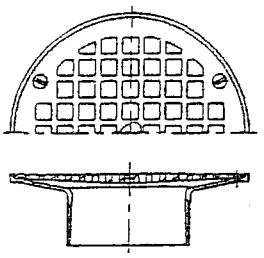
# Z-415

## BODY ASSEMBLY WITH "TYPE B" STRAINER

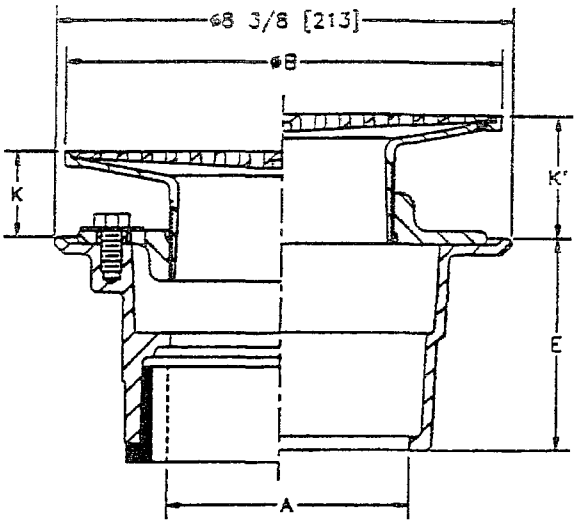
SPECIFICATION SHEET

TAG _____

Dimensional Data (inches and [ mm ]) are Subject to Manufacturing Tolerances and Changs Without Notice



"TYPE B" STRAINER




| A - Pipe Size | B Strainer Dia. | Dimensions In Inches K Min. | K Max. | K' Min. | K' Max. | Approx. Wt. Lbs. [kg] | Strainer Open Area Sq. In. [cm²] |
|---|---|---|---|---|---|---|---|
| 2-3 [50-75] | 5 [127] | 1/2 [13] | 1 5/8 [41] | 1 3/8 [35] | 2 3/8 [60] | 11 [5] | 8 [52] |
| 2-3-4 [50-75-100] | 6 [152] | 3/4 [19] | 1 3/4 [44] | 1 5/8 [41] | 2 3/4 [70] | 13 [6] | 9 [58] |
| 2-3-4 [50-75-100] | 7 [178] | 1 [25] | 2 1/4 [57] | 2 [51] | 3 1/8 [79] | 14 [6] | 12 [77] |
| 3-4 [75-100] | 8 [203] | 1 1/8 [29] | 2 1/4 [57] | 2 [51] | 3 1/8 [79] | 16 [7] | 18 [116] |
| 6 [150] | 8 [203] | 1 1/8 [29] | 2 1/4 [57] | 2 [51] | 3 1/8 [79] | 18 [8] | 18 [116] |
| 6 [150] | 10 [254] | 1 5/8 [41 | 2 5/8 [67] | 2 5/8 [67] | 3 1/2 [89] | 22 [10] | 26 [168] |

**ENGINEERING SPECIFICATION:** ZURN ZN-415 Floor and shower drain, Dura-Coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar with "TYPE B" polished nickel bronze strainer.

**OPTIONS** (Check/specify appropriate options)

| PIPE SIZE | (Specify size/type) OUTLET | | 'E' BODY HT. DIM. |
|---|---|---|---|
| 2 thru 4 [50 thru 100] | ____ IC | Inside Caulk | 3 7/8 [98] |
| 2 [50] | ____ IP | Threaded | 2 3/8 [60] |
| 3 [75] | ____ IP | Threaded | 2 5/8 [67] |
| 4 [100] | ____ IP | Threaded | 2 7/8 [73] |
| 6 [150] | ____ IP | Threaded | 2 3/4 [70] |
| 2 thru 4 [50 thru 100] | ____ NH | No-Hub | 3 7/8 [98] |
| 2 thru 4 [50 thru 100] | ____ NL | Neo-Loc | 4 5/8 [117] |

**PREFIXES**

_____ ZB- D.C.C.I. Body Assembly w/Polished Bronze Top
_____ ZN- D.C.C.I. Body Assembly w/Polished Nickel Bronze Top*
_____ ZS- D.C.C.I. Body Assembly w/6 [152] Dia. Stainless Steel Top

**SUFFIXES**

_____ -AR Acid Resisting Epoxy Coated Cast Iron
_____ -G Galvanized Cast Iron
_____ -HD Heavy Duty Grate
_____ -P Trap Primer Connection (Specify 1/2 [13] or 3/4 [19])
_____ -U 3 [76] High Extension Adapter
_____ -V Backwater Valve
_____ VP Vandal Proof Secured Top
_____ -Y Sediment Bucket
_____ -90 90° Threaded Side Outlet Body (2 [50], 3 [75] Only)

*REGULARLY FURNISHED UNLESS OTHERWISE SPECIFIED

REV. DATE: 03/17/95 C.N. NO. 71067

DWG. NO. 58789 PRODUCT NO. Z-415-B

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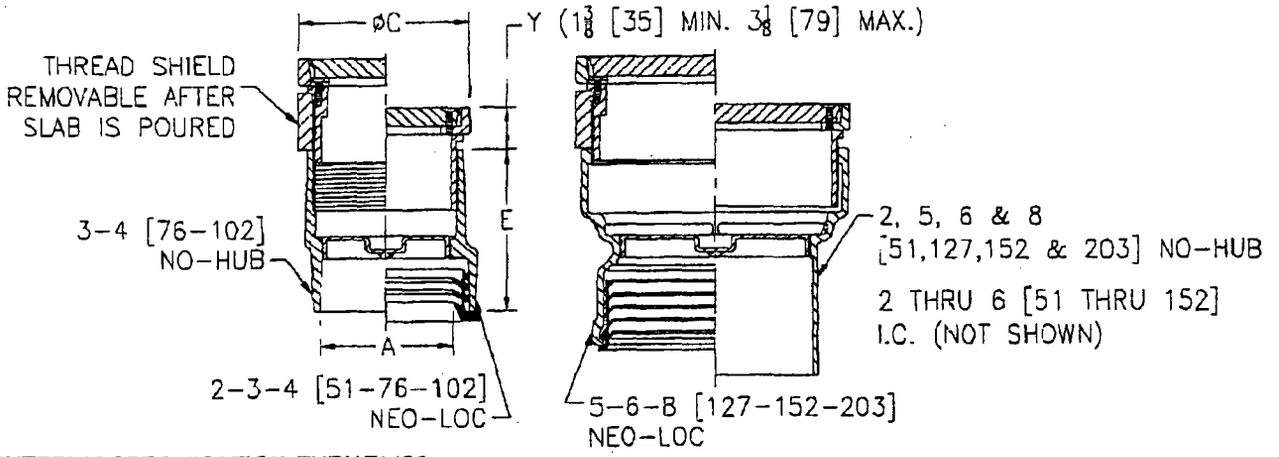
In Canada: ZURN INDUSTRIES LIMITED • 6540 Gottardo Court • Mississauga, Ontario L5T 2A2 • Phone: 905/795-8844 Fax: 905/795-8850

# Z1400
## "LEVEL-TROL"
## ADJUSTABLE FLOOR CLEANOUT

SPECIFICATION SHEET

TAG _____

Dimensional Data (inches and [ mm ]) are Subject to Manufacturing Tolerances and Change Without Notice




**ENGINEERING SPECIFICATION:** ZURN Z1400
"Level-Trol" Adjustable floor cleanout, Dura-Coated cast iron body, with gas and watertight ABS tapered thread plug, and round scoriated secured top (Specify finish Z, ZB, ZN, ZS) adjustable to finished floor.

| A-Pipe Size | Dimension In Inches C | E | Approx. Wt. Lbs. [kg.] |
|---|---|---|---|
| Inside Caulk | | | |
| 2 [51] | 6 1/8 [156] | 6 7/8 [175] | 13.8 [6.3] |
| 3 [76] | 6 1/8 [156] | 6 7/8 [175] | 14 [6.4] |
| 4 [102] | 7 1/4 [184] | 6 7/8 [175] | 18.3 [8.3] |
| 5 [127] | 8 1/4 [210] | 6 7/8 [175] | 22.6 [10.3] |
| 6 [152] | 9 1/4 [235] | 6 7/8 [175] | 32.2 [14.6] |
| No-Hub | | | |
| 2 [51] | 4 1/8 [105] | 7 1/2 [191] | 7 [3] |
| 3 [76] | 4 1/8 [105] | 5 3/8 [137] | 7.7 [3.5] |
| 4 [102] | 5 1/8 [130] | 5 3/8 [137] | 10.3 [4.7] |
| 5 [127] | 7 1/4 [184] | 7 1/2 [191] | 17.6 [8] |
| 6 [152] | 8 1/4 [210] | 7 1/2 [191] | 22.2 [10.1] |
| 8 [203] | 9 1/4 [235] | 7 1/2 [191] | 29.9 [13.6] |
| Neo-Loc | | | |
| 2 [51] | 4 1/8 [105] | 5 3/8 [137] | 7.9 [3.6] |
| 3 [76] | 5 1/8 [130] | 5 3/8 [137] | 10.6 [4.8] |
| 4 [102] | 5 1/8 [130] | 5 3/8 [137] | 11.9 [5.4] |
| 5 [127] | 7 1/4 [184] | 6 1/2 [165] | 18.7 [8.5] |
| 6 [152] | 8 1/4 [210] | 6 1/2 [165] | 21.9 [9.9] |
| 8 [203] | 9 1/4 [235] | 6 1/2 [165] | 23.5 [10.7] |

**OPTIONS** (Check/specify appropriate options)

**PREFIXES**

- ____ Z — Dura Coated Cast Iron*
- ____ ZB — D.C.C.I. w/ Polished Bronze Top (Deduct 1/2 [13] from 'Y' Dim.)
- ✓ ZN — D.C.C.I. w/ Polished Nickel Bronze Top (Deduct 1/2 [13] from 'Y' Dim.)
- ____ ZS — D.C.C.I. w/ Polished Stainless Steel Top

**SUFFIXES**

- ____ -AR — Acid Resisting Epoxy Coated Finish
- ____ -BP — Bronze Plug
- ____ -CF — Carpet Flange Cover (ZB and ZN only)
- ____ -CM — Carpet Marker
- ____ -DC — Duresist Cover
- ____ -DX — Round ZB or ZN Top with Dex-o-tex Flange (2 thru 4 [51 thru 102] Sizes only)
- ____ -G — Galvanized Cast Iron
- ____ -HD — Heavy-Duty Top (Add 1/8 [3] to 'Y' Dim.) (ZB and ZN only)
- ____ -SG — Solid Gasketed Cover
- ____ -SM — Special Marking Stamped on Top
- ____ -T — Square Top
- ____ -TX — Square Top Recessed for 1/8 [3] Tile (ZB and ZN only)
- ____ -VP — Vandal-Proof Screws
- ____ -X — Round Top Recessed for 1/8 [3] Tile (ZB or ZN only)
- ____ -Z — Round Top Recessed for 1 1/4 [32] Terrazzo (ZB or ZN only)

**PIPE SIZE**

| | (Specify size/type) OUTLET | 'E' BODY HT. DIM. |
|---|---|---|
| 2 thru 6 [51 thru 152] | ____ IC Inside Caulk | See Chart |
| 2 thru 6-8 [51 thru 152-203] | ____ NH No-Hub | See Chart |
| 2 thru 6-8 [51 thru 152-203] | ✓ NL Neo-Loc | See Chart |

*REGULARLY FURNISHED UNLESS OTHERWISE SPECIFIED

REV. K DATE: 10/19/05 C.N. NO. 93985

DWG. NO. 58757 PRODUCT NO. Z1400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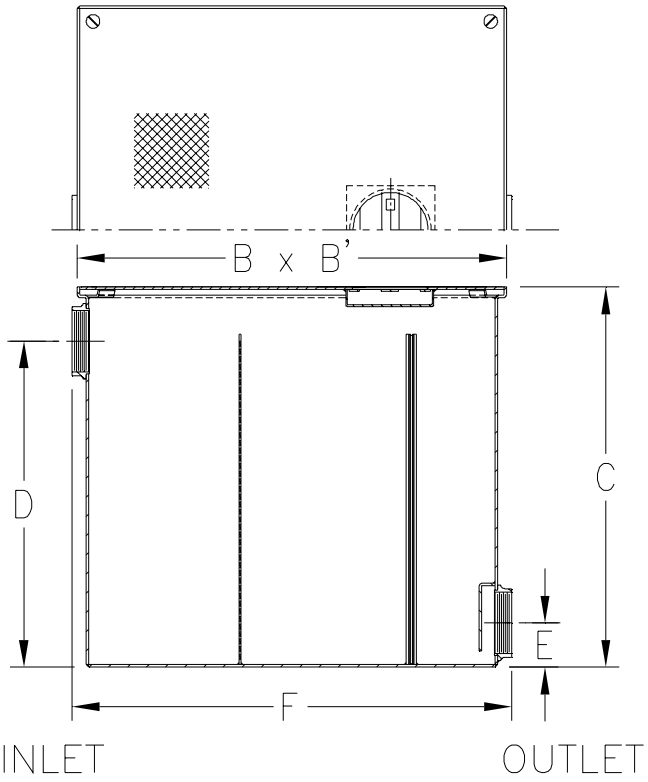
# Z1185
## LINT INTERCEPTOR

**SPECIFICATION SHEET**

TAG _____

Dimensional Data (inches and [ mm ]) are Subject to Manufacturing Tolerances and Change Without Notice




| Size No. of Machines | Inlet/Outlet Size** | Flow Rate G.P.M. [L] | Approx. Wt. Lbs. [kg] | Dimensions In Inches | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | B | B' | C | D | E | F |
| 3 | 2 [51] | 30 [113] | 93 [42] | 17 [432] | 17 [432] | 16 1/2 [419] | 13 1/2 [343] | 3 1/4 [82] | 17 1/4 [438] |
| 7 | 3 [76] | 70 [265] | 155 [70] | 25 [635] | 25 [635] | 20 [508] | 17 [432] | 3 1/4 [82] | 25 1/2 [648] |
| 10 | 4 [102] | 100 [378] | 271 [123] | 33 [838] | 33 [838] | 28 [711] | 25 [635] | 4 [102 | 34 [864] |
| 20 | 4 [102] | 200 [756] | 404 [183] | 40 [1016] | 40 [1016] | 35 [889] | 32 [813] | 4 [102] | 41 [1041] |
| 30 | 6 [152] | 300 [1134] | 654 [297] | 45 [1143] | 45 [1143] | 40 [1016] | 36 [914] | 5 [127] | 46 [1168] |
| 40 | 6 [152] | 400 [1512] | 723 [328] | 48 [1219] | 48 [1219] | 43 [1092] | 39 [991] | 5 [127] | 49 [1245] |
| 50 | 6 [152] | 500 [1890] | 911 [414] | 52 [1321] | 52 [1321] | 47 [1194] | 43 [1092] | 5 [127] | 53 [1346] |

**ENGINEERING SPECIFICATION**: ZURN Z1185 Acid Resistant Coated interior and exterior fabricated steel lint interceptor, non-skid secured cover, with stainless lint intercepting secondary screen assembly and permanent primary straining baffle. Regularly furnished with high inlet and low outlet.

**OPTIONS** (Check/specify appropriate options)

**PREFIXES**

_____ Z Acid Resistant Coated Fabricated Steel*

**SUFFIXES**

_____ -E Acid Resistant Coated interior and exterior fabricated steel extension section (Specify 'C' dimension required for recessed installation).

_____ -RS Stainless Steel Screen Replacement Assembly

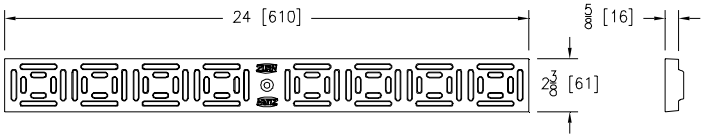
*REGULARLY FURNISHED UNLESS OTHERWISE SPECIFIED

**REV. D DATE: 1/24/07 C.N. NO. 96102**

**DWG. NO. 58915 PRODUCT NO. Z1185**

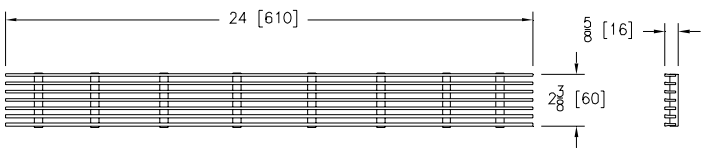
**ZURN INDUSTRIES, INC. ♦ SPECIFICATION DRAINAGE OPERATION ♦ 1801 Pittsburgh Ave. ♦ Erie, PA 16514**
**Phone: 814/455-0921 ♦ Fax: 814/454-7929 ♦ World Wide Web: www.zurn.com**
**In Canada: ZURN INDUSTRIES LIMITED ♦ 3544 Nashua Drive ♦ Mississauga, Ontario L4V1L2 ♦ Phone: 905/405-8272 Fax: 905/405-1292**

# Z880
## 2-3/8" WIDE GRATES



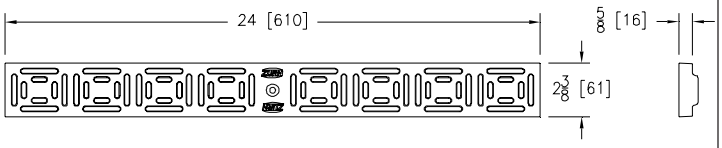

| Please Check ✓ | Item No. |
|---|---|
| | 1 |

| AOG- Aluminum Decorative | | |
|---|---|---|
| Material : Aluminum | | |
| DIN Rating : Class A | | |
| Weight: 1.12 # per ft. | | |
| Open Area: 6.14 sq. in. per ft. | | |
| ANSI Rating: Light Duty | | |
| Application: Decorative Heelproof | | |
| Slot Width/Hole Size: 0.25" | | |
| ADA | H-20 | FAA |
| Yes | No | No |



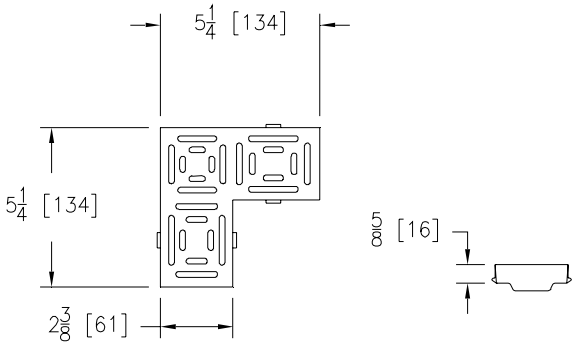

| Please Check ✓ | Item No. |
|---|---|
| | 2 |

| AWG- Aluminum Wire | | |
|---|---|---|
| Material : Aluminum | | |
| DIN Rating : Class A | | |
| Weight: .80 # per ft. | | |
| Open Area: 15.00 sq. in. per ft. | | |
| ANSI Rating: Light Duty | | |
| Application: Decorative Heelproof | | |
| Slot Width/Hole Size: 0.25" | | |
| ADA | H-20 | FAA |
| Yes | No | No |




| Please Check ✓ | Item No. |
|---|---|
| | 3 |

| BZ- Bronze Decorative | | |
|---|---|---|
| Material : Bronze | | |
| DIN Rating : Class A | | |
| Weight: 3.00 # per ft. | | |
| Open Area: 6.14 sq. in. per ft. | | |
| ANSI Rating: Light Duty | | |
| Application: Decorative Heelproof | | |
| Slot Width/Hole Size: 0.25" | | |
| ADA | H-20 | FAA |
| Yes | No | No |



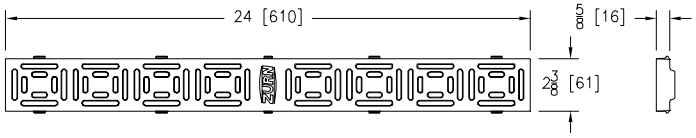

| Please Check ✓ | Item No. |
|---|---|
| | 4 |

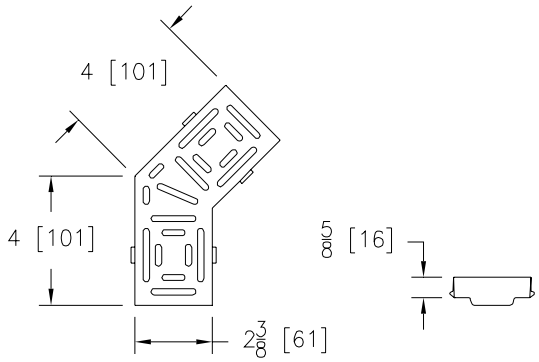
| G90- 90-Degree Plastic | | |
|---|---|---|
| Material : Bronze | | |
| DIN Rating : Class A | | |
| Weight: .50 # per ft. | | |
| Open Area: 10.22 sq. in. per ft. | | |
| ANSI Rating: Light Duty | | |
| Application: Decorative Heelproof | | |
| Slot Width/Hole Size: 0.25" | | |
| ADA | H-20 | FAA |
| Yes | No | No |



**ZURN INDUSTRIES, LLC, FLO-THRU OPERATION, 2640 South Work Street, Falconer, NY 14733**
**Phone: 716/665-1132, Fax: 716/665-1135, World Wide Web: www.zurn.com**
**In Canada: ZURN INDUSTRIES LIMITED, 3544 Nashua Drive, Mississauga, Ontario L4V1L2, Phone: 905\405-8272 Fax: 905\405-1292**

# Z880
## 2-3/8" WIDE GRATES



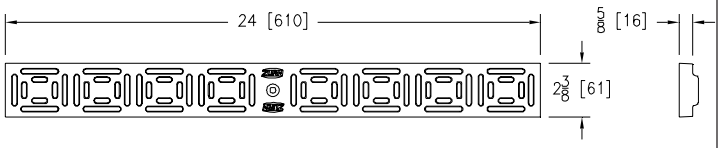



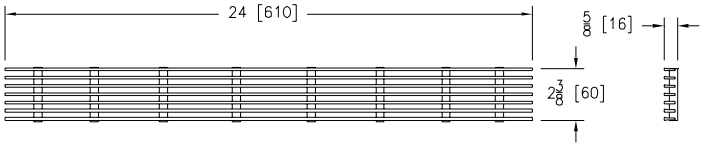

| Please Check ✓ | Item No. |
|---|---|
| | 5 |

| POG- Heelproof Polyethylene Decorative | | |
|---|---|---|
| Material : Polethylene Plastic | | |
| DIN Rating : Class A | | |
| Weight: .50 # per ft. | | |
| Open Area: 6.14 sq. in. per ft. | | |
| ANSI Rating: Light Duty | | |
| Application: Decorative Heelproof | | |
| Slot Width/Hole Size: 0.25" | | |
| ADA | H-20 | FAA |
| Yes | No | No |

| Please Check ✓ | Item No. |
|---|---|
| | 6 |

| S45- 45-Degree Plastic | | |
|---|---|---|
| Material : Plastic | | |
| DIN Rating : Class A | | |
| Weight: .30 # per ft. | | |
| Open Area: 5.28 sq. in. per ft. | | |
| ANSI Rating: Light Duty | | |
| Application: Decorative Heelproof | | |
| Slot Width/Hole Size: 0.25" | | |
| ADA | H-20 | FAA |
| Yes | No | No |




| Please Check ✓ | Item No. |
|---|---|
| | 7 |

| SOG- Stainless Steel Decorative | | |
|---|---|---|
| Material : Stainless Steel | | |
| DIN Rating : Class A | | |
| Weight: 2.75 # per ft. | | |
| Open Area: 6.14 sq. in. per ft. | | |
| ANSI Rating: Light Duty | | |
| Application: Decorative Heelproof | | |
| Slot Width/Hole Size: 0.25" | | |
| ADA | H-20 | FAA |
| Yes | No | No |

| Please Check ✓ | Item No. |
|---|---|
| | 8 |

| SWG- Stainless Steel Wire | | |
|---|---|---|
| Material : Aluminum | | |
| DIN Rating : Class A | | |
| Weight: 1.30 # per ft. | | |
| Open Area: 15.00 sq. in. per ft. | | |
| ANSI Rating: Light Duty | | |
| Application: Decorative Heelproof | | |
| Slot Width/Hole Size: 0.25" | | |
| ADA | H-20 | FAA |
| Yes | No | No |



**ZURN INDUSTRIES, LLC, FLO-THRU OPERATION, 2640 South Work Street, Falconer, NY 14733**
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**In Canada: ZURN INDUSTRIES LIMITED, 3544 Nashua Drive, Mississauga, Ontario L4V1L2, Phone: 905\405-8272 Fax: 905\405-1292**

# RECOMMENDED PRODUCT SPECIFICATIONS

CHARLOTTE PIPE AND FOUNDRY COMPANY

## SUGGESTED SPECIFICATION

**System:** **Hubless Cast Iron Soil Pipe and Fittings**

**Scope:** This specification covers hubless Cast Iron pipe, fittings, and couplings used in sanitary drain, waste, and vent (DWV), sewer, and storm drainage applications. This system is intended for use in non-pressure applications.

**Specification:** Hubless Cast Iron pipe and fittings shall be manufactured from gray cast iron with a tensile strength of not less than 21,000 psi. Regular hubless couplings shall be shielded and conform to CISPI Standard 310 or ASTM C 1277, with an elastomeric gasket meeting the requirements of ASTM C 564. Heavy duty hubless couplings shall be shielded and conform to ASTM C 1540, with an elastomeric gasket meeting the requirements of ASTM C 564.

Pipe and fittings shall comply with ASTM A 888, and CISPI 301. Hubless couplings shall comply with ASTM C 564, and CISPI Standard 310 or ASTM C 1540. All pipe and fittings shall be made in the United States, and marked with the collective trademark of the Cast Iron Soil Pipe Institute, CI®. All pipe and fittings shall be of the same manufacturer. All systems shall utilize a separate waste and vent system.

Installation shall comply with the latest installation instructions published by Charlotte Pipe and Foundry and shall conform to all local plumbing, fire, and building code requirements. Joints shall be made with hubless couplings and tightened using a calibrated torque wrench. The system shall be hydrostatically (water) tested after installation to 4.3 psi. (10 feet of hydrostatic head). Testing with compressed air or gas is not recommended.

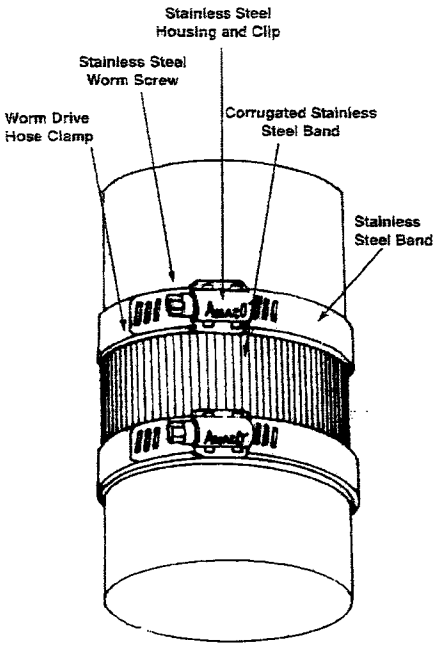
Referenced Standards:

| | |
|---|---|
| ASTM A 888 | Hubless Cast Iron Soil Pipe and Fittings |
| ASTM C 564 | Rubber Gaskets for Cast Iron Soil Pipe and Fittings |
| CISPI 301 | Hubless Cast Iron Soil Pipe and Fittings |
| CISPI 310 | Hubless Couplings for Cast Iron Soil Pipe and Fittings |
| ASTM C 1277 | Hubless Couplings |
| ASTM C 1540 | Hubless Heavy Duty Couplings |

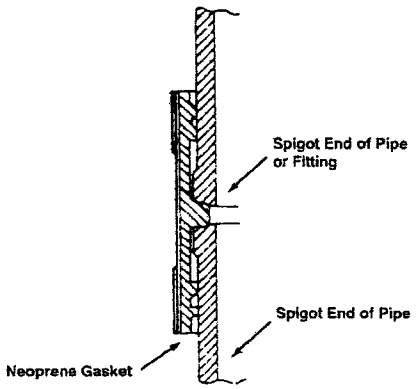
Note: Latest revision of each standard applies.

P0 Box 35430 Charlotte, NC 28235 USA 704/348-6450 800/572-4199 FAX 800/553-1605

www.charlottepipe.com



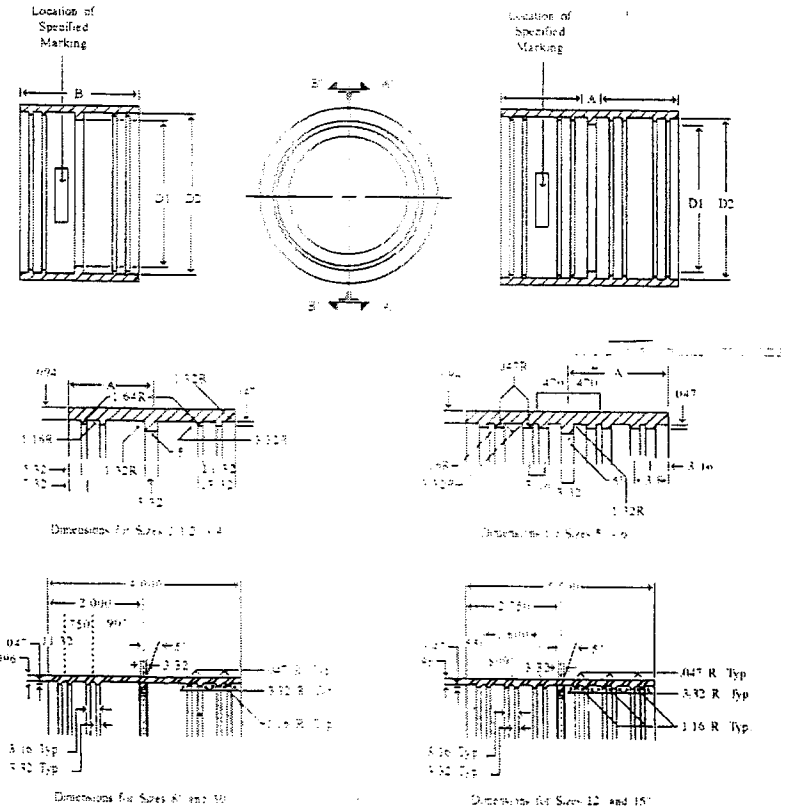

COUPLING BEFORE TIGHTENING




COUPLING AFTER TIGHTENING

# specification data

Specification data for hubless cast iron sanitary system with NO-HUB® pipe fittings. Standard No. 301-97.




| DIMENSIONS IN INCHES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1½" | 2" | 3" | 4" | 5" | 6" | 8" | 10" | 12" | 15" |
| A | 1.062 | 1.062 | 1.062 | 1.062 | 1.500 | 1.500 | 2.000 | 2.000 | 2.750 | 2.750 |
| B | 2.125 | 2.125 | 2.125 | 2.125 | 3.00 | 3.00 | 4.000 | 4.000 | 5.500 | 5.500 |
| $D_1$ | 1.531 | 1.968 | 2.968 | 4.000 | 4.968 | 5.968 | 7.968 | 9.975 | 12.000 | 15.200 |
| $D_2$ | 1.937 | 2.343 | 3.343 | 4.406 | 5.343 | 6.343 | 8.343 | 10.350 | 12.430 | 15.6500 |

## NO-HUB GASKET PHYSICAL REQUIREMENTS

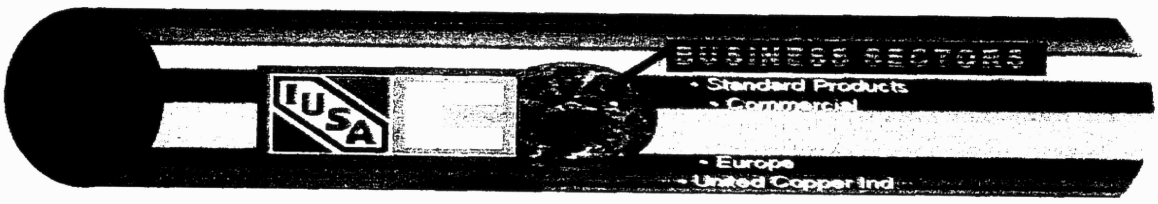
**Detail**

Material: The gasket shall be fabricated from a compound containing high-quality elastomer.

Physical Tests: The test specimens shall be obtained from finished gaskets in conformance with ASTM D 15.

**Tests**

| Test | Physical Tests Min. or Max Requirements | ASTM Method |
|---|---|---|
| Tensile Strength | 1500 psi min. | D 412 |
| Elongation | 250 min. | D 412 |
| Durometer (Shore A) | 70 ± 5 @ 76°F ± 5°F. | D 2240 |
| Accelerated Aging | 15% max. tensile and 20% max. elongation deterioration, 10 points max. increase in hardness, all determinations after oven aging for 96 hours at 158°F. | D 573 |
| Compression Set | 15% max. after 22 hours at 158°F. | D 395 Method B |
| Oil Immersion | 80% max. volume change after immersion in ASTM oil no. 3 for 70 hours at 212°F. | D 471 |
| Ozone Cracking | No visible cracking at 2 times magnification of the gasket after 100 hours exposure in 1.5 ppm ozone concentration at 100°F. Testing and inspection to be on gasket which is loop mounted to give approximately 20% elongation of outer surface. | D 1149 |
| Tear Resistance | DieC; 150 lbs. min. per inch of thickness. | D 624 |
| Water Adsorption | 20% max. by weight after 7 days at 158°F. | D 471 |






Product Range Print

## COPPER TUBE PRODUCT RANGE

Cambridge-Lee Industries manufactures a wide range of copper tube products for use in the plumbing, refrigeration, air-conditioning, and commercial industries. Described herein is our current product range, but other items and specifications are continuously being added and may be available upon request.

| Product | Application | Temper | Lengths | Color | Specifications |
|---|---|---|---|---|---|
| Water Tube Type K | Domestic Water Service<br>Fire Protection<br>Solar, Fuel Oil<br>HVAC | Hard<br><br>Soft | 10 ft. Straight lgth<br>20 ft. Straight lgth<br>60 ft. Coils<br>100 ft. Coils | Green | C12200, ASTM B-88<br>Federal WW-T-799 |
| Water Tube Type L | Domestic Water Service<br>Fire Protection<br>Solar, Fuel Oil<br>HVAC, Natural Gas | Hard<br><br>Soft | 10 ft. Straight lgth<br>20 ft. Straight lgth<br>60 ft. Coils<br>100 ft. Coils | Blue | C12200, ASTM B-88<br>Federal WW-T-799 |
| Water Tube Type M | Domestic Water Service<br>Fire Protection<br>Solar, Fuel Oil<br>HVAC | Hard | 10 ft. Straight lgth<br>20 ft. Straight lgth | Red | C12200, ASTM B-88<br>Federal WW-T-799 |
| ACR Tube (L cleaned and capped/degreased) | Air Conditioning<br>Refrigeration<br>Natural Gas | Hard | 20 ft. Straight lgth | Blue | C12200, ASTM B-280 |
| OXY/MED Tube (K & L cleaned and capped/degreased) | Medical Gas Systems | Hard | 20 ft. Straight lgth | Blue | C12200, ASTM B-280<br>B-819 |
| Refrigeration Tube | Air Conditioning<br>Refrigeration Service | Soft | 50 ft. Coils<br>100 ft. Coils | Red | C12200, ASTM B-280 |
| DWV Tube | Drainage | Hard | 20 ft. Straight lgth | Yellow | C12200, ASTM B-306 |

Last modified: 06/11/07

DAMIEN W. SERAUSKAS, P.E.
PROFESSIONAL ENGINEERING SERVICES

---

✗ No Exceptions Taken ◊ Rejected
◊ Approved As Noted ◊ Resubmit

Date: 3-18-09 By: _____

Review is for general conformance with the design intent and general compliance with the information given in the Project Documents. The Contractor shall be responsible for confirming all dimensions, quantities, and installation methods.

---

HVAC + PLUMBING + FIRE PROTECTION + SITE UTILITIES

---

15 CYPRESS POINT LANE NEW ORLEANS, LA 70131
VOICE: (504) 866-2600 FAX: (504)-218-8480

CAMBRIDGE-LEE INDUSTRIES, LLC.
Reading Tube Division
P.O. Box 14026, Reading, PA 19612 - 4026
Phone 610 - 926 4141 Fax 610 - 926 7317

| | |
|---|---|
| **Distributor:** | **Customer:** |
| **Address:** | **Address:** |
| **Order No.:** | **P.O. No.:** |
| **Product:** | |

# Standard Tube
# Certificate of Conformance

| Tube Type | Specification No.* | Specification Title |
|---|---|---|
| Type K, L & M | ASTM B 88 | Standard Specification for Seamless Copper Water Tube |
| | NSF 61 | ANSI/NSF Standard 61 Drinking Water System Components Health Effects[1] |
| Coils and Straight Lengths Marked as ACR | ASTM B 280 | Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service |
| Type DWV Drainage | ASTM B 306 | Standard Specification for Copper Drainage Tube (DWV) |
| Type K & L Straight Lengths Marked as OXY/MED | ASTM B 819 | Standard Specification for Seamless Copper Tube for Medical Gas Systems |

Cambridge-Lee Industries, LLC certifies that the copper tube manufactured is grade UNS C12200 and meets the chemical, mechanical, cleanness and eddy current testing requirements of the current specification(s) indicated below.

* Although CLI – RTD strives to meet all requirements specified in ASTM, Standard Tube[2] may not fully meet ASTM dimensional requirements. When specified at order placement and for an additional cost, CLI – RTD can produce Certified Tube to meet all requirements of the current ASTM standard, including dimensions.

Copper tube manufactured by Cambridge-Lee Industries does not contain mercury or come in contact with mercury, mercury compounds or mercury containing devices at any stage in manufacturing, inspection, packaging or shipping.

All of the specifications require a minimum copper plus silver content of 99.9% and a phosphorus content between .015 - .040%. As indicated by the compositional requirements, the copper tube is essentially lead free.

---

[1] Seamless Copper Tube (Alloy C12200) is certified by NSF to NSF/ANSI Standard 61 for public water supplies meeting, or in process of meeting the U.S. EPA Lead and Copper Rule (56FR 26460, June 7, 1991). Water Supplies with pH less than 6.5 may require corrosion control to limit copper solubility in drinking water.

[2] Standard Tube will be provided unless Certified Tube is clearly defined on Purchase Order.

## PRODUCT CERTIFICATION - SOLDER, BRAZED AND THREADED COPPER AND COPPER ALLOY PLUMBING FITTINGS

Elkhart Products Corporation manufactures and/or supplies products which meet the following specifications:

| | | |
|---|---|---|
| MSS | SP73 | Brazing Joints for Copper and Copper Alloy Pressure Fittings |
| MSS | SP104 | Wrought Copper Solder Joint Pressure Fittings |
| MSS | SP106 | Cast Copper Alloy Flanges and Flanged Fittings; Class 125, 150 and 300 |
| MSS | SP123 | Non-Ferrous Threaded and Solder-Joint Unions for use with Copper Water Tube |
| MSS | SP109 | Welded Fabricated Copper Solder Joint Pressure Fittings |
| ASME/ANSI | B16.29-2001: | Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings – DWV |
| ASME/ANSI | B16.18-2001: | Cast Copper Alloy Solder Joint Pressure Fittings |
| ASME/ANSI | B16.15-1994: | Cast Bronze Threaded Fittings |
| ASME/ANSI | B16.26-1988: | Cast Copper Alloy Fittings for Flared Copper Tube |
| ASME/ANSI | B16.23-2002: | Cast Copper Alloy Solder Joint Drainage Fittings – DWV |
| ASME/ANSI | B16.24-2001: | Bronze Pipe Flanges and Flanged Fittings |

EPC's wrot copper solder joint fittings also are manufactured to comply with the material, performance, and installation/joining dimensions of ASME/ANSI B16.22. These fittings are also compliant with the European Union's RoHS (Restrictions of Hazardous Substances) Directive, 2002/95/EC.

The materials used to manufacture these fittings are also in compliance with the following specifications:

| | |
|---|---|
| Tubular Wrought Copper: ASTM B75 Alloy C12200, | Standard specification for Seamless Copper Tube, or |
| Products Made From Sheet: ASTM B152 Alloy C11000, | Standard Specification for Copper Sheet, Strip, Plate and Rolled Bar |
| Cast Products: ASTM B584 Alloy C84400, | Standard Specification for Copper Alloy Sand Castings for General Applications; Federal Specification WW-U-516 For Type III, Class A and B Copper Alloy Unions |

**ELKHART PRODUCTS COPRORATION**
Plumbing Division

Dana Buccicone
Director of Technology

State of Massachusetts product approval
Number P1-0698-46, granted 6/3/98.

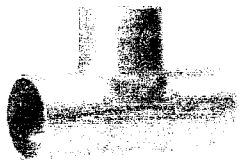
Subscribed and sworn to before me

On this 24th day of July 2006

Vicki A. Vergon

NOTARY PUBLIC
VICKI A VERGON
NOTARY PUBLIC STATE OF INDIANA
ST. JOSEPH COUNTY
MY COMMISSION EXP. FEB 28 2007

an Aalberts Industries company



## RECYCLED MATERIAL FOR "LEED" COMPLIANCE
### Green Building Rating System

"Each year in the United States, nearly as much copper is recovered from recycled material as is derived from newly mined ore. Excluding wire production, more than three-fourths (¾) of the amount used by copper and brass mills, ingot makers, foundries, powder metal plants and other industries comes from recycled scrap copper."

"Almost half of all recycled copper scrap is old post consumer scrap, such as discarded electric cable, automobile radiators and air conditioners."

**Elkhart Products Corporation subscribes to the above facts and encourages its suppliers to do the same.**

The copper tubing and rod used to produce all E.P.C. copper fittings is manufactured from copper cathode which in turn is made up from twenty-five (25) percent post consumer scrap as described above. Another fifty (50) percent is post industrial scrap (turnings, shavings and chips).

Dennis Thompson

Staff Engineer
Elkhart Products Corp.

205/664-3733 Fax: 205/664-3775

Vulcan
THREADED PRODUCTS, INC.

Vulcan Threaded Products
#10 Crosscreek Trail
Pelham, AL 35124
Ph:(205) 620-5100
Fax:(205) 620-5150

Ref: Low Carbon All-Thread Rod

September 14, 2004

This letter is to certify that the All-Thread Rod supplied by Vulcan Threaded Products will meet the minimum physical requirements of ASTM A36 & A307 and produced to a 1A fit. ¼" to 1" All-Thread Rod is produced from 1006/1008/1010 steel. 1-1/8" to 2-1/2" is produced from 1018 steel. The entire threaded rod size range is manufactured in the United States from domestic and foreign raw material.

All Hot-Dip Galvanized threaded rod is plated according to ASTM A153 specifications. All Zinc Threaded Rod is plated according to ASTM B633.

Best Regards,

Jeff Hayes
Purchasing Manager

DAMIEN W. SERAUSKAS, P.E.
PROFESSIONAL ENGINEERING SERVICES

☒ No Exceptions Taken ◇ Rejected
◇ Approved As Noted ◇ Resubmit

Date: 3-18-09 By:

Review is for general conformance with the design intent and general compliance with the information given in the Project Documents. The Contractor shall be responsible for confirming all dimensions, quantities, and installation methods.

HVAC + PLUMBING + FIRE PROTECTION + SITE UTILITIES

15 CYPRESS POINT LANE NEW ORLEANS, LA 70131
VOICE: (504) 866-2600 FAX: (504)-218-8480

1/4" THROUGH 5/8" MANUFACTURED FROM 1006-1010 STEEL
¾" THROUGH 1" MANUFACTURED FROM 1006 – 1010 OR A36 STEEL

ALL ALL-THREAD ROD WILL MEET MINIMUM TENSILE & YIELD REQUIREMENTS OF ASTM A307 GRADE C

| ITEM | MANUFACTURER | MATERIAL AS DESCRIBED ON INVOICE |
|---|---|---|
| 1 | VULCAN THREADED PRODUCTS | 1/4"-20 LOW CARBON STEEL THREADED ROD MELTED DOMESTICALLY AND INTERNATIONALLY MANUFACTURED IN THE UNITED STATES |
| 2 | VULCAN THREADED PRODUCTS | 5/16"-18 LOW CARBON STEEL THREADED ROD MELTED DOMESTICALLY AND INTERNATIONALLY MANUFACTURED IN THE UNITED STATES |
| 3 | VULCAN THREADED PRODUCTS | 3/8"-16 LOW CARBON STEEL THREADED ROD MELTED DOMESTICALLY AND INTERNATIONALLY MANUFACTURED IN THE UNITED STATES |
| 4 | VULCAN THREADED PRODUCTS | 1/2"-13 LOW CARBON STEEL THREADED ROD MELTED DOMESTICALLY AND INTERNATIONALLY MANUFACTURED IN THE UNITED STATES |
| 5 | VULCAN THREADED PRODUCTS | 5/8"-11 LOW CARBON STEEL THREADED ROD MELTED DOMESTICALLY AND INTERNATIONALLY MANUFACTURED IN THE UNITED STATES |
| 6 | VULCAN THREADED PRODUCTS | ¾"-10 LOW CARBON STEEL THREADED ROD MELTED DOMESTICALLY AND INTERNATIONALLY MANUFACTURED IN THE UNITED STATES |
| 7 | VULCAN THREADED PRODUCTS | 7/8"-09 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |
| 8 | VULCAN THREADED PRODUCTS | 1"-08 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |

| ITEM | HEAT# | CARBON | MANG. | PHOS. | SULPHUR | SILICON | CHROM. | NICKEL | MOLY. | COPPER |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 65800 | .06 | .47 | .006 | .010 | .15 | .06 | .09 | .02 | .20 |
| 2 | 64241 | .06 | .45 | .011 | .024 | .12 | .15 | .10 | .03 | .26 |
| 3 | 26863 | .06 | .40 | .016 | .025 | .12 | .13 | .14 | .00 | .26 |
| 4 | 26864 | .07 | .42 | .013 | .02 | .13 | .10 | .11 | .00 | .21 |
| 5 | 1030122 | .04 | .45 | .018 | .034 | .11 | -- | -- | -- | -- |
| 6 | 65197 | .17 | .67 | .014 | .016 | .18 | .14 | .10 | .03 | .32 |
| 7 | 62286 | .22 | .90 | .006 | .025 | .23 | .05 | .07 | .02 | .16 |
| 8 | 62260 | .15 | .72 | .012 | .026 | .19 | .07 | .08 | .02 | .21 |

| ITEM | HEAT # | TENSILE PSI | YIELD PSI | %ELONGATION 8" GAGE | REDUCTION OF AREA | BEND TEST |
|---|---|---|---|---|---|---|
| 1 | 65800 | 62,200 | ---------- | ---------- | ---------- | ---------- |
| 2 | 64241 | 61,500 | ---------- | ---------- | ---------- | ---------- |
| 3 | 26863 | 60,915 | 40,053 | 36.0 | ---------- | ---------- |
| 4 | 26864 | 61,641 | 40,611 | 34.0 | ---------- | ---------- |
| 5 | 1030122 | 58,853 | 39,885 | 40.0 | ---------- | ---------- |
| 6 | 65197 | 73,700 | 51,200 | 32.0 | ---------- | ---------- |
| 7 | 62286 | 78,600 | 50,700 | 31.0 | ---------- | ---------- |
| 8 | 62260 | 69,100 | 45,800 | 27.0 | ---------- | ---------- |

WE HEREBY CERTIFY THAT THE FOREGOING DATA IS A TRUE COPY OF THE DATA FURNISHED BY THE PRODUCING MILL.
ALL DATA SUPPLIED IN THE ABOVE TEST REPORT ARE TYPICAL OF MATERIAL FURNISHED BY VULCAN THREADED PRODUCTS.

DATE: 4/30/2004

BY: _____
AUTHORIZED AGENT
QUALITY CONTROL SUPERVISOR

VULCAN THREADED PRODUCTS
#10 CROSSCREEK TRAIL
PELHAM, AL 35124
205) 620-5100
FAX 205) 620-5150

1-1/8" THROUGH 2" MANUFACTURED FROM 1018 or A36 STEEL
2-1/4" THROUGH 2-1/2" MANUFACTURED FROM 1018 or A36 STEEL

ALL ALL-THREAD ROD WILL MEET MINIMUM PHYSICAL AND CHEMICAL REQUIREMENTS OF ASTM A307 GRADE C

| ITEM | MANUFACTURER | MATERIAL AS DESCRIBED ON INVOICE |
|---|---|---|
| 1 | VULCAN THREADED PRODUCTS | 1-1/8"-7 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |
| 2 | VULCAN THREADED PRODUCTS | 1-1/4"-7 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |
| 3 | VULCAN THREADED PRODUCTS | 1-3/8"-6 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |
| 4 | VULCAN THREADED PRODUCTS | 1-1/2"-6 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |
| 5 | VULCAN THREADED PRODUCTS | 1-3/4"-5 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |
| 6 | VULCAN THREADED PRODUCTS | 2"-4.5 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |
| 7 | VULCAN THREADED PRODUCTS | 2-1/4"-4 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |
| 8 | VULCAN THREADED PRODUCTS | 2-1/2"-4 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |

| ITEM | HEAT# | CARBON | MANG | PHOS. | SULPHUR | SILICON | CHROM. | NICKEL | MOLY. | COPPER |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5899I1120 | .20 | .80 | .015 | .026 | .22 | .10 | .09 | .03 | .43 |
| 2 | 589915771 | .17 | .70 | .02 | .036 | .16 | .12 | .10 | .04 | .41 |
| 3 | 319913248 | .20 | .60 | .012 | .040 | .21 | .11 | .09 | .04 | .37 |
| 4 | 319913251 | .18 | .60 | .012 | .037 | .21 | .13 | .10 | .04 | .33 |
| 5 | 151115 | .14 | .78 | .008 | .023 | .21 | .07 | .15 | .034 | .97 |
| 6 | 151438 | .17 | .82 | .005 | .017 | .23 | .06 | .09 | .016 | .21 |
| 7 | 681952 | .18 | .77 | .01 | .03 | .22 | ——— | ——— | ——— | ——— |
| 8 | 640723 | .18 | .70 | .02 | .04 | .22 | ——— | ——— | ——— | ——— |

| HEAT # | TENSILE PSI MIN | YIELD PSI MIN | %ELONGATION 8" GAGE MIN % | REDUCTION OF AREA MIN % | | |
|---|---|---|---|---|---|---|
| 5899I1120 | 77,400 | 52,100 | 27 | ——— | ——— | ——— |
| 589915771 | 72,400 | 49,600 | 24 | ——— | ——— | ——— |
| 319913248 | 71,338 | 48,408 | 25 | ——— | ——— | ——— |
| 319913251 | 75,796 | 48,408 | 23 | ——— | ——— | ——— |
| 151115 | 68,000 | 46,900 | 27 | ——— | ——— | ——— |
| 151438 | 70,100 | 49,700 | 22 | ——— | ——— | ——— |
| 681952 | 92,300 | 85,400 | 16 | ——— | ——— | ——— |
| 640723 | 89,500 | 80,550 | 15 | ——— | ——— | ——— |

WE HEREBY CERTIFY THAT THE FOREGOING DATA IS A TRUE COPY OF THE DATA FURNISHED BY THE PRODUCING MILL. ALL DATA SUPPLIED IN THE ABOVE TEST REPORT ARE TYPICAL OF MATERIAL FURNISHED BY VULCAN THREADED PRODUCTS.

DATE: 9/12/2007

BY: _____
AUTHORIZED AGENT
QUALITY CONTROL SUPERVISOR

VULCAN THREADED PRODUCTS
#10 CROSSCREEK TRAIL
PELHAM, AL 35124
(205) 620-5100
FAX (205) 620-5150

ITT

**SUBMITTAL**

**A-135D**

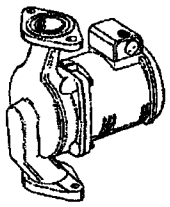
**JOB:** SOF RIVERINE & COMBATANT CRAFT OPER. FAC.

**REPRESENTATIVE:** Hydronic Technology, Inc.

**UNIT TAG:**
**ENGINEER:**
**CONTRACTOR:** GALLO MECHANICAL

**ORDER NO.**
**SUBMITTED BY:** BILLY MARTINEZ
**APPROVED BY:**

**DATE:** 5/1/2009
**DATE:**
**DATE:**



# SERIES PL™

## Permanently Lubricated Iron & Bronze Booster Pumps

c UL us LISTED

### DESCRIPTION

The Series PL™ close coupled booster pumps are specifically designed for quiet operation in hydronic, radiant and geothermal heating and cooling systems. These inline permanently lubricated pumps are available in cast iron or bronze body construction.

### OPERATING DATA

Maximum working Pressure: 150 psi (10 Bar)
Maximum Operating Temperature: 225°F (107°C)

### CONSTRUCTION MATERIALS

Booster Body: Cast Iron or Bronze
Face Plate: Stainless Steel
Impeller: 30% Glass Filled Noryl®
(PL-55 & PL-130): Glass Filled PPS
Shaft: Carbon Steel
(PL-55 & PL-130): Stainless Steel
Shaft Sleeve: Stainless Steel
(PL-55 & PL-130): None
Seal: Mechanical, Carbon on Silicon Carbide
Motor Bearings: Sealed Precision Steel Ball Bearing Permanently Lubricated
Motor Type: ODP
Elastomers: EPDM

### SCHEDULE

| CAST IRON | | | BRONZE | | | STANDARD 60 CYCLE SINGLE PHASE MOTOR CHARACTERISTICS | | | | TAGGING INFORMATION |
|---|---|---|---|---|---|---|---|---|---|---|
| MODEL NUMBER | PART NUMBER | QTY. | MODEL NUMBER | PART NUMBER | QTY. | HP | VOLTAGE | F.L. AMPS | RPM | |
| PL-30 | 1BL012 | | PL-30B | 1BL013 | 1 | 1/12 | 115 | 1.4 | 2650 | REC-1 |
| PL-30 | 1BL014 | | PL-30B | 1BL015 | | 1/12 | 230 | 0.8 | 2650 | |
| PL-36 | 1BL001 | | PL-36B | 1BL003 | | 1/6 | 115 | 2.1 | 3300 | |
| PL-36 | 1BL006 | | PL-36B | 1BL008 | | 1/6 | 230 | 1.1 | 3300 | |
| PL-45 | 1BL002 | | PL-45B | 1BL004 | | 1/6 | 115 | 2.1 | 3300 | |
| PL-45 | 1BL007 | | PL-45B | 1BL009 | | 1/6 | 230 | 1.1 | 3300 | |
| PL-50 | 1BL016 | | PL-50B | 1BL017 | | 1/6 | 115 | 1.8 | 3300 | |
| PL-50 | 1BL018 | | PL-50B | 1BL019 | | 1/6 | 230 | 1.0 | 3300 | |
| PL-55 | 1BL032 | | PL-55B | 1BL068 | | 2/5 | 115 | 4.7 | 3250 | |
| PL-55 | 1BL033 | | PL-55B | 1BL069 | | 2/5 | 230 | 2.4 | 3250 | |
| PL-75 | 1BL034 | | PL-75B | 1BL035 | | 1/6 | 115 | 2.1 | 3400 | |
| PL-75 | 1BL036 | | PL-75B | 1BL037 | | 1/6 | 230 | 1.1 | 3400 | |
| PL-130/2" | 1BL063 | | PL-130B/2" | 1BL065 | | 2/5 | 115 | 4.8 | 3200 | |
| PL-130/2" | 1BL064 | | PL-130B/2" | 1BL066 | | 2/5 | 230 | 2.4 | 3200 | |
| PL-130/3" | 1BL070 | | PL-130B/3" | 1BL072 | | 2/5 | 115 | 4.8 | 3200 | |
| PL-130/3" | 1BL071 | | PL-130B/3" | 1BL073 | | 2/5 | 230 | 2.4 | 3200 | |

**Note: Where potable water is pumped, use a bronze booster.**
PL boosters equipped with a drip-proof motor are recommended for indoor use only.

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**Bell & Gossett**

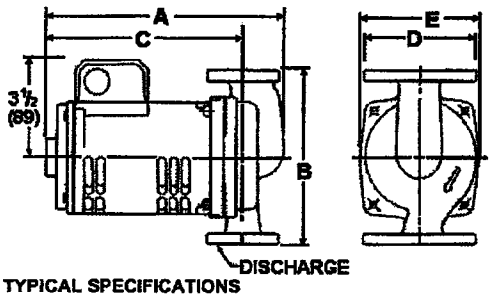
# SERIES PL - Permanently Lubricated Booster Pumps

A-

**DIMENSIONS AND WEIGHTS**

| MODEL NO. | FLANGE SIZE INCHES - NPT | MOTOR HP | DIMENSIONS - INCHES (mm) | | | | | APPROX SHIPPING W (KG |
|---|---|---|---|---|---|---|---|---|
| | | | A | B | C | D | E | |
| PL-30 | 3/4, 1, 1-1/4 & 1-1/2 | 1/12 | 8 5/8 (219) | 6 3/8 (162) | 7 1/8 (181) | 4 3/16 (106) | 4 3/8 (111) | 11.6 (5 |
| PL-36 | 3/4, 1, 1-1/4 & 1-1/2 | 1/6 | 8 5/8 (219) | 6 3/8 (162) | 7 1/8 (181) | 4 3/16 (106) | 4 3/8 (111) | 13.1 (6 |
| PL-45 | 1, 1-1/4 & 1-1/2 | 1/6 | 9 1/8 (232) | 8 1/2 (216) | 7 1/4 (184) | 4 5/8 (117) | 4 1/2 (114) | 14.5 (6 |
| PL-50 | 1, 1-1/4 & 1-1/2 | 1/6 | 9 1/8 (232) | 8 1/2 (216) | 7 1/4 (184) | 4 5/8 (117) | 4 1/2 (114) | 14.5 (6 |
| PL-55 | 3/4, 1, 1-1/4 & 1-1/2 | 2/5 | 9 9/16 (243) | 6 3/8 (162) | 7 15/16 (202) | 4 3/16 (106) | 4 3/4 (121) | 13.1 (6 |
| PL-75 | 2 | 1/6 | 9 15/16 (252) | 8 1/2 (216) | 7 3/8 (187) | 5 3/16 (132) | 4 5/8 (117) | 18.5 (8 |
| PL-130/2" | 2 | 2/5 | 10 3/4 (273) | 8 1/2 (216) | 8 1/4 (210) | 5 3/16 (132) | 5 1/8 (130) | 22 (1 |
| PL-130/3" | 3 | 2/5 | 10 3/4 (273) | 8 1/2 (216) | 8 1/4 (210) | 6 (152) | 5 1/8 (130) | 27 (12 |

Dimensions are approximate and subject to change. Contact factory for certified dimensions.



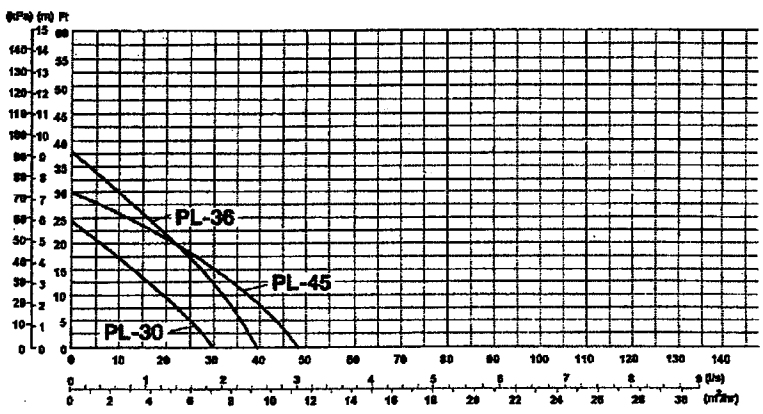

**TYPICAL SPECIFICATIONS**

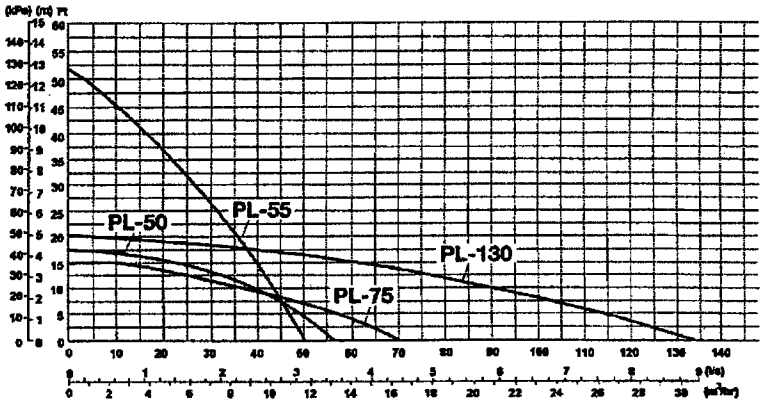
The contractor shall furnish and install inline pumps as illustrated on the plans and in accordance with the following specifications:

1. The pumps shall be of the horizontal, permanently lubricated type, specifically designed and guaranteed for quiet operation.
2. The pumps shall have a steel shaft supported by permanently lubricated, sealed precision ball bearings. The pumps are to be equipped with a water-tight seal to prevent leakage. Mechanical seal faces to be carbon on silicon carbide. The motor shall be non-overloading at any point on the pump performance curve.
3. The motor shall be of the drip-proof, sealed precision ball-bearing, quiet-operating construction. The permanent split-capacitor motor shall be equipped with thermal overload protection.
4. Pumps to be suitable for 225°F (107°C) operating temperature at 150 psig (10 bar) working pressure.

The pumps shall be ITT Bell & Gossett Model No. PL-_____ with a capacity of _____ GPM at _____ feet of head.

**PERFORMANCE CHARACTERISTICS CURVES**




ITT
8200 N. Austin Avenue
Morton Grove, IL 60053
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www.bellgossett.com

SECTION 22 07 19

PLUMBING PIPING INSULATION
**08/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 167 | (1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |
| ASTM A 240/A 240M | (2008) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications |
| ASTM B 209 | (2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate |
| ASTM C 1136 | (2008) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation |
| ASTM C 195 | (2000) Standard Specification for Mineral Fiber Thermal Insulating Cement |
| ASTM C 449 | (2007) Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement |
| ASTM C 533 | (2007) Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation |
| ASTM C 534/C 534M | (2008) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form |
| ASTM C 547 | (2008e1) Standard Specification for Mineral Fiber Pipe Insulation |
| ASTM C 552 | (2007) Standard Specification for Cellular Glass Thermal Insulation |
| ASTM C 591 | (2008) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation |
| ASTM C 592 | (2008a) Standard Specification for Mineral |

| | |
|---|---|
| | Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type) |
| ASTM C 795 | (2008) Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel |
| ASTM C 916 | (1985; R 2007) Standard Specification for Adhesives for Duct Thermal Insulation |
| ASTM C 920 | (2008) Standard Specification for Elastomeric Joint Sealants |
| ASTM C 921 | (2003a) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation |
| ASTM D 226 | (2006) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing |
| ASTM D 579 | (2004) Standard Specification for Greige Woven Glass Fabrics |
| ASTM E 84 | (2008a) Standard Test Method for Surface Burning Characteristics of Building Materials |
| ASTM E 96/E 96M | (2005) Standard Test Methods for Water Vapor Transmission of Materials |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 220 | (2008) Standard on Types of Building Construction |

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

| | |
|---|---|
| SAE AMS 3779 | (1990; Rev A; R 1994) Tape Adhesive, Pressure Sensitive Thermal Radiation Resistant, Aluminum Foil/Glass Cloth |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| FED-STD-595 | (Rev B; Am 1) Colors Used in Government Procurement |

## 1.2 SYSTEM DESCRIPTION

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, AND EXHAUST SYSTEMS applies to work specified in this section.

## 1.3 PERFORMANCE REQUIREMENTS

Provide noncombustible thermal-insulation system materials, as defined by NFPA 220. Adhesives, coatings, sealants, facings, jackets, and thermal-insulation materials, except cellular elastomers, with a flame-spread classification (FSC) of 25 or less, and a smoke-developed

classification (SDC) of 50 or less. Determine these maximum values in accordance with ASTM E 84. Provide coatings and sealants that are nonflammable in their wet state.

Adhesives, coatings, and sealants shall have published or certified temperature ratings suitable for the entire range of working temperatures normal for the surfaces to which they are to be applied.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Adhesives
Coatings
Insulation Materials
Jacketing
Tape

SD-08 Manufacturer's Instructions

Installation manual for Insulation Materials

# PART 2 PRODUCTS

Materials shall be compatible and not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Meet ASTM C 795 requirements for materials to be used on stainless steel surfaces. Provide materials that are asbestos free and conform to the following.

## 2.1 INSULATION MATERIALS

Insulation conductances shall be maximum values, as tested at any point, not an average. Replace or augment insulation conductance found by test to exceed the specified maximum by an additional thickness to bring it to the required maximum conductance and a complete finishing system.

### 2.1.1 Mineral Fiber Insulation

Conform to ASTM C 592, ASTM C 553, or ASTM C 547 for Mineral Fiber Insulation and be suitable for surface temperatures up to 370 degrees F, and not less than 4-pound per cubic foot density with thermal conductivity not greater than 0.26 Btu per hour per square foot square per degree F at 150 degrees F mean.

Mineral fiber pipe wrap insulation having an insulating efficiency not less than that of the specified thickness of fibrous glass pipe insulation may be provided in lieu of fibrous glass pipe insulation for pipe sizes 10 inches and larger.

2.1.2 Cellular Elastomer Insulation

Conform to ASTM C 534/C 534M, except ensure the water vapor permeability does not exceed 0.30 perms per foot per inch per hour per square foot mercury pressure difference for 1 inch thickness for Cellular Elastomer.

2.1.3 Cellular Glass Insulation

Conform to ASTM C 552, Type II, Grade 2, pipe covering for Cellular Glass. Substitutions for this material are not permitted. Ensure minimum thickness is not less than 1-1/2 inches.

2.1.4 Calcium Silicate Insulation

Conform to ASTM C 533. Ensure the apparent thermal conductivity does not exceed 0.54 Btu-inch per hour per square foot per degree F 200 degrees F mean.

2.1.5 Fiberglass Insulation

Conform to ASTM C 547. Ensure the apparent thermal conductivity does not exceed 0.54 Btu-inch per hour per square foot per degree F at 200 degrees F mean.

Fiber glass pipe insulation having an insulating efficiency not less than that of the specified thickness of mineral fiber pipe insulation may be provided in lieu of mineral fiber pipe insulation for aboveground piping.

2.1.6 Polyisocyanurate Pipe Insulation

Conform to ASTM C 591 for polyisocyanurate, minimum density of 1.7 pcf.

2.1.7 Pipe Barrel

Pipe barrel insulation shall be Type II, Molded, Grade A or Type III, Precision V-Groove, Grade A for use at temperatures up to and including 1200 degrees F.

2.1.8 Pipe Fittings

Provide molding pipe fitting insulation covering for use at temperatures up to and including 1200 degrees F.

2.1.9 Flexible Blankets

Provide flexible blankets and felts for use at temperatures up to and including 350 degrees F minimum 1 pound per cubic foot density. Thermal conductivity shall be not greater than 0.26 Btu per hour per square foot per degree F at 75 degrees F mean.

2.2 ADHESIVES

2.2.1 Cloth Adhesives

Adhesives for adhering, sizing, and finishing lagging cloth, canvas, and open-weave glass cloth shall be a pigmented polyvinyl acetate emulsion and conform to the requirements of ASTM C 916, Type I.

2.2.2 Vapor-Barrier Material Adhesives

Adhesives for attaching laps of vapor-barrier materials and presized glass cloth and for attaching insulation to itself, to metal, and to various other substrates, must be solvent-base, synthetic-rubber type and conform to the requirements of ASTM C 916, Type I, for attaching fibrous-glass insulation to metal surfaces. Solvent shall be nonflammable.

2.2.3 Cellular Elastomer Insulation Adhesive

Adhesive for cellular elastomer insulation shall be a solvent cutback chloroprene elastomer conforming to ASTM C 916, Type I, and be of a type approved by the manufacturer of the cellular elastomer for the intended use.

2.3 INSULATING CEMENT

2.3.1 General Purpose Insulating Cement

General purpose insulating cement shall be [diatomaceous silica] [mineral fiber] and conform to ASTM C 195. Composite shall be rated for 1800 degrees F service and have a thermal-conductivity maximum of [0.85] [_____] Btu by inch per hour per square foot for each degree F temperature differential at 200 degrees F mean temperature for 1 inch thickness.

2.3.2 Finishing Insulating Cement

Finishing insulating cement shall be mineral-fiber, hydraulic-setting type conforming to ASTM C 449.

2.4 CALKING

Calking used with specified insulation materials shall be an elastomeric joint sealant in accordance with ASTM C 920, Type S, Grade NS, Class 25, Use A.

2.5 CORNER ANGLES

Corner angle piping insulation shall be nominal 0.016 inch aluminum 1 by 1 inch with factory applied kraft backing. Aluminum shall be in accordance with ASTM B 209, Alloy [3003] [3105] [5005].

2.6 JACKETING

2.6.1 Aluminum Jacket

ASTM B 209, Temper H14, minimum thickness of 0.016 inch, with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside diameters less than 8 inches. Provide corrugated surface jackets for jacket outside diameters 8 inches and larger. Provide stainless steel bands, minimum width of 0.5 inch. Provide factory prefabricated aluminum covers for insulation on fittings, valves, and flanges.[ Aboveground jackets and bands shall have factory-applied baked-on semigloss brown color conforming to Federal Standard FED-STD-595, "Colors," color chip number 20062.]

2.6.2 Asphalt-Saturated Felt

ASTM D 226, without perforations, minimum weight of 10 pounds per 100 square feet.

2.6.3 Stainless Steel Jacket

ASTM A 167 or ASTM A 240/A 240M; Type 304, minimum thickness of 0.010 inch, smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 0.5 inch. Provide factory prefabricated stainless steel covers for insulation on fittings, valves, and flanges.

2.6.4 Glass Cloth Jacket

Provide plain-weave glass cloth conforming to ASTM D 579, Style 141 and weigh not less than 7.23 ounces per square yard before sizing. Factory apply cloth wherever possible.

Provide leno weave glass reinforcing cloth, 26-end and 12-pick thread conservation, with a warp and fill tensile strength of 45 and 30 pounds per inch of width, respectively, and with a weight of not less than 1.5 ounces per square yard. [At the Contractor's option, Style 191 leno-weave glass cloth conforming to ASTM D 579 may be provided.]

2.6.5 PVC Jacket

Provide 0.010 inch thick, factory-premolded, [one-piece fitting] [pipe-barrel sheeting vapor-barrier jacketing]polyvinylchloride that is self-extinguishing, high-impact strength, moderate chemical resistance with a permeability rating of 0.01 grain per hour per square foot per inch of mercury pressure difference, determined in accordance with ASTM E 96/E 96M. Provide manufacturer's standard solvent-weld type vapor-barrier joint adhesive.

Conform to ASTM C 1136 for, Type I, low-vapor transmission, high-puncture resistance vapor barrier for use on insulation for piping, ducts, and equipment.

2.7 COATINGS

2.7.1 Outdoor Vapor-Barrier Finishing

Coatings for outdoor vapor-barrier finishing of insulation surfaces such as fittings and elbows shall be a nonasphaltic, hydrocarbon polymer, solvent-base mastic containing a blend of nonflammable solvents. Conform to the requirements of ASTM C 1136 and ASTM C 921 for coatings.

2.7.2 Indoor Vapor-Barrier Finishing

Provide pigmented resin and solvent compound coatings for indoor vapor-barrier finishing of insulation surfaces and conform to ASTM C 1136, Type II.

2.7.3 Outdoor and Indoor Nonvapor-Barrier Finishing

Provide pigmented polymer-emulsion type recommended by the insulation material manufacturer for outdoor and indoor nonvapor-barrier finish coating of insulation surfaces for the surface to be coated and applied to specified dry-film thickness.

2.7.4 Cellular-Elastomer Insulation Coating

Provide a polyvinylchloride lacquer approved by the manufacturer of the cellular elastomer finish coating.

2.7.5 Coating Color

[Provide white] [Conform to the color code specified] [Blend with background of surrounding area] [Provide as specified by the Contracting Officer]for the coating color.

2.8 TAPE

Provide a knitted elastic cloth glass lagging specifically suitable for continuous spiral wrapping of insulated pipe bends and fittings and produce a smooth, tight, wrinkle-free surface. Conform to requirements of SAE AMS 3779, SAE AMS 3779, ASTM D 579, and ASTM C 921 for tape, and weigh not less than 10 ounces per square yard.

2.9 COLD-WATER AND CONDENSATE-DRAIN PIPING

Insulate aboveground pipes, valve bodies, fittings, unions, flanges, and miscellaneous surfaces shall be insulated

[Provide 3/8 inch mineral fiber insulation with glass cloth jacket, Type T-2, with a thickness of not less than 1/2".]

Provide cellular-elastomer insulation conforming to ASTM C 534/C 534M. Water-vapor permeability shall not exceed 0.1 grain per square foot per hour per inch mercury pressure-differential for 1 inch thickness.

Cold-water piping insulation shall be flexible unicellular-elastomeric thermal insulation, Type T-3, with a thickness of 1/2 inch per calculation. Use expanded, closed-cell pipe insulation only aboveground, not for underground piping.

2.10 REFRIGERANT SUCTION PIPING

Provide cellular-elastomer insulation, Type T-3, with a nominal thickness of 3/4 inch. Insulate surfaces, including valve, fittings, unions, and flanges.

2.11 CHILLED-WATER AND DUAL-TEMPERATURE PUMPS

Provide cellular elastomer insulation, Type T-9, with a thickness of 1 inch. Cover surfaces subject to condensation, and provide a vapor-barrier coating.

PART 3 EXECUTION

3.1 INSTALLATION OF INSULATION SYSTEMS

Install smooth and continuous contours on exposed work. Smoothly and securely paste down cemented laps, flaps, bands, and tapes. Apply adhesives on a full-coverage basis.

Apply insulation only to system or component surfaces that have been tested and approved.

Install insulation lengths tightly butted against each other at joints.

Where lengths are cut, provide smooth and square and without breakage of end surfaces. Where insulation terminates, neatly taper and effectively seal ends, or finish as specified. Direct longitudinal seams of exposed insulation away from normal view.

Apply materials in conformance with the recommendations of the manufacturer.

Clean surfaces free of oil and grease before insulation adhesives or mastics are applied. Provide solvent cleaning required to bring metal surfaces to such condition.

Installation Drawings for pipe insulation shall be in accordance with the adhesive manufacturer's written instructions for installation.

## 3.2 SYSTEM TYPES

### 3.2.1 Type T-1, Mineral Fiber with Vapor-Barrier Jacket

Cover piping with mineral-fiber pipe insulation with factory-and field-attached vapor-barrier jacket. Maintain vapor seal. Securely cement jackets, jacket laps, flaps, and bands in place with vapor-barrier adhesive. Provide jacket overlaps not less than 1-1/2 inches and jacketing bands for butt joints 3 inches wide.

Cover exposed-to-view fittings and valve bodies with preformed mineral-fiber pipe-fitting insulation of the same thickness as the pipe-barrel insulation. Temporarily secure fitting insulation in place with light cord ties. Apply a 60-mil coating of white indoor vapor-barrier coating and, while still wet, wrap with glass lagging tape with 50 percent overlap, and smoothly blend into the adjacent jacketing. Apply additional coating as needed and rubber-gloved to smooth fillet or contour coating, then allowed to fully cure before the finish coating is applied. On-the-job fabricated insulation for concealed fittings and special configurations, build up from mineral fiber and a special mastic consisting of a mixture of insulating cement and lagging adhesive diluted with 3 parts water. Where standard vapor-barrier jacketing cannot be used, make the surfaces vapor tight by using coating and glass lagging cloth or tape as previously specified.

In lieu of materials and methods previously specified, fittings may be wrapped with a twine-secured, mineral-wool blanket to the required thickness and covered with premolded polyvinylchloride jackets. Make seams vapor tight with a double bead of manufacturer's standard vapor-barrier adhesive applied in accordance with the manufacturer's instructions. Hold all jacket ends in place with AISI 300 series corrosion-resistant steel straps, 15 mils thick by 1/2 inch wide.

Set pipe insulation into an outdoor vapor-barrier coating for a minimum of 6 inches at maximum 12-foot spacing and the ends of the insulation sealed to the jacketing with the same material to provide an effective vapor-barrier stop.

Do not use staples in applying insulation. Install continuous vapor-barrier materials over all surfaces, including areas inside pipe sleeves, hangers, and other concealments.

Piping insulation at hangers shall consist of 13-pounds per cubic foot density, fibrous-glass inserts or expanded, rigid, closed-cell, polyvinylchloride. Seal junctions with vapor-barrier jacket where

required, glass-cloth mesh tape, and vapor-barrier coating.

Expose white-bleached kraft paper side of the jacketing to view.

Finish exposed-to-view insulation with not less than a 6-mil dry-film thickness of nonvapor-barrier coating suitable for painting.

3.2.2 Type T-2, Mineral Fiber with Glass Cloth Jacket

Cover piping with a mineral-fiber, pipe insulation with factory-attached, presized, white, glass cloth. Securely cement jackets, jacket laps, flaps, and bands in place with vapor-barrier adhesive with jacket overlap not less than 1-1/2 inches and jacketing bands for butt joints 3 inches wide.

Cover exposed-to-view fittings with preformed mineral-fiber fitting insulation of the same thickness as the pipe insulation and temporarily secured in place with light cord ties. Install impregnated glass lagging tape with indoor vapor-barrier on 50 percent overlap basis and the blend tape smoothly into the adjacent jacketing. Apply additional coating as needed, and rubber gloved to a smooth contour. tape ends of insulation to the pipe at valves 2 inches and smaller. Build up on-the-job fabricated insulation for concealed fittings and special configurations from mineral fiber and a mixture of insulating cement and lagging adhesive, diluted with 3 parts water. Finish surfaces with glass cloth or tape lagging.

[Cover all valves 2-1/2 inches and larger and all flanges with preformed insulation of the same thickness as the adjacent insulation.]

[Finish exposed-to-view insulation with a minimum 6-mil dry-film thickness of nonvapor-barrier coating suitable for painting.]

3.2.3 Type T-3, Cellular Elastomer

Cover piping-system surfaces with flexible cellular-elastomer sheet or preformed insulation. Maintain vapor seal. Cement insulation into continuous material with a solvent cutback chloroprene adhesive recommended by the manufacturer for the specific purpose. Apply adhesive to both of the surfaces on a 100-percent coverage basis to a minimum thickness of 10 mils wet or approximately 150 square feet per gallon of undiluted adhesive.

Seal insulation on cold water piping to the pipe for a minimum of 6 inches at maximum intervals of 12 feet to form an effective vapor barrier. At piping supports, insulation shall be continuous through using outside-carrying type clevis hangers with insulation shield. Install [Cork] [Wood dowel] load-bearing inserts between the pipe and insulation shields to prevent insulation compression.

Insulate hot-water, cold-water, and condensate drain pipes to the extent shown with nominal 1/2 inch thick, fire retardant (FR), cellular elastomer, preformed pipe insulation. Seal joints with adhesive.

At pipe hangers or supports where the insulation rests on the pipe hanger strap, cut the insulation with a brass cork borer and a No. 3 superior grade cork inserted. Seal seams with approved adhesive. Insulate sweat fitting with miter-cut pieces of cellular elastomer insulation of the same nominal pipe size and thickness as the insulation on the adjacent piping or tubing. Joint miter-cut pieces with approved adhesive. Slit and snap covers over the fitting, and seal joints with approved adhesive.

Insulate screwed fittings with sleeve-type covers formed from miter-cut pieces of cellular elastomer thermal insulation having an inside diameter large enough to overlap adjacent pipe insulation. Butt pipe insulation against fittings. Overlap shall be not less than 1 inch. Use adhesive to join cover pieces and cement the cover to the pipe insulation.

Finish surfaces exposed to view or ultraviolet light with a 2-mil minimum dry-film thickness application of a polyvinylchloride lacquer recommended by the manufacturer, and applied in not less than two coats.

3.2.4 Type T-4, Cellular Glass with Vapor-Barrier Jacket

Cover piping with cellular glass insulation and factory- and field-attached vapor-barrier jacket. Maintain vapor seal. Securely cement jackets, jacket laps, flaps, and bands in place with vapor-barrier adhesive. Jacket overlap shall be not less than 1-1/2 inches . Jacket bands for butt joints shall be not less than 3 inches wide. Provide insulation continuous through hangers. Bed insulation in an outdoor vapor-barrier coating applied to all piping surfaces.

Insulate flanges, unions, valves, anchors, and fittings with factory premolded or prefabricated or field fabricated segments of insulation of the same material and thickness as the adjoining pipe insulation. When segments of insulation are used, provide elbows with not less than three segments. For other fittings and valves, cut segments to the required curvature or nesting size.

Secure segments of the insulation in place with twine or copper wire. After the insulation segments are firmly in place, apply a vapor-barrier coating over the insulation in two coats with glass tape imbedded between coats. First coat,tinted, the second, white to ensure application of two coats. Apply coating to a total dry-film thickness of 1/16 inch minimum. Overlap glass tape seams not less than 1 inchand the tape end not less than 4 inches.

In lieu of materials and methods specified above, fittings may be wrapped with 3/8 inch thick, vapor-barrier, adhesive-coated strips of cellular elastomer insulation. Insulation shall be under tension, compressed to 25 percent of original thickness, and wrapped until overall thickness is equal to adjacent insulation. Secure cellular elastomer in place with twine and sealed with vapor-barrier coating applied to produce not less than 1/16 inch dry-film thickness. Cover fittings with premolded polyvinylchloride jackets. Make seams vapor-tight with a double bead of manufacturer's standard vapor-barrier adhesive applied in accordance with the manufacturer's instructions. Hold jacket ends in place with AISI 300 series corrosion-resistant steel straps, 15 mils thick by 1/2 inch wide.

Insulate anchors secured directly to piping, to prevent condensation, for not less than 6 inches from the surface of the pipe insulation.

Install white-bleached kraft paper side of jacket exposed to view. Finish exposed-to-view insulation with not less than a 6-mil dry-film thickness of nonvapor-barrier coating suitable for painting.

3.2.5 Type T-5, Calcium Silicate with Glass Cloth Jacket (Piping)

Cover piping with a calcium-silicate pipe insulation with factory attached and presized, white, glass cloth. Field apply jackets when required. Securely cement jackets, jacket laps, flaps, and bands in place with

vapor-barrier adhesive. Jacket overlap shall be not less than 1-1/2 inches. Jacketing bands for butt joints shall be 4-inches wide. Fabricate fittings from segmented pipe barrel sections bedded in general purpose insulating cement and wired in place. Fill voids with general purpose insulating cement with not less than 1/4 inch thick, final coating. Impregnate glass lagging tape with lagging adhesive, wrapped with a 50-percent overlap, and be blended smoothly into adjacent jacketing. Apply additional adhesive as needed and rubber-gloved to a smooth contour.

### 3.2.6 Type T-6, Mineral Fiber with Aluminum Jacket

Cover piping with mineral-fiber pipe insulation with factory-attached or field-applied aluminum jacketing.

Cover fittings and valve bodies with preformed mineral-fiber pipe-fitting insulation of the same thickness as the pipe-barrel insulation. Temporarily secure fitting insulation in place with light cord ties. Apply a 60-mil coating of vapor-barrier mastic, and while still tacky, wrapped with glass lagging tape.

Apply additional mastic as needed and rubber-gloved to smooth fillets or contours. Build up on-the-job fabricated insulation for special configurations from mineral fiber and a mixture of insulating cement and lagging adhesive diluted with 3 parts water. Only where standard aluminum jacketing cannot be used, make the surfaces vapor-tight by using mastic and glass lagging cloth or tape as specified above with an added finish coat of mastic.

Set pipe insulation into outdoor vapor-barrier coating for a minimum of 6 inches at maximum 12-foot spacing. Seal ends of the insulation to the jacketing with the same material to provide effective vapor barrier stops.

Install continuous vapor barrier over all surfaces, including areas inside pipe sleeves, hangers, and other concealment.

Apply piping insulation to both sides of pipe hangers. Insulate junctions with a special mastic mixture, glass cloth mesh tape, and mastic as previously specified.

Securely cement jacket laps, flaps, and bands in place with aluminum jacket sealant. Jacketing bands for butt joints shall be 6 inches wide.

Lap joints, wherever possible, against the weather so that the water will run off the lower edge and in accordance with the pipe drainage pitch. Locate longitudinal laps on horizontal lines 45 degrees below the horizontal centerline and alternately staggered 1 inch. Lap jacketing material a minimum of 2 inches, circumferentially sealed with mastic, and strapped to provide a waterproof covering throughout. Locate straps 8 inches on center and pull up tight to hold jacketing securely in place. Use screws in addition to straps when necessary to obtain a waterproof covering. Place extra straps on each side of supporting devices and at openings. Where flanging access occurs, strap a chamfer sheet to the pipe at jacketing.

Stiffen exposed longitudinal edges of aluminum jacketing by bending a 1 inch hem on one edge.

Provide expansion joints for maximum and minimum dimensional fluctuations.

To prevent corrosion, do not allow the aluminum jacketing to come in direct contact with other types of metal.

At openings in jacket, apply an outdoor vapor-barrier coating for 2 inches in all directions. Apply jacketing while waterproofing is tacky.

Use screws at each corner of each sheet, at fitting jackets, and as necessary for the service. Place number 7, 3/8 inch long, binding-head aluminum sheet metal screws through the mastic seal.

3.2.7 Type T-7, Calcium Silicate with Glass Cloth Jacket (Surfaces)

Cover surfaces with insulation block bedded in an insulating cement and covered with glass cloth jacketing.

Clean surfaces with a chlorinated solvent. Mix general purpose insulating cement with 3 parts water to 1 part nonvapor-barrier adhesive to bring to application consistency. Set block into bedding and joints and fill spaces with a bedding mix and wrap with galvanized chicken wire mesh well laced into an envelope. Trowel a 3/8 inch thick coating of bedding mix jacket on with nonvapor-barrier adhesive and glass cloth. Finish surfaces with not less than a 6-mil dry-film thickness of nonvapor-barrier coating.

[At the Contractor's option, aluminum sheet jacketing may be used in lieu of glass cloth.]

3.2.8 Type T-9, Cellular Elastomer

Clean pump surfaces with solvent. Apply not less than 1 inch of general purpose insulating cement, mixed with nonvapor-barrier adhesive diluted with 3 parts water, to achieve smooth surface and configuration contours. After all water has been removed, cover surfaces with 1/2 inch thick cellular elastomer insulation attached and joined into a continuous sheet with an outdoor vapor-barrier coating recommended by the insulation manufacturer for the specific purpose. Apply coating to both of the surfaces on a 100-percent coverage basis with a minimum thickness of 10 mils wet, or approximately 150 square feet per gallon of undiluted coating. Blend coating into the adjacent flange insulation and the joint covered with a band of cellular elastomer equal to the flange assembly width. Use same coating to seal insulation to the casing at penetrations and terminations. Insulate pumps in a manner that will permit insulation to be removed to repair or replace pumps.

Finish insulation with a 2-mil minimum dry-film application of a polyvinylchloride lacquer coating recommended by the manufacturer and applied in not less than two coats.

3.2.9 Type T-10, Mineral-Fiber Fill

Pack voids surrounding pipe with mineral-fiber fill.

3.2.10 Type T-17, Calcium Silicate Weatherproof Jacket

Cover piping system surfaces with calcium silicate insulation. Cover fittings and valve bodies with preformed insulation of the same material and thickness as the adjoining pipe insulation.

3.3 ACCEPTANCE

Final acceptance will depend upon providing construction (Record Drawings) details to the Contracting Officer. Include construction details, by building area, the insulation material type, amount, and installation method. An illustration or map of the duct routing locations may serve this purpose. With data provide a cover letter/sheet clearly marked with the system name, date, and the words "Record Drawings insulation/material." Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

SECTION 22 15 14

GENERAL SERVICE COMPRESSED-AIR SYSTEMS, LOW PRESSURE
**02/09**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

| | |
|---|---|
| AISC 360 | (2005) Specification for Structural Steel Buildings, with Commentary |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS WHB-2.9 | (2004) Welding Handbook; Volume Two - Welding Processes |
| AWS-03 | (2001) Welding Handbook, Volumes 1 thru 4 |

ASME INTERNATIONAL (ASME)

| | |
|---|---|
| ASME A112.18.1 | (2005) Standard for Plumbing Fixture Fittings |
| ASME B16.1 | (2005) Standard for Gray Iron Threaded Fittings; Classes 125 and 250 |
| ASME B16.22 | (2001; R 2005) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.3 | (2006) Malleable Iron Threaded Fittings, Classes 150 and 300 |
| ASME B18.2.2 | (1987; R 2005) Standard for Square and Hex Nuts |
| ASME B19.3 | (1991; Addenda A 1994; Addenda B 1995) Safety Standard for Compressors for Process Industries |
| ASME B31.1 | (2007; Addenda 2008) Power Piping |
| ASME B31.3 | (2008) Process Piping |
| ASME B40.100 | (2005) Pressure Gauges and Gauge Attachments |
| ASME BPVC | (2007) Boiler and Pressure Vessel Codes |
| ASME BPVC SEC VIII D1 | (2007; Addenda 2008) Boiler and Pressure Vessel Code; Section VIII, Pressure |

Vessels Division 1 - Basic Coverage

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 126 | (2004) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings |
| ASTM A 183 | (2003) Standard Specification for Carbon Steel Track Bolts and Nuts |
| ASTM A 197/A 197M | (2000; R 2006) Standard Specification for Cupola Malleable Iron |
| ASTM A 307 | (2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength |
| ASTM A 53/A 53M | (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A 666 | (2003) Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar |
| ASTM B 280 | (2008) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service |
| ASTM B 370 | (2003) Standard Specification for Copper Sheet and Strip for Building Construction |
| ASTM B 62 | (2002) Standard Specification for Composition Bronze or Ounce Metal Castings |
| ASTM B 749 | (2003) Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products |
| ASTM C 592 | (2008a) Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type) |
| ASTM C 920 | (2008) Standard Specification for Elastomeric Joint Sealants |
| ASTM D 2000 | (2008) Standard Classification System for Rubber Products in Automotive Applications |
| ASTM F 104 | (2003) Standard Classification System for Nonmetallic Gasket Materials |

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

| | |
|---|---|
| MSS SP-58 | (2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture |

| | |
|---|---|
| MSS SP-69 | (2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application |
| MSS SP-70 | (2006) Standard for Cast Iron Gate Valves, Flanged and Threaded Ends |
| MSS SP-72 | (1999) Standard for Ball Valves with Flanged or Butt-Welding Ends for General Service |
| MSS SP-80 | (2008) Bronze Gate, Globe, Angle and Check Valves |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| FS FF-S-325 | (Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry) |

1.2 GENERAL REQUIREMENTS

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit Equipment and Performance Data for piping systems.

Submit manufacturer's catalog data for the following items:

Aboveground Piping Materials
Piping Specialties
Air Compressors
Valves
Accessories

SD-05 Design Data

Equipment and Performance Data submitted for piping systems shall show conformance with ASME Code.

SD-06 Test Reports

Submit test reports for the following items in accordance with paragraph entitled, "Compressed Air Systems Testing," of this section.

Compressed Air Systems Testing
Pneumatic Testing

Each acceptance test shall require the signature of the

Contracting Officer and two record copies shall be delivered to the Contracting Officer after acceptance.

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with paragraph entitled, "Operation and Maintenance," of this section.

1.4 GENERAL REQUIREMENTS

Equipment and Performance Data submitted for piping systems shall show conformance with ASME Code.

1.5 OPERATION AND MAINTENANCE

Contractor shall submit 6 copies of the Operation and Maintenance Manuals 30 calendar days prior to testing the low-pressure compressed air System. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

1.6 DRAWINGS

In lieu of separate hangers, the Contractor may submit for approval a shop drawing of trapeze hangers with a solid or split-ring clamp which he proposes to furnish.

PART 2 PRODUCTS

2.1 ABOVEGROUND PIPING MATERIALS

2.1.1 Compressed Air Systems 125 Psig and Less

2.1.1.1 Type GCS Galvanized Carbon Steel

Pipe 1/2 through 10 inches shall be Schedule 40, seamless, galvanized steel, conforming to ASTM A 53/A 53M, Grade B, Type E or S. Type F is acceptable for sizes less than 2 inches.

Fittings 2 inches and under shall be 150-psig wsp, banded, galvanized, malleable iron, screwed, conforming to ASTM A 197/A 197M, ASME B16.3.

Unions 2 inches and under shall be 300-psig wsp, female, screwed, galvanized, malleable iron with brass-to-iron seat and ground joint.

2.1.2 Control and Instrumentation Tubing, to 30 Psig

2.1.2.1 Copper

Tubing all sizes with 1/4 inch minimum outside diameter shall be hard-drawn seamless copper, conforming to ASTM B 280.

Fittings shall be solder joint wrought copper conforming to ASME B16.22.

Solder shall be 95-5 tin-antimony, alloy Sb 5, conforming to AWS WHB-2.9.

Copper tubing systems may be installed using mechanical pipe couplings of a bolted type with a central cavity design pressure responsive gasket. Groove copper pipe and fittings in accordance with the coupling manufacturer's recommendations.

## 2.2 PIPING SPECIALTIES

### 2.2.1 Air Pressure Reducing Stations

Install pressure reducing station complete with relieving type pressure reducing valve, valved bypass, particle filter, pressure indicator upstream of station, pressure indicator downstream of station, and regulated air pressure relief valve.

Construct pressure regulator body of zinc or aluminum die castings, rated for the service. Diaphragm shall be reinforced air-, oil-, and water-resistant elastomer. All components, exposed to fluid stream being controlled, shall be of [nonferrous] [suitable nonmetallic materials]. Valves shall be of a balanced construction relieving type to automatically prevent excess pressure buildup.

Construct filters of zinc or aluminum die castings, rated for the service, and furnished with ips connections. Bowl materials shall be aluminum. Filter shall be serviceable by bowl quick-disconnect devices. Equip bowl with manual drain cock. Separate liquid particles by centrifugal and quiet zone action. Remove solid particles to 15-micrometer size by filter elements of sintered bronze or corrosion-resistant steel mesh.

[Combination manual drain filter-regulator units conforming to the above requirements will be acceptable in lieu of separate units.]

Pressure relief valves shall be rated for the pressure of the high-pressure side and sized for the full installed capacity of the pressure regulating station at the pressure of the low-pressure side. Set valve at not more than 20 percent more than the correct low side pressure. Rate and label valve. Seat material shall be suitable for the service.

### 2.2.2 Air Line Lubricators

Air line lubricators shall be of the pulse-type with pickup tube, polycarbonate resin bowl, large fill opening, metering rod flow adjuster, sight ball, and drain cock.

Lubricators shall be suitable for 200 psig at 165 degrees F.

### 2.2.3 Compressed Air Receivers

Compressed air receivers shall conform to the sizes and capacities specified. Design such vessels for the applicable working pressures and service in accordance with the ASME BPVC SEC VIII D1, and label.

Vessels shall be complete with connections for drain, supports, and other required Accessories.

### 2.2.4 Pressure Gages

Pressure gages shall conform to ASME B40.100. Pressure gages shall be Type I, Class 1, (pressure) for pressures indicated. Pressure gage size shall be 3-1/2 inches nominal diameter. Case shall be corrosion-resistant steel conforming to [the AISI 300 series] [ASTM A 666] with an ASM No. 4 standard commercial polish or better. Equip gages with damper screw adjustment in inlet connection.

## 2.3 AIR COMPRESSORS

Provide an air compressor of the rotary type complete with air tank, air dryer, and other appurtenances. Compressor and installation shall conform to ASME B19.3. Air dryers shall be of the mass refrigerated dryer type and shall maintain the air in the system with a dew point low enough to prevent condensation 13 degrees F at 18 psi main pressure. Locate air dryer at the outlet of the tank.

## 2.4 VALVES

### 2.4.1 Ball Valves (BAV)

Ball valves shall conform to MSS SP-72. Valves shall be Style [1] [3].

Grooved end ball valves may be used provided that the manufacturer certifies valve performance in accordance with MSS SP-72.

Rate valves for service at not less than 175 psi at 200 degrees F.

Valve bodies in sizes 2 inch ips and smaller shall be screwed end connection type constructed of Class A copper alloy.

Valve bodies in sizes 2-1/2 inch ips and larger shall be flanged-end connection type constructed of Class [D] [E] [F] material.

Balls and stems of valves 2 inch ips and smaller shall be [manufacturer's standard Class A copper alloy with 900 Brinell hard chrome plating finish] [Class C corrosion-resistant steel alloy with hard chrome plate]. Electroless nickel plating is acceptable.

Balls and stems of valves 2-1/2 inch ips and larger shall be manufacturer's standard Class C corrosion-resistant steel alloy with hard chrome plate. In valves 6 inch ips and larger, balls shall be Class D with 900 Brinell hard chrome plate. Electroless nickel plating is acceptable.

Design valves for flow from either direction and seal equally tight in either direction.

Valves shall have full pipe size flow areas.

Valves with ball seals kept in place by spring washers are not acceptable. All valves shall have adjustable packing glands. Seats and seals shall be tetrafluoroethylene.

Valve body construction shall be such that torque from a pipe with valve in installed condition shall not tend to disassemble the valve by stripping setscrews or by loosening body end inserts or coupling nuts. Torque from a pipe shall be resisted by a one-piece body between end connections or by bolts in shear where body is of mating flange or surface-bolted construction.

### 2.4.2 Gage Cocks (GC)

Gage cocks shall be T-head or lever handle ground key type with washer and screw, constructed of polished ASTM B 62 bronze, and rated for 125 psi saturated steam service. End connections shall suit the service, with or without union and nipple.

2.4.3 Globe and Angle Valves (GLV and ANV)

Globe and angle valves 2 inches and smaller shall conform to MSS SP-80. Valves located in tunnels, equipment rooms, or factory-assembled equipment, shall be union-ring bonnet, screwed-end type. Disk shall be free to swivel on the stem in all valve sizes. Composition seating surface disk construction may be substituted for all metal disk construction. Packing shall be a woven material impregnated with not less than 25 percent, by weight, tetrafluoroethylene resin.

Globe and angle valves 2-1/2 inches and larger shall conform to MSS SP-80. Valve bodies shall be cast iron conforming to ASTM A 126, Class A, as specified for Class 1 valves under MSS SP-70. Flange valve ends in conformance with ASME B16.1, and valve construction shall be OS&Y type. Packing shall be a woven material impregnated with not less than 25 percent, by weight, tetrafluoroethylene resin.

2.5 MISCELLANEOUS MATERIALS

2.5.1 Bolting

Flange and general-purpose bolting shall be hex-head and shall conform to ASTM A 307, Grade B. Heavy hex-nuts shall conform to ASME B18.2.2. Square-head bolts shall not be acceptable.

Grooved couplings shall utilize bolts and nuts of heat treated carbon steel conforming to ASTM A 183.

2.5.2 Elastomer Calk

[Polysulfide] [polyurethane base] elastomer calking material shall be a two-component type conforming to ASTM C 920.

2.5.3 Escutcheons

Escutcheons shall be manufactured from nonferrous metals and [chrome plated] [hot-dipped galvanized] except when AISI 300 series corrosion-resistant steel is provided. Metals and finish shall be in accordance with ASME A112.18.1.

Escutcheons shall be [one-piece] [split-pattern] type. Escutcheons shall maintain a fixed position against a surface by means of internal spring tension devices or setscrews.

2.5.4 Flashing

Sheet lead shall conform to ASTM B 749, Grade [B] [C] [D] and weigh not less than 4 pounds per square foot.

Sheet copper shall conform to ASTM B 370 and weigh not less than 16 ounces per square foot.

2.5.5 Flange Gaskets

Compressed non-asbestos sheet shall conform to ASTM F 104, Type 1, and be coated on both sides with graphite.

Grooved flange adapters gasketing shall be a pressure responsive elastomer conforming to ASTM D 2000.

### 2.5.6 Pipe Thread Compounds

Use tetrafluorethylene tape not less than [2] [3] mils thick in compressed air systems for pipe sizes to and including 1 inch ips. Tetrafluoroethylene dispersions and other suitable compounds may be used for other applications upon approval by the Contracting Officer.

## 2.6 SUPPORTING ELEMENTS

Contractor shall provide all necessary piping system components and miscellaneous required supporting elements. Supporting elements shall be suitable for stresses imposed by system pressures and temperatures, and natural and other external forces.

Supporting elements shall be [FM-approved] [UL-listed] and conform to requirements of ASME B31.3, MSS SP-58, and MSS SP-69, except as otherwise noted. Type devices specified herein are defined in MSS standards unless otherwise noted.

### 2.6.1 Building Structure Attachments

Concrete and masonry anchor devices shall conform to requirements of FS FF-S-325 Group [I] [II], Type 2, Class 2, Style [1] [2]; Group [III] [VIII].

Cast-in floor-mounted equipment anchor devices shall provide adjustable positions.

Masonry anchor devices shall be built-in, unless otherwise approved by the Contracting Officer.

Do not use power actuated anchoring devices to support mechanical systems components.

Use clamps to support piping sizes 1-1/2 inches and smaller. C-clamps shall be FM approved and UL listed with hardened cup tip, setscrew, locknut, and retaining strap. Retaining strap section shall be not less than 1/8 by 1 inch. Beam flange thickness to which clamps are attached shall not exceed 0.60 inch.

Construct concrete inserts in accordance with the requirements of MSS SP-58, for Type 18 and MSS SP-69. When applied to piping in sizes 2 inch ips and larger and where otherwise required by imposed loads, a 1-foot length of 1/2 inch reinforcing rod shall be inserted and wired through wing slots. Approved proprietary-type continuous inserts may be similarly used upon approval by the Contracting Officer.]

### 2.6.2 Horizontal Pipe Attachments

Piping in sizes to and including 2 inch ips shall be supported by Type 6 solid malleable-iron pipe rings except that split-band-type rings may be used in sizes up to 1 inch ips.

Trapeze hangers fabricated from approved structural steel shapes, with U-bolts, shall be used in congested areas and where multiple pipe runs occur. Structural steel shapes shall conform to supplementary steel requirements or be a commercially available, proprietary-design, rolled steel.

### 2.6.3 Vertical Pipe Attachments

Vertical pipe attachments shall be Type 8.

### 2.6.4 Hanger Rods and Fixtures

Use only circular cross-section rod hangers to connect building structure attachments to pipe support devices. Pipe, straps, or bars of equivalent strength may be used for hangers only where approved by the Contracting Officer.

Provide turnbuckles, swing eyes, and clevises as required by support system to accommodate pipe accessibility and adjustment for load and pitch.

### 2.6.5 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, such supplementary steel shall be designed and fabricated in accordance with AISC 360.

## PART 3 EXECUTION

## 3.1 ABOVE GROUND PIPING SYSTEM INSTALLATION

### 3.1.1 Piping Systems

Fabricate and install piping systems in accordance with ASME B31.3, MSS SP-69, ASME BPVC, and applicable AWS requirements.

Fabricate pipe to measurements established on the job and carefully work into place without springing or forcing.

Pipe, tubing, fittings, valves, equipment, and Accessories shall be clean and free of all foreign material before being installed in their respective systems. Clean pipe by a method approved by the Contracting Officer. Purge lines with dry, oil-free compressed air after erection, but purging shall not be relied upon for removing all foreign matter. Purge lines at a velocity equal to 1-1/2 times maximum normal flow velocity. During the progress of construction, protect open ends of pipe, fittings, and valves at all times to prevent the admission of foreign matter. Except when connections are actually underway, install plugs or caps on all pipe and component openings. Plugs or caps shall be commercially manufactured products.

Install piping straight and true, with approved offsets around obstructions and with necessary expansion bends or fitting offsets essential to a satisfactory installation and as may be necessary to increase headroom or to avoid interference with the building construction, electric conduit, or facilities equipment.

Use standard long sweep pipe fittings for changes in direction. No mitered joints or unapproved pipe bends shall be permitted.

Pipe bends in seamless pipe may be made with hydraulic benders in the field for pipe sizes to 4 inch ips, upon approval of the Contracting Officer. Radius of pipe bends shall be not less than five nominal pipe diameters.

Tee connections shall be made with screwed tee fittings or grooved tee fittings, or, where pipe is being welded, branch connections shall be made with either welding tees or forged branch outlet fittings, either being acceptable without size limitations. Branch outlet fittings shall be forged, flared for improved flow where attached to the run, reinforced against external strains, and designed to withstand full burst-pressure strength requirements. Provide tool space between parallel piping runs whenever threaded unions or couplings are installed.

Horizontal piping shall have a grade of 1 inch per 100 feet.

Use eccentric reducers where required to permit proper drainage of pipe lines. Do not permit bushings for this purpose. Provide drain valves in piping systems at low points. Pipe drains shall consist of 1/2 inch globe valves with renewable disks and 3/4 inch hose adapter.

Perform installation of piping in a manner that will prevent stresses and strains from being imposed on connected equipment.

Make expansion bends in steel pipe from pipe sections and long-radius welding elbows in sizes 1 inch and larger. Expansion U-bends shall be cold sprung and welded into the line. Anchor line before removing the spreader from the expansion U-bend.

### 3.1.2 Joints

Ream pipe ends before joint connections are made.

Make up screwed joints with joint compound.

Apply joint compounds to the male thread only, and exercise care to prevent compound from reaching the interior of the pipe.

Provide screwed unions, welded unions, or bolted flanges wherever required to permit convenient removal of equipment, valves, and piping Accessories from the piping system.

Assemble flanged joints with appropriate flanges, gaskets, and bolting. Clearance between flange faces shall be such that the connections can be gasketed and bolted tight without imposing undue strain on the piping system. Flange faces shall be parallel and the bores concentric. Center gaskets on the flange faces without projecting into the bore. Lubricate bolting with oil and graphite before assembly to ensure uniform bolt stressing. Draw up and tighten flange bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Wherever a flange with a raised face is joined to a companion flange with a flat face, the raised face shall be machined to a smooth matching surface, and a full facegasket shall be used. After the piping system has been tested and is in service at its maximum temperature, bolting shall be retightened. Only use hex-head nuts and bolts. Gasket material shall be fresh stock, 1/16 inch thick.

Field welded joints shall conform to the requirements of the AWS-03 and ASME B31.3.

Copper tubing for solder joints shall be cut square, and burrs shall be removed with approved cutting and reaming tools. Clean inside surfaces of fittings and outside surfaces of tubes in joint area before assembly of joint. Apply joint flux, solder, and heat source in accordance with the

manufacturer's instructions to provide proper capillary action to fill the socket space and to achieve 100 percent of shear-line strength capability. Valves in copper piping shall have screwed ends with end adapters to suit mechanical connections, unless solder joining is specified for a given application. Remake copper joints that fail pressure tests with new materials, including pipe or tubing fittings and filler metal.

Tubing for mechanical joints shall be cut square, and burrs shall be removed. Exercise care to avoid work-hardened copper surfaces and cut off or anneal tube ends. Heating temperature and air-cooling shall be in accordance with the manufacturer's instructions.

3.1.3 Control and Instrument Air Tubing

Conceal tubing, except in mechanical rooms or areas where other piping is exposed.

Use hard-drawn copper tubing in exposed areas. Do not use anneal copper in concealed locations.

Fittings for supply system copper tubing shall be wrought copper solder joint-type, except at connection to apparatus where specified brass mechanical and ips thread adapter fittings shall be used. Tool-made bends in lieu of fittings are acceptable. Neatly nest multiple tube runs.

When the tubing run is less than 12 inches, plastic tubing may be used. Otherwise, terminal single line shall be hard-drawn copper tubing.]

Mechanically attach tubing to supporting surfaces. Supports using adhesives shall not be acceptable.

Copper tubing horizontal supports for less than 3 tubes shall be rigid 1-by 3/8 inch metal channel and shall be proprietary metal tube race for 3 or more tubes.

Systematically purge tubing with dry, oil-free compressed air or nitrogen to rid system of impurities generated during joint-making and installation and atmospheric moisture before connection to control instruments.

3.1.4 General Service Valve Locations

Provide valves to permit isolation of branch piping and each equipment item from the balance of the system, to allow safe and convenient access without moving equipment, and to require a minimum of piping and equipment disassembly.

Provide valves in piping mains and branches at equipment and equipment items.

Provide riser and downcomer drains above piping shutoff valves in piping 2-1/2 inches and larger. Tap and fit shutoff valve body with a 1/2 inch plugged globe valve.

Provide three-valve bypass around each pressure-regulating valve.

Provide valves unavoidably located in furred or other normally inaccessible places with access panels.

3.1.5 Bypass Throttling Valves

Valves shall be globe type with composition disc.

3.1.6 Supporting Elements Installation

Provide support elements in accordance with the requirements of ASME B31.1, MSS SP-58, MSS SP-69. Hang piping from building construction. No piping shall be hung from roof deck or from other pipe.

Attachment to building construction concrete shall be by approved cast-in concrete inserts wherever possible. Attachment to building construction solid masonry shall be by built-in anchors. Where attachment by either of above methods is not possible, specified masonry anchor devices may be used upon receipt of written approval from the Contracting Officer.

Embed fish plates in the concrete to transmit hanger loads to the reinforcing steel where hanger rods exceed 7/8 inch diameter.

Construct masonry anchors selected for overhead applications of ferrous materials only.

Size inserts and anchors for the total stress to be applied with a safety factor as required by applicable codes but in no case less than 4.

Insert anchor devices into concrete sections not less than twice the overall length of the device and locate them not less than the following applicable distance from any side or end edge or centerline of adjacent anchor service:

| Anchor Bolt Length (Inches) | Minimum Edge Space (Inches) |
|---|---|
| 1/4 | 3-1/2 |
| 5/16 | 3-3/4 |
| 3/8 | 4 |
| 1/2 | 5 |
| 5/8 | 6 |
| 3/4 | 7 |
| 7/8 | 8 |

In special circumstances, upon prior written approval of the Contracting Officer, center-to-center distance may be reduced to 50 percent of given distance provided the load on the device is reduced in direct proportion to reduced distance.

Piping shall run parallel with the lines of the building. Space and install piping and components so that a threaded pipe fitting may be removed between adjacent pipes and so that there will be not less than 1/2 inch of clear space between the finished surface and other work and between the finished surface and parallel adjacent piping. Hangers on different adjacent service lines running parallel with each other shall be arranged to be in line with each other and parallel to the lines of the building.

Place identical service systems piping, where practical, at same elevation and hung on trapeze hangers adjusted for proper pitch.

Spacing of trapeze hangers where piping is grouped in parallel runs shall be the closest interval required for any size pipe supported.

Where it is necessary to avoid any transfer of load from support to support or onto connecting equipment, pipe hangers shall be constant support type.

Provide approved pipe alignment guides, attached in an approved manner to the building structure, to control pipe movement in true alignment in the piping adjacent to and on each side of all pipe expansion loops.

Anchors incorporated in piping systems for the purpose of maintaining permanent pipe positions shall be welded to the piping and attached to the building structure in a manner approved by the Contracting Officer.

Suitably brace piping against sway and vibration. Bracing shall consist of brackets, anchor chairs, rods, and structural steel for Vibration Isolation.

Install hangers and supports for piping at intervals specified herein at locations not more than 3 feet from the ends of each runout and not over 25 percent of the specified interval from each change in direction of piping.

Load rating for all pipe hanger supports shall be based on weight and forces imposed on all lines. Deflection per span shall not exceed slope gradient of pipe. Schedule 40 and heavier pipe supports shall be in accordance with the following minimum rod size. Maximum allowable hanger spacing and concentrated loads will reduce allowable span proportionately:

| PIPE SIZE INCHES | ROD SIZE INCHES | STEEL PIPE FEET |
|---|---|---|
| Up to 1 | 3/8 | 8 |
| 1-1/4 to 1-1/2 | 3/8 | 10 |
| 2 | 3/8 | 12 |
| 2-1/2 to 3-1/2 | 1/2 | 12 |
| 4 to 5 | 5/8 | 16 |
| 6 | 3/4 | 16 |
| 8 to 12 | 7/8 | 20 |

Where possible, support vertical risers at the base at intervals specified and guide for lateral stability. Place clamps under fittings wherever possible. Support carbon steel pipe at each floor at not more than 15-foot intervals for pipe 2 inches and smaller and at not more than 20-foot intervals for pipe 2-1/2 inches and larger.

After the piping systems have been installed, tested, and placed in satisfactory operation, the Contractor shall firmly tighten hanger rod nuts and jam nuts to prevent any movement.

### 3.1.7 Sleeves

Sleeves are required where piping passes through roofs, through masonry or concrete walls, or through floor.

Lay out and set sleeve work before placement of slabs or construction of walls and roof. Furnish sleeves necessary to complete the work.

Where pipe sleeves are required after slabs and masonry are installed, holes to accommodate these sleeves shall be made with core drills. Set sleeves in place with a two-component epoxy adhesive system approved by the Contracting Officer. Carry no load by such sleeves unless approved by the Contracting Officer.

Sleeves shall be flush with all ceilings.

Sleeves passing through steel decks shall be continuously welded brazed to the deck.

Space between a pipe, bare or insulated, and the inside of a pipe sleeve or a construction surface penetration shall be packed solid with a mineral fiber conforming to ASTM C 592, Form B, Class 8. Wherever the piping passes through firewalls, equipment room walls, floors and ceilings connected to occupied spaces, and other locations where sleeves or construction surface penetrations occur between occupied spaces, similar packing shall be provided. Where sleeves or construction surface penetrations occur between conditioned and unconditioned spaces, the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction surface penetration shall be filled with an elastomer calk to a depth of 1/2 inch. Surfaces to be calked shall be oil- and grease-free.

### 3.1.8 Escutcheons

Provide escutcheons at penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, provide escutcheons on both sides of the partition. Provide plates at the underside only of such ceilings, where suspended ceilings are installed. Plates shall be large enough to fit around the insulation, for insulated pipes. Escutcheons shall be chrome-plated in occupied spaces and shall be of sufficient size to conceal openings in building construction. Firmly attach escutcheons with setscrews.

### 3.1.9 Flashings

Provide required flashings at mechanical systems penetrations of building boundaries.

## 3.2 COMPRESSED AIR SYSTEMS TESTING

Prior to acceptance of the work, pressure-test completed systems in the presence of the Contracting Officer.

### 3.2.1 Preliminary Stage Tests

[Tests shall be pneumatic and shall use dry, oil-free compressed air. Use carbon dioxide or nitrogen in metallic systems.]

[Testing of any system for any purpose shall include preliminary testing by swabbing joints under test with standard high-strength film soap solution and observing for bubbles at internal pressures not in excess of 5 psi.]

When testing reveals that leakage exceeds specified limits, isolate and repair the leaks, replace defective materials where necessary, and retest the system until specified limits are met. Remake leaking gaskets with new gaskets and new flange bolting, and discard used bolting and gaskets.

Other than standard piping flanges, plugs, caps and valves, only use commercially manufactured expandable elastomer plugs for sealing off piping for test purposes. Published safe test pressure rating of any plug used shall be not less than three times the actual test pressure being applied. During pneumatic testing or hydrostatic testing, evacuate personnel from areas where plugs are used.

Remove components that could be damaged by test pressure from piping systems to be tested.

Perform Valve-Operating Tests and Drainage Tests according to referenced standards.

Check piping system components, such as valves, for proper operation under system test pressure.

No test media shall be added to a system during a test for a period specified or determined by the Contracting Officer.

Duration of a test will be determined by the Contracting Officer and will be for a minimum of 15 minutes with a maximum of 24 hours. Test may be terminated by direction of the Contracting Officer at any point after it has been determined that the leakage rate is within limits.

Prepare and maintain test records of all piping systems tests. Records shall show Governmental and Contractor test personnel responsibilities, dates, test gage identification numbers, ambient temperatures, pressure ranges, rates of pressure drop, and leakage rates.

To preclude injury and damage, take necessary precautions by venting the expansive force of compressed air trapped during high-pressure Hydrostatic Testing. When purging or vent valves are not provided, the Contracting Officer may require the removal of any system component such as plugs or caps to verify that the water has reached all parts of the system.

Irrespective of the amount of measured leakage, immediately repair visible leaks or defects in the pipeline.

### 3.2.2 Test Gages

Contractor's test gages shall conform to ASME B40.100 and have a dial size of 4 inches or larger. Maximum permissible scale range for a given test shall be such that the pointer during a test shall have a starting position at midpoint of the dial or within the middle third of the scale range. Certification of accuracy and correction table shall bear a date within 90 calendar days prior to test use, test gage number, and the project number, unless otherwise approved by the Contracting Officer.

### 3.2.3 Acceptance Pressure Testing

Testing shall take place during steady-state ambient temperature conditions.

Test ferrous piping systems at 1-1/2 times maximum operating pressure. Maintain test pressure for a period of not less than 2 hours with an allowable pressure drop of 2 psi during that time unless otherwise approved by the Contracting Officer.

## 3.3 COMPRESSED AIR SYSTEM CLEANING

Remove rust and dirt from the bore and exterior surface of all piping and equipment. Clean pipeline strainers, temporary and permanent, during purging operations, after startup, and immediately prior to final acceptance by the Government.

Flush and clean new steel piping with a suitable degreasing agent, until visible, grease, dirt, and other contaminants have been removed. Degreased waste material including the degreaser itself shall be disposed of in accordance with written instructions received from the Environmental authority having jurisdiction through the Contracting Officer and in accordance with all Local, State and Federal Regulations.

## 3.4 COMPRESSED AIR SYSTEMS IDENTIFICATION

Identification plates shall be protected and kept clean. Replace damaged and illegible identification plates at no additional expense.

Label and arrow piping at each point of entry and exit of piping passing through walls; at each change in direction, such as at elbows and tees; and in congested or hidden areas, at each point required to clarify service or indicate a hazard. Also label each riser.

In long straight runs, locate labels at distances visible to each other, but in no case shall the distance between labels exceed 75 feet. Labels shall be legible from the primary service and operating area.

-- End of Section --

ENGINEERING MANUAL

# SSR

## Small UP - Total Air System

**Ref.:** 9902
**Page :** 602
**Date:** 16 July 2008
**Cancels:** 10 August 2006

Point of Manufacture - Campbellsville, USA

60 HERTZ ENGINEERING DATA

| Model | | UP6-7TAS-125 | UP6-7TAS-150 | UP6-7TAS-210 |
|---|---|---|---|---|
| **GENERAL COMPRESSOR DATA** | | | | |
| Capacity (Ref. Intake Condition.) FAD (1) | m³/min (cfm) | 0.79 (28) | 0.71 (25) | 0.48 (17) |
| Maximum & Rated Operating Pressure | barg (psig) | 8.6 (125) | 10.3 (150) | 14.5 (210) |
| Rated package discharge Pressure (13) | barg (psig) | 8.0 (116) | 9.9 (143) | 14.1 (205) |
| Minimum Operating Pressure | barg (psig) | 4.5 (65) | 4.5 (65) | 4.5 (65) |
| Maximum Operating Temperature | ºC ( ºF ) | 40 (105) | 40 (105) | 40 (105) |
| Minimum Operating Temperature | ºC ( ºF ) | 2 (36) | 2 (36) | 2 (36) |
| **SOUND LEVEL (2)** | | | | |
| Base mounted Enclosed | dB(A) | 65 | 65 | 65 |
| **COOLING DATA** | | | | |
| **Air-cooled (Ambient Temperature 40°C/104°F)** | | | | |
| Coolant Discharge temperature | °C(°F) | 87 (189) | 86 (187) | 90 (194) |
| A/E Injection Temperature | °C(°F) | 79 (174) | 79 (174) | 79 (174) |
| (3) Aftercooler - Inlet | °C(°F) | 79 (174) | 79 (174) | 79 (174) |
| Aftercooler - Outlet | °C(°F) | 51 (124) | 51 (124) | 51 (124) |
| Heat Removal Oil Cooler | kW (1000 Btu/hr) | 5.5 (18.8) | 5.5 (18.8) | 5.5 (18.8) |
| Heat Removal Oil and Aftercooler | kW (1000 Btu/hr) | 6.1 (20.8) | 6.1 (20.8) | 6.1 (20.8) |
| Heat Removal Dryer Condenser (Max) | kW (1000 Btu/hr) | 1.4 (4.8) | 1.4 (4.8) | 1.4 (4.8) |
| Coolant Flow | lpm (UK gpm) | 17.0 (3.7) | 21.0 (4.6) | 32.0 (7.0) |
| **Cooling Air** | | | | |
| Main Cooling Air Flow | m³/min (cfm) | 20.0 (700) | 20.0 (700) | 16.0 (565) |
| Dryer Cooling Airflow | m³/min (cfm) | Included | Included | |
| Cooling Air CTD | ºC (ºF) | 35 (63) | 35 (63) | 35 (63) |
| Aftercooler CTD ( 3 ) | ºC (ºF) | 11 (20) | 11 (20) | 11 (20) |
| **CONSTRUCTION FOUNDATION AND** | | | | |
| **PIPING CONNECTIONS** | | | | |
| Air Discharge Base Mount | Inches BSPT ( 9 ) | 0.75 | | |
| Air Discharge from ASME Receiver | Inches NPT | 0.75 | | |
| Package Automatic Condensate Drain | Inches NPT | 0.25 | | |
| Coolant Drain | Drain Plug | 9/16"-SAE | | |
| Power Inlet (Main) | Inch | 1" | | |
| Power Inlet (Dryer) | Inch | 1/2" | | |
| **COOLANT LUBRICATION DATA** | | | | |
| Coolant Sump Capacity | litres (US gal) | 3 (.8) | | |
| Total coolant fill capacity | litres (US gal) | 4.5 (1.2) | | |
| **DIMENSIONS** | | **Basemount** | **80 gal** | **120 gal** |
| length, width, height | mm | 1042/734/914 | 1362/734/1541 | 1897/734/1541 |
| | Inches | 41/28.9/36 | 53.6/28.9/60.7 | 74.7/28.9/60.7 |
| GA Drawing Numbers | | 22431811 | 22431829 | 22469191 |
| **SHIPPING DATA - NET WEIGHTS** | | **Basemount** | **80 gal** | **120 gal** |
| **T**otal **A**ir **S**ystem package | kg (lb.) | 330 (725) | 455 (1000) | 470 (1035) |

ENGINEERING MANUAL

# SSR

## Small UP - Total Air System

Ingersoll Rand Industrial Technologies

**Ref.:** 9902
**Page :** 603
**Date:** 16 July 2008
**Cancels:** 10 August 2006

Point of Manufacture - Campbellsville, USA

60 HERTZ ENGINEERING DATA

| Model | | UP6-7TAS-125 | UP6-7TAS-150 | UP6-7TAS-210 |
|---|---|---|---|---|
| **Compressor Module Data** | | | | |
| Rotor Diameter ( male ) | mm | 74.25 | 74.25 | 74.25 |
| Male Rotor Speed | rpm | 3200 | 2850 | 2375 |
| Tip Speed | m/sec | 12.44 | 11.08 | 9.23 |
| **Power Data** | | | | |
| Applied main motor power [8] | HP | 8.2 | 8.2 | 8.2 |
| Applied Power - Fan | HP | Included | Included | Included |
| Applied Power - Dryer compressor | HP | 0.6 | 0.6 | 0.6 |
| Applied Power - Dryer Fan | HP | Included | Included | Included |
| Applied Power - Full Package [8] | HP | 8.8 | 8.8 | 8.8 |

| ELECTRICAL DATA - ALL UNITS SSR UP6-7<br>*** NOTE BLUE SHADE DENOTES SINGLE PHASE *** | | 115-1-60 | 230-1-60 | 200v | 230v | 380v | 460v | 575v |
|---|---|---|---|---|---|---|---|---|
| Nominal Current - Main Drive Motor [8] ODP/TEFC | Amps | | 31.0 | 20.6/20.2 | 17.9/17.5 | 10.8/10.6 | 9/8.8 | 7.2/7 |
| Maximum Applied Power - TAS Package [10] ODP/TEFC | Amps | | 34.1 | 22.7/22.2 | 19.7/19.3 | 11.9/11.7 | 9.9/9.7 | 7.9/7.7 |
| Starting current -- Direct on Line | Amps | | 217.0 | 155.0 | 135.0 | 82.0 | 67.0 | 54.0 |
| Starting current -- Star Delta Start | Amps | | N/A | N/A | N/A | N/A | N/A | N/A |
| **Main Motor Data** | | | | | | | | |
| Nominal Power - Main Driver | HP | | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 |
| Drive Motor enclosure Protection | | | TEFC | ODP / TEFC | ODP/TEFC | ODP/TEFC | ODP/TEFC | ODP/TEFC |
| Drive Motor RPM | | | 3495 | 3475 | 3475 | 3475 | 3475 | 3475 |
| Drive Motor Frame | | | 184T | 184TZ | 184TZ | 184TZ | 184TZ | 184TZ |
| Drive Motor Locked Rotor DOL/(S/D) [5] | Amps | | 217.0 | 155.0 | 135.0 | 82.0 | 67.0 | 54.0 |
| Drive Motor Efficiency [8] | | | 84 | 87.5/88.5 | 87.5/88.5 | 87.5/88.5 | 87.5/88.5 | 87.5/88.5 |
| Drive Motor Power Factor [8] | | | 0.92 | .88/.89 | .88/.89 | .88/.89 | .88/.89 | .88/.89 |
| Test Certificate Number [4] | | | BL650710 | | | | AT43040 BK85519 | |
| **Dryer Electrical Data** | | | | | | | | |
| Full Load Current | Amps | 5 | | | | | | |
| Starting Current | Amps | 30 | | | | | | |
| **Electrical Installation -- Total Air System** | | | | | | | | |
| Recommended wire size - Main motor - [6] | Awg | | 6 | 8 | 10 | 12 | 14 | 14 |
| Suggested Fuse Rating [7] | Amps | | 50 | 35 | 35 | 20 | 15 | 12 |
| Recommended wire size - Dryer - [6] | Awg | 18 | | | | | | |

| | | | |
|---|---|---|---|
| **Refrigerated Dryer Data** | | ISO Class | |
| Pressure Dew Point ISO Class [11] | °C (°F) | 5 | lower than 7°C (44°F) |
| Refrigerant weight of R-134a | Grams / (Oz) | | 350/(12.7) |

| | | Particulate | | Liquid | |
|---|---|---|---|---|---|
| **Filter Data** | **Model** | **ISO Class** | **Filtration** | **ISO Class** | **Filtration** |
| Primary filter detail - at 21°C ( 70°F ) | IR GP 64 | 3 | 1 micron | 3 | 0.6 mg/m³ (0.5 ppm) |
| Final filter detail - at 21°C ( 70°F ) | IR HE 64 | 2 | 0.01 micron | 1 | 0,01 mg/m³ (0.1 ppm) |

| | | barG | psig | barG | psig | barG | psig |
|---|---|---|---|---|---|---|---|
| **Pressure Drop data by operating pressure** | barG / (psig) | **8.6** | **125** | **10.3** | **150** | **14.5** | **210** |
| Dryer Pressure Drop | barG / (psig) | 0.28 | 4 | 0.21 | 3 | 0.14 | 2 |
| Primary filter wet pressure drop | barG / (psig) | 0.14 | 2 | 0.10 | 1.5 | 0.07 | 1 |
| Final filter wet pressure drop | barG / (psig) | 0.21 | 3 | 0.14 | 2 | 0.10 | 1.5 |
| Total Pressure Drop [10] For ISO Class 2.5.1 air | barG / (psig) | 0.62 | 9 | 0.45 | 6.5 | 0.31 | 4.5 |

**Notes :**

( 1 ) FAD ( Free Air Delivery ) is full package performance including all losses. Tested in accordance with ISO 1217 : 1996 Annex C.
( 2 ) Measured in free field conditions in accordance with PNEUROP/CAGI test codes PN8NTC2.3, with +/- 3 dB(A) tolerance.
( 3 ) 40% Relative Humidity Inlet Air ( For alternate conditions refer to SSR toolbox or contact IR )
( 4 ) Motor test certificate
( 5 ) Inrush amps
( 6 ) This is a minimum requirement based on 90°C wire - It may be necessary to use larger cables to comply with local regulations or if the voltage drop exceeds 5% of the nominal voltage.
( 7 ) Recommended Time delay Fuse. Refer to local code for proper fuse sizing
( 8 ) Measured at rated compressor duty
( 9 ) Installation kit will provide flexible connection to NPT or BSPT
(10 ) Total Air System package including compressor, integral dryer with pre and final compressed air filters
(11 ) Dew point measured In accordance with ISO 8573-1:2001. With inlet air to package of 25°C (77 °F) and RH at 60%

(13) Discharge pressure when operating at compressor rated pressure, with clean wetted filters

# SSR® UP Series TOTAL AIR SYSTEM Total Air System

Point of Manufacture – Campbellsville KY

**SSR® UP6-5, 7.5, 10, & 15c TAS**

**60 Hz DETAIL DESCRIPTION**

**PACKAGE**

The "***Total-Air-System***" **(TAS)** is a unique compressor package, comprising a fully integrated rotary screw compressor with a high efficiency, cycling, air dryer, general purpose and high efficiency air filters. This is all mounted on to a horizontal air storage receiver. The TAS package occupies less space, costs less to install, and delivers high quality compressed air to maximize operating efficiency and reduce costs.

**PACKAGE PRE-FILTER**

The cooling and intake airflow is pre-filtered through an easy to service electrostatic filter panel, which protects the dryer and main cooler matrix from heavy dirt ingress thus reducing maintenance requirements.

**INTAKE AIR FILTER**

The compressor intake air filtration for UP SERIES is accomplished through the use of a dry-type air cleaner, which is 99.9% efficient at 3 microns and above.

**AIREND**

Since the airend is the fundamental component in a rotary screw compressor package, reliability, performance and efficiency are determined by selection of the most effective design, maintenance of close manufacturing tolerances, and precise assembly of the airend itself. All UP Series units, apply proven airends achieving high levels of efficiency and durability.

A high efficiency asymmetrical profile is developed through a unique two-step machining process. The first stage develops the basic wrap angle profile and is a rough-cut. The final stage is a finish grinding process, which ensures a hard, true rotor surface. The rotor shafts are precision ground to tolerances within 12 microns (0.0005 of an inch). The rotor housings are made of high quality, close grain cast Iron.

Bearing configuration used on all Small UP series models is the tapered rollers thrust bearing and parallel roller journal bearing. These roller bearings are able to handle all loads, radial, thrust or a combination of both. With this bearing configuration, the discharge end of the male and female rotors are each equipped with a pair of tapered roller bearings offset at opposing axis for maximum positional stability and absorption of thrust and radial loads. The thrust bearing housing is made of a close grain cast iron.
Cylindrical roller bearings are used to carry the radial loads on the inlet end of the rotors. All bearings, whether thrust or radial, are premium specification, which provide truer, harder running surfaces for both inner and outer bearing races.

A double shaft seal is fitted on the main input shaft.

Coolant dams are machined at the bearing locations. This provides an area for coolant to accumulate when the compressor is shut off. Upon start-up the bearings, which are resting in coolant retained by the coolant dam is immediately lubricated, thereby assuring long life.

**COOLANT RESEVOIR**

A pre-separator is fully integrated with the airend forming a single module. The highly efficient separation system, combined with suitably sized sump volumes, provides for normal coolant top-up intervals of 500 hours. A pressure relief valve mounted on the housing protects the package. The coolant filler, is designed to prevent overfill the compressor, and a visual coolant level indicator is located on the side of the module. A drain point is provided at the bottom of the sump.

**MAIN DRIVE MOTOR-GENERAL**

The main drive motor is matched to the requirements of the torque and the load of the compressor and to specific design criteria that enable the motor to develop peak efficiency and power factor at full load.

Double shaft construction with the cooling blower mounted on

Ingersoll-Rand SSR® UP Series TOTAL AIR SYSTEM Total Air System

Point of Manufacture – Campbellsville KY
**SSR® UP6-5, 7.5, 10, & 15c TAS**
**60 Hz DETAIL DESCRIPTION**

main shaft provides assured cooling.

**MOTOR FRAME**
Standard NEMA frame, 2 pole, E-pact efficiency rated, open-drip proof, three-phase motors are used for UP6 - 5, 7.5, 10 & 15 hp 60Hz applications.. Single-phase motors are also available up to 7.5 hp. TEFC motors are available as an option.

**ELECTRICAL DESIGN**
Speed, torque and operating characteristics have been designed to match the load of the compressor. Motor efficiency and power factor have been optimized for each size over the entire capacity range of the UP6 - 5, 7.5, 10 & 15 hp. Standard motors are 230/460v 3 Phase 60 cycle and 200, 380, & 575 volt 3 phase motors are available as options. Single-phase motors are optional at 5 & 7,5 hp duties 200 & 230 volt 60Hz.

**MOTOR BEARINGS**
Ball bearings for the drive and non-drive end provide dependable and reliable service both front and back bearings are permanently lubricated on both ODP and TEFC motors.

**MOTOR INSULATION**
The selected motor has a minimum of class F insulation as standard, and is specified to operate in ambient conditions up to 104°F (40°C). In addition the motor is specified to operate at maximum load with a temperature rise some 27°F (15°C) below that permitted by the design code. This conservatism is frequently referred to as “Class F with class B temperature rise”.

**BELT DRIVE**
The power transmission from the drive motor to the airend male rotor is by long life non-stretching poly-vee belt with easy to adjust belt tension control and simple access for maintenance. This assures performance integrity and belt life. The complete drive system is contained within a protective guarding.

**COOLING SYSTEM**

**Coolant Filtration**
The full capacity coolant filter is a high capacity 5-micron, replaceable spin-on element with pressure bypass.

**Coolant / Lubricant Temperature Control**
A thermostatic control valve is mounted downstream of the oil cooler. The temperature sensitive element controls the flow of coolant through the oil cooler. This provides the proper injection temperature and assures fast warm-up.

**Coolant Injection**
The coolant is injected through ports near the airend inlet and directed back toward the inlet cover. This ensures the best possible pre-sealing of the rotors, and an optimum mix of coolant with air. The differential pressure between the separator tank and the airend inlet induces coolant flow.

**COOLANT / AIR SEPARATION**
After compression and discharge from the airend, the air is heavily laden with coolant. A separator is used to remove the fluid from the air stream and does so with a three stage separation system. In the first stage, air and coolant mixture from the airend discharge directly enters the separator tank through a nozzle, which directs the mixture flow within the volume. This action forces heavier coolant particles to the periphery of the tank. These particles combine with the main liquid body in the sump. The airflow then passes through the cartridge coalescing element, which combines the second and third stage of separation. The separator cartridge is two-stage with reinforced construction. Coolant, which has collected at bottom of the cartridge is drawn back to the airend inlet through a scavenge system.

The compressed air then passes to the air-cooled aftercooler where coolant vapour carryover will be further removed as it is condensed and drained together with water condensate. On the SSR-UP 5-15 hp compressors, the carryover after the aftercooler is less than 5PPM (5 mg/$m^3$.)

# SSR® UP Series Total Air System

Point of Manufacture – Campbellsville KY

**SSR® UP6-5, 7.5, 10, & 15c TAS**
**60 Hz DETAIL DESCRIPTION**

Due to the conservative sizing of the air passages and the separator cartridge, there is a minimal pressure drop. This reduces to a minimum, power required to move the air through the compressor system.

A combined minimum pressure / check valve regulates the air discharge from the separator. This ensures that when the unit unloaded sufficient pressure is maintained in the tank to propel the coolant through the system. SSR UP series compressors are supplied with an inclusive factory fill of SSR UltraPlus Coolant that provides extended operating life.

SSR UltraPlus Coolant is a Polyol Ester synthetic lubricant, providing better cooling characteristics and a longer life than other synthetic lubricants. The life of UltraPlus Coolant is two (2) years or 9,000 hours (whichever occurs first). Condensate containing traces of the coolant fluid should be processed to meet local environmental requirements before disposal in an approved manner.

**COOLERS**
SSR UP Series compressors come with integrally mounted air-cooled combination heat exchanger that cools both the coolant and compressed air and is of tube and fin design. Constructed from aluminium, it is designed to operate in ambient temperatures from 35°F (2°C) up to 104°F (40°C) The after cooler cools the compressed air to 18°F (10°C) above ambient air temperature at 104°F (40°C) and 60% RH. Centrifugal cooling fan is mounted in an internal segregated cooling compartment. Cooling air is forced across the cooler with even velocity over the full surface area of the cooler matrix.

The cooler assembly is accessed through a single opening, providing access to both sides of the cooler, for quick and effective cleaning.

**PIPING**
The compressor utilizes flexible SAE hoses with JIC fittings, rigid steel piping, Bundy weld tubing, flexible connectors and nylon tubing as appropriate to provide vibration free operation. SAE "O" Ring fittings are applied on all lubricant connections. Each compressor system, after manufacturing and assembly, will be 100% inspected and tested to provide a piping system with minimum potential for leaks, which is easy for maintenance.

**COMPRESSED AIR FILTERATION**
Two stages of filtration are standard within the ***Total Air System***. These are selected to balance the load between two duty-matched filters with performance characteristic to share the load, reduce total pressure losses, operating costs and extend effective life.

A first filter removes particles down to 1 micron, and coalesced liquids to 0.6 mg/m$^3$ (0.5 ppm). This is followed by a High Efficiency filter, which removes particles down to 0.1 micron including coalesced liquids, providing a maximum remaining aerosol content of 0.01 mg/m$^3$ (0.01 ppm).

**CYCLING REFRIGERATED AIR DRYER**
Totally integrated within the package and using the same cooling air flow, as the compressor package. The refrigerant air dryer which cycles on and off with the compressor, uses a unique single high efficiency welded stainless steel plate heat exchanger to perform the multiple duties of pre-cooler, refrigerant evaporator, and compressed air re-heater. The environmentally sound R-134a refrigeration cycle utilizes a high efficiency “micro channel” condenser and thermal control is provided with a quick acting hot gas bypass. Condensed water is removed from the airflow directly after the evaporator part of the heat exchanger, by a high efficiency, external cyclone separator. This condensate is discharged by solenoid drain from a manifold in parallel with other drain points.

**CONTROL PANEL – GENERAL**

Ingersoll-Rand

SSR®

Ref: 9902
Sheet 513
Date: 1st October 2004
Cancels: First Issue

# UP Series TOTAL AIR SYSTEM Total Air System

Point of Manufacture – Campbellsville KY

**SSR® UP6-5, 7.5, 10, & 15c TAS**
**60 Hz DETAIL DESCRIPTION**

The SSR UP Series compressor includes a standard control module, which provides starting, stopping, capacity and pressure control, together with operating and safety control for the package.

Operation of the compressor is very simple and user friendly. The instrument panel is mounted on the front of the compressor, directly above the starter for good visibility when either floor or receiver mounted. The control panel includes: - Run/Stop selector switch and reset button, "lock off" emergency stop button, pressure gauge, dryer condition indicator, running hour meter. Signal lights indicate: - power on (green), auto restart (amber).

**COMPRESSOR/CAPACITY CONTROLS**
As standard, SSR UP 5-15 hp is provided with automatic start / stop control with constant running control regulator, which allows the compressor to operate online / offline. In addition a simple to apply, range adjustable auxiliary control valve provides a constant running mode of operation and should be selected when load conditions require.

**STARTER**
Two input power supplies are facilitated into the starter enclosure for main motor and dryer operation. A transformer provides 120V 60 Hertz, fuse protected control voltage. Motor overload protection is designed and sized to match the specific characteristics of the motor. The single-phase dryer compressor is separately fuse protected

**TEMPERATURE PROTECTION**
Should the compressed air temperature exceed 228°F (109°C) at the airend discharge, a switch will shut down the compressor, and when provided with optional maintenance indicator will display the fault symbol.

**BASEPLATE**
A one-piece folded mild steel, base-plate protected from corrosion with a high grade of powder coated paint finish, supports all of the components within the package The base-plate is provided with fork truck slots to enable easy handling from front or end of the package. The compressor unit and drive motor are mounted on a secondary sub-base which is supported on vibration isolating mounts, which reduces operating sound emissions to a very low level.

**ENCLOSURE**

The package enclosure is carefully designed to provide effective sound emission control and suppression, while retaining easy access for maintenance and access to major components.
The front door lifts off if required to provide easy access to all routine maintenance points. This door provides easy access to carry out the following maintenance procedures

- Check and top up coolant
- Check intake filter condition
- Change intake filter
- Change coolant filter
- Change separator cartridge
- Service Intake valve
- Check or adjust constant running valve
- Check shuttle valve
- Drain & refill coolant
- Adjust belt tension
- Set and adjust load and unload operating pressures

**Starter**
The starter is accessed through a single front panel, which provides access to all starter components.

**Drive System**
The drive belt system is accessed by removal of the end panel.

**Cooler cleaning**
Cooler cleaning operations are simplified by removing the rear panel, which provides easy access to the inside face of the cooler.

**Coalescing Filter Maintenance**

Access to the twin filters is easy through a simple access panel on the end of the machine

**Ducting**

# SSR® UP Series Total Air System

Point of Manufacture – Campbellsville KY
**SSR® UP6-5, 7.5, 10, & 15c TAS**
**60 Hz DETAIL DESCRIPTION**

Inlet Duct and or discharge duct can easily be connected to the machine to single point connections.
Back pressure provision available for cooling airflow is ¼" (6 mm) water gauge

**HIGH AMBIENT PACKAGE (Optional)**
Rated for operation in ambient conditions up to 122°F (50°C) and as low as 35°F (2°C) The High Ambient units are available in power sizes of 5. 7.5 10 hp with capacities from 16 through 38 CFM and pressures 125, 150 and 210 PSIG

**SERVICE/MAINTENANCE INDICATOR (Optional)**
Advanced but simple indicator, that is highly visual and includes the following -

- Hour meter
- Maintenance indicator - bar graph continuously indicates remaining service life
- Indicator of Fault condition
- Real time clock
- Back light
- Service due warning
- Service overdue

**TEFC MAIN MOTOR (Optional)**
This option is intended for those installations that require TEFC motors by specification.

SECTION 23 00 00

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS
**11/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

| | |
|---|---|
| AMCA 201 | (2002) Fans and Systems |
| AMCA 210 | (2007) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating |
| AMCA 300 | (2005) Reverberant Room Method for Sound Testing of Fans |
| AMCA 301 | (2005) Methods for Calculating Fan Sound Ratings from Laboratory Test Data |
| AMCA 500-D | (1998) Laboratory Methods of Testing Dampers for Rating |

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

| | |
|---|---|
| AHRI 410 | (2001; Addendum 2002) Standard for Forced-Circulation Air-Cooling and Air-Heating Coils |
| AHRI 430 | (1999) Standard for Central-Station Air-Handling Units |
| AHRI Guideline D | (1996) Application and Installation of Central Station Air-Handling Units |

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

| | |
|---|---|
| ABMA 11 | (1990; R 1999) Load Ratings and Fatigue Life for Roller Bearings |
| ABMA 9 | (1990; R 2000) Load Ratings and Fatigue Life for Ball Bearings |

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

| | |
|---|---|
| ASHRAE 52.2 | (2007; Addenda B 2008) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size |
| ASHRAE 62.1 | (2007; INT 2007; INT 2-15 2008; Errata |

| | |
|---|---|
| | 2008; Addenda a, b, e, f and h 2008) Ventilation for Acceptable Indoor Air Quality |
| ASHRAE 70 | (2006) Method of Testing for Rating the Performance of Air Outlets and Inlets |
| ASHRAE 90.1 - IP | (2007) Energy Standard for Buildings Except Low-Rise Residential Buildings, I-P Edition |

ASME INTERNATIONAL (ASME)

| | |
|---|---|
| ASME A13.1 | (2007) Scheme for the Identification of Piping Systems |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 123/A 123M | (2008) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A 167 | (1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |
| ASTM A 53/A 53M | (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A 924/A 924M | (2008a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| ASTM B 117 | (2007a) Standing Practice for Operating Salt Spray (Fog) Apparatus |
| ASTM B 152/B 152M | (2006ae1) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar |
| ASTM B 766 | (1986; R 2008) Standard Specification for Electrodeposited Coatings of Cadmium |
| ASTM C 553 | (2008) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications |
| ASTM C 916 | (1985; R 2007) Standard Specification for Adhesives for Duct Thermal Insulation |
| ASTM D 1654 | (2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments |
| ASTM D 3359 | (2008) Measuring Adhesion by Tape Test |
| ASTM D 520 | (2000; R 2005) Zinc Dust Pigment |

| | |
|---|---|
| ASTM E 2016 | (2006) Standard Specification for Industrial Woven Wire Cloth |
| ASTM E 84 | (2008a) Standard Test Method for Surface Burning Characteristics of Building Materials |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA MG 1 | (2007; Errata 2008) Standard for Motors and Generators |
| NEMA MG 10 | (2001; R 2007) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors |
| NEMA MG 11 | (1977; R 2007) Energy Management Guide for Selection and Use of Single Phase Motors |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |
| NFPA 90A | (2008) Standard for the Installation of Air Conditioning and Ventilating Systems |

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

| | |
|---|---|
| SMACNA 1819 | (2002, 5th Ed) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems |
| SMACNA 1884 | (2003) Fibrous Glass Duct Construction Standards |
| SMACNA 1966 | (2005) HVAC Duct Construction Standards Metal and Flexible |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 40 CFR 82 | Protection of Stratospheric Ozone |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 181 | (2005; Rev thru Oct 2008) Standard for Factory-Made Air Ducts and Air Connectors |
| UL 1995 | (2005) Standard for Heating and Cooling Equipment |
| UL 214 | (1997; Rev thru Aug 2001) Tests for Flame-Propagation of Fabrics and Films |
| UL 555 | (2006) Standard for Fire Dampers |
| UL 586 | (1996; Rev thru Aug 2008) Standard for High-Efficiency Particulate, Air Filter |

| | |
|---|---|
| | Units |
| UL 6 | (2007) Standard for Electrical Rigid Metal Conduit-Steel |
| UL 705 | (2004; Rev thru Mar 2006) Standard for Power Ventilators |
| UL 723 | (2008) Standard for Test for Surface Burning Characteristics of Building Materials |
| UL 900 | (2004; Rev thru Nov 2007) Standard for Air Filter Units |
| UL Bld Mat Dir | (2008) Building Materials Directory |
| UL Electrical Constructn | (2008) Electrical Construction Equipment Directory |
| UL Fire Resistance | (2008) Fire Resistance Directory |

1.2 SYSTEM DESCRIPTION

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different trades to avoid interference between piping, equipment, structural, and electrical work. Provide complete, in place, all necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

1.2.1 Service Labeling

Label equipment, including fans, air handlers, terminal units, etc. with labels made of self-sticking, plastic film designed for permanent installation. Labels shall be in accordance with the typical examples below:

| SERVICE | LABEL AND TAG DESIGNATION |
|---|---|
| Air handling unit Number | AHU - [_____] |
| Control and instrument air | CONTROL AND INSTR. |
| Exhaust Fan Number | EF - [ ] |
| VAV Box Number | VAV - [ ] |

Identify similar services with different temperatures or pressures. Where pressures could exceed 125 pounds per square inch, gage, include the maximum system pressure in the label. Label and arrow piping in accordance with the following:

a. Each point of entry and exit of pipe passing through walls.

b. Each change in direction, i.e., elbows, tees.

c. In congested or hidden areas and at all access panels at each point required to clarify service or indicated hazard.

d. In long straight runs, locate labels at distances within eyesight of each other not to exceed 75 feet. All labels shall be visible and legible from the primary service and operating area.

| For Bare or Insulated Pipes for Outside Diameters of | Lettering |
|---|---|
| 1/2 thru 1-3/8 inch | 1/2 inch |
| 1-1/2 thru 2-3/8 inch | 3/4 inch |
| 2-1/2 inch and larger | 1-1/4 inch |

1.2.2 Color Coding

Color coding of all piping systems shall be in accordance with ASME A13.1 or Stennis Space Center requirements.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Standard Products

Manufacturer's catalog data included with the detail drawings for the following items. Highlight the data to show model, size, options, etc., that are intended for consideration. Provide adequate data to demonstrate compliance with contract requirements for the following:

Metallic Flexible Duct
Insulated Nonmetallic Flexible Duct Runouts
Fire Dampers
Manual Balancing Dampers
Acoustical Duct Liner
Diffusers
Registers and Grilles
Centrifugal Fans
In-Line Centrifugal Fans
Panel Type Power Wall Ventilators
Air Handling Units
Variable Volume, Single Duct Terminal Units

Operation and Maintenance Training

Proposed On-site Training schedule, submitted concurrently with the Operation and Maintenance Manuals.

SD-07 Manufacturer's Instructions

Manufacturer's Installation Instructions
Operation and Maintenance Training

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

Six manuals at least 2 weeks prior to field training. Submit data complying with the requirements specified in Section 01 78 23 0PERATION AND MAINTENANCE DATA. Submit Data Package 3 for the following:

Fire Dampers; G
Manual Balancing Dampers; G
Centrifugal Fans; G
In-Line Centrifugal Fans; G
Panel Type Power Wall Ventilators; G
Air Handling Units; G
Variable Volume, Single Duct Terminal Units; G

1.4 QUALITY ASSURANCE

Except as otherwise specified, approval of materials and equipment is based on manufacturer's published data.

a. Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL Bld Mat Dir, and UL 6 is acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Outline methods of testing used by the specified agencies.

b. Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the ASTM International (ASTM), the ASME International (ASME), or other standards, a manufacturer's certificate of compliance of each item is acceptable as proof of compliance.

c. Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

1.4.1 Prevention of Corrosion

Protect metallic materials against corrosion. Manufacturer shall provide rust-inhibiting treatment and standard finish for the equipment enclosures. Do not use aluminum in contact with earth, and where connected to dissimilar metal. Protect aluminum by approved fittings, barrier material, or treatment. Ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A 123/A 123M for exterior locations and cadmium-plated in conformance with ASTM B 766 for interior locations.

1.4.2 Asbestos Prohibition

Do not use asbestos and asbestos-containing products.

1.4.3 Ozone Depleting Substances Used as Refrigerants

Minimize releases of Ozone Depleting Substances (ODS) during repair, maintenance, servicing or disposal of appliances containing ODS's by complying with all applicable sections of 40 CFR 82 Part 82 Subpart F. Any person conducting repair, maintenance, servicing or disposal of appliances owned by NASA shall comply with the following:

a. Do not knowingly vent or otherwise release into the environment, Class I or Class II substances used as a refrigerant.

b. Do not open appliances without meeting the requirements of 40 CFR 82 Part 82.156 Subpart F, regarding required practices for evacuation and collection of refrigerant, and 40 CFR 82 Part 82.158 Subpart F, regarding standards of recycling and recovery equipment.

c. Only persons who comply with 40 CFR 82 Part 82.161 Subpart F, regarding technician certification, can conduct work on appliances containing refrigerant.

In addition, provide copies of all applicable certifications to the Contracting Officer at least 14 calendar days prior to initiating maintenance, repair, servicing, dismantling or disposal of appliances, including:

a. Proof of Technician Certification

b. Proof of Equipment Certification for recovery or recycling equipment.

c. Proof of availability of certified recovery or recycling equipment.

1.4.4 Use of Ozone Depleting Substances, Other than Refigerants

The use of Class I or Class II ODS's listed as nonessential in 40 CFR 82 Part 82.66 Subpart C is prohibited. These prohibited materials and uses include:

a. Any plastic party spray streamer or noise horn which is propelled by a chlorofluorocarbon

b. Any cleaning fluid for electronic and photographic equipment which contains a chlorofluorocarbon; including liquid packaging, solvent wipes, solvent sprays, and gas sprays

c. Any plastic flexible or packaging foam product which is manufactured with or contains a chlorofluorocarbon, including, open cell foam, open cell rigid polyurethane poured foam, closed cell extruded polystyrene sheet foam, closed cell polyethylene foam and closed cell polypropylene foam except for flexible or packaging foam used in coaxial

d. Any aerosol product or other pressurized dispenser which contains a chlorofluorocarbon, except for those listed in 40 CFR 82 Part 82.66 Subpart C.

Request a waiver if a facility requirement dictates that a prohibited material is necessary to achieve project goals. Submit the waiver request in writing to the Contracting Officer. The waiver will be evaluated and

dispositioned.

1.4.5 Detail Drawings

Submit detail drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to demonstrate that the system has been coordinated and functions properly as a unit on the drawings and show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Submit drawings showing bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Submit function designation of the equipment and any other requirements specifed throughout this Section with the shop drawings

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide components and equipment that are "standard products" of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as being in satisfactory commercial or industrial use for 2 years before bid opening, including applications of components and equipment under similar circumstances and of similar size, satisfactorily completed by a product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Provide equipment items that are supported by a service organization. Where applicable, provide equipment that is an ENERGY STAR Qualified product or a Federal Energy Management Program (FEMP) designated product.

2.2 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates are to designate the function of the equipment. Submit designation with the shop drawings. Identification plates shall be three layers, black-white-black, engraved to show white letters on black background. Letters shall be upper case. Identification plates 1-1/2-inches high and smaller shall be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high shall be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger shall have beveled edges. Install identification plates using a compatible adhesive.

## 2.3 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact according to OSHA requirements. Properly guard or cover with insulation of a type specified, high temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard. The requirements for [catwalks,] [operating platforms,] [ladders,] [and] [guardrails] are specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

## 2.4 ELECTRICAL WORK

a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown. For packaged equipment, include manufacturer provided controllers with the required monitors and timed restart.

b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11. Integral size motors shall be the premium efficiency type in accordance with NEMA MG 1.

c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system , and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Select premium efficiency polyphase motors in accordance with NEMA MG 10.

d. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Provide motors rated for continuous duty with the enclosure specified. Provide motor duty that allows for maximum frequency start-stop operation and minimum encountered interval between start and stop. Provide motor torque capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Fit motor bearings with grease supply fittings and grease relief to outside of the enclosure.

e. [Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers are allowed to accomplish the same function. Use solid-state variable-speed controllers for motors rated 10 hp or less and adjustable frequency drives for larger motors.] [Provide variable frequency drives for motors as specified in Section 26 29 23 VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS.]

## 2.5 ANCHOR BOLTS

Provide anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts to be of the size and number recommended by the equipment manufacturer and located by means of suitable templates. Installation of anchor bolts shall not degrade the surrounding concrete.

## 2.6 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's standards unless specified otherwise. Field retouch only if approved. Otherwise, return equipment to the factory for refinishing.

## 2.7 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

## 2.8 DUCT SYSTEMS

### 2.8.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with SMACNA 1966 unless otherwise specified. Provide radius type elbows with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes are allowed. Provide ductwork that meets the requirements of Seal Class [A][C]. Provide ductwork in VAV systems upstream of the VAV boxes that meets the requirements of Seal Class A. Provide sealants that conform to fire hazard classification specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS and are suitable for the range of air distribution and ambient temperatures to which it is exposed. Do not use pressure sensitive tape as a sealant. Make spiral lock seam duct, and flat oval with duct sealant and lock with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA 1966. Apply the sealant to the exposed male part of the fitting collar so that the sealer is on the inside of the joint and fully protected by the metal of the duct fitting. Apply one brush coat of the sealant over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar are not acceptable. Fabricate outdoor air intake ducts and plenums with watertight soldered or brazed joints and seams.

#### 2.8.1.1 Metallic Flexible Duct

a. Provide duct that conforms to UL 181 and NFPA 90A with factory-applied insulation, vapor barrier, and end connections. Provide duct assembly that does not exceed 25 for flame spread and 50 for smoke developed. Proved ducts designed for working pressures of two inches water gauge positive and 1.5 inches water gauge positive. Provide flexible round duct length that does not exceed five feet. Secure connections by applying adhesive for two inches over rigid duct, apply flexible duct two inches over rigid duct, apply metal clamp, and provide minimum of three No. 8 sheet metal screws through clamp and rigid duct.

b. Inner duct core: Provide interlocking spiral or helically corrugated flexible core constructed of zinc-coated steel, aluminum, or stainless steel; or constructed of inner liner of continuous galvanized spring steel wire helix fused to continuous, fire-retardant, flexible vapor barrier film, inner duct core.

c. Insulation: Provide inner duct core that is insulated with mineral fiber blanket type flexible insulation, minimum of one inch thick. Provide insulation covered on exterior with manufacturer's standard

fire retardant vapor barrier jacket for flexible round duct.

2.8.1.2 Insulated Nonmetallic Flexible Duct Runouts

Use flexible duct runouts only where indicated. Runout length is indicated on the drawings, and is not to exceed 5 feet. Provide runouts that are preinsulated, factory fabricated, and that comply with NFPA 90A and UL 181. Provide either field or factory applied vapor barrier. Provide not less than 20 ounce glass fabric duct connectors coated on both sides with neoprene. Where coil induction or high velocity units are supplied with vertical air inlets, use a streamlined, vaned and mitered elbow transition piece for connection to the flexible duct or hose. Provide a die-stamped elbow and not a flexible connector as the last elbow to these units other than the vertical air inlet type.. Insulated flexible connectors are allowed as runouts. Provide insulated material and vapor barrier that conform to the requirements of Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Do not expose the insulation material surface to the air stream.

2.8.1.3 General Service Duct Connectors

Provide a flexible duct connector approximately 6 inches in width where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, secure the flexible material by plastic draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct construction methods. Provide a composite connector system that complies with UL 214 and is classified as "flame-retarded fabrics" in UL Bld Mat Dir.

2.8.1.4 Copper Sheets

ASTM B 152/B 152M, light cold rolled temper.

2.8.1.5 Corrosion Resisting (Stainless) Steel Sheets

ASTM A 167

2.8.2 Ductwork Accessories

2.8.2.1 Duct Access Doors

Provide hinged access doors conforming to SMACNA 1966 in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system. Provide access doors upstream and downstream of air flow measuring primaries and heating and cooling coils. Provide doors that are a minimum 15 x 18 inches, unless otherwise shown. Where duct size does not accommodate this size door, make the doors as large as practicable. Equip doors 24 x 24 inches or larger with fasteners operable from inside and outside the duct. Use insulated type doors in insulated ducts.

2.8.2.2 Fire Dampers

Use 1.5 hour rated fire dampers unless otherwise indicated. Provide fire dampers that conform to the requirements of NFPA 90A and UL 555. Perform the fire damper test as outlined in NFPA 90A. Provide a pressure relief door upstream of the fire damper. If the ductwork connected to the fire damper is to be insulated then provide a factory installed pressure relief

damper. Provide automatic operating fire dampers with a dynamic rating suitable for the maximum air velocity and pressure differential to which it is subjected. Provide fire dampers approved for the specific application, and install according to their listing. Equip fire dampers with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, does not impair the operation of the damper. Equip sleeves or frames with perimeter mounting angles attached on both sides of the wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the assemblies in conformance with UL Fire Resistance. Provide [curtain type with damper blades] [in the air stream] [out of the air stream] [or] [single blade type] [or] [multi-blade type] fire dampers. Install dampers that do not reduce the duct or the air transfer opening cross-sectional area. Install dampers so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, comply with the installation details given in SMACNA 1819 and in manufacturer's instructions for fire dampers. Perform acceptance testing of fire dampers according to paragraph Fire Damper Acceptance Test and NFPA 90A.

2.8.2.3 Manual Balancing Dampers

Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are operated by locking-type quadrant operators. Install dampers that are 2 gauges heavier than the duct in which installed. Unless otherwise indicated, provide opposed blade type multileaf dampers with maximum blade width of 12 inches. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.8.3 Dampers

Where outdoor air supply and exhaust air dampers are required they shall have a maximum leakage rate when tested in accordance with AMCA 500-D as required by ASHRAE 90.1 - IP, including: Maximum Damper Leakage for: 1) Climate Zones 1,2,6,7,8 the maximum damper leakage at 1.0 inch w.g. for motorized dampers is 4 cfm per sq ft of damper area and non-motorized dampers are not allowed. 2) All other Climate Zones the maximum damper leakage at 1.0 inch w.g. is 10 cfm per sq ft and for non-motorized dampers is 20 cfm per sq ft of damper area.
Dampers smaller than 24 inches in either direction may have leakage of 40 cfm per sq ft.

2.8.4 Plenums and Casings for Field-Fabricated Units

2.8.4.1 Plenum and Casings

Fabricate and erect plenums and casings as shown in SMACNA 1966, as applicable. Construct system casing of not less than 16 gauge galvanized sheet steel. Furnish cooling coil drain pans with 1 inch threaded outlet to collect condensation from the cooling coils. Fabricate drain pans from not lighter than 16 gauge steel, galvanized after fabrication or of 18 gauge corrosion-resisting sheet steel conforming to ASTM A 167, Type 304, welded

and stiffened. Thermally insulate drain pans exposed to the atmosphere to prevent condensation. Coat insulation with a flame resistant waterproofing material. Provide separate drain pans for each vertical coil section, and a separate drain line for each pan. Size pans to ensure capture of entrained moisture on the downstream-air side of the coil. Seal openings in the casing, such as for piping connections, to prevent air leakage. Size the water seal for the drain to maintain a pressure of at least 2 inch water gauge greater than the maximum negative pressure in the coil space.

2.8.4.2 Casing

Terminate casings at the curb line and bolt each to the curb using galvanized angle, as indicated in SMACNA 1966.

2.8.4.3 Access Doors

Provide access doors in each section of the casing. Weld doorframes in place, gasket each door with neoprene, hinge with minimum of two brass hinges, and fasten with a minimum of two brass tension fasteners operable from inside and outside of the casing. Where possible, make doors 36 x 18 inches and locate them 18 inches above the floor. Where the space available does not accommodate doors of this size, use doors as large as the space accommodates. Swing doors so that fan suction or pressure holds doors in closed position, airtight. Provide a push-button station, located inside the casing, to stop the supply.

2.8.4.4 Factory-Fabricated Insulated Sheet Metal Panels

Factory-fabricated components are allowed for field-assembled units, provided all requirements specified for field-fabricated plenums and casings are met. Provide panels of modular design, pretested for structural strength, thermal control, condensation control, and acoustical control. Seal and insulate panel joints. Provide and gasket access doors to prevent air leakage. Provide panel construction that is not less than 20 gauge galvanized sheet steel, assembled with fasteners treated against corrosion. Provide standard length panels that deflect not more than 1/2 inch under operation. Construct details, including joint sealing, not specifically covered, as indicated in SMACNA 1966. Construct the plenums and casings to withstand the specified internal pressure of the air systems.

2.8.4.5 Duct Liner

Unless otherwise specified, duct liner is not permitted.

2.8.5 Diffusers, Registers, and Grilles

Provide factory-fabricated units of [steel] [corrosion-resistant steel] [or] [aluminum] that distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Provide outlets for diffusion, spread, throw, and noise level as required for specified performance. Certify performance according to ASHRAE 70. Provide sound rated and certified inlets and outlets according to ASHRAE 70. Provide sound power level as indicated. Provide diffusers and registers with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device is acceptable. Provide opposed blade type volume dampers for all diffusers and registers, except linear slot diffusers. Provide linear slot diffusers with round or elliptical balancing dampers. Where the inlet and outlet

openings are located less than 7 feet above the floor, protect them by a grille or screen according to NFPA 90A.

#### 2.8.5.1 Diffusers

Provide diffuser types indicated. Furnish ceiling mounted units with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Provide diffusers with air deflectors of the type indicated. Provide air handling troffers or combination light and ceiling diffusers conforming to the requirements of UL Electrical Constructn for the interchangeable use as cooled or heated air supply diffusers or return air units. Install ceiling mounted units with rims tight against ceiling. Provide sponge rubber gaskets between ceiling and surface mounted diffusers for air leakage control. Provide suitable trim for flush mounted diffusers. For connecting the duct to diffuser, provide duct collar that is airtight and does not interfere with volume controller. Provide return or exhaust units that are similar to supply diffusers.

#### 2.8.5.2 Registers and Grilles

Provide units that are four-way directional-control type, except provide return and exhaust registers that are fixed horizontal or vertical louver type similar in appearance to the supply register face. Furnish registers with sponge-rubber gasket between flanges and wall or ceiling. Install wall supply registers at least 6 inches below the ceiling unless otherwise indicated. Locate return and exhaust registers 6 inches above the floor unless otherwise indicated. Achieve four-way directional control by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Provide grilles as specified for registers, without volume control damper.

#### 2.8.5.3 Registers

Double-deflection supply registers. Provide manufacturer-furnished volume dampers. Provide volume dampers of the group-operated, opposed-blade type and key adjustable by inserting key through face of register. Operating mechanism shall not project through any part of the register face. Automatic volume control devices are acceptable. Provide exhaust and return registers as specified for supply registers, except provide exhaust and return registers that have a single set of nondirectional face bars or vanes having the same appearance as the supply registers.

### 2.8.6 Louvers

Provide louvers for installation in exterior walls that are associated with the air supply and distribution system as specified in Section [07 57 13 FLASHING AND SHEET METAL] [08 91 00 METAL [WALL][ AND ][DOOR] LOUVERS].

### 2.8.7 Bird Screens and Frames

Provide bird screens that conform to ASTM E 2016, No. 2 mesh, aluminum or stainless steel. Provide "medium-light" rated aluminum screens. Provide "light" rated stainless steel screens. Provide removable type frames fabricated from either stainless steel or extruded aluminum.

## 2.9 AIR SYSTEMS EQUIPMENT

### 2.9.1 Fans

Test and rate fans according to AMCA 210. Calculate system effect on air moving devices in accordance with AMCA 201 where installed ductwork differs from that indicated on drawings. Install air moving devices to minimize fan system effect. Where system effect is unavoidable, determine the most effective way to accommodate the inefficiencies caused by system effect on the installed air moving device. The sound power level of the fans shall not exceed 85 dBA when tested according to AMCA 300 and rated in accordance with AMCA 301. Provide all fans with an AMCA seal. Connect fans to the motors either directly or indirectly with V-belt drive. Use V-belt drives designed for not less than 150 percent of the connected driving capacity. Provide variable pitch motor sheaves for 15 hp and below, and fixed pitch as defined by AHRI Guideline D. Select variable pitch sheaves to drive the fan at a speed which can produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, provide a replaceable sheave when needed to achieve system air balance. Provide motors for V-belt drives with adjustable rails or bases. Provide removable metal guards for all exposed V-belt drives, and provide speed-test openings at the center of all rotating shafts. Provide fans with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Provide fan and motor assemblies with vibration-isolation supports or mountings as indicated. Use vibration-isolation units that are standard products with published loading ratings. Select each fan to produce the capacity required at the fan static pressure indicated. Provide sound power level as indicated. Obtain the sound power level values according to AMCA 300. Provide standard AMCA arrangement, rotation, and discharge as indicated. Provide power ventilators that conform to UL 705 and have a UL label.

#### 2.9.1.1 Centrifugal Fans

Provide fully enclosed, single-width single-inlet, or double-width double-inlet centrifugal fans, with AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Provide impeller wheels that are rigidly constructed and accurately balanced both statically and dynamically. [Provide forward curved or backward-inclined airfoil design fan blades in wheel sizes up to 30 inches. Provide backward-inclined airfoil design fan blades for wheels over 30 inches in diameter]. [Provide open-wheel radial type booster fans for exhaust dryer systems, and fans suitable for conveying lint and the temperatures encountered. Equip the fan shaft with a heat slinger to dissipate heat buildup along the shaft. Install an access (service) door to facilitate maintenance to these fans.] Provide fan wheels over 36 inches in diameter with overhung pulleys and a bearing on each side of the wheel. Provide fan wheels 36 inches or less in diameter that have one or more extra long bearings between the fan wheel and the drive. Provide sleeve type, self-aligning and self-oiling bearings with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Connect grease fittings to tubing for serviceability from a single accessible point. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide steel, accurately finished fan shafts, with key seats and keys for impeller hubs and fan pulleys. Provide fan outlets of ample proportions, designed for the attachment of angles and bolts for attaching flexible connections. Provide[[manually] [automatically] operated inlet vanes on

suction inlets. Provide [manually] [automatically] operated outlet dampers.] Unless otherwise indicated, provide motors that do not exceed 1800 rpm and have [open] [dripproof] [totally enclosed] [explosion-proof] enclosures. [Provide [manual] [magnetic] [across-the-line] [reduced-voltage-start] type motor starters with [general-purpose] [weather-resistant] [watertight] enclosure.] [Provide remote manual switch with pilot indicating light where indicated.]

2.9.1.2 In-Line Centrifugal Fans

Provide in-line fans with centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Mount fans in a welded tubular casing. Provide a fan that axially flows the air in and out. Streamline inlets with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Enclose and isolate fan bearings and drive shafts from the air stream. Provide precision, self aligning ball or roller type fan bearings that are sealed against dust and dirt and are permanently lubricated. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11.[ Provide motors with [open][dripproof][totally enclosed] [explosion-proof] enclosure.] [Provide [manual] [magnetic] motor starters across-the-line with [general-purpose] [weather-resistant] [explosion-proof] enclosures.][ Provide remote manual switch with pilot indicating light where indicated.]

2.9.1.3 Panel Type Power Wall Ventilators

Provide propeller type fans, assembled on a reinforced metal panel with venturi opening spun into panel. Provide direct or V-belt driven fans with wheels less than 24 inches in diameter and provide V-belt driven fans with wheels 24 inches in diameter and larger. Provide fans with wall mounting collar. Provide lubricated bearings. Equip fans with wheel and motor side metal or wire guards which have a corrosion-resistant finish. Provide [dripproof][totally enclosed fan cooled][explosion-proof] type motor enclosure. Install [gravity][motor operated] backdraft dampers where indicated.

2.9.2 Coils

Provide fin-and-tube type coils constructed of seamless copper] tubes and aluminum fins mechanically bonded or soldered to the tubes. Provide casing and tube support sheets that are not lighter than 16 gauge galvanized steel, formed to provide structural strength. When required, provide multiple tube supports to prevent tube sag. Test each coil at the factory under water at not less than 400 psi air pressure and make suitable for 200 psi working pressure and 300 degrees F operating temperature unless otherwise stated. Mount coils for counterflow service. Rate and certify coils to meet the requirements of AHRI 410.

2.9.2.1 Water Coils

Install water coils with a pitch of not less than 1/8 inch/foot of the tube length toward the drain end. Use headers constructed of cast iron, welded steel or copper. Furnish each coil with a plugged vent and drain connection extending through the unit casing. Provide removable water coils with drain pans.

#### 2.9.2.2 Electric Heating Coil

Provide an electric duct heater coil in accordance with UL 1995 and NFPA 70. Provide duct- or unit-mounted coil. Provide nickel chromium resistor, single stage, strip or stainless steel, fin tubular type coil. Provide coil with a built-in or surface-mounted high-limit thermostat interlocked electrically so that the coil cannot be energized unless the fan is energized. Provide galvanized steel or aluminum coil casing and support brackets. Mount coil to eliminate noise from expansion and contraction and for complete accessibility for service.

#### 2.9.2.3 Eliminators

Equip each cooling coil having an air velocity of over 400 fpm through the net face area with moisture eliminators, unless the coil manufacturer guarantees, over the signature of a responsible company official, that no moisture can be carried beyond the drip pans under actual conditions of operation. Construct of minimum 24 gage zinc-coated steel or stainless steel, removable through the nearest access door in the casing or ductwork. Provide eliminators that have not less than two bends at 45 degrees and are spaced not more than 2-1/2 inches center-to-center on face. Provide each bend with an integrally formed hook as indicated in the SMACNA 1884.

### 2.9.3 Air Filters

List air filters according to requirements of UL 900, except list high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method under the Label Service to meet the requirements of UL 586.

#### 2.9.3.1 Extended Surface Pleated Panel Filters

Provide 2 inch depth, sectional, disposable type filters of the size indicated with a MERV of 8 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.36 inches water gauge. Provide UL Class 2 filters, and nonwoven cotton and synthetic fiber mat media. Attach a wire support grid bonded to the media to a moisture resistant fiberboard frame. Bond all four edges of the filter media to the inside of the frame to prevent air bypass and increase rigidity.

#### 2.9.3.2 Holding Frames

Fabricate frames from not lighter than 16 gauge sheet steel with rust-inhibitor coating. Equip each holding frame with suitable filter holding devices. Make all joints airtight.

#### 2.9.3.3 Filter Gauges

Provide dial type filter gauges, diaphragm actuated draft for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Gauges shall be at least 3-7/8 inches in diameter, with white dials with black figures, and graduations with a minimum range of 1 inch of water beyond the specified final resistance for the filter bank on which each gauge is applied. Provide each gauge with a screw operated zero adjustment and two static pressure tips with integral compression fittings, two molded plastic vent valves, two 5 foot minimum lengths of 1/4 inch diameter aluminum tubing, and all hardware and accessories for gauge mounting.

## 2.10 AIR HANDLING UNITS

### 2.10.1 Factory-Fabricated Air Handling Units

Provide single-zone draw-through type units as indicated. Units shall include fans, coils, airtight insulated casing, filters, adjustable V-belt drives, access sections where indicated, vibration-isolators, and appurtenances required for specified operation. Provide vibration isolators as indicated. Physical dimensions of each air handling unit shall be suitable to fit space allotted to the unit with the capacity indicated. Provide air handling unit that is rated in accordance with AHRI 430 and AHRI certified for cooling.

#### 2.10.1.1 Casings

Provide the following:

a. 2 inch double wall type constructed of a minimum 18 gauge galvanized steel. Design and construct casing with an integral insulated structural galvanized steel frame such that exterior panels are non-load bearing.

b. Individually removable exterior panels with standard tools. Removal shall not affect the structural integrity of the unit. Furnish casings with access sections, according to paragraph AIR HANDLING UNITS, inspection doors, and access doors, all capable of opening a minimum of 90 degrees, as indicated.

c. Insulated, fully gasketed, double-wall type inspection and access doors, of a minimum 18 gauge outer and 20 gauge inner panels made of either galvanized steel. Doors shall be rigid and provided with heavy duty hinges and latches. Inspection doors shall be a minimum 12 inches wide by 12 inches high. Access doors shall be a minimum 24 inches wide, the full height of the unit casing or a minimum of 6 foot, whichever is less.

d. Double-wall insulated type drain pan ( constructed of 16 gauge corrosion resisting sheet steel conforming to ASTM A 167, Type 304, conforming to ASHRAE 62.1. Construct drain pans water tight, treated to prevent corrosion, and designed for positive condensate drainage. When 2 or more cooling coils are used, with one stacked above the other, condensate from the upper coils shall not flow across the face of lower coils. Provide intermediate drain pans or condensate collection channels and downspouts, as required to carry condensate to the unit drain pan out of the air stream and without moisture carryover. Construct drain pan to allow for easy visual inspection, including underneath the coil without removal of the coil and to allow complete and easy physical cleaning of the pan underneath the coil without removal of the coil. Coils shall be individually removable from the casing.

e. Casing insulation that conforms to NFPA 90A. Single-wall casing sections handling conditioned air shall be insulated with not less than 1 inch thick, 1-1/2 pound density coated fibrous glass material having a thermal conductivity not greater than 0.23 Btu/hr-sf-F. Double-wall casing sections handling conditioned air shall be insulated with not less than 2 inches of the same insulation specified for single-wall casings. Foil-faced insulation is not an acceptable substitute for use with double wall casing. Double wall insulation shall be completely

sealed by inner and outer panels.

h. A latched and hinged inspection door, in the fan and coil sections. Plus additional inspection doors, access doors and access sections where indicated.

2.10.1.2 Heating and Cooling Coils

Provide coils as specified in paragraph AIR SYSTEMS EQUIPMENT.

2.10.1.3 Air Filters

Provide air filters as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.10.1.4 Fans

Provide the following:

a. Fans that are double-inlet, centrifugal type with each fan in a separate scroll. Dynamically balance fans and shafts prior to installation into air handling unit, then after it has been installed in the air handling unit, statically and dynamically balance the entire fan assembly. Mount fans on steel shafts, accurately ground and finished.

b. Fan bearings that are sealed against dust and dirt and are precision self-aligning ball or roller type, with L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Bearings shall be permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit. Support bearings by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing. Do not fasten bearings directly to the unit sheet metal casing. Furnish fans and scrolls with coating indicated.

c. Furnish belt guards that are the three-sided enclosed type with solid or expanded metal face. Belt drives shall be designed for not less than a 1.3 service factor based on motor nameplate rating.

d. Motor sheaves that are variable pitch for 25 hp and below and fixed pitch above 25 hp as defined by AHRI Guideline D. Where fixed sheaves are required, the use of variable pitch sheaves is allowed during air balance, but replace them with an appropriate fixed sheave after air balance is completed. Select variable pitch sheaves to drive the fan at a speed that produces the specified capacity when set at the approximate midpoint of the sheave adjustment. Furnish motors for V-belt drives with adjustable bases, and with ODP enclosures.

2.10.1.5 Access Sections

Provide access sections where indicated and furnish with access doors as shown. Construct access sections in a manner identical to the remainder of the unit casing and equip with access doors.

2.10.1.6 Dampers

Provide dampers as specified in paragraph CONTROLS.

## 2.11 TERMINAL UNITS

### 2.11.1 Variable Air Volume (VAV)Terminal Units

#### 2.11.1.1 Variable Volume, Single Duct Terminal Units

Provide variable volume, single duct, terminal units with a calibrated air volume sensing device, air valve or damper, actuator, and accessory relays. Provide units that control air volume to within plus or minus 5 percent of each air set point volume as determined by the thermostat with variations in inlet pressures from 3/4 to 6 inch water gauge. Provide units with an internal resistance not exceeding 0.4 inch water gauge at maximum flow range. Provide external differential pressure taps separate from the control pressure taps for air flow measurement with a 0 to 1 inch water gauge range.

#### 2.11.1.2 Reheat Units

a. Electric Resistance Heaters: Provide the duct-mounting type electric resistance heaters consisting of a nickel-chromium resistor mounted on refractory material and a steel or aluminum frame for attachment to ductwork. Provide electric duct heater that meets the requirement of Underwriters Laboratories and NFPA 70 and is provided with a built-in or surface-mounted high-limit thermostat. Interlock electric duct heaters electrically so that they cannot be energized unless the fan is running.

## 2.12 FACTORY PAINTING

Factory paint units, which are not of galvanized construction, with a corrosion resisting paint finish according to ASTM A 123/A 123M or ASTM A 924/A 924M. Clean, phosphatize and coat internal and external ferrous metal surfaces with a paint finish which has been tested according to ASTM B 117, ASTM D 1654, and ASTM D 3359. Submit evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors. Provide rating of failure at the scribe mark that is not less than 6, average creepage not greater than 1/8 inch. Provide rating of the inscribed area that is not less than 10, no failure. On units constructed of galvanized steel that have been welded, provide a final shop docket of zinc-rich protective paint on exterior surfaces of welds or welds that have burned through from the interior according to ASTM D 520 Type I.

## 2.13 SUPPLEMENTAL COMPONENTS/SERVICES

### 2.13.1 Chilled, Condenser, or Dual Service Water Piping

The requirements for chilled, condenser, or dual service water piping and accessories are specified in Section 23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS

### 2.13.2 Refrigerant Piping

The requirements for refrigerant piping are specified in Section 23 23 00 REFRIGERANT PIPING.

### 2.13.3 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that

generates condensate in accordance with Section [22 00 00 PLUMBING, GENERAL PURPOSE][23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS] except as modified herein.

2.13.4 Backflow Preventers

The requirements for backflow preventers are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.13.5 Insulation

The requirements for shop and field applied insulation are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.13.6 Controls

The requirements for controls are specified in [Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS][ and ][Section 23 09 23 DIRECT DIGITAL CONTROL FOR HVAC AND OTHER LOCAL BUILDING SYSTEMS][Section 23 09 53.00 20 SPACE TEMPERATURE CONTROL SYSTEMS][ and ][23 09 23 BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC].

PART 3 EXECUTION

3.1 FIELD MEASUREMENTS

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

a. Install materials and equipment in accordance with the requirements of the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.

b. No installation is permitted to block or otherwise impede access to any existing machine or system. Install all hinged doors to swing open a minimum of 120 degrees. Provide an area in front of all access doors that clears a minimum of 3 feet. In front of all access doors to electrical circuits, clear the area the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333 (Electrical-Safety Related work practices)and an additional 3 feet.

c. Except as otherwise indicated, install emergency switches and alarms in conspicuous locations. Mount all indicators, to include gauges, meters, and alarms in order to be easily visible by people in the area.

3.2.1 Condensate Drain Lines

Provide water seals in the condensate drain from all [units][units except room [fan-coil units][ and ][coil-induction units]]. Provide a depth of each seal of 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Provide water seals that are constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Provide pipe cap

or plug cleanouts where indicated. Connect drains indicated to connect to the sanitary waste system using an indirect waste fitting. Insulate air conditioner drain lines as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.2.2 Equipment and Installation

Provide frames and supports for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Floor mount or ceiling hang air handling units as indicated. Anchor and fasten as detailed. Set floor-mounted equipment on not less than 6 inch concrete pads or curbs doweled in place unless otherwise indicated. Make concrete foundations for circulating pumps heavy enough to minimize the intensity of the vibrations transmitted to the piping and the surrounding structure, as recommended in writing by the pump manufacturer. In lieu of a concrete pad foundation, build a concrete pedestal block with isolators placed between the pedestal block and the floor. Make the concrete foundation or concrete pedestal block a mass not less than three times the weight of the components to be supported. Provide the lines connected to the pump mounted on pedestal blocks with flexible connectors. Submit foundation drawings as specified in paragraph DETAIL DRAWINGS. Provide concrete for foundations as specified in Section [03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE] [03 30 00 CAST-IN-PLACE CONCRETE].

3.2.3 Access Panels

Install access panels for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance of sufficient size, and locate them so that the concealed items are easily serviced and maintained or completely removed and replaced. Provide access panels as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.2.4 Flexible Duct

Install pre-insulated flexible duct in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Provide hangers, when required to suspend the duct, of the type recommended by the duct manufacturer and set at the intervals recommended.

3.2.5 Metal Ductwork

Install according to SMACNA 1966 unless otherwise indicated. Install duct supports for sheet metal ductwork according to SMACNA 1966, unless otherwise specified. Do not use friction beam clamps indicated in SMACNA 1966. Anchor risers on high velocity ducts in the center of the vertical run to allow ends of riser to move due to thermal expansion. Erect supports on the risers that allow free vertical movement of the duct. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, provide retainer clips.

3.2.6 Acoustical Duct Lining

Apply lining in cut-to-size pieces attached to the interior of the duct with nonflammable fire resistant adhesive conforming to ASTM C 916, Type I, NFPA 90A, UL 723, and ASTM E 84. Provide top and bottom pieces that lap

the side pieces and are secured with welded pins, adhered clips of metal, nylon, or high impact plastic, and speed washers or welding cup-head pins installed according to SMACNA 1966. Provide welded pins, cup-head pins, or adhered clips that do not distort the duct, burn through, nor mar the finish or the surface of the duct. Make pins and washers flush with the surfaces of the duct liner and seal all breaks and punctures of the duct liner coating with the nonflammable, fire resistant adhesive. Coat exposed edges of the liner at the duct ends and at other joints where the lining is subject to erosion with a heavy brush coat of the nonflammable, fire resistant adhesive, to prevent delamination of glass fibers. Apply duct liner to flat sheet metal prior to forming duct through the sheet metal brake. Additionally secure lining at the top and bottom surfaces of the duct by welded pins or adhered clips as specified for cut-to-size pieces. Other methods indicated in SMACNA 1966 to obtain proper installation of duct liners in sheet metal ducts, including adhesives and fasteners, are acceptable.

### 3.2.7 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, perform temporary dust control protection. Protect the distribution system (supply and return) with temporary seal-offs at all inlets and outlets at the end of each day's work. Keep temporary protection in place until system is ready for startup.

### 3.2.8 Insulation

Provide thickness and application of insulation materials for ductwork, piping, and equipment according to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Externally insulate outdoor air intake ducts and plenums [up to the point where the outdoor air reaches the conditioning unit] [or] [up to the point where the outdoor air mixes with the outside air stream].

### 3.2.9 Duct Test Holes

Provide holes with closures or threaded holes with plugs in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Provide extensions, complete with cap or plug, where the ducts are insulated.

### 3.2.10 Power Transmission Components Adjustment

Test V-belts and sheaves for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Uniformly load belts on drive side to prevent bouncing. Make alignment of direct driven couplings to within 50 percent of manufacturer's maximum allowable range of misalignment.

## 3.3 EQUIPMENT PADS

Provide equipment pads to the dimensions shown or, if not shown, to conform to the shape of each piece of equipment served with a minimum 3-inch margin around the equipment and supports. Allow equipment bases and foundations, when constructed of concrete or grout, to cure a minimum of 14 calendar days before being loaded.

## 3.4 CUTTING AND PATCHING

Install work in such a manner and at such time that a minimum of cutting and patching of the building structure is required. Make holes in exposed locations, in or through existing floors, by drilling and smooth by sanding. Use of a jackhammer is permitted only where specifically approved. Make holes through masonry walls to accommodate sleeves with an iron pipe masonry core saw.

## 3.5 CLEANING

Thoroughly clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks. When the work area is in an occupied space such as an office, protect all furniture and equipment from dirt and debris. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces vacuum-swept clean.

## 3.6 PENETRATIONS

Provide sleeves and prepared openings for duct mains, branches, and other penetrating items, and install during the construction of the surface to be penetrated. Cut sleeves flush with each surface. Place sleeves for round duct 15 inches and smaller. Build framed, prepared openings for round duct larger than 15 inches and square, rectangular or oval ducts. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Provide one inch clearance between penetrating and penetrated surfaces except at grilles, registers, and diffusers. Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber conforming with ASTM C 553, Type 1, Class B-2.

a. Sleeves: Fabricate sleeves, except as otherwise specified or indicated, from 20 gauge thick mill galvanized sheet metal. Where sleeves are installed in bearing walls or partitions, provide black steel pipe conforming with ASTM A 53/A 53M, Schedule 20.

b. Framed Prepared Openings: Fabricate framed prepared openings from 20 gauge galvanized steel, unless otherwise indicated.

c. Insulation: Provide duct insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS continuous through sleeves and prepared openings except firewall penetrations. Terminate duct insulation at fire dampers and flexible connections. For duct handling air at or below 60 degrees F, provide insulation continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air.

d. Closure Collars: Provide closure collars of a minimum 4 inches wide, unless otherwise indicated, for exposed ducts and items on each side of penetrated surface, except where equipment is installed. Install collar tight against the surface and fit snugly around the duct or insulation. Grind sharp edges smooth to prevent damage to penetrating surface. Fabricate collars for round ducts 15 inches in diameter or less from 20 gauge galvanized steel. Fabricate collars for square and rectangular ducts, or round ducts with minimum dimension over

15 inches from 18 gauge galvanized steel. Fabricate collars for square and rectangular ducts with a maximum side of 15 inches or less from 20 gauge galvanized steel. Install collars with fasteners a maximum of 6 inches on center. Attach to collars a minimum of 4 fasteners where the opening is 12 inches in diameter or less, and a minimum of 8 fasteners where the opening is 20 inches in diameter or less.

e. Firestopping: Where ducts pass through fire-rated walls, fire partitions, and fire rated chase walls, seal the penetration with fire stopping materials as specified in Section 07 84 00 FIRESTOPPING.

## 3.7 FIELD PAINTING

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except clean to bare metal on metal surfaces subject to temperatures in excess of 120 degrees F. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Provide aluminum or light gray finish coat.

a. Temperatures less than 120 degrees F: Immediately after cleaning, apply one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat to metal surfaces subject to temperatures less than 120 degrees F.

b. Temperatures between 120 and 400 degrees F: Apply two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of two mils to metal surfaces subject to temperatures between 120 and 400 degrees F.

c. Temperatures greater than 400 degrees F: Apply two coats of 315 degrees C 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of two mils to metal surfaces subject to temperatures greater than 400 degrees F.

### 3.7.1 Finish Painting

The requirements for finish painting of items only primed at the factory, and surfaces not specifically noted otherwise, are specified in Section 09 90 00 PAINTS AND COATINGS.

### 3.7.2 Color Coding Scheme for Locating Hidden Utility Components

Use scheme in buildings having suspended grid ceilings. Provide color coding scheme that identifies points of access for maintenance and operation of components and equipment that are not visible from the finished space and are accessible from the ceiling grid, consisting of a color code board and colored metal disks. Make each colored metal disk approximately 3/8 inch diameter and secure to removable ceiling panels with fasteners. Insert each fastener into the ceiling panel so as to be concealed from view. Provide fasteners that are manually removable without the use of tools and that do not separate from the ceiling panels when the panels are dropped from ceiling height. Make installation of colored metal

disks follow completion of the finished surface on which the disks are to be fastened. Provide color code board that is approximately 3 foot wide, 30 inches high, and 1/2 inches thick. Make the board of wood fiberboard and frame under glass or 1/16 inch transparent plastic cover. Make the color code symbols approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. Mount the color code board in the mechanical or equipment room]. Make the color code system as indicated below:

| Color | System | Item | Location |
|---|---|---|---|
| [_____] | [_____] | [_____] | [_____] |

## 3.8 IDENTIFICATION SYSTEMS

Provide identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and item number on all valves and dampers. Provide tags that are 1-3/8 inch minimum diameter with stamped or engraved markings. Make indentations black for reading clarity. Attach tags to valves with No. 12 AWG 0.0808-inch diameter corrosion-resistant steel wire, copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

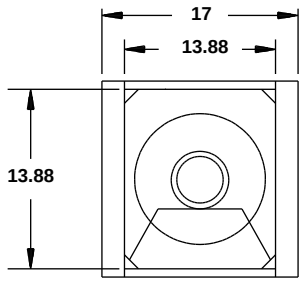
## 3.9 TESTING, ADJUSTING, AND BALANCING

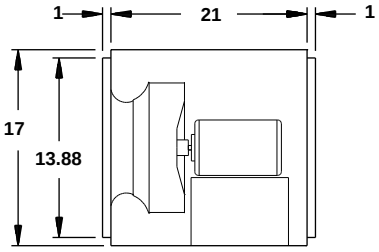
The requirements for testing, adjusting, and balancing are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING. Begin testing, adjusting, and balancing only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

## 3.10 CLEANING AND ADJUSTING

Provide a temporary bypass for water coils to prevent flushing water from passing through coils. Inside of [room fan-coil units][coil-induction units,] [air terminal units,] [unit ventilators,] thoroughly clean ducts, plenums, and casing of debris and blow free of small particles of rubbish and dust and then vacuum clean before installing outlet faces. Wipe equipment clean, with no traces of oil, dust, dirt, or paint spots. Provide temporary filters prior to startup of all fans that are operated during construction, and install new filters after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. Maintain system in this clean condition until final acceptance. Properly lubricate bearings with oil or grease as recommended by the manufacturer. Tighten belts to proper tension. Adjust control valves and other miscellaneous equipment requiring adjustment to setting indicated or directed. Adjust fans to the speed indicated by the manufacturer to meet specified conditions.

-- End of Section --




# SQ

## Direct Drive Centrifugal Inline Fan

**Tag:** EF-1

### STANDARD CONSTRUCTION FEATURES

• Galvanized steel housing • Backward inclined aluminum wheel • Two bolted access panels • Integral duct connection flanges • Ball bearing motors (sizes 100-160), sleeve bearing motors (sizes 60-95) • Corrosion resistant fasteners

### SELECTED OPTIONS & ACCESSORIES

Switch - Nema-1, Toggle, Mounted & Wired
(Inline)Damper WD-330-PB-14x14, Gravity Operated, Int Mnt.
Spring Hanging Isolators and Brackets
Solid State Speed Control - 5WSSC, Shipped Loose
PSC Motor

NOTES: All dimensions shown are in units of inches
Fan weight is without accessories

**DIMENSIONS**

| Approx. Fan Weight (lb) | Optional Damper (in) |
|---|---|
| 56 | 14 x 14 |

**PERFORMANCE** (Elevation ft = 0, Airstream Temperature F = 70)

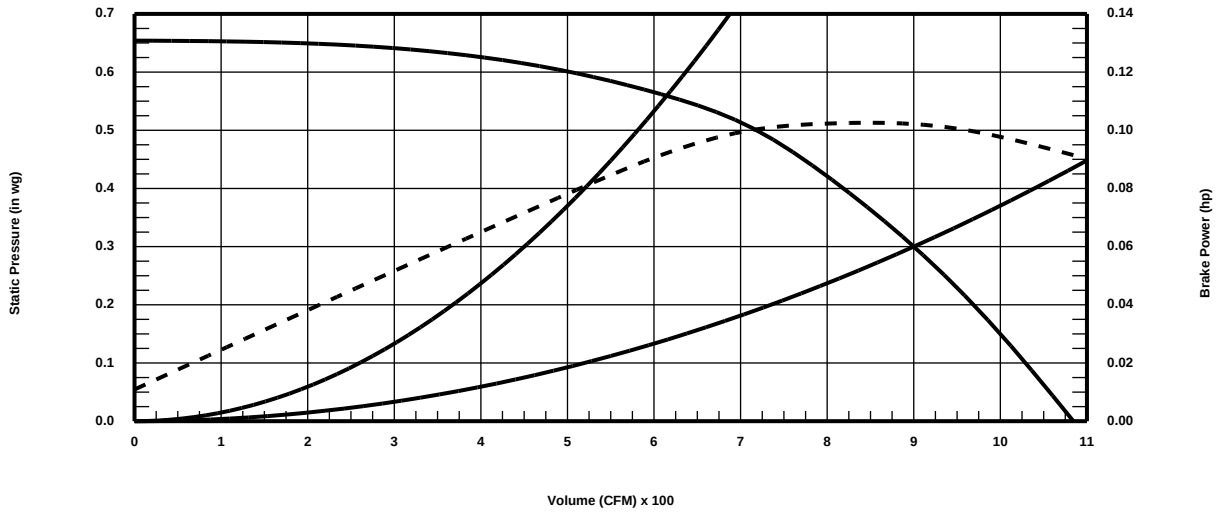
| Qty | Model | Volume (CFM) | SP (in wg) | FRPM | Operating Power (hp) | Motor Information | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Size (hp) | V/C/P | Encl: | Motor RPM: | Windings | FLA (A) |
| 1 | SQ-100-A | 900 | 0.3 | 1,286 | 0.1 | 1/4 | 115/60/1 | ODP | 1725 | 1 | 5.8 |

**SOUND**

| Inlet / Radiated Sound Power by Octave Band | | | | | | | | LwA | dBA | Sones |
|---|---|---|---|---|---|---|---|---|---|---|
| 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | | | |
| 66 / 67 | 69 / 71 | 66 / 60 | 66 / 59 | 62 / 57 | 56 / 51 | 50 / 43 | 48 / 44 | 66 / 62 | 55 / 51 | 7.2 / 5.7 |

FLA - Based on tables 150 or 148 of National Electrical Code 2002.

LwA - A weighted sound power level, based on ANSI S1.4.
dBA - A weighted sound pressure level, based on 11.5 dB attenuation per octave band at 5.0 ft. Sones calculated using AMCA 301 at 5.0 ft.



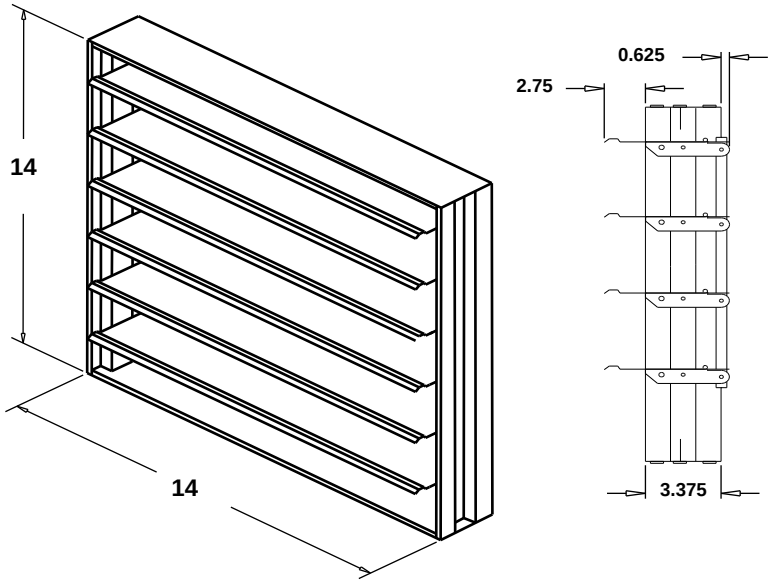
# WD-330 Vertical Mount Exhaust Damper

## STANDARD CONSTRUCTION FEATURES

Vertical mount exhaust damper is constructed of 18 ga. galvanized steel with pre-punched mounting holes and a flangeless frame.
• Damper blades are 0.025 in roll formed aluminum with vinyl seals on the closing edge • Steel axles are 0.188 in diameter zinc plated mounted in acetal bushing • Synthetic axle bearings

## Accessory Configuration

| | |
|---|---|
| **Blade Action** | Parallel |
| **Actuator Type** | Gravity |



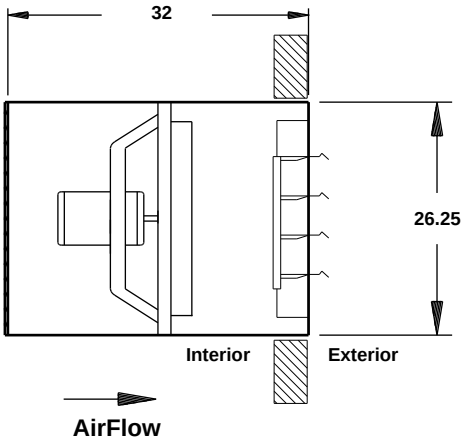

NOTES: All dimensions shown are in units of inches
Width and height furnished approximately 0.125 in undersize.

**1A - Flush Exterior Standard Exhaust**

**For Interior Service Applications**

# SE2

## Sidewall Direct Drive Exhaust Fan




**Note: Wall Housing Sizes 42 and Larger with heavy motors and all Filtered Wall Housings need additional bracing.**

**Tag:** EF2,3

### STANDARD CONSTRUCTION FEATURES

• Galvanized steel fan panel • Die formed, galvanized steel drive frame assembly • Welded and painted steel propeller • Ball bearing motors • Corrosion resistant fasteners

### SELECTED OPTIONS & ACCESSORIES

Damper WD-320-PB-22x22, Gravity Operated
Short Wall Hsg., Flush Exterior w/ OSHA Guard
Switch - Nema-1, Toggle, Ship With Unit, Field Mounted
Galv. Weatherhood 45 Degree w/ B.S.

NOTES: All dimensions shown are in units of inches
Fan weight is without accessories

**DIMENSIONS**

| Approx. Fan Weight (lb) | Recommended Roof/Wall Opening: (in) | Optional Damper (in) |
|---|---|---|
| 60 | 27.25 x 27.25 | 22 x 22 |

**PERFORMANCE** (Elevation ft = 0, Airstream Temperature F = 70)

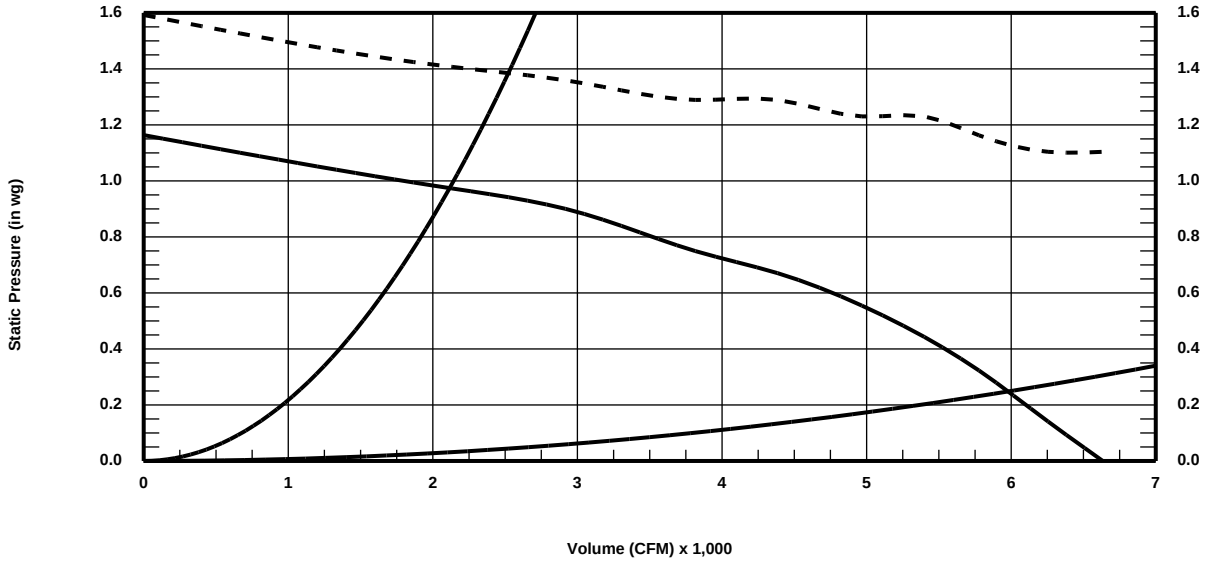
| Qty | Model | Volume (CFM) | SP (in wg) | FRPM | Operating Power (hp) | Motor Information | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Size (hp) | V/C/P | Encl: | Motor RPM: | Windings | NEC FLA (A) |
| 2 | SE2-20-427-A10 | 5,969 | 0.25 | 1,750 | 1.14 | 1 | 115/60/1 | ODP | 1750 | 1 | 16.0 |

**SOUND**

| Inlet Sound Power by Octave Band | | | | | | | | Lwa | dBA | Sones |
|---|---|---|---|---|---|---|---|---|---|---|
| 62.5 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | | | |
| 85 | 88 | 87 | 89 | 87 | 82 | 78 | 76 | 91 | 80 | 31 |

FLA - Based on tables 148 or 150 of National Electrical Code 2002. Actual motor FLA may vary, for sizing thermal overload, consult factory.

LwA - A weighted sound power level, based on ANSI S1.4. dBA - A weighted sound pressure level, based on 11.5 dB attenuation per octave band at 5.0 ft. Sones calculated using AMCA 301 at 5.0 ft.



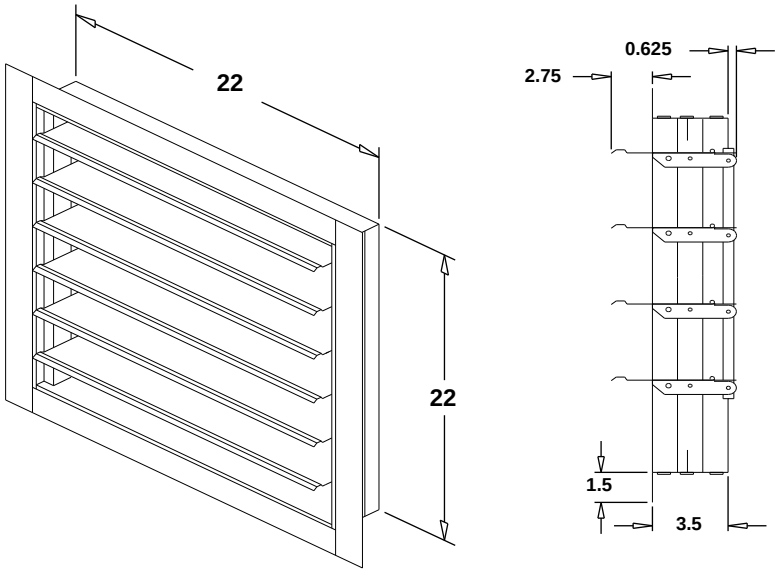
# WD-320 Vertical Mount Exhaust Damper

## STANDARD CONSTRUCTION FEATURES

Vertical mount exhaust damper is constructed of 18 ga. galvanized steel with pre-punched mounting holes and a flanged frame.
• Damper blades are 0.025 in roll formed aluminum with vinyl seals on the closing edge • Steel axles are 0.188 in diameter zinc plated steel mounted in acetal bushings • Synthetic axle bearings

## Accessory Configuration

| | |
|---|---|
| **Blade Action** | Parallel |
| **Actuator Type** | Gravity |

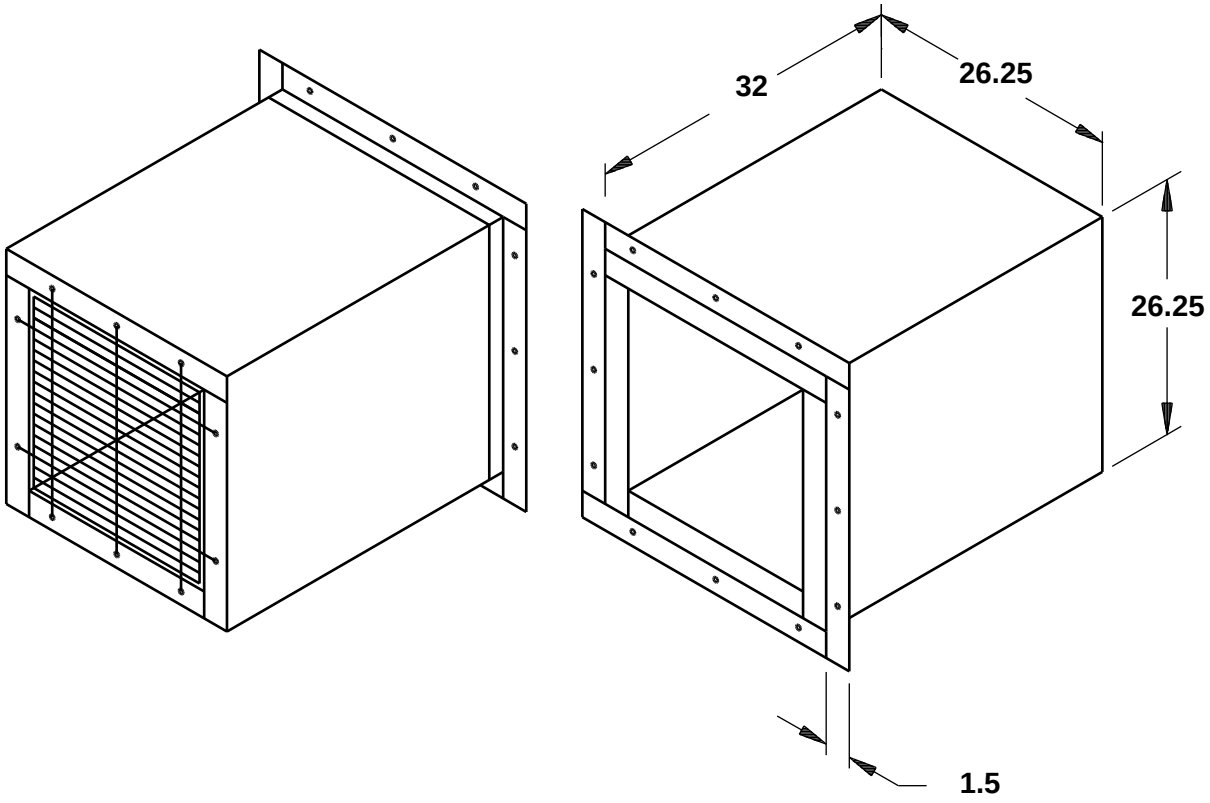



NOTES: All dimensions shown are in units of inches
Width and height furnished approximately 0.125 in undersize.

# WH Wall Housing

## STANDARD CONSTRUCTION FEATURES

• Galvanized steel construction • Heavy gauge mounting flanges • Pre-punched mounting holes • Inside flanges allow damper to be mounted • Overlapping weatherhood flange keeps rain out • Protective guard of welded steel wire completely protects the drive side of the wall housing.




NOTES: All dimensions shown are in units of inches

SECTION 23 03 00.00 20

BASIC MECHANICAL MATERIALS AND METHODS
**01/07**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM B 117 | (2007a) Standing Practice for Operating Salt Spray (Fog) Apparatus |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C2 | (2007; Errata 2007; INT 2008) National Electrical Safety Code |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA MG 1 | (2007; Errata 2008) Standard for Motors and Generators |
| NEMA MG 10 | (2001; R 2007) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors |
| NEMA MG 11 | (1977; R 2007) Energy Management Guide for Selection and Use of Single Phase Motors |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |

1.2 RELATED REQUIREMENTS

This section applies to all sections of Divisions: 22, PLUMBING; and 23, HEATING, VENTILATING, AND AIR CONDITIONING of this project specification, unless specified otherwise in the individual section.

1.3 QUALITY ASSURANCE

1.3.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements,

manufacturers' catalogs, or brochures during the 2 year period.

1.3.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.3 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.4 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.5.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.5.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's

recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

## 1.5 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

## 1.6 ELECTRICAL INSTALLATION REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

### 1.6.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters [(except starters/controllers which are indicated as part of a motor control center)], control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, [the motor control equipment forming a part of motor control centers,] and the electrical power circuits shall be provided under Division 26, except internal wiring for components of package equipment shall be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

### 1.6.2 Modifications to Existing Systems

Where existing mechanical systems and motor-operated equipment require modifications, provide electrical components under Division 26.

### 1.6.3 High Efficiency Motors

#### 1.6.3.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

#### 1.6.3.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors shall be selected based on

high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

### 1.6.4 Three-Phase Motor Protection

Provide controllers for motors rated one one horsepower and larger with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

## 1.7 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

## 1.8 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

# PART 2 PRODUCTS

Not Used

# PART 3 EXECUTION

## 3.1 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

### 3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B 117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test,

the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

-- End of Section --

# ACH 550 Series
# Adjustable Frequency AC Drives

## Submittal

Project: SOF Riverine & Combatant Craft Operations

Specification Section:15000

Architect:Dammon Engineering, Inc.

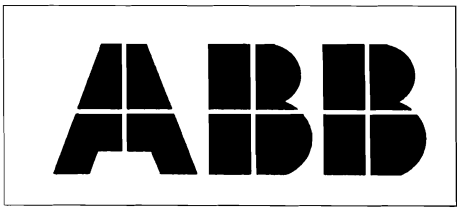
Submitted By:
Automated Control Systems, Inc.
Paul Reuter

Contractor: Gallo Mechanical Contr

Engineer: Damien P Serauskas

Customer: Stennis Space Center

Date: April 13th, 2009



# Submittal Schedule

This schedule includes the products supplied as part of this submittal.

| Schedule | | | Motor Data[1] | | | Drive Data | | | |
|---|---|---|---|---|---|---|---|---|---|
| Item | Qty | Tag / Equipment ID | HP | FLA | Voltage | Product ID | HP | Output Amps | Voltage |
| 1 | 1 | AHU-2 | 7.5 | 11 | 460 VAC | ACH550-BCR-012A-4+B055+F267 | 7.5 | 11.9 | 480 VAC |
| 2 | 3 | AHU-1 P-1 P-2 | 2 | 3.4 | 460 VAC | ACH550-BCR-04A1-4+B055+F267 | 2 | 4.1 | 480 VAC |

**Notes:** 1. AC Motor Data is per National Electrical Code Table 430.250 for typical motors used in most applications and is provided as typical data only. DC motor data is per typical industry standards. Actual motor data may vary.

# Clarifications and Exceptions to Specification and Terms

The comments and clarifications that follow are offered in response to the specification items identified below. Please refer to the specification section and paragraph indicated. Any contract executed based on this proposal is done based acceptance of the exceptions noted herein.

| Item ID | Title | Clarifications and Exceptions |
|---|---|---|
| P-1, P-2 | | Field provided disconnect by division 16 shall include auxiliary contacts for field interlock wiring requirements. Auxiliary contact should be interlocked to VFD located in the mechanical room. |
| | | |
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| | | |

# Submittal Schedule Details for AHU-2

| Item | Tag / Equipment ID | Product ID |
|---|---|---|
| 1 | AHU-2 | ACH550-BCR-012A-4+B055+F267 |

| Item Description |
|---|
| **Input Voltage:** 480 VAC<br>**Rated Output Current:** 11.9 AMPS<br>**Construction:** E-clipse-Bypass, Circuit Breaker<br>**Enclosure:** NEMA 12 UL Type 12<br>**Nominal Horsepower:** 7.5<br>**Frame Size:** R1<br>**Input Disconnecting Means:** Circuit Breaker<br>**Bypass:** E-Clipse Bypass<br>**Input Impedance:** 5%<br>**Short Circuit Current Rating:** 100 kA<br>**Communication Protocols:** Johnson Controls N2, Siemens Buildings Technologies FLN (P1), Modbus RTU, BACnet<br>**Other Options:** Service Switch |

| Drive Input Fuse Ratings[1] | |
|---|---|
| (Note: Drive is UL approved without the need for input fuses. Fuse rating information provided for customer reference) | |
| **Amps (600 V)** | **Bussmann Type** |
| 15 | KTK-R-15 |

| Wire Size Capacities of Power Terminals | | | | |
|---|---|---|---|---|
| **Circuit Breaker** | **Disconnect Switch** | **Terminal Block** | **Overload Relay** | **Ground Lug** |
| #8<br>40 in-lbs | N/A<br>N/A | #8<br>15 in-lbs | N/A<br>N/A | #8<br>35 in-lbs |

| Dimensions and Weights | | | | |
|---|---|---|---|---|
| **Height in / mm** | **Width in / mm** | **Depth in / mm** | **Weight lbs / kg** | **Dimension Drawing** |
| 33.2 / 842 | 17.4 / 443 | 13.5 / 343 | 78 / 35.4 | 3AUA0000016376 1 |

| Heat Dissipation & Airflow Requirements | | | |
|---|---|---|---|
| **Power Losses** | | **Airflow** | |
| **Watts** | **BTU/Hr** | **CFM** | **CM/Hr** |
| 172 | 587 | 26 | 44 |

| Reference Drawings | | |
|---|---|---|
| **Power Wiring** | **Connection Diagram** | **Dimension Detail** |
| BCVCR012PW-C | BCBDR018CC-A | 3AUA0000016376 |

# Submittal Schedule Details for AHU-1 P-1 P-2

| Item | Tag / Equipment ID | Product ID |
|---|---|---|
| 2 | AHU-1 P-1 P-2 | ACH550-BCR-04A1-4+B055+F267 |

| Item Description |
|---|
| **Input Voltage:** 480 VAC<br>**Rated Output Current:** 4.1 AMPS<br>**Construction:** E-clipse-Bypass, Circuit Breaker<br>**Enclosure:** NEMA 12 UL Type 12<br>**Nominal Horsepower:** 2<br>**Frame Size:** R1<br>**Input Disconnecting Means:** Circuit Breaker<br>**Bypass:** E-Clipse Bypass<br>**Input Impedance:** 5%<br>**Short Circuit Current Rating:** 100 kA<br>**Communication Protocols:** Johnson Controls N2, Siemens Buildings Technologies FLN (P1), Modbus RTU, BACnet<br>**Other Options:** Service Switch |

| Drive Input Fuse Ratings[1] | |
|---|---|
| (Note: Drive is UL approved without the need for input fuses. Fuse rating information provided for customer reference) | |
| **Amps (600 V)** | **Bussmann Type** |
| 15 | KTK-R-15 |

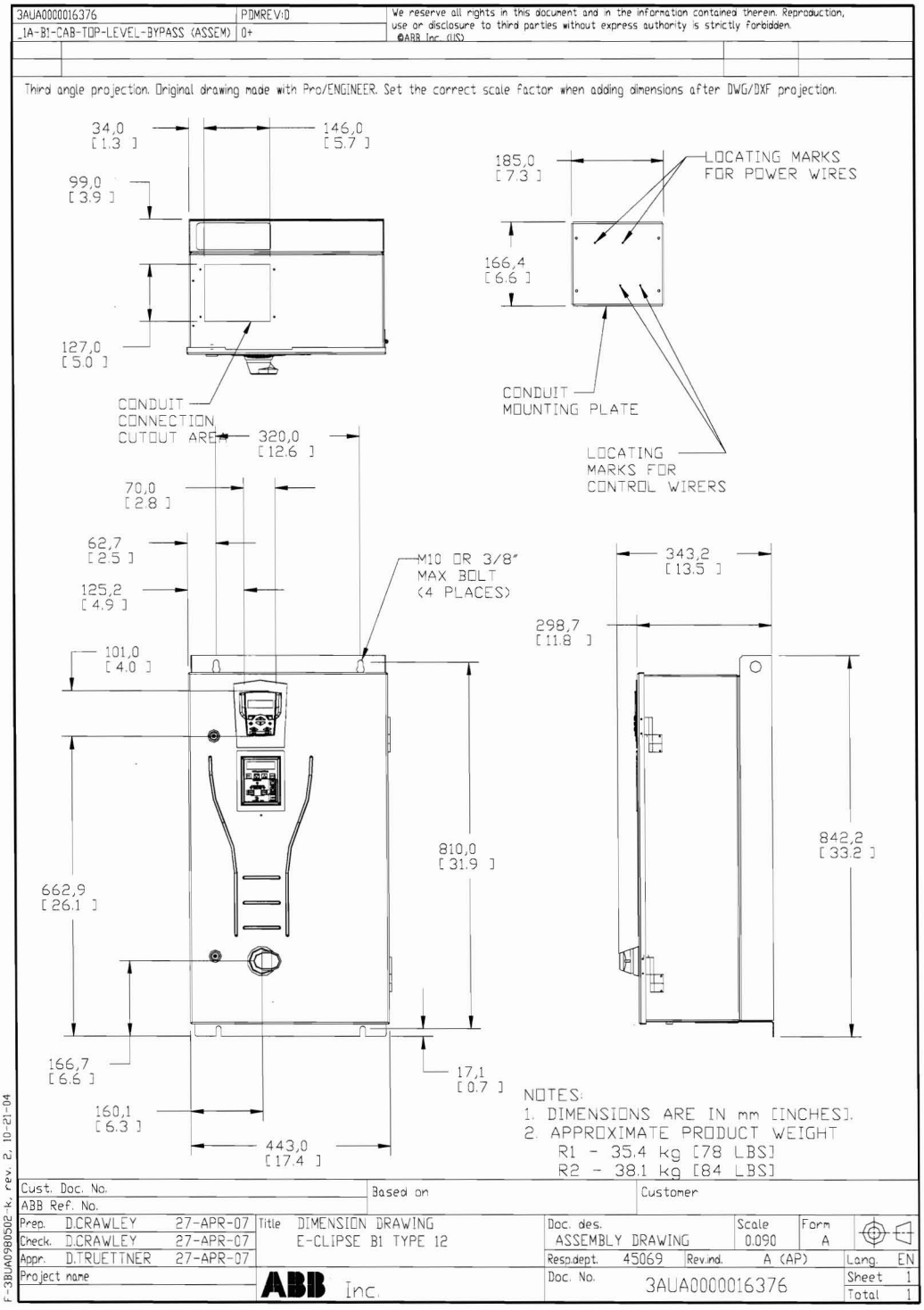
| Wire Size Capacities of Power Terminals | | | | |
|---|---|---|---|---|
| **Circuit Breaker** | **Disconnect Switch** | **Terminal Block** | **Overload Relay** | **Ground Lug** |
| #8<br>40 in-lbs | N/A<br>N/A | #8<br>15 in-lbs | N/A<br>N/A | #8<br>35 in-lbs |

| Dimensions and Weights | | | | |
|---|---|---|---|---|
| **Height in / mm** | **Width in / mm** | **Depth in / mm** | **Weight lbs / kg** | **Dimension Drawing** |
| 33.2 / 842 | 17.4 / 443 | 13.5 / 343 | 78 / 35.4 | 3AUA0000016376 1 |

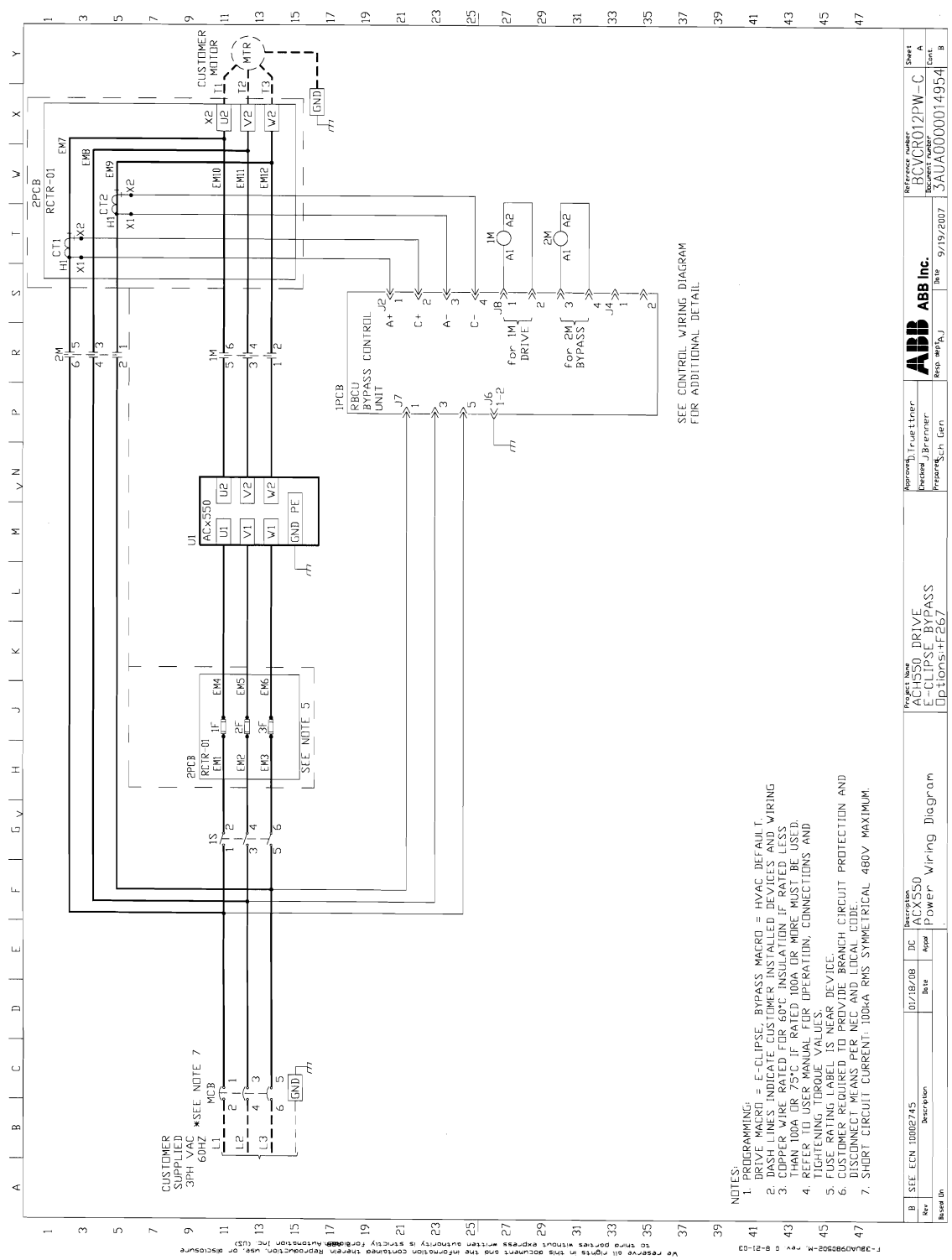
| Heat Dissipation & Airflow Requirements | | | |
|---|---|---|---|
| **Power Losses** | | **Airflow** | |
| **Watts** | **BTU/Hr** | **CFM** | **CM/Hr** |
| 52 | 177 | 26 | 44 |

| Reference Drawings | | |
|---|---|---|
| **Power Wiring** | **Connection Diagram** | **Dimension Detail** |
| BCVCR012PW-C | BCBDR018CC-A | 3AUA0000016376 |

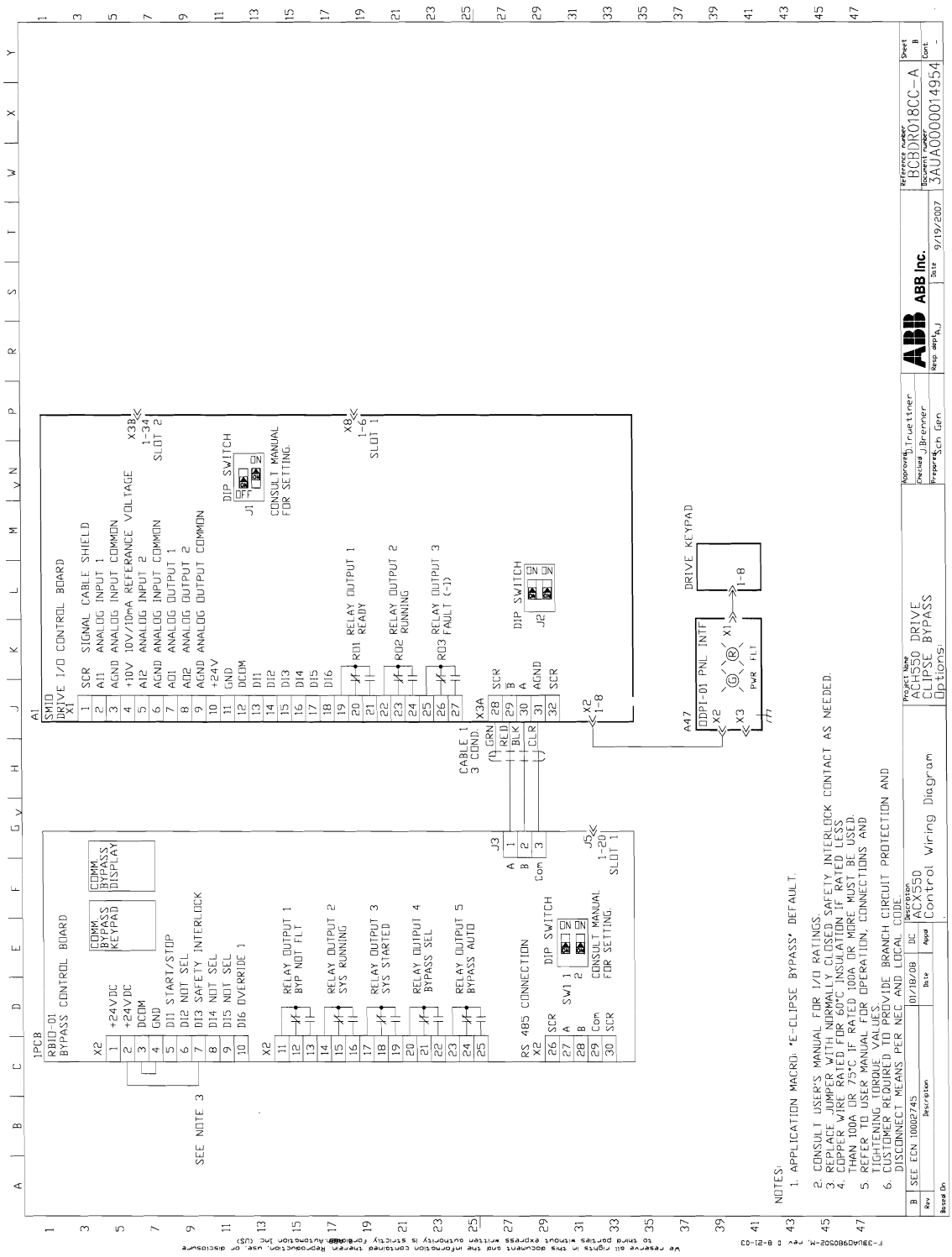
# Dimension Drawing for AHU-2, AHU-1 P-1 P-2



# Power Drawing for AHU-2, AHU-1 P-1 P-2



# Connection Drawing for AHU-2, AHU-1 P-1 P-2



SECTION 23 05 15

COMMON PIPING FOR HVAC
**02/09**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

| | |
|---|---|
| AISC 325 | (2005) Manual of Steel Construction |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS A5.8/A5.8M | (2004; Errata 2004) Specification for Filler Metals for Brazing and Braze Welding |
| AWS WHB-2.9 | (2004) Welding Handbook; Volume Two - Welding Processes |

ASME INTERNATIONAL (ASME)

| | |
|---|---|
| ASME A112.18.1 | (2005) Standard for Plumbing Fixture Fittings |
| ASME A112.19.2 | (2008) Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals |
| ASME B1.20.7 | (1991; R 2008) Standard for Hose Coupling Screw Threads (Inch) |
| ASME B16.1 | (2005) Standard for Gray Iron Threaded Fittings; Classes 125 and 250 |
| ASME B16.11 | (2005) Forged Fittings, Socket-Welding and Threaded |
| ASME B16.22 | (2001; R 2005) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.25 | (2007) Standard for Buttwelding Ends |
| ASME B16.26 | (2006) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes |
| ASME B16.3 | (2006) Malleable Iron Threaded Fittings, Classes 150 and 300 |
| ASME B16.39 | (1998; R 2006) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300 |

| | |
|---|---|
| ASME B16.4 | (2006) Standard for Gray Iron Threaded Fittings; Classes 125 and 250 |
| ASME B16.5 | (2003) Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 |
| ASME B16.9 | (2007) Standard for Factory-Made Wrought Steel Buttwelding Fittings |
| ASME B31.3 | (2008) Process Piping |
| ASME B36.10M | (2004) Standard for Welded and Seamless Wrought Steel Pipe |
| ASME B40.100 | (2005) Pressure Gauges and Gauge Attachments |
| ASME BPVC SEC IX | (2007; Addenda 2008) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications |
| ASME BPVC SEC VIII D1 | (2007; Addenda 2008) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 105/A 105M | (2005) Standard Specification for Carbon Steel Forgings for Piping Applications |
| ASTM A 106/A 106M | (2008) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service |
| ASTM A 126 | (2004) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings |
| ASTM A 183 | (2003) Standard Specification for Carbon Steel Track Bolts and Nuts |
| ASTM A 197/A 197M | (2000; R 2006) Standard Specification for Cupola Malleable Iron |
| ASTM A 234/A 234M | (2007) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service |
| ASTM A 276 | (2008a) Standard Specification for Stainless Steel Bars and Shapes |
| ASTM A 278/A 278M | (2001; R 2006) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 degrees F (350 degrees C) |
| ASTM A 307 | (2007b) Standard Specification for Carbon |

| | |
|---|---|
| | Steel Bolts and Studs, 60 000 PSI Tensile Strength |
| ASTM A 312/A 312M | (2008a) Standard Specification for Seamless, Welded, and Heavily Worked Austenitic Stainless Steel Pipes |
| ASTM A 480/A 480M | (2008b) Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip |
| ASTM A 53/A 53M | (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A 563 | (2007a) Standard Specification for Carbon and Alloy Steel Nuts |
| ASTM A 6/A 6M | (2008a) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling |
| ASTM A 74 | (2008a) Standard Specification for Cast Iron Soil Pipe and Fittings |
| ASTM B 117 | (2007a) Standing Practice for Operating Salt Spray (Fog) Apparatus |
| ASTM B 32 | (2008) Standard Specification for Solder Metal |
| ASTM B 370 | (2003) Standard Specification for Copper Sheet and Strip for Building Construction |
| ASTM B 62 | (2002) Standard Specification for Composition Bronze or Ounce Metal Castings |
| ASTM B 749 | (2003) Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products |
| ASTM B 88 | (2003) Standard Specification for Seamless Copper Water Tube |
| ASTM C 109/C 109M | (2008) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens) |
| ASTM C 404 | (2007) Standard Specification for Aggregates for Masonry Grout |
| ASTM C 476 | (2008) Standard Specification for Grout for Masonry |
| ASTM C 553 | (2008) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications |

| | |
|---|---|
| ASTM C 564 | (2008) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings |
| ASTM C 67 | (2008) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile |
| ASTM C 920 | (2008) Standard Specification for Elastomeric Joint Sealants |
| ASTM D 2000 | (2008) Standard Classification System for Rubber Products in Automotive Applications |
| ASTM E 1 | (2007) Standard Specification for ASTM Liquid-in-Glass Thermometers |
| ASTM E 814 | (2008b) Standard Test Method for Fire Tests of Through-Penetration Fire Stops |
| ASTM F 104 | (2003) Standard Classification System for Nonmetallic Gasket Materials |

FLUID SEALING ASSOCIATION (FSA)

| | |
|---|---|
| FSA-0017 | (1995e6) Standard for Non-Metallic Expansion Joints and Flexible Pipe Connectors Technical Handbook |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C2 | (2007; Errata 2007; INT 2008) National Electrical Safety Code |

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

| | |
|---|---|
| MSS SP-125 | (2000) Standard for Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves |
| MSS SP-58 | (2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture |
| MSS SP-67 | (2002a; R 2004) Standard for Butterfly Valves |
| MSS SP-69 | (2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application |
| MSS SP-70 | (2006) Standard for Cast Iron Gate Valves, Flanged and Threaded Ends |
| MSS SP-71 | (2005) Standard for Gray Iron Swing Check Valves, Flanged and Threaded Ends |
| MSS SP-72 | (1999) Standard for Ball Valves with Flanged or Butt-Welding Ends for General Service |

| | |
|---|---|
| MSS SP-85 | (2002) Standard for Cast Iron Globe & Angle Valves, Flanged and Threaded Ends |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA MG 1 | (2007; Errata 2008) Standard for Motors and Generators |
| NEMA MG 10 | (2001; R 2007) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors |
| NEMA MG 11 | (1977; R 2007) Energy Management Guide for Selection and Use of Single Phase Motors |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| CID A-A-1922 | (Rev A; Notice 1) Shield, Expansion (Caulking Anchors, Single Lead) |
| CID A-A-1923 | (Rev A; Notice 1) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors) |
| CID A-A-55614 | (Basic; Notice 1) Shield, Expansion (Non-Drilling Expansion Anchors) |
| CID A-A-55615 | (Basic; Notice 1) Shield, Expansion (Wood Screw and Lag Bolt Self-Threading Anchors |
| FS A-A-1924 | (1995, R 2001-Rev A) Standard for Shield, Expansion; (Self Drilling Tubular Expansion Shell Bolt Anchors) |
| FS A-A-1925 | (Rev A; Notice 1) Shield, Expansion (Nail Anchors) |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1479 | (2003; Rev thru Dec 2008) Standard for Fire Tests of Through-Penetration Fire Stops |

## 1.2 GENERAL REQUIREMENTS

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section.

Submit Record Drawings for pipes, valves and accessories providing current factual information including deviations and amendments to the drawings, and concealed and visible changes in the work.

Submit Coordination Drawings for pipes, valves and specialties showing coordination of work between different trades and with the structural and architectural elements of work. Detail all drawings sufficiently to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Indicate on drawings where conflicts or clearance problems exist between various trades.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit the following for pipes, valves and specialties showing conformance with the referenced standards contained within this section.

Record Drawings

Submit Installation Drawings for pipes, valves and specialties in accordance with the paragraph entitled, "Pipe Installation," of this section.

SD-03 Product Data

Submit equipment and performance data for the following items consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

Submit Manufacturer's catalog data for the following items:

Pipe and Fittings
Piping Specialties
Valves
Miscellaneous Materials
Supporting Elements

Equipment Foundation Data shall be in accordance with paragraph entitled, "General Requirements," of this section.

SD-06 Test Reports

Submit test reports on the following tests in accordance with paragraph entitled, "Piping Installation," of this section.

Hydrostatic Tests
Air Tests
Drainage Tests
Pneumatic Tests

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with paragraph entitled, "Operation and Maintenance," of this section.

## 1.4 QUALITY ASSURANCE

### 1.4.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

### 1.4.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

### 1.4.3 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

### 1.4.4 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

### 1.4.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

#### 1.4.5.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

#### 1.4.5.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative

requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.5 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

[1.6 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.
]
[1.7 ELECTRICAL INSTALLATION REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.7.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters except starters/controllers which are indicated as part of a motor control center, control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors are not permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, [the motor control equipment forming a part of motor control centers,] and the electrical power circuits shall be provided under Division 26, except internal wiring for components of package equipment shall be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

1.7.2 High Efficiency Motors

1.7.2.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower

alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

1.7.2.2 High Efficiency Polyphase Motors

Unless otherwise specified, select polyphase motors based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

1.7.3 Three-Phase Motor Protection

Provide controllers for motors rated one one horsepower and larger with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

]1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and trained in operating theory as well as practical operation and maintenance work.

Give instruction during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.9 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 Type BCS, Black Carbon Steel

Pipe 1/8 through 12 inches shall be Schedule 40 black carbon steel, conforming to ASTM A 53/A 53M.

Pipe 1/8 through 10 inches shall be Schedule 40 seamless or electric-resistance welded black carbon steel, conforming to ASTM A 53/A 53M, [Type E, Grade B (electric-resistance welded)] [Type S (seamless)]. Grade A should be used for permissible field bending, in both cases.

Pipe 12 through 24 inches shall be 0.375-inch wall seamless black carbon steel, conforming to ASTM A 53/A 53M, [Type E, Grade B (electric-resistance welded)] [Type S (seamless)].

Fittings 2 inches and under shall be 150-pounds per square inch, gage (psig) working steam pressure (wsp) banded black malleable iron screwed, conforming to ASTM A 197/A 197M and ASME B16.3.

Unions 2 inches and under shall be 250 pounds per square inch, wsp female, screwed, black malleable iron with brass-to-iron seat, and ground joint, conforming to ASME B16.39.

Fittings 2-1/2 inches and over shall be Steel butt weld, conforming to ASTM A 234/A 234M and ASME B16.9 to match pipe wall thickness.

Flanges 2-1/2 inches and over shall be 150-pound forged-steel conforming to ASME B16.5, welding neck to match pipe wall thickness.

2.1.2 Type BCS-125, 125-psi Service

Pipe 1/8 through 1-1/2 inches shall be Schedule 40 steam, Schedule 80 condensate, furnace butt weld, black carbon steel, conforming to ASTM A 53/A 53M, Type F (furnace butt welded, continuous welded) and ASME B36.10M.

Pipe 2 through 10 inches shall be Schedule 40 steam, Schedule 80 condensate, seamless or electric-resistance welded black carbon steel, conforming to ASTM A 53/A 53M [Type E, Grade B (electric-resistance welded)] [Type S (seamless)] and ASME B36.10M.

Pipe 12 through 24 inches shall be 0.375-inch wall, [seamless] [electric-resistance] welded black carbon steel, conforming to ASTM A 53/A 53M [Type E, Grade B (electric-resistance welded)] [Type S (seamless) and ASME B36.10M].

[Fittings 2 inches and under shall be 125-psigwsp, cast iron, screwed end, conforming to ASTM A 126 Class A and ASME B16.4.]

[Fittings 2 inches and under shall be 150-psig wsp banded black malleable iron screwed, conforming to ASTM A 197/A 197M and ASME B16.3.]

[Fittings 1 through 2 inches shall be 2,000-or 3,000-psi water, oil, or gas (wog) to match pipe wall, forged carbon steel socket weld, conforming to ASTM A 105/A 105M and ASME B16.11.]

[Fittings 2 inches and under shall be 125-psig wsp, cast iron, screwed end, conforming to ASTM A 126 Class A and ASME B16.4.]

[Fittings 2-1/2 inches and over shall be wall thickness to match pipe, long radius butt weld, black carbon steel, conforming to ASTM A 234/A 234M, Grade WPB and ASME B16.9.]

[Couplings 2 inches and under shall be commercial standard weight for Schedule 40 pipe and commercial extra heavy weight for Schedule 80 pipe, black carbon steel where threaded, and 2,000-or 3,000-psi wog forged carbon steel, conforming to ASTM A 105/A 105M and ASME B16.11, where welded.]

[Flanges 2-1/2 inches and over shall be 150-pound, forged carbon-steel

welding neck, with raised face or flat face and concentric serrated finish, conforming to ASTM A 105/A 105M and ASME B16.5.]

[Conform grooved pipe couplings and fittings to paragraph entitled, "Grooved Pipe Couplings and Fittings."]

2.1.3 Type GCS, Galvanized Carbon Steel

Pipe 1/2 through 10 inches, and where indicated shall be Schedule 40 seamless or electric-resistance welded galvanized steel conforming to ASTM A 53/A 53M, Type E, Grade B (electric-resistance welded) or Type S (seamless).

Pipe 12 inches and over shall be 0.375-inch wall, seamless, galvanized steel, conforming to ASTM A 53/A 53M, Grade B.

Fittings 2 inches and under shall be 150-psigwsp banded galvanized malleable iron screwed, conforming to ASTM A 197/A 197M and ASME B16.3.

Unions 2 inches and under shall be 150-psig wsp female, screwed, galvanized malleable iron with brass-to-iron seat and ground joint.

Fittings 2-1/2 inches and over shall be 125-psig wsp cast-iron flanges and flanged fittings, conforming to ASTM A 126, Class A and ASME B16.1.

Conform grooved pipe couplings and fittings shall conform to paragraph entitled, "Grooved Pipe Couplings and Fittings."

Contractor has the option of using 150-psig wsp banded galvanized malleable iron screwed fittings, conforming to ASTM A 197/A 197M and ASME B16.3.

2.1.4 Type GCS-DWV, Galvanized Steel Drain, Waste and Vent

Pipe (all sizes) shall be Schedule 40 [seamless] [electric-resistance welded] galvanized carbon steel, conforming to ASTM A 53/A 53M, Grade A.

Furnace butt weld pipe is acceptable for sizes less than 2 inches.

[Risers 3 inches and larger shall be Type CISP-DWV.]

[Fittings shall be galvanized, [coated] [uncoated], screwed, cast iron, recessed pattern drainage fittings, conforming to ASTM A 126.]

[Use long radius fittings wherever space permits. Short-turn tees, branches, and ells may be used for vent piping and connections of branch lines to battery fixtures, except wall-hung water closets.]

2.1.5 Type CISP-DWV, Cast-Iron Drain, Waste and Vent

Provide soil pipe drain, waste, and vent bell-and-spigot type pipe cast iron, conforming to ASTM A 74. Caulk and lead all joints in lines where necessary to provide proper leaktight support and alignment; other-wise joints may be two-gasket system type chloroprene, conforming to ASTM C 564. Pipe class shall be extra heavy (CISP-DWV-XH).

2.1.6 Type CPR, Copper

2.1.6.1 Type CPR-A, Copper Above Ground

Tubing 2 inches and under shall be seamless copper tubing, conforming to ASTM B 88, Type L (hard-drawn for all horizontal and all exposed vertical lines, annealed for concealed vertical lines).

Fittings 2 inches and under shall be 150-psigwsp wrought-copper solder joint fittings conforming to ASME B16.22.

Unions 2 inches and under shall be 150-psig wsp wrought-copper solder joint, conforming to ASME B16.22.

[Provide brazing rod with Classification BCuP-5, conforming to AWS A5.8/A5.8M.]

[Solder must be 60-40 tin-antimony, alloy Sb-5, conforming to ASTM B 32.]

2.1.6.2 Type CPR-U, Copper Under Ground

Provide Type K seamless copper tube piping, conforming to ASTM B 88. Socket-joint fittings shall be wrought copper, conforming to ASME B16.22. Fittings for connection to corporation cocks shall be cast bronze, flared-type, conforming to ASME B16.26. Joints shall be brazed.

2.1.6.3 Type CPR-INS, Copper Under Ground Insulated

Provide insulated Type K seamless copper tube piping conforming to ASTM B 88. Socket-joint fittings shall be wrought copper, conforming to ASME B16.22. Joints shall be brazed.

Provide insulation not less than 2 inches thick, suitable for continuous service temperatures of not less than 250 degrees F. Insulation shall be factory-molded, closed-cell polyurethane foam of not less than 2.5 pounds per cubic foot density. Insulation shall be waterproofed with an extruded rigid Type II virgin polyvinylchloride, with minimum wall thickness of 60 mils through 4 inches outside diameter, 85 mils through 6.625 inches and 110 mils through 12.750 inches. Provide fitting covers fabricated from the same materials and thickness as adjacent pipe covering according to the manufacturer's directions.

2.1.7 Grooved Pipe Couplings and Fittings

Provide housing for all couplings, fabricated in two or more parts, of black, ungalvanized malleable iron castings. Coupling gasket shall be molded synthetic rubber, conforming to ASTM D 2000. Coupling bolts shall be oval-neck, track-head type, with hexagonal heavy nuts conforming to ASTM A 183.

Fabricate all pipe fittings used with couplings of black, ungalvanized malleable iron castings. Where a manufacturer's standard-size malleable iron fitting pattern is not available, approved fabricated fittings may be used.

Fabricate fittings from Schedule 40 or 0.75-inch wall ASTM A 53/A 53M, Grade B seamless steel pipe; long radius seamless welding fittings with wall thickness to match pipe, conforming to ASTM A 234/A 234M and ASME B16.9.

## 2.2 PIPING SPECIALTIES

### 2.2.1 Air Separator

Air separated from converter discharge water shall be ejected by a reduced-velocity device vented to the compression tank.

[Commercially constructed separator shall be designed and certified to separate not less than 80 percent of entrained air on the first passage of water and not less than 80 percent of residual on each successive pass. Provide shop drawings detailing all piping connections proposed for this work.]

[Air separator shall be carbon steel, designed, fabricated, tested, and stamped in conformance with ASME BPVC SEC VIII D1 for service pressures not less than 125 psi.]

### 2.2.2 Air Vents

[Manual air vents shall be 3/8-inch globe valves.]

[Automatic air vents on pumps, mains, and where indicated shall be of ball-float construction. Vent inlet shall be not less than 3/4-inch ips and the outlet not less than 1/4-inch ips. Orifice shall be 1/8 inch. Provide corrosion-resistant steel trim conforming to [ASTM A 276] [ ASTM A 480/A 480M]. Vent shall be fitted with try-cock. Vent shall discharge air at any pressure up to 150 psi. Outlet shall be copper tube routed.]

### 2.2.3 Compression Tank

Provide compression tank designed, fabricated, tested, and stamped for a working pressure of not less than 125 psi in accordance with ASME BPVC SEC VIII D1. Tank shall be hot-dip galvanized after fabrication to produce not less than 1.5 ounces of zinc coating per square foot of single-side surface.

Tank accessories shall include red-lined gage-glass complete with glass protectors and shutoff valves, air charger and drainer, and manual vent.

### 2.2.4 Dielectric Connections

Dissimilar pipe metals shall be electrically insulated from each other by couplings, unions, or flanges commercially manufactured for that purpose and rated for the service pressure and temperature.

### 2.2.5 Expansion Vibration Isolation Joints

Single or multiple arch-flanged expansion vibration isolation joints shall be constructed of steel-ring reinforced chloroprene-impregnated cloth materials. Design joint to absorb the movement of the pipe sections in which installed with no detrimental effect on the pipe or connected equipment. Back flanges with ferrous-metal backing rings. Provide control rod assemblies to restrict joint movement. All nonmetallic exterior surfaces of the joint shall be coated with chlorosulphinated polyethylene. Provide grommets in limit bolt hole to absorb noise transmitted through the bolts.

Joints shall be suitable for continuous-duty working temperature of at

least 250 degrees F.

Fill arches with soft chloroprene.

Joint, single-arch, movement limitations and size-related, pressure characteristics shall conform to FSA-0017.

2.2.6 Flexible Pipe

Flexible pipe vibration and pipe-noise eliminators shall be constructed of wire-reinforced, rubber-impregnated cloth and cord materials and shall be flanged. Flanges shall be backed with ferrous-metal backing rings. Service pressure-rating shall be minimum 1.5 times actual service. Surge pressure shall be at 180 degrees F.

Flexible pipe vibration and pipe noise eliminators shall be constructed of wire-reinforced chloroprene-impregnated cloth and cord materials and they shall be flanged. Provide all flanges backed with ferrous-metal backing rings. Nonmetallic exterior surfaces of the flexible pipe shall be coated with an acid- and oxidation-resistant chlorosulphinated polyethylene. Flexible pipe shall be rated for continuous duty at 130 psi and 250 degrees F.

Unit pipe lengths, face-to-face, shall be not less than the following:

| INSIDE DIAMETER | UNIT PIPE LENGTH |
|---|---|
| [To 2-1/2 inches, inclusive | 12 inches |
| 3 to 4 inches, inclusive | 18 inches |
| 5 to 12 inches, inclusive | 24 inches] |
| [To 3 inches, inclusive | 18 inches |
| 4 to 10 inches, inclusive | 24 inches |
| 12 inches and larger | 36 inches] |

2.2.7 Flexible Metallic Pipe

Flexible pipe shall be the bellows-type with wire braid cover and designed, constructed, and rated in accordance with the applicable requirements of ASME B31.3.

Working pressure minimum rating shall be [50] [100] psi at 300 degrees F.

[Minimum burst pressure shall be four times working pressure at 300 degrees F. Bellows material shall be AISI Type 316L corrosion-resistant steel. Braid shall be AISI 300 series corrosion-resistant steel wire.]

[Welded end connections shall be Schedule 80 carbon steel pipe, conforming to ASTM A 106/A 106M, Grade [B] [C].]

[Threaded end connections shall be hex-collared Schedule 40, AISI Type 316L corrosion-resistant steel, conforming to ASTM A 312/A 312M.]

[Flanged end connection rating and materials shall conform to specifications for system primary-pressure rating.]

2.2.8 Flexible Metal Steam Hose

Hose shall be bellows type with wire braid cover and designed, constructed, and rated in accordance with the applicable requirements of ASME B31.3.

Working steam pressure rating shall be 125 psi at 500 degrees F.

[Minimum burst pressure shall be nine times working steam pressure at 300 degrees F.]

Bellows material shall be AISI Type 316L corrosion-resistant steel. Braid shall be AISI Type 300-series corrosion-resistant steel wire.

[Welded end connections shall be Schedule 80 carbon steel pressure tube, conforming to ASTM A 106/A 106M, Grade [B] [C].]

[Threaded end connections shall be hex-collared Schedule 40, AISI Type 316L corrosion-resistant steel, conforming to ASTM A 312/A 312M.]

[Flanged end connection rating and materials shall conform to specifications for system primary-pressure rating.]

2.2.9 Metallic Expansion Joints

Design and construct joints to absorb all of the movements of the pipe sections in which installed, with no detrimental effect on pipe or supporting structure.

Rate, design, and construct joints for pressures to 125 psig and temperatures to 500 degrees F.

Joints shall have a designed bursting strength in excess of four times their rated pressure.

Joints shall be capable of withstanding a hydrostatic test of 1.5 times their rated pressure while held at their uncompressed length without leakage or distortion that may adversely affect their life cycle.

Life expectancy shall be not less than 10,000 cycles.

Bellows and internal sleeve material shall be AISI Type 304, 304L, or 321 corrosion-resistant steel.

End connections shall require no field preparation other than cleaning.

[Butt weld end preparation of expansion joints shall conform to the same codes and standards requirements as applicable to the piping system materials at the indicated joint location.]

[Flanges of flanged-end expansion joints shall conform to the same codes and standard requirements as are applicable to companion flanges specified for the given piping system at the indicated joint location.]

Joints, 2-1/2 inches and smaller, shall have internal guides and limit stops.

Joints, 3 inches and larger, shall be provided with removable external covers, internal sleeves, and purging connection. Sleeves shall be sized

to accommodate lateral clearance required, with minimum reduction of flow area, and with oversized bellows where necessary. When a sleeve requires a gasket as part of a locking arrangement, the gasket shall be provided by the manufacturer. Joints without purging connection may be provided; however, remove these from the line prior to, or not installed until, cleaning operations are complete.

[Cylindrical end portion of the reinforced bellows element shall be provided with a thrust sleeve of sufficient thickness to bring that portion within applicable code-allowable stress. Sleeve shall provide 360 degrees support for the element and end-reinforcing ring.]

[Expansion joints shall have four, equidistant, permanent tram points clearly marked on each joint end. Locate points to prevent obliteration during installation. Distance between tram points indicating installed lengths shall be included in shop drawings. Overall dimension after joint installation shall be subject to approval.]

Each expansion joint shall have adjustable clamps or yokes provided at quarter points, straddling the bellows. Overall joint length shall be set by the manufacturer to maintain joints in manufacturer's recommended position during installation.

Permanently and legibly mark each joint with the manufacturer's name or trademark and serial number; the size, series, or catalog number; bellows material; and directional-flow arrow.

### 2.2.10 Hose Faucets

Construct hose faucets with 1/2 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection, conforming to ASME A112.18.1. Hose-coupling screw threads shall conform to ASME B1.20.7.

Vandalproof, atmospheric-type vacuum breaker shall be provided on the discharge of all potable water lines.

### 2.2.11 Pressure Gages

Pressure gages shall conform to ASME B40.100 and to requirements specified herein. Pressure-gage size shall be 3-1/2 inches nominal diameter. Case shall be corrosion-resistant steel, conforming to any of the AISI 300 series of ASTM A 6/A 6M, with an ASM No. 4 standard commercial polish or better. Equip gages with adjustable red marking pointer and damper-screw adjustment in inlet connection. Service-pressure reading shall be at midpoint of gage range. All gages shall be Grade B or better and be equipped with gage isolators.

[Fit steam gages with black steel syphons and steam service pressure-rated gage cocks or valves.]

### 2.2.12 Sight-Flow Indicators

Sight-flow indicators for pressure service on 3-inch ips and smaller shall be constructed of bronze with specially treated single- or double-glass sight windows and have a bronze, nylon, or tetrafluoroethylene rotating flow indicator mounted on an AISI Type [304] [316] corrosion-resistant steel shaft. Body may have screwed or flanged end. Assembly shall be pressure- and temperature-rated for the applied service. Flapper flow-type indicators are not acceptable.

2.2.13 Sleeve Couplings

Sleeve couplings for plain-end pipe shall consist of one steel middle ring, two steel followers, two chloroprene or Buna-N elastomer gaskets, and the necessary steel bolts and nuts.

2.2.14 Thermometers

Thermometers shall conform to ASTM E 1, except for being filled with a red organic liquid. Thermometers shall be an industrial pattern armored glass model, (well-threaded and seal-welded). Thermometers installed 6 feet or higher above the floor shall have an adjustable angle body. Scale shall be not less than 7 inches long. Case face shall be manufactured from manufacturer's standard polished aluminum or AISI 300 series polished corrosion-resistant steel. Thermometer range shall be [_____]. Provide thermometers with nonferrous separable wells. Provide lagging extension to accommodate insulation thickness.

2.2.15 Pump Suction Strainers

Strainer body shall be cast iron, rated for not less than 25 psig at 100 degrees F, with flanges conforming to ASME B16.1, Class 125. Strainer construction shall be such that there is a machined surface joint between body and basket that is normal to the centerline of the basket.

Minimum ratio of open area of each basket to pipe area shall be 3 to 1. Basket shall be AISI 300 series corrosion-resistant steel wire mesh with perforated backing.

Mesh shall be capable of retaining all particles larger than 1,000 micrometer, with a pressure drop across the strainer body of not more than 0.5 psi when the basket is two-thirds dirty at maximum system flow rate. Reducing fittings from strainer-flange size to pipe size shall be provided.

A [differential-pressure gage] [pressure gage with 0.25-pound graduations] fitted with a two-way brass cock shall be provided across the strainer.

Provide manual air vent cocks in cap of each strainer.

2.2.16 Line Strainers, Water Service

Strainers shall be Y-type with removable basket. Strainers in sizes 2-inch ips and smaller shall have screwed ends. In sizes 2-1/2-inch ips and larger, strainers shall have flanged ends. Body working-pressure rating shall exceed maximum service pressure of system in which installed by at least 50 percent. Body shall have cast-in arrows to indicate direction of flow. All strainer bodies fitted with screwed screen retainers shall have straight threads and gasketed with nonferrous metal. Strainer bodies 2-1/2-inches and larger, fitted with bolted-on screen retainers, shall have offset blowdown holes. All strainers larger than2-1/2-inches shall be fitted with manufacturer's standard ball-type blowdown valve. Body material shall be [cast bronze conforming to ASTM B 62] [cast iron conforming to Class 30 ASTM A 278/A 278M]. Where system material is nonferrous, metal strainer body material shall be nonferrous metal.

Minimum free-hole area of strainer element shall be equal to not less than 3.4 times the internal area of connecting piping. Strainer screens shall have perforations not to exceed 0.045-inch. Strainer screens shall have

finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material shall be [AISI Type [304] [316] corrosion-resistant steel] [Monel metal].

## 2.3 VALVES

### 2.3.1 Ball and Butterfly Valves

Ball valves shall conform to MSS SP-72 for Figure [1A], 1 piece body [1B], vertically split body [1C], top entry [1D], three piece body and shall be rated for service at not less than 175 psig at 200 degrees F. Valve bodies in sizes 2 inches and smaller shall be screwed-end connection-type constructed of Class A copper alloy. Valve bodies in sizes 2-1/2 inches and larger shall be flanged-end connection type, constructed of Class [D] [E] [F] material. Balls and stems of valves 2 inches and smaller shall be manufacturer's standard with hard chrome plating finish. Balls and stems of valves 2-1/2 inches and larger shall be manufacturer's standard Class C corrosion-resistant steel alloy with hard chrome plating. Balls of valves 6 inches and larger may be Class D with 900 Brinell hard chrome plating. Valves shall be suitable for flow from either direction and shall seal equally tight in either direction. Valves with ball seals held in place by spring washers are not acceptable. All valves shall have adjustable packing glands. Seats and seals shall be tetrafluoroethylene.

Butterfly valves shall conform to MSS SP-67. Valves shall be wafer type for mounting between specified flanges and shall be rated for 150-psig shutoff and nonshock working pressure. Bodies shall be cast ferrous metal conforming to ASTM A 126, Class B, and to ASME B16.1 for body wall thickness. Seats and seals shall be of the resilient elastomer type designed for field removal and replacement.

### 2.3.2 Drain, Vent, and Gage Cocks

Drain, vent, and gage cocks shall be [T-head] [lever handle], ground key type, with washer and screw, constructed of polished ASTM B 62 bronze, and rated 125-psi wsp. End connections shall be rated for specified service pressure.

Pump vent cocks, and where spray control is required, shall be UL umbrella-hood type, constructed of manufacturer's standard polished brass. Cocks shall be 1/2-inch ips male, end threaded, and rated at not less than 125 psi at 225 degrees F.

### 2.3.3 Gate Valves (GAV)

Gate valves 2 inches and smaller shall conform to MSS SP-72. Valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated shall be union-ring bonnet, screwed-end type. Make packing of non-asbestos type materials. Valves shall be rising stem type.

Gate valves 2-1/2 inches and larger, shall be Type I, (solid wedge disc, tapered seats, steam rated); Class 125 (125-psig steam-working pressure at 353 degrees F saturation); and 200-psig, wog (nonshock), conforming to MSS SP-70 and to requirements specified herein. Valves shall be flanged, with bronze trim and outside screw and yoke (OS&Y) construction. Make packing of non-asbestos type materials.

2.3.4 Globe and Angle Valves (GLV-ANV)

Globe and angle valves 2 inches and smaller, shall be 125-pound, 125-psi conforming to MSS SP-85 and to requirements specified herein. Valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated shall be union-ring bonnet, screwed-end type. Disc shall be free to swivel on the stem in all valve sizes. Composition seating-surface disc construction may be substituted for all metal-disc construction. Make packing of non-asbestos type materials. Disk and packing shall be suitable for pipe service installed.

Globe and angle valves 2-1/2 inches and larger, shall be cast iron with bronze trim. Valve bodies shall be cast iron conforming to ASTM A 126, Class A, as specified for Class 1 valves under MSS SP-70. Valve ends shall be flanged in conformance with ASME B16.1. Valve construction shall be outside screw and yoke (OS&Y) type. Make packing of non-asbestos type materials.

2.3.5 Standard Check Valves (SCV)

Standard check valves in sizes 2 inches and smaller shall be 125-psi swing check conforming to MSS SP-71, except as otherwise specified. Provide lift checks where indicated. Swing-check pins shall be nonferrous and suitably hard for the service. Discs shall be composition type. Swing-check angle of closure shall be manufacturer's standard unless a specific angle is needed.

Check valves in sizes 2-1/2 inches and larger shall be cast iron, bronze trim, swing type. Valve bodies shall be cast iron, conforming to ASTM A 126, Class A. Valve ends shall be flanged in conformance with ASME B16.1. Swing-check pin shall be AISI Type or approved equal corrosion-resistant steel. Angle of closure shall be manufacturer's standard unless a specific angle is needed. Valves shall have bolted and gasketed covers.

Provide check valves with [external spring-loaded] [lever-weighted], positive-closure devices and valve ends shall be [mechanical joint] [push-on] [flanged].

2.3.6 Nonslam Check Valves (NSV)

Check valves at pump discharges in sizes 2 inches and larger shall be nonslam or silent-check type conforming to MSS SP-125. Valve disc or plate shall close before line flow can reverse to eliminate slam and water-hammer due to check-valve closure. Valve shall be Class 125 rated for 200-psi maximum, nonshock pressure at 150 degrees F in sizes to 12 inches. Valves shall be [wafer type to fit between flanges conforming to ASME B16.1] [fitted with flanges conforming to ASME B16.1]. Valve body may be cast iron, conforming to ASTM A 278/A 278M, Class 40 or equivalent strength ductile iron. Disks shall be manufacturer's standard bronze, aluminum bronze, or corrosion-resistant steel. Pins, springs, and miscellaneous trim shall be manufacturer's standard corrosion-resistant steel. Disk and shaft seals shall be Buna-N elastomer tetrafluoroethylene.

2.4 MISCELLANEOUS MATERIALS

2.4.1 Bolting

Flange and general purpose bolting shall be hex-head and must conform to ASTM A 307, Grade B (bolts, for flanged joints in piping systems where one

or both flanges are cast iron). Heavy hex-nuts shall conform to ASTM A 563. Square-head bolts and nuts are not acceptable. Threads shall be coarse-thread series.

2.4.2 Elastomer Calk

Polysulfide- or polyurethane-base elastomer calking material shall be two-component type, conforming to ASTM C 920.

2.4.3 Escutcheons

Escutcheons shall be manufactured from nonferrous metals and chrome-plated except when AISI 300 series corrosion-resistant steel is provided. Metals and finish shall conform to ASME A112.19.2.

Escutcheons shall be one-piece type where mounted on chrome-plated pipe or tubing, and one-piece of split-pattern type elsewhere. All escutcheons shall have provisions consisting of [internal spring-tension devices] [setscrews] for maintaining a fixed position against a surface.

2.4.4 Flashing

Sheet lead shall conform to ASTM B 749, [UNS Alloy Number L50049 (intended for use in laboratories and shops in general application)] [UNS Alloy Number L51121 (for use where lead sheet of high purity and improved structural strength is indicated)].

Sheet copper shall conform to ASTM B 370 and be of not less than 16 ounces per square foot weight.

2.4.5 Flange Gaskets

Compressed non-asbestos sheet, conforming to ASTM F 104, coated on both sides with graphite or similar lubricant, with nitrile composition, binder rated to 750 degrees F.

2.4.6 Grout

Shrink-resistant grout shall be a premixed and packaged metallic-aggregate, mortar-grouting compound conforming to ASTM C 404 and ASTM C 476.

Shrink-resistant grout shall be a combination of premeasured and packaged epoxy polyamide or amine resins and selected aggregate mortar grouting compound conforming to the following requirements:

| | | |
|---|---|---|
| Tensile strength | | 1,900 psi, minimum |
| Compressive strength | ASTM C 109/C 109M | 14,000 psi, minimum |
| Shrinkage, linear | | 0.00012 inch per inch, maximum |
| Water absorption | ASTM C 67 | 0.1 percent, maximum |
| Bond strength to | | 1,000 psi, minimum steel in shear minimum |

2.4.7 Pipe Thread Compounds

Use tetrafluoroethylene tape not less than 2 to 3 mils thick in potable and

process water and in chemical systems for pipe sizes to and including 1-inch ips. Tetrafluoroethylene dispersions and other suitable compounds shall be used for all other applications upon approval by the Contracting Officer; however, no lead-containing compounds shall be used in potable water systems.

## 2.5 SUPPORTING ELEMENTS

Provide all necessary piping systems and equipment supporting elements, including but not limited to: building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides; and spring-cushion, variable, or constant supports. All supporting elements shall be suitable for stresses imposed by systems pressures and temperatures and natural and other external forces normal to this facility without damage to supporting element system or to work being supported.

Supporting elements shall conform to requirements of ASME B31.3, MSS SP-58, and MSS SP-69 except as noted.

Attachments welded to pipe shall be made of materials identical to that of pipe or materials accepted as permissible raw materials by referenced code or standard specification.

Supporting elements exposed to weather shall be hot-dip galvanized or stainless steel. Materials shall be of such a nature that their apparent and latent-strength characteristics are not reduced due to galvanizing process. Supporting elements in contact with copper tubing shall be electroplated with copper.

Type designations specified herein are based on MSS SP-58 and MSS SP-69. Masonry anchor group-, type-, and style-combination designations shall be in accordance with CID A-A-1922, CID A-A-1923, FS A-A-1924, FS A-A-1925 , CID A-A-55614, and CID A-A-55615. Support elements, except for supplementary steel, shall be cataloged, load rated, commercially manufactured products.

### 2.5.1 Building Structure Attachments

#### 2.5.1.1 Anchor Devices, Concrete and Masonry

Anchor devices shall conform to CID A-A-1922, CID A-A-1923, FS A-A-1924, FS A-A-1925 , CID A-A-55614, and CID A-A-55615

Cast-in, floor mounted, equipment anchor devices shall provide adjustable positions.

[Masonry anchor devices shall be built-in.]

Powder-actuated anchoring devices shall not be used to support any mechanical systems components.

#### 2.5.1.2 Beam Clamps

Beam clamps shall be center-loading MSS SP-58.

When it is not possible to use center-loading beam clamps, eccentric-loading beam clamps, MSS SP-58 may be used for piping sizes 2 inches and less and for piping sizes 2 through 10 inches provided two

counterbalancing clamps are used per point of pipe support. Where more than one rod is used per point of pipe support, rod diameter shall be determined in accordance with referenced standards.]

2.5.1.3 C-Clamps

Do not use C-clamps.

2.5.1.4 Inserts, Concrete

Concrete inserts shall be MSS SP-58 Type 18. When applied to piping in sizes 2 inches ips and larger and where otherwise required by imposed loads, insert and wire a 1-foot length of 1/2-inch reinforcing rod through wing slots. Submit proprietary-type continuous inserts for approval.

2.5.2 Horizontal Pipe Attachments

2.5.2.1 Single Pipes

Support piping in sizes to and including 2-inch ips by MSS SP-58 Type 6 solid malleable iron pipe rings, except that split-band-type rings shall be used in sizes up to 1-inch ips.

Support piping in sizes through 8-inch ips inclusive by MSS SP-58 Type [1] [3] [4] attachments.

MSS SP-58 Type 1 and Type 6 assemblies shall be used on vapor-sealed insulated piping and shall have an inside diameter larger than pipe being supported to provide adequate clearance during pipe movement.

MSS SP-58 Type 40 shields shall be used on all insulated piping. Area of the supporting surface shall be such that compression deformation of insulated surfaces does not occur. Longitudinal and transverse shield edges shall be rolled away from the insulation.

Provide insulated piping without vapor barrier on roll supports with MSS SP-58 Type 39 saddles.

Spring supports shall be as indicated.

2.5.2.2 Parallel Pipes

Trapeze hangers fabricated from structural steel shapes, with U-bolts, shall be used in congested areas and where multiple pipe runs occur. Structural steel shapes shall [conform to supplementary steel requirements] [be of commercially available, proprietary design, rolled steel].

2.5.3 Vertical Pipe Attachments

Vertical pipe attachments shall be MSS SP-58 Type 8.

Shop drawing data shall include complete fabrication and attachment details of any spring supports.

2.5.4 Hanger Rods and Fixtures

Only circular cross section rod hangers shall be used to connect building structure attachments to pipe support devices. Pipe, straps, or bars of equivalent strength shall be used for hangers only where approved by the

Contracting Officer.

Turnbuckles, swing eyes, and clevises shall be provided as required by support system to accommodate temperature change, pipe accessibility, and adjustment for load and pitch. Rod couplings are not acceptable.

2.5.5 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, design and fabricate such supplementary steel in accordance with AISC 325.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

Submit certificates for pipes, valves and specialties showing conformance with test requirements as contained in the reference standards contained in this section. Certificates shall verify Surface Resistance, Shear and Tensile Strengths, Temperature Ratings, Bending Tests, Flattening Tests and Transverse Guided Weld Bend Tests.

Test reports for Hydrostatic Tests, Air Tests, Valve-Operating Tests, Drainage Tests, Pneumatic Tests, and System Operation Tests shall be provided by the Contractor, in compliance with referenced standards contained within this section.

Fabricate and install piping systems in accordance with ASME B31.3, MSS SP-69, and AWS WHB-2.9.

Submit Installation Drawings for pipes, valves and specialties. Drawings shall include the manufacturer's design and construction calculations, forces required to obtain rated axial, lateral, or angular movements, installation criteria, anchor and guide requirements for equipment, and equipment room layout and design. Drawings shall specifically advise on procedures to be followed and provisions required to protect expansion joints during specified hydrostatic testing operations.

Connections between steel piping and copper piping shall be electrically isolated from each other with [dielectric couplings (or unions)] [flanged with gaskets] rated for the service.

Make final connections to equipment with [unions] [flanges] provided every 100 feet of straight run. Provide unions in the line downstream of screwed- and welded-end valves.

Ream all pipe ends before joint connections are made.

Screwed joints shall be made up with specified joint compound and not more than three threads shall show after joint is made up.

Apply joint compounds to the male thread only and exercise care to prevent compound from reaching the unthreaded interior of the pipe.

Provide screwed unions, welded unions, or bolted flanges wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system for maintenance.

Securely support piping systems with due allowance for thrust forces, thermal expansion and contraction, and shall not be subjected to mechanical, chemical, vibrational or other damage as specified in ASME B31.3.

Field welded joints shall conform to the requirements of the AWS WHB-2.9, ASME B31.3, and ASME BPVC SEC IX.

[Make piping systems butt weld joints with backing rings. Backing ring materials shall be compatible with materials being joined. Joint configuration shall conform to ASME B16.25.]

[Preheat and postheat treatment of welds shall be done in accordance with ASME BPVC SEC IX and ASME B31.3.]

[Take all necessary precautions during installation of flexible pipe and hose including flushing and purging with water, steam, and compressed air to preclude bellows failure due to pipe line debris lodged in bellows. Installation shall conform to manufacturer's instructions.]

## 3.2 VALVES

Provide valves in piping mains and all branches and at equipment where indicated and as specified.

Provide valves to permit isolation of branch piping and each equipment item from the balance of the system.

Riser and downcomer drains above piping shutoff valves in piping 2-1/2 inches and larger shall be provided. Tap and fit shutoff valve body with a 1/2-inch plugged globe valve.

Valves unavoidably located in furred or other normally inaccessible places shall be provided with access panels adequately sized for the location and located so that concealed items may be serviced, maintained, or replaced.

## 3.3 SUPPORTING ELEMENTS INSTALLATION

Provide supporting elements in accordance with the referenced codes and standards.

Support piping from building structure. No piping shall be supported from roof deck or from other pipe.

Piping shall run parallel with the lines of the building. Space and install piping and components so that a threaded pipe fitting may be removed between adjacent pipes and so that there shall be no less than 1/2 inch of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Hangers on different adjacent service lines running parallel with each other shall be arranged to be in line with each other and parallel to the lines of the building.

Install piping support elements at intervals specified hereinafter, at locations not more than 3 feet from the ends of each runout, and not over 1 foot from each change in direction of piping.

Load rating for all pipe-hanger supports shall be based on insulated weight of lines filled with water and forces imposed. Deflection per span shall not exceed slope gradient of pipe. Supports shall be in accordance with the following minimum rod size and maximum allowable hanger spacing for

specified pipe. For concentrated loads such as valves, the allowable span must be reduced proportionately:

| PIPE SIZE INCHES | ROD SIZE INCHES | STEEL PIPE FEET | COPPER PIPE FEET |
|---|---|---|---|
| 1 and smaller | 3/8 | 8 | 6 |
| 1-1/4 to 1-1/2 | 3/8 | 10 | 8 |
| 2 | 3/8 | 10 | 8 |
| 2-1/2 to 3-1/2 | 1/2 | 12 | 12 |
| 4 to 5 | 5/8 | 16 | 14 |
| 6 | 3/4 | 16 | 16 |
| 8 to 12 | 7/8 | 20 | 20 |
| 14 to 18 | 1 | 20 | 20 |
| 20 and over | 1-1/4 | 20 | 20 |

Provide vibration isolation supports where needed. Refer to Section 23 05 48 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT where A/C equipment and piping is installed.

Vertical risers shall be supported independently of connected horizontal piping, whenever practicable, with fixed or spring supports at the base and at intervals to accommodate system range of thermal conditions. Risers shall be guided for lateral stability. For risers subject to expansion, provide only one rigid support at a point approximately one-third down from the top. Place clamps under fittings unless otherwise specified. Support carbon-steel pipe at each floor and at not more than 15-footintervals for pipe 2 inches and smaller and at not more than 20-footintervals for pipe 2-1/2 inches and larger.

## 3.4 PENETRATIONS

Effective sound stopping and adequate operating clearance shall be provided to prevent structure contact where piping penetrates walls, floors, or ceilings into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces shall include space above ceilings where no special acoustic treatment of ceiling is provided. Penetrations shall be finished to be compatible with surface being penetrated.

[Sound stopping and vapor-barrier sealing of pipe shafts and large floor and wall openings shall be accomplished by packing to high density with properly supported fibrous-glass insulation or, where ambient or surface temperatures do not exceed 120 degrees F, by foaming-in-place with self-extinguishing, 2-pound density polyurethane foam to a depth not less than 6 inches. Foam shall be finished with a rasp. Vapor barrier shall be not less than 1/8-inch thick vinyl coating applied to visible and accessible surfaces. Where high temperatures and fire stopping are a consideration, only mineral wool shall be used and openings must also be covered with 16-gage sheet metal.]

## 3.5 SLEEVES

Provide sleeves where piping passes through roofs, masonry, concrete walls and floors.

Sleeves passing through steel decks shall be continuously [welded] [brazed] to the deck.

Sleeves that extend through floors, roofs, load bearing walls, and fire barriers shall be continuous and fabricated from Schedule 40 steel pipe, with welded anchor lugs. All other sleeves shall be formed by molded linear polyethylene liners or similar materials that are removable. Diameter of sleeves shall be large enough to accommodate pipe, insulation, and jacketing without touching the sleeve and shall provide a minimum 3/8-inch clearance. Sleeve size must accommodate mechanical and thermal motion of pipe to preclude transmission of vibration to walls and the generation of noise.

Space between a pipe, bare or insulated, and the inside of a pipe sleeve or a construction surface penetration shall be packed solid with a mineral fiber conforming to ASTM C 553 Type V (flexible blanket), (to 1,000 degrees F). Provide this packing wherever the piping passes through firewalls, equipment room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction surface penetrations occur between conditioned and unconditioned spaces, the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction surface penetration shall be filled with an elastomer calk to a depth of 1/2 inch. All surfaces to be calked shall be oil- and grease-free.

Through-Penetration fire stop materials and methods shall be in accordance with ASTM E 814 and UL 1479.

Exterior wall sleeves shall be calked watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed metal components.

[Sleeve height above roof surface shall be a minimum of 12 and a maximum of 18 inches.]

## 3.6 ESCUTCHEONS

Provide escutcheons at all penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, provide escutcheons on both sides of the partition. Where suspended ceilings are installed, provide plates at the underside only of such ceilings. For insulated pipes, the plates shall be large enough to fit around the insulation. Escutcheons shall be chrome-plated in all occupied spaces and of size sufficient to effectively conceal openings in building construction. Firmly attach escutcheons with setscrews.

## 3.7 FLASHINGS

[Provide flashings at penetrations of building boundaries by mechanical systems and related work.]

## 3.8 UNDERGROUND PIPING INSTALLATION

Prior to being lowered into a trench, all piping shall be cleaned, visually inspected for apparent defects, and tapped with a hammer to audibly detect hidden defects.

Suspect cast-ferrous piping shall be further inspected by painting with kerosene on external surfaces to reveal cracks.

Distinctly mark defective materials found using a road-traffic quality yellow paint; promptly remove defective material from the site.

After conduit has been inspected, and not less than 48 hours prior to being lowered into a trench, all external surfaces of cast ferrous conduit shall be coated with a compatible bituminous coating for protection against brackish ground water. Application shall be single coat, in accordance with the manufacturer's instructions, to result in a dry-film thickness of not less than 12 mils.

Excavations shall be dry and clear of extraneous materials when pipe is being laid.

Cutting of piping shall be by wheel cutters or other machines designed specifically for that purpose. Electric-arc and oxyacetylene cutting will not be permitted.

Laying of pipe shall begin at the low point of a system. When in final acceptance position, it shall be true to the grades and alignment indicated, with unbroken continuity of invert. Blocking and wedging will not be permitted.

[Bell or grooved ends of piping shall point upstream.]

Make changes in direction with long sweep fittings.

Necessary socket clamping, piers, bases, anchors, and thrust blocking shall be provided. Protect rods, clamps, and bolting with a coating of bitumen.

Underground piping below supported or suspended slabs shall be supported from the slab with a minimum of two supports per length of pipe. Protect supports with a coating of bitumen.

On excavations that occur near and below building footings, the backfilling material shall consist of 2,000-psi cured compressive-strength concrete poured or pressure-grouted up to the level of the footing.

Vertical downspouts; soil, waste, and vent stacks; water risers; and similar work shall be properly supported on approved piers at the base and provided with approved structural supports attached to building construction.

[Provide cleanout, flushing, and observation risers.]

## 3.9 DISINFECTION

[Water piping, including all valves, fittings, and other devices, shall be disinfected with a solution of chlorine and water. Solution shall contain not less than 50 parts per million (ppm) of available chlorine. Hold solution for a period of not less than 8 hours, after which the solution

must contain not less than 10 ppm of available chlorine or the piping shall be redisinfected. After successful sterilization, thoroughly flush the piping before placing into service. Flushing shall be complete when the flush water contains less than 0.5 ppm of available chlorine. Water for disinfected will be furnished by the Government. Contractor shall be responsible for approved disposal of contaminated flush water in accordance with written instructions received from the Environmental authority having jurisdiction through the Contracting Officer and all Local, State and Federal Regulations.]

[Flush piping with potable water until visible grease, dirt and other contaminants are removed (visual inspection).]

## 3.10 OPERATION AND MAINTENANCE

Operation and Maintenance Manuals shall be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions. Test data shall be clear and readily legible.

## 3.11 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

### 3.11.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B 117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, design the factory painting system for the temperature service.

### 3.11.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F

shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

-- End of Section --

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC
**11/08**

PART 1 **GENERAL**

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

| | |
|---|---|
| AMCA 203 | (1990) Field Performance Measurements of Fan Systems |

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

| | |
|---|---|
| ASHRAE 62.1 | (2007; INT 2007; INT 2-15 2008; Errata 2008; Addenda a, b, e, f and h 2008) Ventilation for Acceptable Indoor Air Quality |

ASSOCIATED AIR BALANCE COUNCIL (AABC)

| | |
|---|---|
| AABC MN-1 | (2002) National Standards for Total System Balance |
| AABC MN-4 | (1996) Test and Balance Procedures |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

| | |
|---|---|
| RCBEA GUIDE | (2004) NASA Reliability Centered Building and Equipment Acceptance Guide |

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

| | |
|---|---|
| NEBB MASV | (2006) Procedural Standards for Measurements and Assessment of Sound and Vibration |
| NEBB PROCEDURAL STANDARDS | (2005) Procedural Standards for TAB (Testing, Adjusting and Balancing) Environmental Systems |

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

| | |
|---|---|
| SMACNA 1143 | (1985) HVAC Air Duct Leakage Test Manual |
| SMACNA 1780 | (2002; 3rd Ed) HVAC Systems - Testing, Adjusting and Balancing |
| SMACNA 1858 | (2004) HVAC Sound And Vibration Manual - First Edition |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 82 Protection of Stratospheric Ozone

1.2 DEFINITIONS

a. AABC: Associated Air Balance Council.

b. COTR: Contracting Officer's Technical Representative.

c. DALT: Duct air leakage test

d. DALT'd: Duct air leakage tested

e. HVAC: Heating, ventilating, and air conditioning; or heating, ventilating, and cooling.

f. NEBB: National Environmental Balancing Bureau

g. Out-of-tolerance data: Pertains only to field acceptance testing of Final DALT or TAB report. When applied to DALT work, this phase means "a leakage rate measured during DALT field acceptance testing which exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction and sealant class." When applied to TAB work this phase means "a measurement taken during TAB field acceptance testing which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the TAB Report for a specific parameter."

h. Season of maximum heating load: The time of year when the outdoor temperature at the project site remains within plus or minus 30 degrees Fahrenheit of the project site's winter outdoor design temperature, throughout the period of TAB data recording.

i. Season of maximum cooling load: The time of year when the outdoor temperature at the project site remains within plus or minus 5 degrees Fahrenheit of the project site's summer outdoor design temperature, throughout the period of TAB data recording.

j. Season 1, Season 2: Depending upon when the project HVAC is completed and ready for TAB, Season 1 is defined, thereby defining Season 2. Season 1 could be the season of maximum heating load, or the season of maximum cooling load.

k. Sound measurements terminology: Defined in AABC MN-1, NEBB MASV, or SMACNA 1858 (TABB).

l. TAB: Testing, adjusting, and balancing (of HVAC systems).

m. TAB'd: HVAC Testing/Adjusting/Balancing procedures performed.

n. TAB Agency: TAB Firm

o. TAB team field leader: TAB team field leader

p. TAB team supervisor: TAB team engineer.

q. TAB team technicians: TAB team assistants.

r. TABB: Testing Adjusting and Balancing Bureau.

1.2.1 Similar Terms

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results.

The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC, NEBB, or TABB requirements where differences exist.

SIMILAR TERMS

| Contract Term | AABC Term | NEBB Term | TABB Term |
|---|---|---|---|
| TAB Standard | National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems | Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems | International Standards for Environmental Systems Balance |
| TAB Specialist | TAB Engineer | TAB Supervisor | TAB Supervisor |
| Systems Readiness Check | Construction Phase Inspection | Field Readiness Check & Preliminary Field Procedures. | Field Readiness Check & Prelim. Field Procedures |

1.3 WORK DESCRIPTION

The work includes duct air leakage testing (DALT) and testing, adjusting, and balancing (TAB) of new heating, ventilating, and cooling (HVAC) air and water distribution systems including equipment and performance data, ducts, and piping which are located within, on, under, between, and adjacent to buildings.

Perform TAB in accordance with the requirements of the TAB procedural standard recommended by the TAB trade association that approved the TAB Firm's qualifications. Comply with requirements of AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 (TABB) as supplemented and modified by this specification section. All recommendations and suggested practices contained in the TAB procedural standards are considered mandatory.

Conduct DALT and TAB of the indicated existing systems and equipment and submit the specified DALT and TAB reports for approval. Conduct DALT testing in compliance with the requirements specified in SMACNA 1143, except as supplemented and modified by this section. Conduct DALT and TAB work in accordance with the requirements of this section.

1.3.1 Air Distribution Systems

Test, adjust, and balance system[s] (TAB) in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to exterior of air distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.2 Water Distribution Systems

TAB system[s] in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to water distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEM. At Contractor's option and with Contracting Officer's written approval, the piping systems may be insulated before systems are TAB'd.

Terminate piping insulation immediately adjacent to each flow control valve, automatic control valve, or device. Seal the ends of pipe insulation and the space between ends of pipe insulation and piping, with waterproof vapor barrier coating.

After completion of work under this section, insulate the flow control valves and devices as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.3 TAB SCHEMATIC DRAWINGS

Show the following information on TAB Schematic Drawings:

1. A unique number or mark for each piece of equipment or terminal.

2. Air quantities at air terminals.

3. Air quantities and temperatures in air handling unit schedules.

4. Water quantities and temperatures in thermal energy transfer equipment schedules.

5. Water quantities and heads in pump schedules.

6. Water flow measurement fittings and balancing fittings.

7. Ductwork Construction and Leakage Testing Table that defines the DALT test requirements, including each applicable HVAC duct system ID or mark, duct pressure class, duct seal class, and duct leakage test pressure. This table is included in the file for Graphics for Unified Facilities Guide Specifications: http://www.wbdg.org/ccb/browse_org.php?o=70

The Testing, Adjusting, and Balancing (TAB) Specialist must review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the effective and accurate TAB of the system, including records of existing conditions, and systems readiness check. The TAB Specialist must provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

Submit three copies of the TAB Schematic Drawings and Report Forms to the Contracting Officer, no later than 21 days prior to the start of TAB field

measurements.

1.3.4 Related Requirements

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section.

Specific requirements relating to Reliability Centered Maintenance (RCM) principals and Predictive Testing and Inspection (PTI), by the construction contractor to detect latent manufacturing and installation defects must be followed as part of the Contractor's Quality Control program. Refer to the paragraph titled "Sustainability" for detailed requirements.

Requirements for price breakdown of HVAC TAB work are specified in Section 01 20 00.00 20 PRICE AND PAYMENT PROCEDURES.

Requirements for construction scheduling related to HVAC TAB work are specified in Section 01 32 17.00 20 NETWORK ANALYSIS SCHEDULES.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms; G

SD-03 Product Data

Equipment and Performance Data; G
TAB Related HVAC Submittals; G

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB team engineer.

TAB Procedures; G

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

Calibration; G

Systems Readiness Check; G

TAB Execution; G

TAB Verification; G

SD-06 Test Reports

DALT and TAB Work Execution Schedule; G

DALT and TAB Procedures Summary; G

Design review report; G

Pre-Final DALT report; G

Final DALT report; G

TAB report for Season 1; G

TAB report for Season 2; G

SD-07 Certificates

Independent TAB agency and personnel qualifications; G

TAB Firm; G

Independent TAB Agency and Personnel Qualifications

1.5 QUALITY ASSURANCE

1.5.1 Independent Tab Agency and Personnel Qualifications

To secure approval for the proposed agency, submit information certifying that the TAB agency is a first tier subcontractor who is not affiliated with any other company participating in work on this contract, including design, furnishing equipment, or construction. Further, submit the following, for the agency, to Contracting Officer for approval:

a. Independent AABC or NEBB or TABB TAB agency:

TAB agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification; or TABB certification number and expiration date of current certification.

TAB team supervisor: Name and copy of AABC or NEBB or TABB TAB supervisor certificate and expiration date of current certification.

TAB team field leader: Name and documented evidence that the team field leader has satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.

TAB team field technicians: Names and documented evidence that each field technician has satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

Current certificates: Registrations and certifications are current, and valid for the duration of this contract. Renew Certifications which expire prior to completion of the TAB work, in a timely manner so that there is no lapse in registration or certification. TAB agency or TAB team personnel without a current registration or current certification are not to perform TAB work on this contract.

b. TAB Team Members: TAB team approved to accomplish work on this contract are full-time employees of the TAB agency. No other personnel is allowed to do TAB work on this contract.

c. Replacement of TAB team members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the Contracting Officer.

### 1.5.2 Tab Standard

Perform TAB in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard are considered mandatory. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practical, to satisfy the Contract requirements. Use the TAB Standard for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, adhere to the manufacturer's recommendations.

All quality assurance provisions of the TAB Standard such as performance guarantees are part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures must be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements are considered mandatory, including the latest requirements of ASHRAE 62.1.

### 1.5.3 Sustainability

Contractor must submit the following as part of the Quality Control Plan for acceptance testing:

a. List all test equipment to be used, including its manufacturer,model number, calibration date, and serial number.

b. Certificates of test personnel qualifications and certifications. Provide certification of compliance with 40 CFR 82.

c. Proof of equivalency if the contractor desires to substitute a test requirement.

Perform the following PTI as an integral part of the TAB process per the most recent edition of the NASA RCBEA GUIDE:

[ Compressors:
a. Vibration Analysis
b. Balance Test and Measurement
c. Alignment (laser preferred)
d. Lubricating Oil Test
e. Thermodynamic Performance Test
][ f. Hydraulic Oil Test (optional)
]
[ Fans:
a. Vibration Analysis
b. Balance Test and Measurement
c. Alignment (laser preferred)
d. Lubricating Oil Test
e. Thermodynamic Performance Test

]
[ Heat Exchangers (General):
a. Hydrostatic Test
b. Airborne Ultrasonic Test
c. Thermodynamic Performance Test
][ d. Infrared Thermography (optional)]

[ Heat Exchangers (Condenser Air Cooled):
a. Hydrostatic Test
b. Thermodynamic Performance Test
][ c. Airborne Ultrasonic Test (optional)]
[ d. Pulse Ultrasonic Test (optional)]
[ e. Infrared Thermography (optional)]

[ HVAC Ducts:
a. Operational Test
b. Ductwork Leak Testing (DALT); Pre-Final DALT report, Final DALT report
]
[ Piping Systems:
a. Vibration Analysis
b. Infrared Thermography
]
[ Steam Coils:
a. Warranty Test
b. Vibration Analysis
c. Performance Test
d. Infrared Thermography
]
[ Valves:
a. Hydrostatic Test
]

1.5.4 Qualifications

1.5.4.1 TAB Firm

The TAB Firm must be either a member of AABC or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications, including [TAB of environmental systems] [the performance of clean rooms and clean air devices] [building systems commissioning] [and] [the measuring of sound and vibration in environmental systems].

Certification must be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor must immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm will be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor.

These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The TAB Firm must be a prime subcontractor of the Contractor and be financially and corporately independent of the mechanical subcontractor, reporting directly to and paid

by the Contractor.

1.5.4.2 TAB Specialist

The TAB Specialist must be either a member of AABC,an experienced technician of the Firm certified by the NEBB, or a Supervisor certified by the TABB. The certification must be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist will be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

1.5.4.3 TAB Specialist Responsibilities

TAB Specialist responsibilities include all TAB work specified herein and in related sections under his direct guidance. The TAB specialist is required to be onsite on a daily basis to direct TAB efforts. The TAB Specialist must participate in the commissioning process.

1.5.4.4 Tab Related HVAC Submittals

The TAB Specialist must prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. Accompany the submittals identified on this list with a letter of approval signed and dated by the TAB Specialist when submitted to the Government. Ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

1.5.5 Responsibilities

The Contractor is responsible for ensuring compliance with the requirements of this section. The following delineation of specific work responsibilities is specified to facilitate TAB execution of the various work efforts by personnel from separate organizations. This breakdown of specific duties is specified to facilitate adherence to the schedule listed in paragraph entitled "TAB Submittal and Work Schedule."

1.5.5.1 Contractor

a. TAB personnel: Ensure that the DALT work and the TAB work is accomplished by a group meeting the requirements specified in paragraph entitled "TAB Personnel Qualification Requirements."

b. Pre-DALT/TAB meeting: Attend the meeting with the TAB Supervisor, and ensure that a representative is present for the sheetmetal contractor, mechanical contractor, electrical contractor, and automatic temperature controls contractor.

c. HVAC documentation: Furnish one complete set of the following HVAC-related documentation to the TAB agency:

(1) Contract drawings and specifications

(2) Approved submittal data for equipment

(3) Construction work schedule

(4) Up-to-date revisions and change orders for the previously listed items

d. Submittal and work schedules: Ensure that the schedule for submittals and work required by this section and specified in paragraph entitled "TAB Submittal and Work Schedule," is met.

e. Coordination of supporting personnel:

Provide the technical personnel, such as factory representatives or HVAC controls installer required by the TAB field team to support the DALT and the TAB field measurement work.

Provide equipment mechanics to operate HVAC equipment and ductwork mechanics to provide the field designated test ports to enable TAB field team to accomplish the DALT and the TAB field measurement work. Ensure these support personnel are present at the times required by the TAB team, and cause no delay in the DALT andthe TAB field work.

Conversely, ensure that the HVAC controls installer has required support from the TAB team field leader to complete the controls check out.

f. Deficiencies: Ensure that the TAB Agency supervisor submits all Design/Construction deficiency notifications directly to the Contracting officer within 3 days after the deficiency is encountered. Further, ensure that all such notification submittals are complete with explanation, including documentation, detailing deficiencies.

g. Prerequisite HVAC work: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as prerequisite work items, the deficiencies pointed out by the TAB team supervisor in the design review report.

h. Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's pre-field engineering report. Do not allow the TAB team to commence TAB field work until all of the following are completed.

(1) HVAC system installations are fully complete.

(2) HVAC prerequisite checkout work lists specified in the paragraph "Pre-Field TAB Engineering Report" are completed, submitted, and approved. Ensure that the TAB Agency gets a copy of the approved prerequisite HVAC work checklist.

(3) DALT field checks for all systems are completed.

(4) HVAC system filters are clean for both Season 1 and Season 2 TAB field work.

i. Advance notice: Furnish to the Contracting Officer with advance written notice for the commencement of the DALT field work and for the commencement of the TAB field work.

j. Insulation work: For required DALT work , ensure that insulation is not installed on ducts to be DALT'd until DALT work on the subject ducts is complete. Later, ensure that openings in duct and machinery insulation coverings for TAB test ports are marked, closed and sealed.

1.5.5.2 TAB Agency

Provide the services of a TAB team which complies with the requirements of paragraph entitled "Independent TAB Agency Personnel Qualifications". The work to be performed by the TAB agency is limited to testing, adjusting, and balancing of HVAC air and water systems to satisfy the requirements of this specification section.

1.5.5.3 TAB Team Supervisor

a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical DALT and TAB procedures and TAB team field work.

b. Pre-DALT/TAB meeting: Attend meeting with Contractor.

c. Design review report: Review project specifications and accompanying drawings to verify that the air systems and water systems are designed in such a way that the TAB engineer can accomplish the work in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.

d. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the pre-field engineering report, the during the DALT or TAB field work.

e. Pre-field DALT preliminary notification: Monitor the completion of the duct installation of each system and provide the necessary written notification to the Contracting Officer.

f. Pre-field engineering report: Utilizing the following HVAC-related documentation; contract drawings and specifications, approved submittal data for equipment, up-to-date revisions and change orders; prepare this report.

g. Prerequisite HVAC work checklist: Ensure the Contractor gets a copy of this checklist at the same time as the pre-field

engineering report is submitted.

h. Technical assistance for DALT work.

(1) Technical assistance: Provide immediate technical assistance to TAB field team.

(2) DALT field visit: Near the end of the DALT field work effort, visit the contract site to inspect the HVAC installation and the progress of the DALT field work. Conduct a site visit to the extent necessary to verify correct procedures are being implemented and to confirm the accuracy of the Pre-final DALT Report data which has been reported. Also, perform sufficient evaluation to allow the TAB supervisor to issue certification of the final report. Conduct the site visit full-time for a minimum of one 8 hour workday duration.

i. Final DALT report: Certify the DALT report. This certification includes the following work:

(1) Review: Review the Pre-final DALT report data. From these field reports, prepare the Certified Final DALT report.

(2) TAB Verification: Verify adherence, by the TAB field team, to the procedures specified in this section.

j. Technical Assistance for TAB Work: Provide immediate technical assistance to the TAB field team for the TAB work.

[(1) TAB field visit: At the midpoint of the Season 1 and Season 2 TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of one 8 hour workday[s] duration.]

[(2) TAB field visit: Near the end of the TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of one 8 hour workday duration. Review the TAB final report data and certify the TAB final report.]

[(1) TAB field visit: Near the end of the TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of one 8 hour workday duration. Review the TAB final report data and certify the TAB final report.]

k. Certified TAB report: Certify the TAB report. This certification includes the following work:

(1) Review: Review the TAB field data report. From this field report, prepare the certified TAB report.

(2) Verification: Verify adherence, by the TAB field team, to the TAB plan prescribed by the pre-field engineering report and verify adherence to the procedures specified in this section.

l. Design/Construction deficiencies: Within 3 working days after the TAB Agency has encountered any design or construction

deficiencies, the TAB Supervisor must submit written notification directly to the Contracting Officer, with a separate copy to the Contractor, of all such deficiencies. Provide in this submittal a complete explanation, including supporting documentation, detailing deficiencies. Where deficiencies are encountered that are believed to adversely impact successful completion of TAB, the TAB Agency must issue notice and request direction in the notification submittal.

m. TAB Field Check: The TAB team supervisor must attend and supervise [Season 1] [and Season 2] TAB field check.

1.5.5.4 TAB Team Field Leader

a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, "Execution."

b. Full time: Be present at the contract site when DALT field work or TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.

c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC Checklist, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

1.5.6 Test Reports

1.5.6.1 Data from DALT Field Work

Report the data for the Pre-final DALT Report and Certified Final DALT Report in compliance the following requirements:

a. Report format: Submit report data on Air Duct Leakage Test Summary Report Forms as shown on Page 6-2 of SMACNA 1143. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct tested with assigned node numbers for each section. Include node numbers in the completed report forms to identify each duct section. The TAB supervisor must review and certify the report.

b. The TAB supervisor must include a copy of all calculations prepared in determining the duct surface area of each duct test section. In addition,provide the ductwork air leak testing (DALT) reports with a copy(s) of the calibration curve for each of the DALT test orifices used for testing.

c. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date. Instruments must have been calibrated within one year of the date of use in the field. Instrument calibration must be traceable to the measuring standards of the National Institute of Standards and Technology.

c. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

1.5.6.2 Certified TAB Reports

Submit: TAB Report for Season 1 and TAB Report for Season 2 in the following manner:

a. Report format: Submit the completed pre-field data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed and certified by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data must be typewritten. Handwritten report forms or report data are not acceptable.

b. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded. Include in the TAB report continuous time versus temperature recording data of wet and dry bulb temperatures for the rooms, or zones, as designated in the following list:

(1) Measure and record data only after the HVAC systems installations are complete, the systems fully balanced and the HVAC systems controls operating in fully automatic mode.

(2) Data may be compiled using direct digital controls trend logging where available. Otherwise, temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls must be fully operational a minimum of 24 hours in advance of commencing data compilation. Include the specified data in the [Season I TAB Report] [Season I and Season 2 TAB Report].

[ c. System Diagrams: Provide updated diagrams with final installed locations of all terminals and devices, any numbering changes, and actual test locations. Use a key numbering system on the diagram which identifies each outlet contained in the outlet airflow report sheets.]

[ d. Static Pressure Profiles: Report static pressure profiles for air duct systems. Report static pressure data for all supply, return, relief, exhaust and outside air ducts for the systems listed. Include the following in the static pressure report data, in addition to AABC/NEBB/TABB required data:

(1) Report supply fan, return fan, relief fan, and exhaust fan inlet and discharge static pressures.

(2) Report static pressure drop across chilled water coils, DX coils, hot water coils, steam coils, electric resistance heating coils and heat reclaim devices installed in unit cabinetry or the system ductwork.

(3) Report static pressure drop across outside air, return air, and supply air automatic control dampers, both proportional and two-position, installed in unit cabinetry.

(4) Report static pressure drop across air filters, acoustic silencers, moisture eliminators, air flow straighteners, air flow

measuring stations or other pressure drop producing specialty items installed in unit cabinetry, or in the system ductwork. Examples of these specialty items are smoke detectors, white sound generators, RF shielding, wave guides, security bars, blast valves, small pipes passing through ductwork, and duct mounted humidifiers.

Do not report static pressure drop across duct fittings provided for the sole purpose of conveying air, such as elbows, transitions, offsets, plenums, manual dampers, and branch takes-offs.

(5) Report static pressure drop across outside air and relief/exhaust air louvers.]

[ (6) Report static pressure readings of supply air, return air, exhaust/relief air, and outside air in duct at the point where these ducts connect to each air moving unit.[and also at the following locations:

Main Duct: Take readings at four locations along the full length of the main duct, 25 percent, 50 percent, 75 percent, and 100 percent of the total duct length.

Floor Branch Mains: Take readings at floor branch mains served by a main duct vertical riser.

Branch Main Ducts: Take readings at branch main ducts.

VAV Terminals: Take readings at inlet static pressure at VAV terminal box primary air branch ducts.

VAV Terminals, Fan Powered: Take readings at fan discharge and inlet static pressures for series and parallel fan powered VAV terminal boxes.]]

e. Duct Traverses: Report duct traverses for main [and branch main] supply, return, exhaust, relief and outside air ducts. This includes all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency must evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pilot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane."

f. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

Instrumentation, used for taking wet bulb temperature readings must provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

g. Certification: Include the typed name of the TAB supervisor and

the dated signature of the TAB supervisor.

h. Performance Curves: The TAB Supervisor must include, in the TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.

i. Calibration Curves: The TAB Supervisor must include, in the TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturi's and flow orifices TAB'd on the job.

1.6 PROJECT/SITE CONDITIONS

1.6.1 DALT and TAB Services to Obtain Existing Conditions

Conduct DALT and TAB of the indicated existing systems and equipment and submit the specified DALT and TAB reports for approval. Conduct this DALT and TAB work in accordance with the requirements of this section.

]1.7 SEQUENCING AND SCHEDULING

1.7.1 Dalt and Tab Submittal and Work Schedule

Comply with additional requirements specified in 23 05 93 - Appendix C: DALT AND TAB SUBMITTAL AND WORK SCHEDULE included at the end of this section

[1.7.2 Projects with Phased Construction

This specification section is structured as though the HVAC construction, and thereby the TAB work, will be completed in a single phase. When the construction is completed in phases, the DALT work and TAB work must be planned, completed, and accepted for each construction phase.

1.7.2.1 Phasing of Work

This specification section is structured as though the HVAC construction, and thereby the TAB work, is going to be completed in a single phase[ in spite of the fact that there will be two seasons]. All elements of the TAB work are addressed on this premise. When a contract is to be completed in construction phases, including the TAB work, and the DALT work, the TAB work and DALT work must be planned for, completed and approved by the Contracting Officer with each phase. An example of this case would be one contract that requires the rehabilitation of the HVAC in each of several separated buildings. At the completion of the final phase, compile all approved reports and submit as one document.

1.7.3 DALT and TAB Submittal and Work Schedule

Submit this schedule,and TAB Schematic Drawings, adapted for this particular contract, to the Contracting Officer (CO) for review and approval. Include with the submittal the planned calendar dates for each submittal or work item. Resubmit an updated version for CO approval every 90 calendar days days. Compliance with the following schedule is the Contractor's responsibility.

Qualify TAB Personnel: Within 45 calendar days after date of contract award, submit TAB agency and personnel qualifications.

Pre-DALT/TAB Meeting: Within 30 calendar days after the date of

approval of the TAB agency and personnel, meet with the Contracting Officer's TAB representative.

Design Review Report: Within 60 calendar days after the date of the TAB agency personnel qualifications approval, submit design review report.

Pre-Field DALT Preliminary Notification: On completion of the duct installation for each system, notify the Contracting Officer in writing within 5 days after completion.

Ductwork Selected for DALT: Within 7 calendar days of Pre-Field DALT Preliminary Notification, the Contracting Officer's TAB representative (COTR) will select which of the project ductwork must be DALT'd.

DALT Field Work: Within 48 hours of COTR's selection, complete DALT field work on selected.

Submit Pre-final DALT Report: Within one working day after completion of DALT field work, submit Pre-final DALT Report. Separate Pre-final DALT reports may be submitted to allow phased testing from system to system.

DALT Work Field Check: Upon approval of the Pre-final DALT Report, schedule the COTR's DALT field check work with the Contracting Officer.

Submit Final DALT Report: Within 15 calendar days after completion of successful DALT Work Field Check, submit [Season 1] TAB report.

Pre-Field TAB Engineering Report: Within 21 calendar days after approval of the TAB agency Personnel Qualifications, submit the Pre-Field TAB Engineering Report.

Prerequisite HVAC Work Check Out List [For Season 1] and Advanced Notice For [Season 1] TAB Field Work: At a minimum of 115 calendar days prior to CCD, submit [Season 1] prerequisite HVAC work check out list certified as complete, and submit advance notice of commencement of [Season 1] TAB field work.

[[Season 1] TAB Field Work: At a minimum of 90 calendar days prior to CCD, [and when the ambient temperature is within Season 1 limits,] accomplish [Season 1] TAB field work.

Submit [Season 1] TAB Report: Within 15 calendar days after completion of [Season 1] TAB field work, submit [Season 1] TAB report.

[Season 1] TAB Field Check: 30 calendar days after Season 1 TAB report is approved by the Contracting Officer, conduct [Season 1] field check.

Complete [Season 1] TAB Work: Prior to CCD, complete all TAB work [except Season 2 TAB work].]

[[Season 1] TAB Field Work: At a minimum of 90 calendar days prior to CCD, [and when the ambient temperature is within Season 1

limits,] accomplish [Season 1] TAB field work; submit [Season 1] TAB report; and conduct [Season 1] field check.

Complete [Season 1] TAB Work: Prior to CCD, complete all TAB work [except Season 2 TAB work].]

[Prerequisite HVAC Work Check Out List For Season 2 and Advanced Notice For Season 2 TAB Field Work: Within 150 calendar days after date of the commencement of the Season 1 TAB field work, submit the Season 2 prerequisite HVAC work check out list certified as complete and submit advance notice of commencement of Season 2 TAB field work.]

[Season 2 TAB Field Work: Within 180 calendar days after date of commencement of the Season 1 TAB field work and when the ambient temperature is within Season 2 limits, accomplish Season 2 TAB field work.

Submit Season 2 TAB Report: Within 15 calendar days after completion of Season 2 TAB field work, submit Season 2 TAB report.

Season 2 TAB Field Check: 30 calendar days after the Season 2 TAB report is approved by the Contracting Officer, conduct Season 2 field check.

Complete Season 2 TAB Work: Within 15 calendar days after the completion of Season 2 TAB field data check, complete all TAB work.]

[Season 2 TAB Field Work: Within 180 calendar days after date of commencement of the Season 1 TAB field work and when the ambient temperature is within Season 2 limits, accomplish [Season 2] TAB field work; submit [Season 2] TAB report; and conduct Season 2 field check.

Complete Season 2 TAB Work: Within 15 calendar days after the completion of Season 2 field data check, complete TAB work.]

#### 1.7.3.1 Design Review Report

Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the duct leakage testing work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.

#### 1.7.3.2 Pre-Field DALT Preliminary Notification

a. Notification: On completion of the installation of each duct system indicated to be DALT'd, notify the Contracting Officer in writing within 7 calendar days after completion.

#### 1.7.3.3 Pre-Field TAB Engineering Report

Submit report containing the following information:

a. Step-by-step TAB procedure:

(1) Strategy: Describe the method of approach to the TAB field work from start to finish. Include in this description a complete methodology for accomplishing each seasonal TAB field work session.

(2) Air System Diagrams: Use the contract drawings and duct fabrication drawings if available to provide air system diagrams in the report showing the location of all terminal outlet supply, return, exhaust and transfer registers, grilles and diffusers. Use a key numbering system on the diagrams which identifies each outlet contained in the outlet airflow report sheets. Show intended locations of all traverses and static pressure readings.

(3) Procedural steps: Delineate fully the intended procedural steps to be taken by the TAB field team to accomplish the required TAB work of each air distribution system and each water distribution system. Include intended procedural steps for TAB work for subsystems and system components.

b. Pre-field data: Submit AABC or NEBB or SMACNA 1780 data report forms with the following pre-field information filled in:

(1) Design data obtained from system drawings, specifications, and approved submittals.

(2) Notations detailing additional data to be obtained from the contract site by the TAB field team.

(3) Designate the actual data to be measured in the TAB field work.

(4) Provide a list of the types of instruments, and the measuring range of each, which are anticipated to be used for measuring in the TAB field work. By means of a keying scheme, specify on each TAB data report form submitted, which instruments will be used for measuring each item of TAB data. If the selection of which instrument to use, is to be made in the field, specify from which instruments the choice will be made. Place the instrument key number in the blank space where the measured data would be entered.

c. Prerequisite HVAC work checkout list: Provide a list of inspections and work items which are to be completed by the Contractor. This list must be acted upon and completed by the Contractor and then submitted and approved by the Contracting Officer prior to the TAB team coming to the contract site.

At a minimum, a list of the applicable inspections and work items listed in the NEBB PROCEDURAL STANDARDS, Section III, "Preliminary TAB Procedures" under paragraphs titled, "Air Distribution System Inspection" and "Hydronic Distribution System Inspection" must be provided for each separate system to be TAB'd.

## 1.8 SUBCONTRACTOR SPECIAL REQUIREMENTS

[Perform all work in this section in accordance with the paragraph entitled "Subcontractor Special Requirements" in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS, stating that all contract requirements of this section must be accomplished directly by a first tier subcontractor. No work may be performed by a second tier subcontractor.]

1.9 WARRANTY

Furnish workmanship and performance warranty for the [DALT and ] TAB system work performed for a period not less than 2 years from the date of Government acceptance of the work; issued directly to the Government. Include provisions that if within the warranty period the system shows evidence of major performance deterioration, or is significantly out of tolerance, resulting from defective TAB or DALT workmanship, the corrective repair or replacement of the defective materials and correction of the defective workmanship is the responsibility of the TAB firm. Perform corrective action that becomes necessary because of defective materials and workmanship while system TAB and DALT is under warranty 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time constitutes grounds for having the corrective action and repairs performed by others and the cost billed to the TAB firm. The Contractor must also provide a 1 year contractor installation warranty.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 WORK DESCRIPTIONS OF PARTICIPANTS

Comply with requirements of this section as specified in 23 05 93 - Appendix A WORK DESCRIPTIONS OF PARTICIPANTS.

3.2 PRE-DALT/TAB MEETING

Meet with the Contracting Officer's technical representative (COTR)[and the designing engineer of the HVAC systems] to develop a mutual understanding relative to the details of the DALT work and TAB work requirements. Ensure that the TAB supervisor is present at this meeting. Requirements to be discussed include required submittals, work schedule, and field quality control.

3.3 DALT PROCEDURES

3.3.1 Instruments, Consumables and Personnel

Provide instruments, consumables and personnel required to accomplish the DALT field work. Follow the same basic procedure specified below for TAB Field Work, including maintenance and calibration of instruments, accuracy of measurements, preliminary procedures, field work, workmanship and treatment of deficiencies. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

3.3.2 Advance Notice of Pre-Final DALT Field Work

On completion of the installation of each duct system indicated to be DALT'd, notify the Contracting Officer in writing prior to the COTR's duct selection field visit.

3.3.3 Ductwork To Be DALT'd

From each duct system indicated as subject to DALT, the COTR will randomly select sections of each completed duct system for testing by the

Contractor's TAB Firm. The sections selected will not exceed 20 percent of the total measured linear footage of duct systems indicated as subject to DALT. Sections of duct systems subject to DALT will include 20 percent of main ducts, branch main ducts, branch ducts and plenums for supply, return, exhaust, and plenum ductwork.

[ It is acceptable for an entire duct system to be DALT'd instead of disassembling that system in order to DALT only the 20 percent portion specified above.]

3.3.4 DALT Testing

Perform DALT on the HVAC duct sections of each system as selected by the COTR. Use the duct class, seal class, leakage class and the leak test pressure data indicated on the drawings, to comply with the procedures specified in SMACNA 1143.

In spite of specifications of SMACNA 1143 to the contrary, DALT ductwork of construction class of 3-inch water gauge static pressure and below if indicated to be DALT'd. Complete DALT work on the COTR selected ductwork within 48 hours after the particular ductwork was selected for DALT. Separately conduct DALT work for large duct systems to enable the DALT work to be completed in 48 hours.

3.3.5 Pre-final DALT Report

After completion of the DALT work, prepare a Pre-final DALT Report meeting the additional requirements specified in UFGS-23 05 93 - Appendix B REPORTS - DALT and TAB. Data required by those data report forms shall be furnished by the TAB team. Prepare the report neatly and legibly; the Pre-final DALT report shall provide the basis for the Final DALT Report.

TAB supervisor shall review, approve and sign the Pre-Final DALT Report and submit this report within one day of completion of DALT field work. Verbally notify the Contracting Officer's TAB representative that the field check of the Pre-Final DALT Report data can commence.

After completion of the DALT work, prepare a Pre-final DALT Report using the reporting forms specified. TAB team to furnish data required by those data report forms . Prepare the report neatly and legibly; the Pre-final DALT report is the basis for the Final DALT Report. TAB supervisor must review and certify the Pre-final DALT Report and submit this report within one day of completion of DALT field work. Verbally notify the Contracting Officer's TAB representative that the field check of the Pre-final DALT Report data can commence.

3.3.6 Quality Assurance - COTR DALT Field Acceptance Testing

In the presence of the COTR and TAB team field leader, verify for accuracy Pre-final DALT Report data selected by the COTR. For each duct system, this acceptance testing shall be conducted on a maximum of 50 percent of the duct sections DALT'd..

Further, if any data on the Pre-final DALT report form for a given duct section is out-of-tolerance, then field acceptance testing shall be conducted on data for one additional duct section, preferably in the same duct system, in the presence of the COTR.

3.3.7 Additional COTR Field Acceptance Testing

If any of the duct sections checked for a given system are determined to have a leakage rate measured that exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction class and sealant class, terminate data checking for that section. The associated Pre-final DALT Report data for the given duct system will be disapproved. Make the necessary corrections and prepare a revised Pre-final DALT Report. Reschedule a field check of the revised report data with the Contracting Officer's TAB representative.

3.3.8 Certified Final DALT Report

On successful completion of all field checks of the Pre-final DALT Report data for all systems, the TAB Supervisor is to assemble, review, certify and submit the Final DALT Report to the Contracting Officer for approval.

On successful completion of all field checks of the Pre-Final DALT Report data for all systems, the TAB Supervisor shall assemble, review, approve, sign and submit the Final DALT Report in compliance with 23 05 93 - Appendix B REPORTS - DALT and TAB to the Contracting Officer for approval.

3.3.9 Prerequisite for TAB Field Work

Do not commence TAB field work prior to the completion and approval, for all systems, of the Final DALT Report.

3.4 TAB PROCEDURES

3.4.1 TAB Field Work

Test, adjust, and balance the listed HVAC systems to the state of operation indicated on and specified in the contract design documents. That is, comply with the the requirements of AABC MN-1 [and AABC MN-4],[ NEBB PROCEDURAL STANDARDS, NEBB MASV,] or SMACNA 1780 (TABB) and SMACNA 1858 (TABB),except as supplemented and modified by this section.[ Provide instruments and consumables required to accomplish the TAB work. Calibrate and maintain instruments in accordance with manufacturer's written procedures.]

Test, adjust, and balance the listed HVAC systems to the state of operation indicated on and specified in the contract design documents. Conduct TAB work, including measurement accuracy, and sound measurement work in conformance with the AABC MN-1 and AABC MN-4, or NEBB TABES and NEBB MASV, or SMACNA 1780 (used by TABB) and SMACNA 1858 sound measurement procedures, except as supplemented and modified by this section.[ The only water flow and air flow reporting which can be deferred until the Season 2 is that data which would be affected in terms of accuracy due to outside ambient conditions.]

3.4.2 Preliminary Procedures

Use the approved pre-field engineering report as instructions and procedures for accomplishing TAB field work. TAB engineer is to locate, in the field, test ports required for testing. It is the responsibility of the sheet metal contractor to provide and install test ports as required by the TAB engineer.

3.4.3 TAB Air Distribution Systems

3.4.3.1 Units With Coils

Report heating and cooling performance capacity tests for hot water, chilled water, DX and steam coils for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

a. For air handlers with capacities greater than 7.5 tons (90,000 Btu) cooling, such as factory manufactured units, central built-up units and rooftop units, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing."

   Do not determine entering and leaving wet and dry bulb temperatures by single point measurement, but by the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

   Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

b. For units with capacities of 7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

   Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

3.4.3.2 Air Handling Units

Air handling unit systems including fans (air handling unit fans, exhaust fans and winter ventilation fans), coils, ducts, plenums, mixing boxes, terminal units, variable air volume boxes, and air distribution devices for supply air, return air, outside air, mixed air relief air, and makeup air.

3.4.3.3 Heating and Ventilating Units

Heating and ventilating unit systems including fans, coils, ducts, plenums, roof vents, registers, diffusers, grilles, and louvers for supply air, return air, outside air, and mixed air.

3.4.3.4 Exhaust Fans

Exhaust fan systems including fans, ducts, plenums, grilles, and hoods for exhaust air.

3.4.3.5 Unit Heaters

3.4.4 TAB Water Distribution Systems

3.4.4.1 Chilled Water

Chilled water systems including chillers, condensers, cooling towers, pumps, coils, system balance valves and flow measuring devices.

For water chillers, report data as required by AABC, NEBB and TABB standard procedures, including refrigeration operational data.

3.4.4.2 Heating Hot Water

Heating hot water systems including boilers, hot water converters (e.g., heat exchangers), pumps, coils, system balancing valves and flow measuring devices.

3.4.4.3 Dual Temperature Water

Dual temperature water systems including boilers, converters, chillers, condensers, cooling towers, pumps, coils, and system balancing valves, and flow measuring devices.

3.4.5 TAB Work on Performance Tests Without Seasonal Limitations

3.4.5.1 Performance Tests

In addition to the TAB proportionate balancing work on the air distribution systems and the water distribution systems, accomplish TAB work on the HVAC systems which directly transfer thermal energy. TAB the operational performance of the [heating systems] [and] [cooling systems].

3.4.5.2 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. Record these temperatures at beginning and at the end of data taking.

3.4.5.3 Water Chillers

For water chillers, report data as required by NEBB Form TAB 15-83, NEBB PROCEDURAL STANDARDS, including refrigeration operational data.

3.4.5.4 Refrigeration Units

For refrigeration compressors/condensers/condensing units, report data as required by NEBB Form TAB 15-83, NEBB PROCEDURAL STANDARDS, including refrigeration operational data.

3.4.5.5 Coils

Report heating and cooling performance capacity tests for [hot water], [chilled water], [DX] [and steam coils] for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

[a. For Central station air handlers with capacities greater than 7.5 tons (90,000 Btu) cooling, such as factory manufactured units, central built-up units and rooftop units, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing".

Entering and leaving wet and dry bulb temperatures are not determined by single point measurement, but the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).]

[b. For units with capacities of 7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.]

3.4.6 TAB Work on Performance Tests With Seasonal Limitations

3.4.6.1 Performance Tests

Accomplish proportionate balancing TAB work on the air distribution systems and water distribution systems, in other words, accomplish adjusting and balancing of the air flows and water flows, any time during the duration of this contract, subject to the limitations specified elsewhere in this section. However, accomplish, within the following seasonal limitations, TAB work on HVAC systems which directly transfer thermal energy.

3.4.6.2 Season Of Maximum Load

Visit the contract site for at least two TAB work sessions for TAB field measurements. Visit the contract site during the season of maximum heating load and visit the contract site during the season of maximum cooling load], the goal being to TAB the operational performance of the heating systems and cooling systems under their respective maximum outdoor environment-caused loading. During the seasonal limitations, TAB the operational performance of the heating systems and cooling systems.

3.4.6.3 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. Record these temperatures at beginning and at the end of data taking.

3.4.6.4 Water Chillers

Water chillers: For water chillers,report data as required by NEBB Form TAB 15-83, NEBB PROCEDURAL STANDARDS, including refrigeration operational data.

3.4.6.5 Coils

Report heating and cooling performance capacity tests for chilled water, and DX coils for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

a. For Central station air handlers with capacities greater than 7.5 tons (90,000 Btu) cooling, such as factory manufactured units, central built-up units and rooftop units, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing."

   Entering and leaving wet and dry bulb temperatures are not determined by single point measurement, but by the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

   Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

b. For units with capacities of 7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

   Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

3.4.7 Workmanship

Conduct TAB work on specified HVAC systems, as installed, until measured flow rates are equal to the design flow rates as specified or indicated on the contract documents. This TAB work includes adjustment of balancing valves, balancing dampers, and sheaves. Further, this TAB work includes changing out fan sheaves and pump impellers if required to obtain air and water flow rates specified or indicated. If, with these adjustments and equipment changes, the specified or indicated design flow rates cannot be attained, contact the Contracting Officer for direction.

3.4.8 Deficiencies

Strive to meet the intent of this section to maximize the performance of the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of design values specified in the paragraph entitled "Workmanship," provide written notice as soon as possible to the Contractor

and the Contracting Officer describing the deficiency and recommended correction.

Responsibility for correction of installation deficiencies is the Contractor's. If a deficiency is in equipment design, call the TAB team supervisor for technical assistance. Responsibility for reporting design deficiencies to Contractor is the TAB team supervisor's.

3.4.9 TAB Reports

Additional requirements for TAB Reports are specified in 23 05 93 - Appendix B REPORTS - DALT and TAB
After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and certification, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms is to be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and thereby the TAB report is considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship."

Prepare the report neatly and legibly; the pre-final TAB report is the final TAB report minus the TAB supervisor's review and certification. Obtain, at the contract site, the TAB supervisor's review and certification of the TAB report.

Verbally notify the Contracting Officer's TAB representative that the field check of the TAB report data can commence; give this verbal notice 48 hours in advance of field check commencement. Do not schedule field check of the TAB report until the specified workmanship requirements have been met or written approval of the deviations from the requirements have been received from the Contracting Officer.]

3.4.10 Quality Assurance - COTR TAB Field Acceptance Testing

3.4.10.1 TAB Field Acceptance Testing

During the field acceptance testing, verify, in the presence of the Contracting Officer's TAB representative, random selections of data (water, air quantities, air motion, [sound level readings]) recorded in the TAB Report. Points and areas for field acceptance testing are to be selected by the Contracting Officer's TAB representative. Measurement and test procedures are the same as approved for TAB work for the TAB Report.

Field acceptance testing includes verification of TAB Report data recorded for the following equipment groups:

Group 1: All chillers, boilers, return fans, computer room units, and air handling units (rooftop and central stations).

Group 2: 25% of the VAV terminal boxes and associated diffusers and registers.

Group 3: 25% of the supply diffusers, registers, grilles associated with constant volume air handling units.

Group 4: 25% of the return grilles, return registers, exhaust grilles and exhaust registers.

Group 5: 25% of the supply fans, exhaust fans, and pumps.

Further, if any data on the TAB Report for Groups 2 through 5 is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, additional group data verification is required in the presence of the COTR. Verify TAB Report data for one additional piece of equipment in that group. Continue this additional group data verification until out-of-tolerance data ceases to be found.

3.4.10.2 Additional COTR TAB Field Acceptance Testing

If any of the acceptance testing measurements for a given equipment group is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, terminate data verification for all affected data for that group. The affected data for the given group will be disapproved. Make the necessary corrections and prepare a revised TAB Report. Reschedule acceptance testing of the revised report data with the Contracting Officer's TAB representative.

Further, if any data on the TAB Report for a given field acceptance test group is out-of-tolerance, then field test data for one additional field test group as specified herein. Continue this increase field test work until out-of-tolerance data ceases to to be found. This additional field testing is up and above the original 25 percent of the of reported data entries to be field tested.

If there are no more similar field test groups from which to choose, additional field testing from another, but different, type of field testing group must be tested.

3.4.10.3 Prerequisite for Approval

Compliance with the field acceptance testing requirements of this section is a prerequisite for the final Contracting Officer approval of the TAB Report submitted.

3.5 MARKING OF SETTINGS

Upon the final TAB work approval, permanently mark the settings of HVAC adjustment devices including valves, gauges, splitters, and dampers so that adjustment can be restored if disturbed at any time. Provide permanent markings clearly indicating the settings on the adjustment devices which result in the data reported on the submitted TAB report.

3.6 MARKING OF TEST PORTS

The TAB team is to permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, make these markings on the exterior side of the duct insulation. Show the location of test ports on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

3.7 APPENDICES

UFGS-23 05 93 - Appendix A WORK DESCRIPTIONS OF PARTICIPANTS
UFGS-23 05 93 - Appendix B REPORTS - DALT and TAB
UFGS-23 05 93 - Appendix C DALT AND TAB SUBMITTAL AND WORK SCHEDULE

UFGS-23 05 93 - Appendix A

WORK DESCRIPTIONS OF PARTICIPANTS

The Contractor is responsible for ensuring compliance with all requirements of this specification section. However, the following delineation of specific work items is provided to facilitate and co-ordinate execution of the various work efforts by personnel from separate organizations.

1. Contractor

a. HVAC documentation: Provide pertinent contract documentation to the TAB Firm, to include the following: the contract drawings and specifications; copies of the approved submittal data for all HVAC equipment, air distribution devices, and air/water measuring/balancing devices; the construction work schedule; and other applicable documents requested by the TAB Firm. Provide the TAB Firm copies of contract revisions and modifications as they occur.

b. Schedules: Ensure the requirements specified under the paragraph "DALT and TAB Schedule" are met.

c. Pre-DALT and TAB meeting: Arrange and conduct the Pre-DALT and TAB meeting. Ensure that a representative is present for the sheet metal contractor, the mechanical contractor, the electrical contractor, and the automatic temperature controls contractor.

d. Coordinate Support: Provide and coordinate support personnel required by the TAB Firm in order to accomplish the DALT and TAB field work. Support personnel may include factory representatives, HVAC controls installers, HVAC equipment mechanics, sheet metal workers, pipe fitters, and insulators. Ensure support personnel are present at the work site at the times required.

e. Correct Deficiencies: Ensure the notifications of Construction Deficiencies are provided as specified herein. Refer to the paragraph entitled "Construction Deficiencies." Correct each deficiency as soon as practical with the Contracting Officer, and submit revised schedules and other required documentation.

f. Pre-TAB Work Checklists: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as pre-TAB work checklist items, the deficiencies pointed out by the TAB team supervisor in the design review report.

Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's DALT and TAB Work Procedures Summary. Do not allow the TAB team to commence TAB field work until all of the following are completed.

g. Give Notice of Testing: Submit advance notice of TAB field work accompanied by completed prerequisite HVAC Work List

h. Insulation work: Ensure that no insulation is shall not be

installed on ducts to be DALT'd until DALT work on the subject ducts is complete.

Ensure the duct and piping systems are properly insulated and vapor sealed upon the successful completion and acceptance of the DALT and TAB work.

2. TAB Team Supervisor

a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical DALT and TAB procedures and TAB team field work.

b. Schedule: Ensure the requirements specified under the paragraph "DALT and TAB Schedule" are met.

c. Submittals: Provide the submittals specified herein.

d. Pre-DALT/TAB meeting: Attend meeting with Contractor. Ensure TAB personnel that will be involved in the TAB work under this contract attend the meeting.

e. Design Review Report: Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the duct leakage testing work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.

f. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the DALT and TAB Procedures Summary, the during the DALT or TAB field work.

Ensure the Contractor is properly notified and aware of all support personnel needed to perform the TAB work. Maintain communication with the Contractor regarding support personnel throughout the duration of the TAB field work, including the TAB field acceptance testing checking.

Ensure all inspections and verifications for the Pre-Final DALT and Pre-TAB Checklists are completely and successfully conducted before DALT and TAB field work is performed.

g. Advance Notice: Monitor the completion of the duct system installations and provide the Advance Notice for Pre-Final DALT field work as specified herein.

h. Technical Assistance: Provide technical assistance to the DALT and TAB field work.

i. Deficiencies Notification: Ensure the notifications of Construction Deficiencies are provided as specified herein. Comply with requirements of the paragraph entitled "Construction Deficiencies." Resolve each deficiency as soon as practical and submit revised schedules and other required documentation.

j. Procedures: Develop the required TAB procedures for systems or system components not covered in the TAB Standard.

3. TAB Team Field Leader

a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, "Execution."

b. Full time: Be present at the contract site when DALT field work or TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.

c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC work list, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

UFGS-23 05 93 - Appendix B

REPORTS - DALT and TAB

All submitted documentation must be typed, neat, and organized. All reports must have a waterproof front and back cover, a title page, a certification page, sequentially numbered pages throughout, and a table of contents. Tables, lists, and diagrams must be titled. Generate and submit for approval the following documentation:

1. DALT and TAB Work Execution Schedule

Submit a detailed schedule indicating the anticipated calendar date for each submittal and each portion of work required under this section. For each work entry, indicate the support personnel (such as controls provider, HVAC mechanic, etc.) that are needed to accomplish the work. Arrange schedule entries chronologically.

2. DALT and TAB Procedures Summary

Submit a detailed narrative describing all aspects of the DALT and TAB field work to be performed. Clearly distinguish between DALT information and TAB information. Include the following:

a. A list of the intended procedural steps for the DALT and TAB field work from start to finish. Indicate how each type of data measurement will be obtained. Include what Contractor support personnel are required for each step, and the tasks they need to perform.

b. A list of the project's submittals that are needed by the TAB Firm in order to meet this Contract's requirements.

c. The schematic drawings to be used in the required reports, which may include building floor plans, mechanical room plans, duct system plans, and equipment elevations. Indicate intended TAB measurement locations, including where test ports need to be provided by the Contractor.

d. The data presentation forms to be used in the report, with the preliminary information and initial design values filled in.

e. A list of DALT and TAB instruments to be used, edited for this project, to include the instrument name and description, manufacturer, model number, scale range, published accuracy, most recent calibration date, and what the instrument will be used for on this project.

f. A thorough checklist of the work items and inspections that need to be accomplished before DALT field work can be performed. The Contractor must complete, submit, and receive approval of the Completed Pre-Final DALT Work Checklist before DALT field work can be accomplished.

g. A thorough checklist of the work items and inspections that need to be accomplished before the [Season 1 ]TAB field work can be performed. The Contractor must complete, submit, and receive approval of the Completed [Season 1 ]Pre-TAB Work Checklist before the [Season 1 ]TAB field work can be accomplished.

[h. A thorough checklist of the work items and inspections that need to be accomplished before the Season 2 TAB field work can be performed. The Contractor must complete, submit, and receive approval of the Completed Season 2 Pre-TAB Work Checklist before the Season 2 TAB field work can be accomplished.]

i. The checklists specified above shall be individually developed and tailored specifically for the work under this contract. Refer to NEBB PROCEDURAL STANDARDS, Section III, "Preliminary TAB Procedures" under the paragraphs titled, "Air Distribution System Inspection" and "Hydronic Distribution System Inspection" for examples of items to include in the checklists.

3. Design Review Report

Submit report containing the following information:

a. Review the contract specifications and drawings to verify that the TAB work can be successfully accomplished in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.

b. Submit a typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the DALT work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. If no deficiencies are evident, state so in the report.

4. Pre-Final DALT Report for COTR DALT Field Checks

Report the data for the Pre-Final DALT Report meeting the following requirements:

a. Submit a copy of the approved DALT and TAB Procedures Summary: Provide notations describing how actual field procedures differed from the procedures listed.

b. Report format: Submit a comprehensive report for the DALT field work data using data presentation forms equivalent to the "Air Duct Leakage Test Summary Report Forms" located in the SMACNA 1143. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct tested with assigned node numbers for each section. Node numbers shall be included in the completed report forms to identify each duct section.

c. Calculations: Include a copy of all calculations prepared in determining the duct surface area of each duct test section. Include in the DALT reports copy(s) of the calibration curve for each of the DALT test orifices used for testing.

d. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date. Instruments are to be calibrated within one year of the date of use in the field; instrument calibration is to be traceable to the

measuring standards of the National Institute of Standards and Technology.

d. TAB Supervisor Approval: Include on the submitted report the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

5. Final DALT Report

On successful completion of all COTR field checks of the Pre-final DALT Report data for all systems, the TABS Supervisor shall assemble, review, sign and submit the Final DALT Report to the Contracting Officer for approval.

6. TAB Reports: Submit TAB Report for Season 1 and TAB Report for Season 2 in the following manner:

a. Procedure Summary: Submit a copy of the approved DALT and TAB Procedures Summary. When applicable, provide notations describing how actual field procedures differed from the procedures listed.

b. Report format: Submit the completed data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed, approved and signed by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data shall be typewritten. Handwritten report forms or report data are not acceptable.

c. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded. Include in the TAB report continuous time versus temperature recording data of wet and dry bulb temperatures for the rooms, or zones, as designated in the following list:

[_____]

(1) Data shall be measured and compiled on a continuous basis for the period in which TAB work affecting those rooms is being done.

(2) Data shall be measured/recorded only after the HVAC systems installations are complete, the systems fully balanced and the HVAC systems controls operating in fully automatic mode. Provide a detailed explanation wherever a final measurement did not achieve the required value.

(3) Data may be compiled using direct digital controls trend logging where available. Otherwise, the Contractor shall temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls shall have been fully operational a minimum of 24 hours in advance of commencing data compilation. The specified data shall be included in the [Season I TAB Report] [Season I and Season 2 TAB Report].

d. Air System Diagrams: Provided updated diagrams with final installed locations of all terminals and devices, any numbering changes, and actual test locations.

e. Air Static Pressure Profiles: Report static pressure profiles for air duct systems including: [AHU-1][RTAC-1][MUA-1][_____]. Report static pressure data for all supply, return, relief, exhaust and outside air ducts for the systems listed. The static pressure report data shall include, in addition to AABC or NEBB or TABB required data, the following:

(1) Report supply fan, return fan, relief fan, and exhaust fan inlet and discharge static pressures.

(2) Report static pressure drop across chilled water coils, DX coils, hot water coils, steam coils, electric resistance heating coils and heat reclaim devices installed in unit cabinetry or the system ductwork.

(3) Report static pressure drop across outside air, return air, and supply air automatic control dampers, both proportional and two-position, installed in unit cabinetry.

(4) Report static pressure drop across air filters, acoustic silencers, moisture eliminators, air flow straighteners, air flow measuring stations or other pressure drop producing specialty items installed in unit cabinetry, or in the system ductwork. Examples of these specialty items are smoke detectors, white sound generators, RF shielding, wave guides, security bars, blast valves, small pipes passing through ductwork, and duct mounted humidifiers.

Do not report static pressure drop across duct fittings provided for the sole purpose of conveying air, such as elbows, transitions, offsets, plenums, manual dampers, and branch takes-offs.

(5) Report static pressure drop across outside air and relief/exhaust air louvers.

(6) Report static pressure readings of supply air, return air, exhaust/relief air, and outside air in duct at the point where these ducts connect to each air moving unit.

[f. Duct Transverses: Report duct traverses for main [and branch main] supply, return[, exhaust, relief and outside air] ducts. [This shall include all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows.] The TAB Agency shall evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pitot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane".]

g. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

Instrumentation, used for taking wet bulb temperature readings shall provide accuracy of plus or minus 5 percent at the measured face

velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

h. Performance Curves: The TAB Supervisor shall include, in the TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.

i. Calibration Curves: The TAB Supervisor shall include, in the TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturis and flow orifices TAB'd on the job.

j. Data From Tab Field Work: After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and approval signature, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms shall be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and thereby the TAB report shall be considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship."

UFGS-23 05 93 - Appendix C

DALT AND TAB SUBMITTAL AND WORK SCHEDULE

Perform the following items of work in the order listed adhering to the dates schedule specified below. Include the major items listed in this schedule in the project network analysis schedule required by Section 01 32 17.00 20 NETWORK ANALYSIS SCHEDULES.

Submit TAB Agency and TAB Personnel Qualifications: Within 42 calendar days after date of contract award.

Submit the DALT and TAB Work Execution Schedule: within 14 days after receipt of the TAB agency and TAB personnel qualifications approval. Revise and re-submit this schedule 28 days prior to commencement of DALT work and 28 days prior to the commencement of TAB Season 1 work and TAB Season 2 work.

Submit the DALT and TAB Work Procedures Summary: within 14 days after receipt of the initial approved DALT and TAB Work Execution Schedule.

Meet with the COTR at the Pre-DALT/TAB Meeting: Within 28 calendar days after receipt of the approved initial DALT/TAB Execution Schedule.

Submit Design Review Report: Within 56 calendar days after the receipt of the approved initial DALT and TAB Work Execution Schedule.

[Conduct measurements and submit the Record of Existing Facility Conditions: within 28 days after receipt of approved DALT and TAB Work Procedures Summary.]

Advance Notice of Pre-Final DALT Field Work: After the completed installation of the HVAC duct system to be DALT'd, submit to the Contracting Officer an Advance Notice of Pre-Final DALT Field Work accompanied by the completed Pre-Final DALT Work Checklistchecklist for the subject duct system.

Ductwork Selected for DALT: Within 14 calendar days after receiving an acceptable completed Pre-Final DALT Work Checklist, the Contracting Officer's technical representative (COTR) will select the project ductwork sections to be DALT'd.

DALT Field Work: Within 48 hours of COTR's selection, complete DALT field work on selected project ductwork.

Submit Pre-Final DALT Report: Within two working days after completion of DALT field work, submit Pre-final DALT Report. Separate Pre-final DALT reports may be submitted to allow phased testing from system to system.

Quality Assurance - COTR DALT Field Checks: Upon approval of the Pre-final DALT Report, the COTR's DALT field check work shall be scheduled with the Contracting Officer.

Submit Final DALT Report: Within 14 calendar days after completion of successful DALT Work Field Check, submit Season 1 TAB report.

Advance Notice of TAB Field Work: At a minimum of 14 calendar days

prior to TAB Field Work, submit advance notice of TAB field work accompanied by completed
[Season 1 ]Pre-TAB Work Checklist.

TAB Field Work: At a minimum of 84 calendar days prior to CCD, and when the ambient temperature is within limits, accomplish TAB field work.

Submit TAB Report: Within 14 calendar days after completion of TAB field work, submit initial TAB report.

Quality Assurance - COTR TAB Field Check: 30 calendar days after initial TAB report is approved by the Contracting Officer, conduct field check.

Complete TAB Work: Prior to CCD, complete all TAB work and submit final.

Receive the approved TAB report: Within 21 calendar days, receive the report from Contracting Officer approved TAB report.

Advance Notice of Season 2 TAB Field Work: At a minimum of 126 days after CCD, submit advance notice of Season 2 TAB field work accompanied by completed Season 2 Pre-TAB Work Checklist.

Season 2 TAB Field Work: Within 14 calendar days after date of advance notice of Season 2 TAB field work and when the ambient temperature is within Season 2 limits, accomplish Season 2 TAB field work.

Submit Season 2 TAB Report: Within 14 calendar days after completion of Season 2 TAB field work, submit Season 2 TAB report.

Season 2 Quality Assurance - COTR TAB Field Checks: 28 calendar days after the Season 2 TAB report is approved by the Contracting Officer, conduct Season 2 field check.

Complete Season 2 TAB Work: Within 14 calendar days after the completion of Season 2 TAB field data check, complete all TAB work.]

Receive the approved TAB report: Within calendar 21 days, receive the report from Contracting Officer.

-- End of Section --

SECTION 23 07 00

THERMAL INSULATION FOR MECHANICAL SYSTEMS
**04/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

| | |
|---|---|
| ASHRAE 90.1 - IP | (2007) Energy Standard for Buildings Except Low-Rise Residential Buildings, I-P Edition |
| ASHRAE 90.2 | (2007) Energy Efficient Design of Low-Rise Residential Buildings |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 167 | (1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |
| ASTM A 240/A 240M | (2008) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications |
| ASTM A 580/A 580M | (2008) Standard Specification for Stainless Steel Wire |
| ASTM B 209 | (2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate |
| ASTM C 1126 | (2004) Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation |
| ASTM C 1136 | (2008) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation |
| ASTM C 1290 | (2006e1) Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts |
| ASTM C 1427 | (2007) Specification for Preformed |

| | |
|---|---|
| | Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form |
| ASTM C 195 | (2000) Standard Specification for Mineral Fiber Thermal Insulating Cement |
| ASTM C 449 | (2007) Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement |
| ASTM C 533 | (2007) Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation |
| ASTM C 534/C 534M | (2008) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form |
| ASTM C 547 | (2008e1) Standard Specification for Mineral Fiber Pipe Insulation |
| ASTM C 552 | (2007) Standard Specification for Cellular Glass Thermal Insulation |
| ASTM C 553 | (2008) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications |
| ASTM C 591 | (2008) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation |
| ASTM C 610 | (2007) Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation |
| ASTM C 612 | (2004e1) Mineral Fiber Block and Board Thermal Insulation |
| ASTM C 647 | (2008) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation |
| ASTM C 665 | (2006) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing |
| ASTM C 795 | (2008) Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel |
| ASTM C 916 | (1985; R 2007) Standard Specification for Adhesives for Duct Thermal Insulation |
| ASTM C 920 | (2008) Standard Specification for Elastomeric Joint Sealants |
| ASTM C 921 | (2003a) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation |

| | |
|---|---|
| ASTM D 774/D 774M | (1997; R 2007) Bursting Strength of Paper |
| ASTM D 882 | (2002) Tensile Properties of Thin Plastic Sheeting |
| ASTM E 2231 | (2007a) Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics |
| ASTM E 84 | (2008a) Standard Test Method for Surface Burning Characteristics of Building Materials |
| ASTM E 96/E 96M | (2005) Standard Test Methods for Water Vapor Transmission of Materials |

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

| | |
|---|---|
| MSS SP-69 | (2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application |

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

| | |
|---|---|
| MICA Insulation Stds | (1999) National Commercial & Industrial Insulation Standards |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 255 | (2005; Errata 2006) Standard Method of Test of Surface Burning Characteristics of Building Materials |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| MIL-A-3316 | (Rev C; Am 2) Adhesives, Fire-Resistant, Thermal Insulation |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 723 | (2008) Standard for Test for Surface Burning Characteristics of Building Materials |

## 1.2 SYSTEM DESCRIPTION

### 1.2.1 General

Provide field-applied insulation and accessories on mechanical systems as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated. Field applied insulation materials required for use on Government-furnished items as listed in the SPECIAL CONTRACT REQUIREMENTS shall be furnished and installed by the Contractor.

### 1.2.2 Surface Burning Characteristics

Unless otherwise specified, insulation shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in

accordance with ASTM E 84. Flame spread, and smoke developed indexes, shall be determined by ASTM E 84, NFPA 255 or UL 723. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Test specimens shall be prepared and mounted according to ASTM E 2231. Insulation materials located exterior to the building perimeter are not required to be fire rated.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Submit the three SD types, SD-02 Shop Drawings, SD-03 Product Data, and SD-08 Manufacturer's Instructions at the same time for each system.

SD-03 Product Data

Pipe Insulation Systems
Duct Insulation Systems
Equipment Insulation Systems

A complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories including adhesives, sealants and jackets for each mechanical system requiring insulation shall be included. The product data must be copywrited, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. Materials furnished under this section of the specification shall be submitted together in a booklet.

SD-08 Manufacturer's Instructions

Pipe Insulation Systems
Duct Insulation Systems
Equipment Insulation Systems

Submit a booklet containing manufacturer's published installation instructions for the insulation systems. The instructions must be copywrited, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation.

## 1.4 QUALITY ASSURANCE

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

## 1.5 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Contracting Officer may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means. Packages or standard

containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material. Insulation packages and containers shall be asbestos free.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Provide materials which are the standard products of manufacturers regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Provide insulation systems in accordance with the approved MICA National Insulation Standards plates as supplemented by this specification. Provide field-applied insulation for heating, ventilating, and cooling (HVAC) air distribution systems and piping systems which are located within, on, under, and adjacent to buildings; and for plumbing systems.

### 2.2 MATERIALS

Provide insulation that meets or exceed the requirements of ASHRAE 90.1 - IP. Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling. Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

#### 2.2.1 Adhesives

##### 2.2.1.1 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C 916, Type I.

##### 2.2.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C 195.

##### 2.2.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. Lagging adhesives shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. Adhesive shall be MIL-A-3316, Class 1, pigmented [white] [red] and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or Class 2 for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations for pipe and duct insulation.

2.2.2 Contact Adhesive

Adhesives may be any of, but not limited to, the neoprene based, rubber based, or elastomeric type that have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation shall be used to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices.

2.2.3 Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

2.2.4 Corner Angles

Nominal 0.016 inch aluminum 1 by 1 inch with factory applied kraft backing. Aluminum shall be ASTM B 209, Alloy 3003, 3105, or 5005.

2.2.5 Finishing Cement

ASTM C 449: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must comply with ASTM C 795.

2.2.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth, with 20X20 maximum mesh size, and glass tape shall have maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces/square yard.

2.2.7 Staples

Outward clinching type [ASTM A 167, Type 304 or 316 stainless steel].

2.2.8 Jackets

2.2.8.1 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B 209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands shall be 2 by 0.016 inch aluminum matching jacket material. Bands for insulation below ground shall be 3/4 by 0.020 inch thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the

Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

2.2.8.2 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

2.2.8.3 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive, greater than 3 plys standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive); with 0.0000 permeability when tested in accordance with ASTM E 96/E 96M; heavy duty, white or natural; and UV resistant.

2.2.9 Vapor Retarder Required

ASTM C 921, Type I, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C 921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require factory applied jackets are mineral fiber, cellular glass, polyisocyanurate, and phenolic foam. Insulation materials that do not require jacketing are flexible elastomerics. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.2.9.1 White Vapor Retarder All Service Jacket (ASJ)

Standard reinforced fire retardant jacket for use on hot/cold pipes, ducts, or . Vapor retarder jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

2.2.9.2 Vapor Retarder/Vapor Barrier Mastic Coatings

a. The vapor barrier shall be self adhesive (minimum 2 mils adhesive, 3 mils embossed) greater than 3 plys standard grade, silver, white, black and embossed white jacket for use on hot/cold pipes. Less than 0.02 permeability when tested in accordance with ASTM E 96/E 96M. Meeting UL 723 or ASTM E 84 flame and smoke requirements; UV resistant.

b. The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be determined according to procedure B of ASTM E 96/E 96M utilizing apparatus described in ASTM E 96/E 96M. The coating shall be a nonflammable, fire resistant type. All other application and service properties shall be in accordance with ASTM C 647.

2.2.9.3 Laminated Film Vapor Retarder

ASTM C 1136, Type I, maximum moisture vapor transmission 0.02 perms,

minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable. Vapor retarder shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.2.9.4 Polyvinylidene Chloride (PVDC) Film Vapor Retarder

The PVDC film vapor retarder shall have a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 30 lb/inch when tested in accordance with ASTM D 882, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.2.9.5 Polyvinylidene Chloride Vapor Retarder Adhesive Tape

Requirements must meet the same as specified for Laminated Film Vapor Retarder above.

2.2.9.6 Vapor Barrier

The vapor barrier shall be greater than 3 ply self adhesive laminate -white vapor barrier jacket- superior performance (less than 0.0000 permeability when tested in accordance with ASTM E 96/E 96M). Vapor barrier shall meet UL 723 or ASTM E 84 25 flame and 50 smoke requirements; and UV resistant. Minimum burst strength 185 psi in accordance with ASTM D 774/D 774M. Tensile strength 68 lb/inch width (PSTC-1000). Tape shall be as specified for laminated film vapor barrier above.

2.2.10 Vapor Retarder Not Required

ASTM C 921, Type II, Class D, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable. Jacket shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.2.11 Wire

Soft annealed ASTM A 580/A 580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.2.12 Insulation Bands

Insulation bands shall be 1/2 inch wide; 26 gauge stainless steel.

2.2.13 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum moisture vapor transmission of 0.02 perms, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

## 2.3 PIPE INSULATION SYSTEMS

Insulation materials shall conform to Table 1. Insulation thickness shall be as listed in Table 2 and meet or exceed the requirements of [ ASHRAE 90.1 - IP]. Comply with EPA requirements in accordance with Section

01 62 35 RECYCLED / RECOVERED MATERIALS. Pipe insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.3.1 Aboveground Cold Pipeline ( -30 to 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications, shall be as follows:

a. Cellular Glass: ASTM C 552, Type II, and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

b. Flexible Elastomeric Cellular Insulation: ASTM C 534/C 534M, Grade 1, Type I or II. Type II shall have vapor retarder/vapor barrier skin on one or both sides of the insulation. Insulation with pre-applied adhesive shall not be used.

c. Phenolic Insulation: ASTM C 1126, Type III. Phenolic insulations shall comply with ASTM C 795 and with the ASTM C 665 paragraph Corrosiveness. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

d. Polyisocyanurate Insulation: ASTM C 591, type I. Supply the insulation with manufacturer's recommended factory-applied vapor retarder/vapor barrier. Insulation with pre-applied adhesive shall not be used.

e. Flexible Polyolefin Cellular Insulation: ASTM C 1427, Grade 1 Type I or II.

f. Mineral Fiber Insulation with Integral Wicking Material (MFIWM): ASTM C 547. Install in accordance with manufacturer's instructions.

2.3.2 Below-ground Pipeline Insulation

For below-ground pipeline insulation the following requirements shall be met.

2.3.2.1 Cellular Glass

ASTM C 552, type II.

2.3.2.2 Polyisocyanurate

ASTM C 591, Type 1, to 300 degrees F.

2.4 DUCT INSULATION SYSTEMS

2.4.1 Duct Insulation

Provide factory-applied cellular glass polyisocyanurate or phenolic foam insulation with insulation manufacturer's standard reinforced fire-retardant vapor barrier, with identification of installed thermal resistance (R) value and out-of-package R value.

2.4.1.1 Rigid Insulation

Rigid mineral fiber in accordance with ASTM C 612, Class 2 (maximum surface temperature 400 degrees F), 3 pcf average, 1-1/2 inch thick, Type IA, IB,

II, III, and IV. [Alternately, minimum thickness may be calculated in accordance with [ASHRAE 90.2][ASHRAE 90.1 - IP].]

2.4.1.2 Blanket Insulation

Blanket flexible mineral fiber insulation conforming to ASTM C 553, Type 1, Class B-3, 3/4 pcf nominal, 2.0 inches thick or Type II up to 250 degrees F. Also ASTM C 1290 Type III may be used. Alternately, minimum thickness may be calculated in accordance with [ASHRAE 90.1 - IP].

2.4.2 Acoustical Duct Lining

For ductwork indicated or specified in Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM to be acoustically lined, provide external insulation in accordance with this specification section and in addition to the acoustical duct lining.

2.4.3 Duct Insulation Jackets

2.4.3.1 All-Purpose Jacket

Provide insulation with insulation manufacturer's standard reinforced fire-retardant jacket with or without integral vapor barrier as required by the service. In exposed locations, provide jacket with a white surface suitable for field painting.

2.4.3.2 Metal Jackets

a. Aluminum Jackets: ASTM B 209, Temper H14, minimum thickness of 27 gauge ( 0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside dimension 8 inches and larger. Provide corrugated surface jackets for jacket outside dimension 8 inches and larger. Provide stainless steel bands, minimum width of 1/2 inch.

b. Stainless Steel Jackets: ASTM A 167 or ASTM A 240/A 240M; Type 304, minimum thickness of 33 gauge ( 0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 1/2 inch.

2.4.3.3 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive), heavy duty white or natural).

2.4.4 Weatherproof Duct Insulation

Provide [ASTM C 591 Type I, polyurethane or polyisocyanate board insulation, minimum density of 1.7 pcf] [ASTM C 552, cellular glass thermal insulation] [ASTM C 534/C 534M Grade 1, Type II, flexible cellular insulation], and weatherproofing as specified in manufacturer's instruction.

## PART 3 EXECUTION

### 3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

#### 3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until [tests] [tests and heat tracing] specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

#### 3.1.2 Firestopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in Section 07 84 00 FIRESTOPPING.

#### 3.1.3 Painting and Finishing

Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

#### 3.1.4 Installation of Flexible Elastomeric Cellular Insulation

Flexible elastomeric cellular insulation shall be installed with seams and joints sealed with rubberized contact adhesive. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 200 degrees F. Seams shall be staggered when applying multiple layers of insulation. Insulation exposed to weather and not shown to have jacketing shall be protected with two coats of UV resistant finish or PVC or metal jacketing as recommended by the manufacturer after the adhesive is dry and cured. A brush coating of adhesive shall be applied to both butt ends to be joined and to both slit surfaces to be sealed. The adhesive shall be allowed to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

#### 3.1.5 Welding

No welding shall be done on piping, duct or without written approval of

the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.1.6 Pipes/Ducts/ which Require Insulation

Insulation is required on all pipes, ducts, or except for omitted items, as specified.

## 3.2 PIPE INSULATION SYSTEMS INSTALLATION

### 3.2.1 Pipe Insulation

#### 3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder/barrier, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

a. Pipe used solely for fire protection.

b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.

c. Sanitary drain lines.

d. Air chambers.

e. Adjacent insulation.

f. ASME stamps.

g. Access plates of fan housings.

h. Cleanouts or handholes.

#### 3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

a. Pipe insulation shall be continuous through the sleeve.

b. An aluminum jacket or vapor barrier/weatherproofing - self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 ply standard grade, silver, white, black and embossed with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.

c. Where pipes penetrate interior walls, the aluminum jacket or vapor barrier/weatherproofing - self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 plys standard grade, silver, white, black and embossed shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.

d. Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 10 inches above the floor

with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

e. Where penetrating waterproofed floors, the aluminum jacket shall extend from below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.

f. Where penetrating exterior walls, the aluminum jacket required for pipe exposed to weather shall continue through the sleeve to a point 2 inches beyond the interior surface of the wall.

g. Where penetrating roofs, pipe shall be insulated as required for interior service to a point flush with the top of the flashing and sealed with vapor retarder coating. The insulation for exterior application shall butt tightly to the top of flashing and interior insulation. The exterior aluminum jacket shall extend 2 inches down beyond the end of the insulation to form a counter flashing. The flashing and counter flashing shall be sealed underneath with caulking.

h. For hot water pipes supplying lavatories or other similar heated service that requires insulation, the insulation shall be terminated on the backside of the finished wall. The insulation termination shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. Glass tape seams shall overlap 1 inch. The annular space between the pipe and wall penetration shall be caulked with approved fire stop material. The pipe and wall penetration shall be covered with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 3/8 inches.

i. For domestic cold water pipes supplying lavatories or other similar cooling service that requires insulation, the insulation shall be terminated on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration). The insulation shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch. The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. The annular space between the outer surface of the pipe insulation and the wall penetration shall be caulked with an approved fire stop material having vapor retarder properties. The pipe and wall penetration shall be covered with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 3/8 inches.

3.2.1.3 Pipes Passing Through Hangers

a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed, or factory insulated hangers (designed with a load bearing core) can be used.

b. Horizontal pipes larger than 2 inches at 60 degrees F and above

shall be supported on hangers in accordance with MSS SP-69, and Section 22 00 00 PLUMBING, GENERAL PURPOSE.

c. Horizontal pipes larger than 2 inches and below 60 degrees F shall be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass, calcium silicate (or perlite above 80 degrees F), or the necessary strength polyisocyanurate shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

d. Vertical pipes shall be supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360-degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe that are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

e. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 1-1/2 inches, and shall be sealed as required for the pipe jacket. The jacket material used to cover inserts in flexible elastomeric cellular insulation shall conform to ASTM C 1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 6 inches and less. Grade 1, Type II sheet insulation used on pipes larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, the insulation shall be adhered directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

3.2.1.5 Pipes in high abuse areas.

In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum or flexible laminate cladding (comprised of elastomeric, plastic or metal foil laminate) laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket, - less than 0.0000 permeability; (greater than 3 ply, standard grade, silver, white, black and embossed) jackets shall be utilized. Pipe insulation to the 6 foot level shall be protected.

3.2.1.6 Pipe Insulation Material and Thickness

TABLE 1
Insulation Material For Piping (°F)

| Service | Material | Spec. | Type | Class | Vapor Retarder/ Vapor Barrier Required |
|---|---|---|---|---|---|
| Chilled Water (Supply & Return, Dual Temperature Piping, 40°F nominal) | Cellular Glass | ASTM C 552 | II | 2 | No |
| | Flex Elast Cell'r | ASTM C 534/C 534M | I | | No |
| | Faced Phenol Foam | ASTM C 1126 | III | | Yes |
| | Polyisocianurate | ASTM C 591 | I | | Yes |
| | Mineral Fiber with | ASTM C 547 | I | | Yes |
| Heating Hot Water Supply & Return, Heated Oil (Max 250°F) | Mineral Fiber | ASTM C 547 | I | 1 | No |
| | Calcium Silicate | ASTM C 533 | I | | No |
| | Cellular Glass | ASTM C 552 | II | 2 | No |
| | Faced Phenol Foam | ASTM C 1126 | III | | Yes |
| | Perlite | ASTM C 610 | | | No |
| | Polyisocianurate | ASTM C 591 | I | | No |
| Cold Domestic Water Piping, Makeup Water & Drinking Fount Drain Piping | Polyisocianurate | ASTM C 591 | I | | Yes |
| | Cellular Glass | ASTM C 552 | II | 2 | No |
| | Flex Elast Cell'r | ASTM C 534/C 534M | I | | No |
| | Faced Phenol Foam | ASTM C 1126 | III | | Yes |
| | Polyofin Clos'cell | ASTM C 1427 | I | | No |
| Hot Domestic Water Supply & Recirculating Piping (Max. 200°F) | Mineral Fiber | ASTM C 547 | I | 1 | No |
| | Cellular Glass | ASTM C 552 | II | 2 | No |
| | Flex Elast Cell'r | ASTM C 534/C 534M | I | | No |
| | Faced Phenol Foam | ASTM C 1126 | III | | Yes |
| | Polyisocianurate | ASTM C 591 | I | | No |
| Refrigerant Suction Piping (35°F nominal) | Flex Elast Cell'r | ASTM C 534/C 534M | I | | No |
| | Cellular Glass | ASTM C 552 | II | 1 | Yes |
| | Faced Phenol Foam | ASTM C 1126 | III | | Yes |
| | Polyisocianurate | ASTM C 591 | I | | Yes |
| Compressed Air Discharge, Steam and Condensate Return | Cellular Glass | ASTM C 552 | II | | No |
| | Mineral Fiber | ASTM C 547 | I | 1 | No |
| | Calcium Silicate | ASTM C 533 | I | | No |
| | Faced Phenol Foam | ASTM C 1126 | III | | Yes |
| | Perlite | ASTM C 610 | | | No |

TABLE 1
Insulation Material For Piping (°F)

| Service | Material | Spec. | Type | Class | Vapor Retarder/ Vapor Barrier Required |
|---|---|---|---|---|---|
| (201 to 250°F) | Polyisocianurate | ASTM C 591 | I | | No |
| Exposed Lav'ry Drains, Expo'd Domestic Water Piping & Drains to Areas for Handicap Personnel | Flex Elast Cell'r | ASTM C 534/C 534M | I | | No |
| | Polyofin Clos'cell | ASTM C 1427 | I | | No |
| Horizontal Roof Drain Leaders (Including Underside of Roof Drain Fittings) | Polyisocianurate | ASTM C 591 | I | | Yes |
| | Flex Elast Cell'r | ASTM C 534/C 534M | I | | No |
| | Faced Phenol Foam | ASTM C 1126 | III | | Yes |
| | Cellular Glass | ASTM C 552 | III | | Yes |
| A/C condensate Drain Located Inside Bldg. | Polyisocianurate | ASTM C 591 | I | | Yes |
| | Cellular Glass | ASTM C 552 | II | 2 | No |
| | Flex Elast Cell'r | ASTM C 534/C 534M | I | | No |
| | Faced Phenol Foam | ASTM C 1126 | II | | Yes |
| Medium Tempera-ture Hot Water, Steam and Condensate (251 to 350°F) | Mineral Fiber | ASTM C 547 | I | 1 | No |
| | Calcium Silicate | ASTM C 533 | I | | No |
| | Cellular Glass | ASTM C 552 | I or II | | No |
| | Perlite | ASTM C 610 | | | No |
| | polyisocianurate | ASTM C 591 | I | | No |
| High Tempera-ture Hot Water & Steam (351 to 700°F) | Mineral Fiber | ASTM C 547 | I | 2 | No |
| | Calcium Silicate | ASTM C 533 | I | | No |
| | Perlite | ASTM C 610 | | | No |
| | Cellular Glass | ASTM C 552 | | | No |
| | Polyisocianurate | ASTM C 591 | I | | No |
| Brine Systems Cryogenics (Minus 30 to 0°F) | Cellular Glass | ASTM C 552 | II | 2 | No |
| | Flex Elast Cell'r | ASTM C 534/C 534M | I | | No |
| | Faced Phenol Foam | ASTM C 1126 | III | | Yes |
| | Polyisocianurate | ASTM C 591 | I | | Yes |
| Brine Systems Cryogenics (Zero to 34°F) | Cellular Glass | ASTM C 552 | II | 2 | No |
| | Flex Elast Cell'r | ASTM C 534/C 534M | I | | No |
| | Faced Phenol Foam | ASTM C 1126 | III | | Yes |
| | Polyisocianurate | ASTM C 591 | I | | Yes |

TABLE 2
Piping Insulation Thickness (inch and °F)

| Service | Material | Tube And Pipe Size (Inches) <1 | 1- <1.5 | 1.5- <4 | 4- <8 | >or = to 8 |
|---|---|---|---|---|---|---|
| [Chilled Water (Supply & Return, & Dual Temperature Piping) (40°F Nominal)] | Cellular Glass | 1.5 | 2 | 2 | 2.5 | 3 |
| | Faced Phenol Foam | 1 | 1 | 1 | 1.5 | 1.5 |
| | Polyisocianurate | 1 | 1 | 1 | 1 | 1 |
| | Mineral Fiber with Wicking Material | 1 | 1.5 | 1.5 | 2 | 2 |
| [Chilled Water (Supply & Return, & Dual Temperature Piping) (40°F Nominal)] | Cellular Glass | 1.5 | 1.5 | 1.5 | 1.5 | 2 |
| | Flex Elas Cell'r | 1 | 1 | 1 | N/A | N/A |
| | Faced Phenol Foam | 1 | 1 | 1 | 1 | 1.5 |
| | Mineral Fiber with Wicking Material | 1 | 1.5 | 1.5 | 2 | 2 |
| Heating Hot Water Supply & Return, Heated Oil (Max. 250°F) | Mineral Fiber | 1.5 | 1.5 | 2 | 2 | 2 |
| | Calcium Silicate | 2.5 | 2.5 | 3 | 3 | 3 |
| | Cellular Glass | 2 | 2 5 | 3 | 3 | 3 |
| | Perlite | 2.5 | 2.5 | 3 | 3 | 3 |
| | Polyisocianurate | 1 | 1 | 1.5 | 1.5 | 1.5 |
| Cold Domestic Water Piping, Makeup Water, & Drinking Fountain Drain Piping | Cellular Glass | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | Flex Elas Cell'r | 1 | 1 | 1 | N/A | N/A |
| | Faced Phenol Foam | 1 | 1 | 1 | 1 | 1 |
| | Polyisocianurate | 1 | 1 | 1 | 1 | 1 |
| Hot Domestic Water Supply and Recirculating Piping (Max 200°F) | Mineral Fiber | 1 | 1 | 1 | 1.5 | 1.5 |
| | Cellular Glass | 1.5 | 1.5 | 1.5 | 2 | 2 |
| | Flex Elas Cell'r | 1 | 1 | 1 | N/A | N/A |
| | Polyisocianurate | 1 | 1 | 1 | 1 | 1.5 |
| Refrigerant Suction Piping (35°F nominal) | Flex Elas Cell'r | 0.5 | 0.5 | 1 | N/A | N/A |
| | Cellular Glass | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | Faced Phenol Foam | 1 | 1 | 1 | 1 | 1 |
| | Polyisocianurate | 1 | 1 | 1 | 1 | 1 |
| Compressed Air Discharge, Steam, and Condensate Return (201°F to 250°F) | Mineral Fiber | 1.5 | 1.5 | 2 | 2 | 2 |
| | | 1.5* | 2* | 2.5* | 3* | 3.5* |
| | Calcium Silicate | 2.5 | 3 | 4 | 4 | 4.5 |
| | Cellular Glass | 2 | 2.5 | 3 | 3 | 3 |
| | Perlite | 2.5 | 3 | 4 | 4 | 4.5 |
| | Polyisocianurate | 1.5 | 1.5 | 2 | 2 | 2 |
| Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicap Personnel | Flex Elas Cell'r | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |

TABLE 2
Piping Insulation Thickness (inch and °F)

| Service | Material | Tube And Pipe Size (Inches) <1 | 1- <1.5 | 1.5- <4 | 4- <8 | >or = to 8 |
|---|---|---|---|---|---|---|
| Horizontal Roof Drain Leaders (including Underside of Roof Drain Fitting) | Cellular Glass | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | Flex Elas Cell'r | 1 | 1 | 1 | 1 | 1 |
| | Faced Phenol Foam | 1 | 1 | 1 | 1 | 1 |
| | Polyisocianurate | 1 | 1 | 1 | 1 | 1 |
| A/C condensate Drain Located Inside Bldg. | Cellular Glass | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | Flex Elas Cell'r | 1 | 1 | 1 | N/A | N/A |
| | Faced Phenol Foam | 1 | 1 | 1 | 1 | 1 |
| Medium Temp-erature Hot Water and Steam (251°F to 350°F) | Mineral Fiber | 1.5<br>2.5* | 3 | 3<br>3.5* | 4 | 4 |
| | Calcium Silicate | 2.5 | 3.5 | 4.5 | 4.5 | 5 |
| | Perlite | 2.5 | 3.5 | 4.5 | 4.5 | 5 |
| High Temperature Water (351o to 400°F) and Steam (351°F to 500°F) | Mineral Fiber | 2.5 | 3 | 3 | 4 | 4 |
| | Calcium Silicate | 4 | 4.5 | 6 | 6 | 6 |
| | Perlite | 4 | 4.5 | 6 | 6 | 6 |
| | Polyisocianurate | 1 | 1 | 1 | 1 | 1 |
| Brine Systems Cryogenics (Minus 30 to Zero°F) | Cellular Glass | 2.5 | 2.5 | 3 | 3 | 3.5 |
| | Flex Elas Cell'r | 1 | 1 | N/A | N/A | N/A |
| | Faced Phenol Foam | 1.5 | 1.5 | 2 | 2 | 2 |
| | Polyisocianurate | 1.5 | 1.5 | 2 | 2 | 2 |
| Brine Systems, Cryogenics (Zero to 34°F) | Cellular Glass | 2 | 2 | 2 | 2.5 | 3 |
| | Flex Elas Cell'r | 1 | 1 | 1 | N/A | N/A |
| | Faced Phenol Foam | 1 | 1 | 1 | 1.5 | 1.5 |
| | Polyisocianurate | 1 | 1 | 1 | 1.5 | 1.5 |

3.2.2 Aboveground Cold Pipelines

The following cold pipelines for minus 30 to plus 60 degrees F, shall be insulated in accordance with Table 2 except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted. This includes but is not limited to the following:

a. [Domestic cold and chilled drinking water.]

b. Make-up water.

c. Horizontal and vertical portions of interior roof drains.

d. Refrigerant suction lines.

e. Chilled water.

f. Dual temperature water, i.e. HVAC hot/chilled water.

g. Air conditioner condensate drains.

h. Brine system cryogenics

i. Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap persons.

3.2.2.1 Insulation Material and Thickness

Insulation thickness for cold pipelines shall be determined using Table 2.

3.2.2.2 Factory or Field applied Jacket

Insulation shall be covered with a factory applied vapor retarder jacket/vapor barrier or field applied seal welded PVC jacket or greater than 3 ply laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, standard grade, sliver, white, black and embossed for use with Mineral Fiber, Cellular Glass, Phenolic Foam, and Polyisocyanurate Foam Insulated Pipe. Insulation inside the building, to be protected with an aluminum jacket or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, Embossed Silver, White & Black, shall have the insulation and vapor retarder jacket installed as specified herein. The aluminum jacket or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, White & Black, shall be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, white & black, shall be provided for pipe insulation to the 6 ft level. Other areas that specifically require protection to the 6 ft level are [_____].

3.2.2.3 Installing Insulation for Straight Runs Hot and Cold Pipe

a. Insulation shall be applied to the pipe with joints tightly butted. All butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating, greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or PVDC adhesive tape.

b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches. Butt strips 3 inches wide shall be provided for circumferential joints.

c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing. If staples are used, they shall be sealed in accordance with item "e." below. Note that staples are not required with cellular glass systems.

d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 and 120 degrees F during installation. The lap system shall be installed in accordance with manufacturer's recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall

be replaced or the gap repaired by applying adhesive under the lap and then stapling.

e. All Staples, including those used to repair factory self-seal lap systems, shall be coated with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape. All seams, except those on factory self-seal systems shall be coated with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

f. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape. The patch shall extend not less than 1-1/2 inches past the break.

g. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

h. Installation of flexible elastomeric cellular pipe insulation shall be by slitting the tubular sections and applying them onto the piping or tubing. Alternately, whenever possible slide un-slit sections over the open ends of piping or tubing. All seams and butt joints shall be secured and sealed with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Insulation shall be pushed on the pipe, never pulled. Stretching of insulation may result in open seams and joints. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp knives shall be used. Grade 1, Type II sheet insulation when used on pipe larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

3.2.2.4 Insulation for Fittings and Accessories

a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates except as modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow'.

c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with PVDC or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or two coats of vapor retarder coating with a minimum total thickness of 1/16 inch, applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches. Fabricated insulation with a factory vapor retarder jacket shall be protected with either greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape, standard grade, silver, white, black and embossed or PVDC adhesive tape or two coats of vapor retarder coating with a minimum thickness of 1/16 inch and with a 2 inch wide glass tape embedded between coats. Where fitting insulation butts to pipe insulation, the joints shall be sealed with a vapor retarder coating and a 4 inch wide ASJ tape which matches the jacket of the pipe insulation.

d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.

e. Insulation shall be marked showing the location of unions, strainers, and check valves.

3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory precut or premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

3.2.3 Aboveground Hot Pipelines

3.2.3.1 General Requirements

All hot pipe lines above 60 degrees F, except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted, shall be insulated in accordance with Table 2. This includes but is not limited to the following:

a. Domestic hot water supply & re-circulating system.

b. Steam.

c. Condensate & compressed air discharge.

d. Hot water heating.

e. Heated oil.

f. Water defrost lines in refrigerated rooms.

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type I jacket or field applied aluminum where required or seal welded PVC.

3.2.3.2 Insulation for Fittings and Accessories

a. General. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant. Insulation shall be marked showing the location of unions, strainers, check valves and other components that would otherwise be hidden from view by the insulation.

b. Precut or Preformed. Precut or preformed insulation shall be placed around all fittings and accessories. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity.

c. Rigid Preformed. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".

3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, a laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability (greater than 3 ply, standard grade, silver, white, black and embossed aluminum jacket or PVC jacket shall be applied. PVC jacketing requires no factory-applied jacket beneath it, however an all service jacket shall be applied if factory applied jacketing is not furnished. Flexible elastomeric cellular insulation exposed to weather shall be treated in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION in PART 3.

3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 60 degrees F and below shall be sealed with caulking while overlapping to prevent moisture penetration. Where jacketing on piping 60 degrees F and below abuts an un-insulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 60 degrees F shall be sealed with a moisture retarder.

3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed

aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be provided when PVC jackets are used for straight runs of pipe. PVC fitting covers shall have adhesive welded joints and shall be weatherproof laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed, and UV resistant.

3.2.4.3 PVC Jacket

PVC jacket shall be ultraviolet resistant and adhesive welded weather tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

3.2.5 Below Ground Pipe Insulation

Below ground pipes shall be insulated in accordance with Table 2, except as precluded in subparagraph Pipe Insulation in PART 3. This includes, but is not limited to the following:

a. Heated oil.

b. Domestic hot water.

c. Heating hot water.

d. Dual temperature water.

e. Steam.

f. Condensate.

3.2.5.1 Type of Insulation

Below ground pipe shall be insulated with Cellular Glass insulation, or with Polyisocyanurate insulation, in accordance with manufacturer's instructions for application with thickness as determined from Table 2 (whichever is the most restrictive).

3.2.5.2 Installation of Below ground Pipe Insulation

a. Bore surfaces of the insulation shall be coated with a thin coat of gypsum cement of a type recommended by the insulation manufacturer. Coating thickness shall be sufficient to fill surface cells of insulation. Mastic type materials shall not be used for this coating. Note that unless this is for a cyclic application (i.e., one that fluctuates between high and low temperature on a daily process basis) there is no need to bore coat the material.

b. Stainless steel bands, 3/4 inch wide by 0.020 inch thick shall be used to secure insulation in place. A minimum of two bands per section of insulation shall be applied. As an alternate, fiberglass reinforced tape may be used to secure insulation on piping up to 12 inches in diameter. A minimum of two bands per section of insulation shall be applied.

c. Insulation shall terminate at anchor blocks but shall be continuous through sleeves and manholes.

d. At point of entry to buildings, underground insulation shall be terminated 2 inches inside the wall or floor, shall butt tightly against the aboveground insulation and the butt joint shall be sealed with high temperature silicone sealant and covered with fibrous glass tape.

e. Provision for expansion and contraction of the insulation system shall be made in accordance with the insulation manufacturer's recommendations.

f. Flanges, couplings, valves, and fittings shall be insulated with factory pre-molded, prefabricated, or field-fabricated sections of insulation of the same material and thickness as the adjoining pipe insulation. Insulation sections shall be secured as recommended by the manufacturer.

g. Insulation, including fittings, shall be finished with three coats of asphaltic mastic, with 6 by 5.5 mesh synthetic reinforcing fabric embedded between coats. Fabric shall be overlapped a minimum of 2 inches at joints. Total film thickness shall be a minimum of 3/16 inch. As an alternate, a prefabricated bituminous laminated jacket, reinforced with internal reinforcement mesh, shall be applied to the insulation. Jacketing material and application procedures shall match manufacturer's written instructions. Vapor barrier - less than 0.0000 permeability self adhesive (minimum 2 mils adhesive, 3 mils embossed) jacket greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive), heavy duty, white or natural). Application procedures shall match the manufacturer's written instructions.

h. At termination points, other than building entrances, the mastic and cloth or tape shall cover the ends of insulation and extend 2 inches along the bare pipe.

## 3.3 DUCT INSULATION SYSTEMS INSTALLATION

Except for oven hood exhaust duct insulation, corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. [Duct insulation shall be omitted on exposed supply and return ducts in air conditioned spaces [where the difference between supply air temperature and room air temperature is less than 15 degrees F] unless otherwise shown.] Air conditioned spaces shall be defined as those spaces directly supplied with cooled conditioned air (or provided with a cooling device such as a fan-coil unit) and heated conditioned air (or provided with a heating device such as a unit heater, radiator or convector).

### 3.3.1 Duct Insulation Thickness

Duct insulation thickness shall be in accordance with Table 4.

Table 4 - Minimum Duct Insulation (inches)

| | |
|---|---|
| Cold Air Ducts | 2.0 |
| Relief Ducts | 1.5 |
| Fresh Air Intake Ducts | 1.5 |

Table 4 - Minimum Duct Insulation (inches)

| | |
|---|---|
| Warm Air Ducts | 2.0 |
| Relief Ducts | 1.5 |
| Fresh Air Intake Ducts | 1.5 |

3.3.2 Insulation and Vapor Retarder/Vapor Barrier for Cold Air Duct

Insulation and vapor retarder/vapor barrier shall be provided for the following cold air ducts and associated equipment.

a. Supply ducts.

b. Return air ducts.

c. Relief ducts.

d. Flexible run-outs (field-insulated).

e. Plenums.

f. Duct-mounted coil casings.

g. Coil headers and return bends.

h. Coil casings.

i. Fresh air intake ducts.

j. Filter boxes.

k. Mixing boxes (field-insulated).

l. Supply fans (field-insulated).

m. Site-erected air conditioner casings.

n. Ducts exposed to weather.

o. Combustion air intake ducts.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf, and rigid type where exposed, minimum density 3 pcf. Insulation for both concealed or exposed round/oval ducts shall be flexible type, minimum density 3/4 pcf or a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered. Insulation for all exposed ducts shall be provided with either a white, paint-able, factory-applied Type I jacket or a field applied vapor retarder/vapor barrier jacket coating finish as specified, the total field applied dry film thickness shall be approximately 1/16 inch. Insulation on all concealed duct shall be provided with a factory-applied Type I or II vapor retarder/vapor barrier jacket. Duct insulation shall be continuous through sleeves and prepared openings except firewall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder/vapor barrier shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and

grills. Vapor retarder/vapor barrier materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.3.2.1 Installation on Concealed Duct

a. For rectangular, oval or round ducts, flexible insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

d. Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder/vapor barrier jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.

e. Where mechanical fasteners are used, self-locking washers shall be installed and the pin trimmed and bent over.

f. Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall be coated with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating or PVDC adhesive tape greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating.. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

3.3.2.2 Installation on Exposed Duct Work

a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches. Mechanical fasteners shall be as corrosion resistant as G60 coated galvanized steel, and shall indefinitely sustain a 50 lb tensile dead load test perpendicular to the duct wall.

b. Duct insulation shall be formed with minimum jacket seams. Each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder/barrier jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors.

c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and the pin trimmed and bent over.

d. Joints in the insulation jacket shall be sealed with a 4 inch wide strip of tape. Tape seams shall be sealed with a brush coat of vapor retarder coating.

e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with tape and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.

f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a brush coat of vapor retarder coating.

g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 3/4 pcf, attached as in accordance with MICA standards.

3.3.3 Insulation for Warm Air Duct

Insulation and vapor barrier shall be provided for the following warm air ducts and associated equipment:.

a. Supply ducts.

b. Return air ducts.

c. Relief air ducts

d. Flexible run-outs (field insulated).

e. Plenums.

f. Duct-mounted coil casings.

g. Coil-headers and return bends.

h. Coil casings.

i. Fresh air intake ducts.

j. Filter boxes.

k. Mixing boxes.

l. Supply fans.

m. Site-erected air conditioner casings.

n. Ducts exposed to weather.

Insulation for rectangular ducts shall be flexible type where concealed, and rigid type where exposed. Insulation on exposed ducts shall be provided with a white, paint-able, factory-applied Type II jacket, or finished with adhesive finish. Flexible type insulation shall be used for round ducts, with a factory-applied Type II jacket. Insulation on concealed duct shall be provided with a factory-applied Type II jacket. Adhesive finish where indicated to be used shall be accomplished by applying two coats of adhesive with a layer of glass cloth embedded between the coats. The total dry film thickness shall be approximately 1/16 inch. Duct insulation shall be continuous through sleeves and prepared openings. Duct insulation shall terminate at fire dampers and flexible connections.

3.3.3.1 Installation on Concealed Duct

a. For rectangular, oval and round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts 24 inches and larger, insulation shall be secured to the bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corner.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.

d. The insulation shall be impaled on the mechanical fasteners where used. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type hangers.

e. Self-locking washers shall be installed where mechanical fasteners

are used and the pin trimmed and bent over.

f. Insulation jacket shall overlap not less than 2 inches at joints and the lap shall be secured and stapled on 4 inch centers.

3.3.3.2 Installation on Exposed Duct

a. For rectangular ducts, the rigid insulation shall be secured to the duct by the use of mechanical fasteners on all four sides of the duct, spaced not more than 16 inches apart and not more than 6 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger and a minimum of one row for each side of duct less than 12 inches.

b. Duct insulation with factory-applied jacket shall be formed with minimum jacket seams, and each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projection is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over the projection. Jacket shall be continuous across seams, reinforcing, and projections. Where the height of projections is greater than the insulation thickness, insulation and jacket shall be carried over the projection.

c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and pin trimmed and bent over.

d. Joints on jacketed insulation shall be sealed with a 4 inch wide strip of tape and brushed with vapor retarder coating.

e. Breaks and penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with adhesive and stapled.

f. Insulation terminations and pin punctures shall be sealed with tape and brushed with vapor retarder coating.

g. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation, minimum density of 3/4 pcf attached by staples spaced not more than 16 inches and not more than 6 inches from the degrees of joints. Joints shall be sealed in accordance with item "d." above.

3.3.4 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, ducts shall be insulated as specified for cold air duct.

3.3.5 Insulation for Evaporative Cooling Duct

Evaporative cooling supply duct located in spaces not evaporatively cooled, shall be insulated. Material and installation requirements shall be as specified for duct insulation for warm air duct.

3.3.6 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable

section of this specification for the type of duct insulation to be repaired.

3.3.7 Duct Exposed to Weather

3.3.7.1 Installation

Ducts exposed to weather shall be insulated and finished as specified for the applicable service for exposed duct inside the building. After the above is accomplished, the insulation shall then be further finished as detailed in the following subparagraphs.

3.3.7.2 Round Duct

Laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - Less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply, heavy duty, white and natural) membrane shall be applied overlapping material by 3 inches no bands or caulking needed - see manufacturer's recommended installation instructions. Aluminum jacket with factory applied moisture retarder shall be applied with the joints lapped not less than 3 inches and secured with bands located at circumferential laps and at not more than 12 inch intervals throughout. Horizontal joints shall lap down to shed water and located at 4 or 8 o'clock position. Joints shall be sealed with caulking to prevent moisture penetration. Where jacketing abuts an un-insulated surface, joints shall be sealed with caulking.

3.3.7.3 Fittings

Fittings and other irregular shapes shall be finished as specified for rectangular ducts.

3.3.7.4 Rectangular Ducts

Two coats of weather barrier mastic reinforced with fabric or mesh for outdoor application shall be applied to the entire surface. Each coat of weatherproof mastic shall be 1/16 inch minimum thickness. The exterior shall be a metal jacketing applied for mechanical abuse and weather protection, and secured with screws.

-- End of Section --

SECTION 23 08 00.00 10

COMMISSIONING OF HVAC SYSTEMS
**01/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

ACG Commissioning Guideline (2005) Commissioning Guideline

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Commissioning Standard (1999) Procedural Standards for Building Systems Commissioning

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1429 (1994, 1st Ed) HVAC Systems Commissioning Manual

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 DEFINITIONS

In some instances, terminology differs between the Contract and the Commissioning Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results. The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding ACG, NEBB, or TABB requirements where differences exist.

SIMILAR TERMS

| Contract Term | ACG | NEBB | TABB |
|---|---|---|---|
| Commissioning Standard | ACG Commissioning Guideline | Procedural Standards for Building Systems Commissioning | SMACNA HVAC Commissioning Guideline |
| Commissioning Specialist | ACG Certified Commissioning Agent | NEBB Qualified Commissioning Administrator | TABB Certified Commissioning Supervisor |

## 1.3 SYSTEM DESCRIPTION

### 1.3.1 General

Perform Commissioning in accordance with the requirements of the standard under which the Commissioning Firm's qualifications are approved, i.e., ACG Commissioning Guideline, NEBB Commissioning Standard, or SMACNA 1429 unless otherwise stated herein. Consider mandatory all recommendations and suggested practices contained in the Commissioning Standard. Use the Commissioning Standard for all aspects of Commissioning, including qualifications for the Commissioning Firm and Specialist and calibration of Commissioning instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the Commissioning Standard, the manufacturer's recommendations shall be adhered to. All quality assurance provisions of the Commissioning Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the Commissioning Standard, Commissioning procedures shall be developed by the Commissioning Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the Commissioning Standard used (ACG, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

### 1.3.2 Energy

Formal LEED certification is not required; however, the Contractor is required to provide documentation that meets the LEED Energy & Atmosphere (EA) Prerequisite 1, Fundamental Commissioning.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Commissioning Plan; G

Commissioning Plan prepared in accordance with Commissioning Standard, no later than 28 days after the approval of the Commissioning Specialist.

SD-03 Product Data

Pre-Functional Performance Test Checklists

At least 28 days prior to the start of Pre-Functional Performance Test Checks. Submit the schedule for the test checks at least 14 days prior to the start of Pre-Functional Performance Test Checks.

Functional Performance Tests; G

Test procedures at least 28 days prior to the start of Functional Performance Tests. The schedule for the tests at least

14 days prior to the start of Functional Performance Tests.

SD-06 Test Reports

Commissioning Report; G

No later than 14 days after completion of Functional Performance Tests.

SD-07 Certificates

Commissioning Firm; G

Certification of the proposed Commissioning Firm's qualifications by one of the following ACG, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. Include in the documentation the date that the Certification was initially granted and the date when the current Certification expires. Any lapses in Certification of the proposed Commissioning Firm or disciplinary action taken by ACG, NEBB, or TABB against the proposed Commissioning Firm shall be described in detail.

Commissioning Specialist; G

Certification of the proposed Commissioning Specialist's qualifications by one of the following ACG, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date when the current Certification expires. Any lapses in Certification of the proposed Commissioning Specialist or disciplinary action taken by ACG, NEBB, or TABB against the proposed Commissioning Specialist shall be described in detail.

## 1.5 QUALITY ASSURANCE

### 1.5.1 Commissioning Firm

Provide a Commissioning Firm that is either a member of ACG or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, immediately notify the Contracting Officer and submit another Commissioning Firm for approval. Any firm that has been the subject of disciplinary action by the ACG, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including Commissioning. All work specified in this Section and in other related Sections to be performed by the Commissioning Firm shall be considered invalid if the Commissioning Firm loses its certification prior to Contract completion and must be performed by an approved successor. These Commissioning services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The Commissioning Firm shall be a subcontractor of the prime Contractor and shall be financially and corporately independent of all other subContractors. The Commissioning Firm shall report to and be paid by the prime Contractor.

1.5.2 Commissioning Specialist

1.5.2.1 General

The Commissioning Specialist shall be an ACG Certified Commissioning Agent, a NEBB Qualified Commissioning Administrator, or a TABB Certified Commissioning Supervisor and shall be an employee of the approved Commissioning Firm. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Commissioning Specialist loses subject certification during this period, immediately notify the Contracting Officer and submit another Commissioning Specialist for approval. Any individual that has been the subject of disciplinary action by the ACG, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including Commissioning. All work specified in this Section and in other related Sections performed by the Commissioning Specialist shall be considered invalid if the Commissioning Specialist loses his certification prior to Contract completion and must be performed by the approved successor.

1.5.2.2 Responsibilities

Perform all Commissioning work specified herein and in related sections under the direct guidance of the Commissioning Specialist. The Commissioning Specialist shall prepare the Commissioning Plan, which will be a comprehensive schedule and will include all submittal requirements for procedures, notifications, reports and the Commissioning Report. After approval of the Commissioning Plan, revise the Contract NAS schedule to reflect the schedule requirements in the Commissioning Plan.

1.6 SEQUENCING AND SCHEDULING

Begin the work described in this Section only after all work required in related Sections has been successfully completed, and all test and inspection reports and operation and maintenance manuals required in these Sections have been submitted and approved. Pre-Functional Performance Test Checklists shall be performed at appropriate times during the construction phase of the Contract.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 COMMISSIONING TEAM AND TEST FORMS AND CHECKLISTS

Designate Contractor team members to participate in the Pre- Functional Performance Test Checklists and the Functional Performance Tests specified herein. In addition, the Government team members will include a representative of the Contracting Officer, the Design Agent's Representative, and the Using Agency's Representative. The team members shall be as follows:

| Designation | Function |
|---|---|
| A | Contractor's Commissioning Specialist |
| M | Contractor's Mechanical Representative |
| E | Contractor's Electrical Representative |
| T | Contractor's Testing, Adjusting, and Balancing |

| | |
|---|---|
| (TAB) Specialist | |
| C | Contractor's Controls Representative |
| D | Design Agency Representative |
| O | Contracting Officer's Representative |
| U | Using Agency's Representative |

Appendices A and B shall be completed by the commissioning team. Acceptance by each commissioning team member of each Pre- Functional Performance Test Checklist item shall be indicated by initials and date unless an "X" is shown indicating that participation by that individual is not required. Acceptance by each commissioning team member of each functional performance test item shall be indicated by signature and date.

## 3.2 TESTS

Perform the pre-functional performance test checklists and functional performance tests in a manner that essentially duplicates the checking, testing, and inspection methods established in the related Sections. Where checking, testing, and inspection methods are not specified in other Sections, establish methods which will provide the information required. Testing and verification required by this section shall be performed during the Commissioning phase. Requirements in related Sections are independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section. Provide all materials, services, and labor required to perform the pre- functional performance tests checks and functional performance tests. A functional performance test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating non-Government commissioning team member of which participation is specified is not present for the test.

### 3.2.1 Pre-Functional Performance Test Checklists

Perform Pre-Functional Performance Test Checklists for the items indicated in Appendix A. Correct and re-inspect deficiencies discovered during these checks in accordance with the applicable contract requirements.

### 3.2.2 Functional Performance Tests

Perform Functional Performance Tests for the items indicated in Appendix B. Begin Functional Performance Tests only after all Pre-Functional Performance Test Checklists have been successfully completed. Tests shall prove all modes of the sequences of operation, and shall verify all other relevant contract requirements. Begin Tests with equipment or components and progress through subsystems to complete systems. Upon failure of any Functional Performance Test item, correct all deficiencies in accordance with the applicable contract requirements. The item shall then be retested until it has been completed with no errors.

## 3.3 COMMISSIONING REPORT

The Commissioning Report shall consist of completed Pre- Functional Performance Test Checklists and completed Functional Performance Tests organized by system and by subsystem and submitted as one package. The Commissioning Report shall also include all HVAC systems test reports, inspection reports (Preparatory, Initial and Follow-up inspections), start-up reports, TAB report, TAB verification report, Controls start-up test reports and Controls Performance Verification Test (PVT) report. The results of failed tests shall be included along with a description of the corrective action taken.

APPENDIX A

PRE-FUNCTIONAL PERFORMANCE TEST CHECKLISTS

Pre-Functional Performance Test Checklist - Multizone Air Handling Unit

For Air Handling Unit: [_____]

| Checklist Item | A | M | E | T | C | O |
|---|---|---|---|---|---|---|
| Installation | | | | | | |
| a. Inspection and access doors are operable and sealed. | ___ | ___ | X | ___ | X | ___ |
| b. Condensate drainage is unobstructed. (Visually verify pan drains completely by pouring a cup of water into drain pan.) | ___ | ___ | X | X | X | ___ |
| c. Fan belt adjusted. | ___ | ___ | X | ___ | X | ___ |

| Electrical | A | M | E | T | C | O |
|---|---|---|---|---|---|---|
| a. Power available to unit disconnect. | ___ | X | ___ | X | X | ___ |
| b. Power available to unit control panel. | ___ | X | ___ | X | X | ___ |
| c. Proper motor rotation verified. | ___ | X | ___ | ___ | X | ___ |
| d. Verify that power disconnect is located within sight of the unit it controls. | ___ | X | ___ | X | X | ___ |
| e. Power available to electric heating coil. | ___ | X | ___ | X | X | ___ |

| Coils | A | M | E | T | C | O |
|---|---|---|---|---|---|---|
| a. Chilled water piping properly connected. | ___ | ___ | X | X | X | ___ |
| a. Refrigerant piping properly connected. | ___ | ___ | X | X | X | ___ |
| b. Hot water piping properly connected. | ___ | ___ | X | X | X | ___ |

| Controls | A | M | E | T | C | O |
|---|---|---|---|---|---|---|
| a. Control valves/actuators properly installed. | ___ | X | X | X | ___ | ___ |
| b. Control valves/actuators operable. | ___ | X | X | X | ___ | ___ |
| c. O/A dampers/actuators properly installed. | ___ | X | X | X | ___ | ___ |
| d. O/A dampers/actuators operable. | ___ | X | X | X | ___ | ___ |

Pre-Functional Performance Test Checklist - Multizone Air Handling Unit (cont)

| | A | M | E | T | C | O |
|---|---|---|---|---|---|---|
| e. Zone dampers/actuators properly | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| installed & dampers leak checked. | ___ | X | X | X | ___ | ___ |
| f. Zone dampers/actuators operable. | ___ | X | X | X | ___ | ___ |

| Testing, Adjusting, and Balancing (TAB) | A | M | E | T | C | O |
|---|---|---|---|---|---|---|
| a. Construction filters removed and replaced. | ___ | ___ | X | ___ | X | ___ |
| b. TAB report approved. | | ___ | X | X | ___ | X |

Pre-Functional Performance Test Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: [_____]

| Checklist Item | A | M | E | T | C | O |
|---|---|---|---|---|---|---|
| Installation | | | | | | |
| a. Inspection and access doors are operable and sealed. | ___ | ___ | X | ___ | X | ___ |
| b. Condensate drainage is unobstructed. (Visually verify drainage by pouring a cup of water into drain pan.) | ___ | ___ | X | X | X | ___ |
| c. Fan belt adjusted. | ___ | ___ | X | ___ | X | ___ |
| **Electrical** | **A** | **M** | **E** | **T** | **C** | **O** |
| a. Power available to unit disconnect. | ___ | X | ___ | X | X | ___ |
| b. Power available to unit control panel. | ___ | X | ___ | X | X | ___ |
| c. Proper motor rotation verified. | ___ | X | ___ | ___ | X | ___ |
| d. Verify that power disconnect is located within sight of the unit it controls. | ___ | X | ___ | X | X | ___ |
| e. Power available to electric heating coil. | ___ | X | ___ | X | X | ___ |
| **Coils** | **A** | **M** | **E** | **T** | **C** | **O** |
| a. Chilled water piping properly connected. | ___ | ___ | X | X | X | ___ |
| a. Refrigerant piping properly connected. | ___ | ___ | X | X | X | ___ |
| b. Hot water piping properly connected. | ___ | ___ | X | X | X | ___ |

Pre-Functional Performance Test Checklist - Variable Volume Air Handling Unit

| Controls | A | M | E | T | C | O |
|---|---|---|---|---|---|---|
| a. Control valves/actuators properly installed. | ___ | X | X | X | ___ | ___ |
| b. Control valves/actuators operable. | ___ | X | X | X | ___ | ___ |
| c. Dampers/actuators properly installed. | ___ | X | X | X | ___ | ___ |
| d. Dampers/actuators operable. | ___ | X | X | X | ___ | ___ |
| e. Verify proper location, installation and calibration of duct static pressure sensor. | ___ | X | X | X | ___ | ___ |
| f. Fan air volume controller operable. | ___ | X | X | X | ___ | ___ |
| g. Air handler controls system operational. | ___ | X | X | X | ___ | ___ |

| Testing, Adjusting, and Balancing (TAB) | A | M | E | T | C | O |
|---|---|---|---|---|---|---|
| a. Construction filters removed and replaced. | ___ | ___ | X | ___ | ___ | ___ |
| b. TAB report approved. | ___ | X | X | ___ | X | ___ |

Pre-Functional Performance Test Checklist - VAV Terminal

For VAV Terminal: [_____]

| Checklist Item | A | M | E | T | C | O |
|---|---|---|---|---|---|---|
| Installation | | | | | | |
| a. Electric reheat coil connected to local disconnect. | ___ | X | ___ | ___ | X | ___ |
| **Controls** | **A** | **M** | **E** | **T** | **C** | **O** |
| a. Cooling only VAV terminal controls set. | ___ | X | X | X | ___ | ___ |
| b. Cooling only VAV controls verified. | ___ | X | X | X | ___ | ___ |
| c. Reheat VAV terminal controls set. | ___ | X | X | X | ___ | ___ |
| d. Reheat terminal/coil controls verified. | ___ | X | X | X | ___ | ___ |
| **Testing, Adjusting, and Balancing (TAB)** | **A** | **M** | **E** | **T** | **C** | **O** |
| a. TAB report approved. | ___ | ___ | X | ___ | X | ___ |

Pre-Functional Performance Test Checklist - DX Air Cooled Condensing Unit

For Condensing Unit: [_____]

| Checklist Item | A | M | E | T | C | O |
|---|---|---|---|---|---|---|
| Installation | | | | | | |
| a. Check condenser fans for proper rotation. | ___ | ___ | X | ___ | X | ___ |
| **Electrical** | **A** | **M** | **E** | **T** | **C** | **O** |
| a. Power available to unit disconnect. | ___ | X | ___ | X | X | ___ |
| b. Power available to unit control panel. | ___ | X | ___ | X | ___ | ___ |
| c. Verify that power disconnect is located within sight of the unit it controls | ___ | X | ___ | X | ___ | ___ |
| **Controls** | **A** | **M** | **E** | **T** | **C** | **O** |
| a. Unit safety/protection devices tested. | ___ | ___ | X | X | ___ | ___ |
| b. Control system and interlocks installed. | ___ | ___ | X | X | ___ | ___ |
| c. Control system and interlocks operational. | ___ | ___ | X | X | ___ | ___ |

Pre-Functional Performance Test Checklist - Pumps

For Pump: [_____]

| Checklist Item | A | M | E | T | C | O |
|---|---|---|---|---|---|---|
| Installation | | | | | | |
| a. Piping system installed. | ___ | ___ | X | X | X | ___ |

| Electrical | A | M | E | T | C | O |
|---|---|---|---|---|---|---|
| a. Power available to pump disconnect. | ___ | X | ___ | X | X | ___ |
| b. Pump rotation verified. | ___ | X | ___ | X | X | ___ |
| c. Control system interlocks functional. | ___ | X | ___ | X | ___ | ___ |

| Testing, Adjusting, and Balancing (TAB) | A | M | E | T | C | O |
|---|---|---|---|---|---|---|
| a. Pressure/temperature gauges installed. | ___ | ___ | X | ___ | X | ___ |
| b. TAB Report approved. | ___ | ___ | X | ___ | X | ___ |

Pre-Functional Performance Test Checklist - Packaged Air Cooled Chiller

For Chiller: [_____]

| Checklist Item | A | M | E | T | C | O |
|---|---|---|---|---|---|---|
| Installation | | | | | | |
| a. Chiller properly piped. | ___ | ___ | X | ___ | ___ | ___ |
| **Electrical** | **A** | **M** | **E** | **T** | **C** | **O** |
| a. Power available to unit disconnect. | ___ | X | ___ | X | ___ | ___ |
| b. Power available to unit control panel. | ___ | X | ___ | X | ___ | ___ |
| c. Separate power is supplied to electric heating tape. | ___ | X | ___ | X | ___ | ___ |
| d. Verify that power disconnect is located within sight of the unit it controls. | ___ | X | ___ | X | ___ | ___ |
| **Controls** | **A** | **M** | **E** | **T** | **C** | **O** |
| a. Factory startup and checkout complete. | ___ | ___ | X | X | ___ | ___ |
| b. Chiller safety/protection devices tested. | ___ | ___ | X | X | ___ | ___ |
| c. Chilled water flow switch installed. | ___ | ___ | X | X | ___ | ___ |
| d. Chilled water flow switch tested. | ___ | ___ | X | X | ___ | ___ |
| e. Chilled water pump interlock installed. | ___ | ___ | X | X | X | ___ |
| f. Chilled water pump interlock tested. | ___ | ___ | ___ | X | | |

Pre-Functional Performance Test Checklist - Unit Heater

For Unit Heater: [_____]

| Checklist Item | | | | | | |
|---|---|---|---|---|---|---|
| Electrical | A | M | E | T | C | O |
| a. Power available to unit disconnect. | ___ | ___ | ___ | X | ___ | ___ |
| b. Proper motor rotation verified. | ___ | ___ | ___ | X | X | ___ |
| c. Verify that power disconnect is located within sight of the unit it controls. | ___ | ___ | ___ | X | ___ | ___ |
| d. Power available to electric heating coil. | ___ | ___ | ___ | X | ___ | ___ |
| Controls | A | M | E | T | C | O |
| a. Verify proper location and installation of thermostat. | ___ | ___ | X | ___ | ___ | ___ |
| Testing, Adjusting, and Balancing (TAB) | A | M | E | T | C | O |
| a. TAB Report approved. | ___ | ___ | X | ___ | X | ___ |

Pre-Functional Performance Test Checklist - Exhaust Fan

For Exhaust Fan: [_____]

| Checklist Item | | | | | | |
|---|---|---|---|---|---|---|
| Installation | A | M | E | T | C | O |
| a. Fan belt adjusted. | | | X | | X | |
| Electrical | A | M | E | T | C | O |
| a. Power available to fan disconnect. | | | | X | | |
| b. Proper motor rotation verified. | | | | | X | |
| c. Verify that power disconnect is located within sight of the unit it controls. | | | | X | | |
| Controls | A | M | E | T | C | O |
| a. Control interlocks properly installed. | | | | X | | |
| b. Control interlocks operable. | | | | X | | |
| c. Dampers/actuators properly installed. | | | X | | | |
| d. Dampers/actuators operable. | | | X | | | |
| e. Verify proper location and installation of thermostat. | | | X | | | |
| Testing, Adjusting, and Balancing (TAB) | A | M | E | T | C | O |
| a. TAB Report approved. | | | X | | X | |

Pre-Functional Performance Test Checklist - HVAC System Controls

For HVAC System: [_____]

| Checklist Item | | | | | | |
|---|---|---|---|---|---|---|
| Installation | A | M | E | T | C | O |
| a. Layout of control panel matches drawings. | ___ | ___ | X | X | ___ | ___ |
| b. Framed instructions mounted in or near control panel. | ___ | ___ | X | X | ___ | ___ |
| c. Components properly labeled (on inside and outside of panel). | ___ | ___ | X | X | ___ | ___ |
| d. Control components piped and/or wired to each labeled terminal strip. | ___ | ___ | X | X | ___ | ___ |
| e. EMCS connection made to each labeled terminal strip as shown. | ___ | ___ | X | X | ___ | ___ |
| f. Control wiring and tubing labeled at all terminations, splices, and junctions. | ___ | ___ | X | X | ___ | ___ |
| Main Power | | | | | | |
| a. 120 volt AC power available to panel. | ___ | ___ | ___ | X | ___ | ___ |
| Testing, Adjusting, and Balancing (TAB) | A | M | E | T | C | O |
| a. TAB Report submitted. | ___ | ___ | X | ___ | X | ___ |

Pre-Functional Performance Test Checklist - Single Zone Air Handling Unit

For Air Handling Unit: [_____]

| Checklist Item | | | | | | |
|---|---|---|---|---|---|---|
| Installation | A | M | E | T | C | O |
| a. Inspection and access doors are operable and sealed. | ___ | ___ | X | ___ | X | ___ |
| b. Condensate drainage is unobstructed. | ___ | ___ | X | X | X | ___ |
| c. Fan belt adjusted. | ___ | ___ | X | ___ | X | ___ |
| Electrical | A | M | E | T | C | O |
| a. Power available to unit disconnect. | ___ | ___ | ___ | X | X | ___ |
| b. Power available to unit control panel. | ___ | ___ | ___ | X | ___ | ___ |
| c. Proper motor rotation verified. | ___ | ___ | ___ | ___ | X | ___ |
| d. Verify that power disconnect is located within sight of the unit it controls. | ___ | ___ | ___ | X | ___ | ___ |
| e. Power available to electric heating coil. | ___ | ___ | ___ | X | ___ | ___ |
| Coils | A | M | E | T | C | O |
| a. Chilled water piping properly connected. | ___ | ___ | X | ___ | ___ | ___ |
| a. Refrigerant piping properly connected. | ___ | ___ | X | X | X | ___ |
| Controls | A | M | E | T | C | O |
| a. Control valves/actuators properly installed. | ___ | ___ | X | ___ | ___ | ___ |
| b. Control valves/actuators operable. | ___ | ___ | X | ___ | ___ | ___ |
| c. Dampers/actuators properly installed. | ___ | ___ | X | ___ | ___ | ___ |
| d. Dampers/actuators operable. | ___ | ___ | X | ___ | ___ | ___ |
| e. Verify proper location and installation of thermostat. | ___ | ___ | X | ___ | ___ | ___ |
| Testing, Adjusting, and Balancing (TAB) | A | M | E | T | C | O |
| a. TAB Report approved. | ___ | ___ | X | ___ | X | ___ |

- End of Appendix A -

APPENDIX B

FUNCTIONAL PERFORMANCE TESTS CHECKLISTS

**Functional Performance Test - Pump**

NOTE: Prior to performing this test, for closed loop systems ensure that the system is pressurized and the make-up water system is operational, or for open loop systems ensure that the sumps are filled to the proper level.

1. Activate pump start using control system commands.

a. Verify correct operation in:

HAND_____ OFF_____ AUTO_____

b. Verify pressure drop across strainer:

Strainer inlet pressure _____ psig

Strainer outlet pressure _____ psig

c. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report and pump design conditions.

| | DESIGN | TAB | ACTUAL |
|---|---|---|---|
| Pump inlet pressure psig | _____ | _____ | _____ |
| Pump outlet pressure psig | _____ | _____ | _____ |

d. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

| | SHUTOFF | 100 percent |
|---|---|---|
| Pump inlet pressure psig | _____ | _____ |
| Pump outlet pressure psig | _____ | _____ |
| Pump flow rate gpm | _____ | _____ |

| | SETPOINT |
|---|---|
| Differential Pressure Transmitter | _____ |

**Functional Performance Test (cont) - Pump**

e. For variable speed pumps, operate pump at shutoff (shutoff to be done in manual on var1able speed drive at the minimum rpm that the system is being controlled at) and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

| | SHUTOFF | 100 percent |
|---|---|---|
| Pump inlet pressure psig | _____ | _____ |
| Pump outlet pressure psig | _____ | _____ |
| Pump flow rate gpm | _____ | _____ |

| | SETPOINT |
|---|---|
| Differential Pressure Transmitter | _____ |

2. Measure motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions. Compare amperage to nameplate FLA

a. Full flow:

Nameplate FLA _____

| | | | | | |
|---|---|---|---|---|---|
| Amperage | Phase 1 | _____ | Phase 2 | _____ | Phase 3 _____ |
| Voltage | Ph1-Ph2 | _____ | Ph1-Ph3 | _____ | Ph2-Ph3 _____ |
| Voltage | Ph1-gnd | _____ | Ph2-gnd | _____ | Ph3-gnd _____ |

b. Minimum flow:

| | | | | | |
|---|---|---|---|---|---|
| Amperage | Phase 1 | _____ | Phase 2 | _____ | Phase 3 _____ |
| Voltage | Ph1-Ph2 | _____ | Ph1-Ph3 | _____ | Ph2-Ph3 _____ |
| Voltage | Ph1-gnd | _____ | Ph2-gnd | _____ | Ph3-gnd _____ |

3. Note unusual vibration, noise, etc.

_____

_____

**Functional Performance Test (cont) - Pump**

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

| | Signature and Date |
|---|---|
| Contractor's Commissioning Specialist | _____ |
| Contractor's Mechanical Representative | _____ |
| Contractor's Electrical Representative | _____ |
| Contractor's TAB Representative | _____ |
| Contractor's Controls Representative | _____ |
| Contracting Officer's Representative | _____ |
| Design Agency Representative | _____ |
| Using Agency's Representative | _____ |

**Functional Performance Test Checklist - VAV Terminals**

The Contracting officer will select VAV terminals to be spot-checked during the functional performance test. The number of terminals selected shall not exceed 10 percent.

1. Functional Performance Test: Contractor shall demonstrate operation of selected VAV boxes in accordance with specifications including the following:

a. Cooling only VAV boxes:

(1) Verify VAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F below ambient and measure maximum airflow. Turn thermostat to 5 degrees F above ambient and measure minimum airflow.

| | Setting | Measured | Design |
|---|---|---|---|
| Maximum flow | [_____] | [_____] | [_____] cfm |
| Minimum flow | [_____] | [_____] | [_____] cfm |

b. Cooling with reheat VAV boxes:

(1) Verify VAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum airflow. Turn thermostat to 5 degrees F below ambient and measure minimum airflow.

| | Setting | Measured | Design |
|---|---|---|---|
| Maximum flow | [_____] | [_____] | [_____] cfm |
| Minimum flow | [_____] | [_____] | [_____] cfm |

(2) Verify reheat coil operation range (full closed to full open) by turning room thermostat 5 degrees F above ambient _____.

With heating water system and boiler in operation providing design supply hot water temperature record the following:

Design HW supply temperature_____ deg F
Actual HW supply temperature_____ deg F
AHU supply air temperature_____ deg F
VAV supply air temperature_____ deg F
Calculate coil capacity and compare to design:
Design _____ BTU/hr Actual _____BTU/hr

**Functional Performance Test Checklist (cont)- VAV Terminals**

c. Parallel Fan powered VAV boxes:

(1) Verify VAV box responses to call for heating via set point adjustment. Change from cooling set point to heating set point. Verify cooling damper closes to minimum position, blower fan energizes according to sequence of operation, and upon further drop in space temperature, heating coil activation. _____

With heating water system in operation providing design supply hot water temperature record the following:

Design HW supply temperature_____ deg F
Actual HW supply temperature_____ deg F
AHU supply air temperature_____ deg F
VAV supply air temperature_____ deg F
Calculate coil capacity and compare to design:
Design _____ BTU/hr Actual _____BTU/hr

(2) Check primary air damper maximum/minimum flow settings and compare to actual measured flows.

| | Setting | Measured | Design | |
|---|---|---|---|---|
| Maximum flow | [_____] | [_____] | [_____] | cfm |
| Minimum flow | [_____] | [_____] | [_____] | cfm |

(1) Ensure VAV fan starts prior to AHU fan

(2) Verify VAV box response to sensor call for heating via set point adjustment. Change from cooling set point to heating set point. Verify cooling damper closes to minimum position and upon further drop in space temperature, heating coil activation. With heating water system and boiler in operation providing design supply hot water temperature record the following:

Design HW supply temperature_____ deg F
Actual HW supply temperature_____ deg F
AHU supply air temperature_____ deg F
VAV supply air temperature_____ deg F
Calculate coil capacity and compare to design:
Design _____ BTU/hr Actual _____BTU/hr

(3) Check primary air damper maximum/minimum flow settings and compare to actual measured flows.

| | Setting | Measured | Design | |
|---|---|---|---|---|
| Maximum flow | [_____] | [_____] | [_____] | cfm |
| Minimum flow | [_____] | [_____] | [_____] | cfm |

**Functional Performance Test Checklist (cont)- VAV Terminals**

(4) Verify that minimal primary air is discharging into the plenum space when in full cooling mode.

(5) Verify that no plenum air is being induced from the plenum space into the supply air during full cooling by measuring supply air temperature and comparing to primary air temperature

Primary air temp _____ deg F
Supply air temp _____ deg F

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

| | Signature and Date |
|---|---|
| Contractor's Commissioning Specialist | _____ |
| Contractor's Mechanical Representative | _____ |
| Contractor's Electrical Representative | _____ |
| Contractor's TAB Representative | _____ |
| Contractor's Controls Representative | _____ |
| Contracting Officer's Representative | _____ |
| Design Agency Representative | _____ |
| Using Agency's Representative | _____ |

**Functional Performance Test Checklist - Variable Volume Air Handling Unit**

For Air Handling Unit: [_____]

1. Functional Performance Test: Contractor shall verify operation of air handling unit in accordance with specification including the following:

a. Ensure that a slight negative pressure exists on inboard side of the outside air dampers throughout the operation of the dampers. Modulate OA, RA, and EA dampers from fully open to fully closed positions_____.

b. The following shall be verified [supply fan operating][supply and return fans operating] mode is initiated:

(1) All dampers in normal position prior to fan start_____.

(2) All valves in normal position prior to fan start_____.

(3) System safeties allow start if safety conditions are met.____

(4) VAV fan controller shall "soft-start" fan. _____

(5) Modulate all VAV boxes to minimum air flow and verify that the static pressure does not exceed the high static pressure shutdown setpoint_____.

(6) Return all VAV boxes to auto _____.

c. Occupied mode of operation - economizer de-energized.

(1) Outside air damper at minimum position. _____

(2) Return air damper open. _____

(3) Relief air damper [at minimum position] [closed]. _____

(4) Chilled water control valve modulating to maintain leaving air temperature set point. Setpoint _____deg F Actual _____deg F

(5) Fan VAV controller receiving signal from duct static pressure sensor and modulating fan to maintain supply duct static pressure set point.
Setpoint _____inches-wg Actual _____inches-wg

d. Occupied mode of operation - economizer energized.

(1) Outside air damper modulated to maintain mixed air temperature set point. Setpoint _____deg F, Actual _____deg F, Outside air damper position _____%.

(2) Relief air damper modulates with outside air damper according to sequence of operation. Relief air damper position_____%.

(3) Chilled water control valve modulating to maintain leaving air temperature set point. Setpoint _____deg F Actual _____deg F

(4) Hot water control valve modulating to maintain leaving air

temperature set point. Setpoint _____deg F Actual _____deg F

**Functional Performance Test Checklist (cont) - Variable Volume Air Handling Unit**

(5) Fan VAV controller receives signal from duct static pressure sensor and modulates fan to maintain supply duct static pressure set point. Setpoint inches-wg_____ Actual inches-wg_____

e. Unoccupied mode of operation

(1) Observe fan starts when space temperature calls for heating and/or cooling. _____ Note: This does not apply to series boxes.
(2) All dampers in normal position. _____
(3) Verify space temperature is maintained as specified in sequence of operation. _____

f. The following shall be verified when the [supply fan off][supply and return fans off] mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) Fan de-energizes. _____

g. Verify the chilled water coil control valve operation by setting all VAV's to maximum and minimum cooling.

Max Cooling

Supply air temp. _____ deg F Verify cooling valve operation_____.

Min cooling

Supply air temp. _____ deg F Verify cooling valve operation_____.

h. Verify safety shut down initiated by low temperature protection thermostat. _____

i. Verify occupancy schedule is programmed into time clock/UMCS_____.

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Commissioning Specialist _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's TAB Representative _____

Contractor's Controls Representative _____

Design Agency Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

**Functional Performance Test Checklist - Single Zone Air Handling Unit**

For Air Handling Unit: [_____]

1. Functional Performance Test: Contractor shall verify operation of air handling unit in accordance with specification including the following:

a. Ensure that a slight negative pressure exists on inboard side of the outside air dampers throughout the operation of the dampers. Modulate OA, RA, and EA dampers from fully open to fully closed positions.

a. The following shall be verified when the [supply fan operating] [supply and return fans operating] mode is initiated:

(1) All dampers in normal position prior to fan start_____.

(2) All valves in normal position prior to fan start_____.

(3) System safeties allow start if safety conditions are met. ___

b. Occupied mode of operation - economizer de-energized.

(1) Outside air damper at minimum position._____

(2) Return air damper open._____

(3) Relief air damper [at minimum position][closed]._____

(4) Chilled water control valve modulating to maintain space cooling temperature set point. Setpoint _____deg F Actual _____deg F

(5) Hot water control valve modulating to maintain space heating temperature set point input from outside air temperature controller. _____

c. Occupied mode of operation - economizer energized.

(1) Outside air damper modulated to maintain mixed air temperature set point. Setpoint _____deg F Actual _____deg F O/A damper position _____% Return Air Temperature_____deg F Outside Air Temperature _____ deg F

(2) Relief air damper modulates with outside air damper according to sequence of operation. Relief air damper position _____%

(3) Chilled water control valve modulating to maintain space cooling temperature set point. Setpoint _____deg F Actual _____deg F Return sensor overrides to normal operation.

d. Unoccupied mode of operation.

(1) Observe fan starts when space temperature calls for heating/cooling ____.

(2) All dampers in normal position. _____

(3) Verify low limit space temperature is maintained as specified in sequence of operation. _____

**Functional Performance Test Checklist (cont) - Single Zone Air Handling Unit**

e. The following shall be verified when the [supply fan off][supply and return fans off] mode is initiated:

(1) All dampers in normal position._____

(2) All valves in normal position._____

(3) Fan de-energizes. _____

f. Verify cooling coil and heating coil operation by varying thermostat set point from cooling set point to heating set point and returning to cooling set point_____.

g. Verify safety shut down initiated by low temperature protection thermostat_____.

h. Verify occupancy schedule is programmed into time clock/UMCS_____.

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

| | Signature and Date |
|---|---|
| Contractor's Commissioning Specialist | _____ |
| Contractor's Mechanical Representative | _____ |
| Contractor's Electrical Representative | _____ |
| Contractor's TAB Representative | _____ |
| Contractor's Controls Representative | _____ |
| Design Agency Representative | _____ |
| Contracting Officer's Representative | _____ |
| Using Agency's Representative | _____ |

**Functional Performance Test Checklist - Packaged Air Cooled Chiller**

For Chiller: CH-1

1. Functional Performance Test: Contractor shall demonstrate operation of chilled water system in accordance with specifications including the following: Start building air handler to provide load for chiller. Activate controls system chiller start sequence as follows.

a. Start chilled water pump and establish chilled water flow. Verify chiller-chilled water proof-of-flow switch operation. _____

b. Verify control system energizes chiller start sequence. _____

c. Verify chiller senses chilled water temperature above set point and control system activates chiller start. Setpoint_____deg F Actual_____ deg F

d. Verify functioning of "soft start" sequence. _____

e. Verify and record chiller data in accordance with 2, 3 and 4 below on fully loaded chiller.

f. Shut off air handling equipment to remove load on chilled water system. Verify chiller shutdown sequence is initiated and accomplished after load is removed. _____

g. Restart air handling equipment one minute after chiller shut down. Verify chiller restart sequence. _____

2. Verify chiller inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report, chiller design conditions, and chiller manufacturer's performance data.

| | DESIGN | TAB TEST | ACTUAL |
|---|---|---|---|
| Chiller inlet pressure (psig) | _____ | _____ | _____ |
| Chiller outlet pressure (psig) | _____ | _____ | _____ |
| Chiller flow GPM | _____ | _____ | _____ |

3. Verify chiller amperage each phase and voltage phase-to-phase and phase-to-ground.

| | | | | | Motor F/L AMPS |
|---|---|---|---|---|---|
| Amperage | Phase 1 _____ | Phase 2_____ | Phase 3_____ | | _____ |
| Voltage | Ph1-Ph2 _____ | Ph1-Ph3_____ | Ph2-Ph3_____ | | |
| Voltage | Ph1-gnd _____ | Ph2-gnd_____ | Ph3-gnd_____ | | |

**Functional Performance Test Checklist (cont) - Packaged Air Cooled Chiller**

4.

a. Record the following information:

| | | Design |
|---|---|---|
| Ambient dry bulb temperature _____ | degrees F _____ | degrees F |
| Entering chilled water temperature _____ | degrees F _____ | degrees F |
| Leaving chilled water temperature _____ | degrees F _____ | degrees F |

b. Calculate chiller load at ambient conditions and compare to chiller rated capacity from manufacturer's literature. Calculated _____ Ton Rated _____ Ton.

5. Unusual vibration, noise, etc.

_____

_____

6. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

| | Signature and Date |
|---|---|
| Contractor's Commissioning Specialist | _____ |
| Contractor's Mechanical Representative | _____ |
| Contractor's Electrical Representative | _____ |
| Contractor's TAB Representative | _____ |
| Contractor's Controls Representative | _____ |
| Design Agency Representative | _____ |
| Contracting Officer's Representative | _____ |
| Using Agency's Representative | _____ |

**Functional Performance Test Checklist - Air Cooled Condensing Unit**

For Condensing Unit: [_____]

1. Functional Performance Test: Contractor shall demonstrate operation of refrigeration system in accordance with specifications including the following: Start building air handler to provide load for condensing unit. Activate controls system start sequence as follows.

a. Start air handling unit. Verify control system energizes condensing unit start sequence. _____

b. Verify and record data in 2 and 3 below.

c. Shut off air handling equipment to verify condensing unit de-energizes. _____

d. Restart air handling equipment one minute after condensing unit shut down. Verify condensing unit restart sequence. _____

2. Verify condensing unit amperage each phase and voltage phase to phase and phase to ground.

Motor Full-Load Amps _____

Amperage Phase 1 _____ Phase 2_____ Phase 3_____

Voltage Ph1-Ph2 _____ Ph1-Ph3_____ Ph2-Ph3_____

Voltage Ph1-gnd _____ Ph2-gnd_____ Ph3-gnd_____

3. Record the following information:

Ambient dry bulb temperature _____ degrees F
Suction pressure _____ psig
Discharge pressure _____ psig

4. Unusual vibration, noise, etc.

_____

_____

5. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Commissioning Specialist _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's TAB Representative _____

Contractor's Controls Representative _____

Design Agency Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

**Functional Performance Test Checklist - Unit Heaters**

The Contracting Officer will select unit heaters to be spot-checked during the functional performance test. The number of terminals shall not exceed 10 percent. Hot water systems {for hot water unit heaters} must be in operation and supplying design hot water supply temperature water.

1. Functional Performance Test: Contractor shall demonstrate operation of selected unit heaters:

a. Verify unit heater response to room temperature set point adjustment._____

b. Check heating mode inlet air temperature. _____ deg F

c. Check heating mode outlet air temperature. _____ deg F

d. Record manufacturer's submitted fan capacity _____cfm

e. Calculate unit heater capacity using manufacturer's fan capacity and recorded temperatures and compare to design.

f. Calculated_____BTU/hr Design_____BTU/hr

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

| | Signature and Date |
|---|---|
| Contractor's Commissioning Specialist | _____ |
| Contractor's Mechanical Representative | _____ |
| Contractor's Electrical Representative | _____ |
| Contractor's TAB Representative | _____ |
| Contractor's Controls Representative | _____ |
| Design Agency Representative | _____ |
| Contracting Officer's Representative | _____ |
| Using Agency's Representative | _____ |

**Functional Performance Test Checklist - HVAC Controls**

For HVAC System: [_____]

The Contracting Officer will select HVAC control systems to undergo functional performance testing. The number of systems shall not exceed 10 percent. Perform this test simultaneously with FPT for AHU or other controlled equipment.

1. Functional Performance Test: Contractor shall verify operation of HVAC controls by performing the Performance Verification Test {PVT} test for that system. Contractor to provide blank PVT test procedures previously done by the controls Contractor.

2. Verify interlock with Building EMS system_____.

3. Verify all required I/O points function from the Building EMS system_____.

4. Certification: We the undersigned have witnessed the Performance Verification Test and certify that the item tested has met the performance requirements in this section of the specifications.

| | Signature and Date |
|---|---|
| Contractor's Commissioning Specialist | _____ |
| Contractor's Mechanical Representative | _____ |
| Contractor's Electrical Representative | _____ |
| Contractor's TAB Representative | _____ |
| Contractor's Controls Representative | _____ |
| Design Agency Representative | _____ |
| Contractor's Officer's Representative | _____ |
| Using Agency's Representative | _____ |

- End of Appendix B -

-End of document
-- End of Section --

SECTION 23 09 23

DIRECT DIGITAL CONTROL FOR HVAC AND OTHER LOCAL BUILDING SYSTEMS
**11/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

| | |
|---|---|
| AMCA 500-D | (1998) Laboratory Methods of Testing Dampers for Rating |

ASME INTERNATIONAL (ASME)

| | |
|---|---|
| ASME B16.15 | (2006) Cast Bronze Threaded Fittings Classes 125 and 250 |
| ASME B16.34 | (2004) Valves - Flanged, Threaded and Welding End |
| ASME B40.100 | (2005) Pressure Gauges and Gauge Attachments |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 269 | (2008) Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service |
| ASTM B 88 | (2003) Standard Specification for Seamless Copper Water Tube |
| ASTM B 88M | (2005) Standard Specification for Seamless Copper Water Tube (Metric) |
| ASTM D 1693 | (2008) Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics |
| ASTM D 635 | (2006) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position |

CONSUMER ELECTRONICS ASSOCIATION (CEA)

| | |
|---|---|
| CEA-709.1B | (2002) Control Network Protocol Specification |
| CEA-709.3 | (1999) Free-Topology Twisted-Pair Channel Specification |

| | |
|---|---|
| CEA-852-A | (2004) Tunneling Component Network Protocols Over Internet Protocol Channels |

FLUID CONTROLS INSTITUTE (FCI)

| | |
|---|---|
| FCI 70-2 | (2006) Control Valve Seat Leakage |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C62.41.1 | (2002) IEEE Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits |
| IEEE C62.41.2 | (2002) IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits |
| IEEE Std 142 | (2007) Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book (Color Book Series) |

LONMARK INTERNATIONAL (LonMark)

| | |
|---|---|
| LonMark Interoperability Guide | (2002) LonMark Application-Layer Interoperability Guide; Version 3.3 |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA 250 | (2003) Enclosures for Electrical Equipment (1000 Volts Maximum) |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |
| NFPA 90A | (2008) Standard for the Installation of Air Conditioning and Ventilating Systems |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1585 | (1998; Rev thru May 2006) UL Standard for Safety Class 2 and Class 3 Transformers - Fourth Edition |
| UL 94 | (1996; Rev thru Jun 2006) Tests for Flammability of Plastic Materials for Parts in Devices and Appliances |

1.2 DEFINITIONS

The following list of definitions may contain terms not found elsewhere in the Section but are included here for completeness.

a. Application Specific Controller: A device that is furnished with a pre-established built in application that is configurable but not re-programmable. An ASC has a fixed factory-installed application program (i.e Program ID) with configurable settings.

b. Binary: A two-state system where an "ON" condition is represented by a high signal level and an "OFF" condition is represented by a low signal level. 'Digital' is sometimes used interchangeably with 'binary'.

c. Binding: The act of establishing communications between CEA-709.1B devices by associating the output of a device to the input of another.

d. Building Control Network: The CEA-709.1B control network installed under this Section, consisting of a backbone and one or more local control busses.

e. Building Point of Connection (BPOC): The BPOC is the point of connection between the UMCS network backbone (an IP network) and the building control network backbone. The hardware at this location, that provides the connection is referred to as the BPOC Hardware. In general, the term "BPOC Location" means the place where this connection occurs, and "BPOC Hardware" means the device that provides the connection. Sometimes the term "BPOC" is used to mean either and its actual meaning (i.e. location or hardware) is determined by the context in which it is used.

f. Channel: A portion of the control network consisting of one or more segments connected by repeaters. Channels are separated by routers. The device quantity limitation is dependent on the topology/media and device type. For example, a TP/FT-10 network with locally powered devices is limited to 128 devices per channel.

g. Configuration Parameter: Controller setting usually written to EEPROM. Also see 'Standard Configuration Parameter Type (SCPT)'

h. Control Logic Diagram: A graphical representation of control logic for multiple processes that make up a system.

i. Domain: A grouping of up to 32,385 nodes that can communicate directly with each other. (Devices in different domains cannot communicate directly with each other.) Part of the Node Addressing scheme.

j. Explicit Messaging: A method of communication between devices where each message contains a message code that identifies the type of message and the devices use these codes to determine the action to take when the message is received. These messages are non-standard and often vendor (application) dependent.

k. External Interface File (XIF): A file which documents a device's external interface, specifically the number and types of LonMark objects; the number, types, directions, and connection attributes of network variables; and the number of message tags.

l. Functional Profile: The description of one or more LonMark Objects used to classify and certify devices.

m. Gateway: A device that translates from one protocol to another. Gateways are also called Communications Bridges or Protocol Translators.

n. General Purpose Programmable Controller (GPPC): Unlike an ASC, a GPPC is not furnished with a fixed application program. A GPPC can be

(re-)programmed, usually using vendor-supplied software.

o. LonMark Object: A collection of network variables, configuration parameters, and associated behavior defined by LonMark International and described by a Functional Profile. Defines how information is exchanged between devices on a network (inputs from and outputs to the network).

p. LNS Plug-in: Software which runs in an LNS compatible software tool. Device configuration plug-ins provide a 'user friendly' interface to configuration parameters.

q. LonMark: See LonMark International. Also, a certification issued by LonMark International to CEA-709.1B devices.

r. LonMark International: Standards committee consisting of numerous independent product developers and systems integrators dedicated to determining and maintaining the interoperability guidelines for the LonWorks industry. Maintains guidelines for the interoperability of CEA-709.1B devices and issues the LonMark Certification for CEA-709.1B devices.

s. LonMark Interoperability Association: See 'LonMark International'.

t. LonWorks: The overall communications technology, developed by Echelon Corporation, for control systems. The term is often used to refer to the technology in general, and may include reference to any/all of the: protocol, network management, and interoperability guidelines where the technology is based on the CEA-709.1B protocol and employs interoperable devices along with the capability to openly manage these devices (via multiple vendors) using a network configuration (or service) tool.

u. LonWorks Network Services (LNS): A network management and database standard for CEA-709.1B devices.

v. Monitoring and Control (M&C) Software: The UMCS 'front end' software which performs supervisory functions such as alarm handling, scheduling and data logging and provides a user interface for monitoring the system and configuring these functions.

w. Network Variable: See 'Standard Network Variable Type (SNVT)'.

x. Network Configuration Tool: The software used to configure the control network and set device configuration properties. This software creates and modifies the control network database (LNS Database).

y. Node: A device that communicates using the CEA-709.1B protocol and is connected to an CEA-709.1B network.

z. Node Address: The logical address of a node on the network. Variations in node addressing are possible, but the 'Domain, Subnet, Node' format is the established standard for this specification.

aa. Node ID: A unique 48-bit identifier assigned (at the factory) to each CEA-709.1B device, sometimes called the Neuron ID.

bb. Program ID: An identifier (number) stored in the device (usually EEPROM) that identifies the node manufacturer, functionality of device

(application & sequence), transceiver used, and the intended device usage.

cc. Repeater: A device that connects two control network segments and retransmits all information received on one side onto the other.

dd. Router: A device that connects two channels and controls traffic between the channels by retransmitting signals received from one subnet onto the other based on the signal destination. Routers are used to subdivide a control network and to control bandwidth usage.

ee. Segment: A 'single' section of a control network that contains no repeaters or routers. The device quantity limitation is dependent on the topology/media and device type. For example, a TP/FT-10 network with locally powered devices is limited to 64 devices per segment.

ff. Service Pin: A hardware push-button on a device which causes the device to broadcast a message (over the control network) containing its Node ID and Program ID. This broadcast can also be initiated via software.

gg. Standard Configuration Parameter Type (SCPT): Pronounced 'skip-it'. A standard format type (maintained by LonMark International) for Configuration Parameters.

hh. Standard Network Variable Type (SNVT): Pronounced 'snivet'. A standard format type (maintained by LonMark International) used to define data information transmitted and received by the individual nodes. The term SNVT is used in two ways. Technically it is the acronym for Standard Network Variable Type, and is sometimes used in this manner. However, it is often used to indicate the network variable itself (i.e. it can mean "a network variable of a standard network variable type"). In general, the intended meaning should be clear from the context.

ii. Subnet: Consists of a logical (not physical) grouping of up to 127 nodes, where the logical grouping is defined by node addressing. Part of the Node Addressing scheme.

jj. TP/FT-10: A Free Topology Twisted Pair network defined by CEA-709.3. This is the most common media type for an ANSI-709.1 control network.

kk. UMCS Network: An IP network connecting multiple building level control networks using the CEA-852-A standard.

ll. User-defined Configuration Parameter Type (UCPT): Pronounced 'u-keep-it'. A Configuration Parameter format type that is defined by the device manufacturer.

mm. User-defined Network Variable Type (UNVT): A network variable format defined by the device manufacturer. Note that UNVTs create non-standard communications (other vendor's devices may not correctly interpret it) and may close the system and therefore are not permitted by this specification.

## 1.3 SYSTEM DESCRIPTION

Provide a Direct Digital Control (DDC) system as a complete system suitable for the control of the heating, ventilating and air conditioning (HVAC) and

other building-level systems as specified and shown.

1.3.1 System Requirements

Systems installed under this guide specification shall have the following characteristics:.

System shall be a Siemens APOGEE(R) Network system compatible with the existing DDC systems in place at Stennis Space Center. Reference Shop Drawings and product data submittals for detailed information.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval.

a. Technical data packages consisting of technical data and computer software (meaning technical data which relates to computer software) which are specifically identified in this project and which may be defined/required in other specifications shall be delivered strictly in accordance with the CONTRACT CLAUSES and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. All submittals not specified as technical data packages are considered 'shop drawings' under the Federal Acquisition Regulation Supplement (FARS) and shall contain no proprietary information and be delivered with unrestricted rights.

b. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES, the CONTRACT CLAUSES and DD Form 1423 and according to the sequencing specified in paragraph PROJECT SEQUENCING:

SD-02 Shop Drawings

DDC Contractor Design Drawings; G

DDC Contractor Design Drawings in hard copy and on CDROM in AutoCAD format.

Final As-Built Drawings; G

Final As-Built Drawings in hard copy and on CDROM in AutoCAD format.

SD-03 Product Data

Manufacturer's Catalog Data; G

Product specific catalog cuts for each product provided under this specification.

Programming Software; G

The most recent version of the Programming software for each type (manufacturer and model) of General Purpose Programmable Controller (GPPC) as a Technical Data Package licensed to the project site. Software on CD-ROM and 2 hard copies of the software user manual for each piece of software provided.

SD-06 Test Reports

Post-Construction QC Checklist; G

Four copies of the Post-Construction QC Checklist.

SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions; G

2 copies of the Operation and Maintenance Instructions, indexed and in booklet form. The Operation and Maintenance Instructions shall be a single volume or in separate volumes, and may be submitted as a Technical Data Package.

Training Documentation; G

Deliver training manuals for each trainee on the Course Attendee List with 2 additional copies delivered for archival at the project site. Deliver 2 copies of the Course Attendee List with the archival copies. The Training Documentation may be submitted as a Technical Data Package.

SD-11 Closeout Submittals

Closeout QC Checklist; G

Four copies of the Closeout QC Checklist.

## 1.5 QUALITY ASSURANCE

### 1.5.1 QUALITY CONTROL (QC) CHECKLISTS

The Contractor's Chief Quality Control (QC) Representative shall complete the QC Checklist in APPENDIX A and submit a Pre-Construction QC Checklist, Post-Construction QC Checklist and a Closeout QC Checklist as specified. The QC Representative shall verify each item in the Checklist and initial in the provided area to indicate that the requirement has been met. The QC Representative shall sign and date the Checklist prior to submission to the Government.

### 1.5.2 Surge Protection

#### 1.5.2.1 Power-Line Surge Protection

Protect equipment connected to ac circuits against or withstand power-line surges. Equipment protection shall meet the requirements of IEEE C62.41.1, IEEE C62.41.2. Fuses shall not be used for surge protection.

#### 1.5.2.2 Surge Protection for Transmitter and Control Wiring

Protect DDC hardware against or withstand surges induced on control and transmitter wiring installed outdoors and as shown. The equipment protection shall be protected against the following two waveforms:

a. A waveform with a 10-microsecond rise time, a 1,000-microsecond decay time and a peak current of 60 amps.

b. A waveform with an 8-microsecond rise time, a 20-microsecond decay time and a peak current of 500 amperes.

1.5.3 Input Measurement Accuracy

Select, install and configure sensors, transmitters and DDC Hardware such that the maximum error of the measured value at the SNVT output of the DDC hardware is less than 150 percent of the maximum allowable error specified for the sensor or instrumentation.

1.5.4 System Modifications

Submit recommendations for system modification in writing. No system modifications, including operating parameters and control settings, shall be made without prior approval of the Government. Incorporate any modifications made to the system into the Operations and Maintenance Instructions, and other documentation affected.

1.5.5 Drawings

The Government will not indicate all offsets, fittings, and accessories that may be required on the drawings. Carefully investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, arrange such work accordingly, and provide all work necessary to meet such conditions. Drawings shall be on [ISO A1 34 by 22 inches ][or][A3 17 by 11 inches] sheets in the form and arrangement shown. Use in the drawings the same abbreviations, symbols, nomenclature and identifiers shown. Each control system element on a drawing shall be assigned a unique identifier as shown. Deliver the DDC Contractor Design Drawings together as a complete submittal. Deviations shall be approved by the Contracting Officer. DDC Contractor Design Drawings shall include the following:

a. Drawing Index and HVAC Design Drawing Legend: The HVAC Control System Drawing Index shall show the name and number of the building, military site, State or other similar designation, and Country. The Drawing Index shall list all Contractor Design Drawings, including the drawing number, sheet number, drawing title, and computer filename when used. The Design Drawing Legend shall show and describe all symbols, abbreviations and acronyms used on the Design Drawings.

b. Valve Schedule: The valve schedule shall contain each valve's unique identifier, size, flow coefficient Kv (Cv), pressure drop at specified flow rate, spring range, positive positioner range, actuator size, close-off pressure to torque data, dimensions, and access and clearance requirements data. The valve schedule shall contain actuator selection data supported by calculations of the force required to move and seal the valve, access and clearance requirements. A valve schedule shall be submitted for each HVAC system.

c. Damper Schedule: The damper schedule shall contain each damper's unique identifier, type (opposed or parallel blade), nominal and actual sizes, orientation of axis and frame, direction of blade rotation, actuator size and spring ranges, operation rate, positive positioner range, location of actuators and damper end switches, arrangement of sections in multi-section dampers, and methods of connecting dampers, actuators, and linkages. The Damper Schedule shall include the AMCA 500-D maximum leakage rate at the operating static-pressure differential. A damper schedule shall be submitted for each HVAC system.

d. Thermostat and Occupancy Sensor Schedule: The thermostat and occupancy sensor schedule shall contain each thermostat's unique identifier, room identifier and control features and functions as shown. A thermostat and occupancy sensor schedule shall be submitted for each HVAC system.

e. Critical Alarm Handling Schedule: The critical alarm handling schedule shall contain the same fields as the critical alarm handling schedule Contract Drawing with Contractor updated information and any other project-specific information required to implement the alarm handling function. A critical alarm handling schedule shall be submitted for each HVAC system.

f. Equipment Schedule: The equipment schedule shall contain the unique identifier, manufacturer, model number, part number and descriptive name for each control device, hardware and component provided under this specification. An equipment schedule shall be submitted for each HVAC system.

g. Occupancy Schedule: The occupancy schedule drawing shall contain the same fields as the occupancy schedule Contract Drawing with Contractor updated information. An occupancy schedule shall be submitted for each HVAC system.

h. Points Schedule: The Points Schedule drawing shall contain the same fields as the Points Schedule Contract Drawing with Contractor updated information. A Points Schedule shall be submitted for each HVAC system.

i. Riser diagram of building control network: The Riser Diagram of the Building Control Network shall show all network cabling, DDC Hardware, and Network Hardware including:

(1) All DDC Hardware with room number and location within room.

(2) DDC Hardware unique identifiers and common descriptive names.

(3) All Network hardware with room number and location within room.

(4) Network hardware unique identifiers.

(5) All cabling.

(6) Room number and location within room of all cabling termination points.

(7) Room number and location within room of all network interface jacks.

j. A single riser diagram shall be submitted for each building.

k. Control System Schematics: The control system schematics shall be in the same form as the control system schematic Contract Drawing with Contractor updated information. A control system schematic shall be submitted for each HVAC system.

l. Sequences of Operation: The HVAC control system sequences of

operation shall be in the same format as the Contract Drawings and shall refer to the devices by their unique identifiers. No operational deviations from specified sequences will be permitted without prior written approval of the Government. Sequences of operation shall be submitted for each HVAC control system.

m. Controller, Motor Starter and Relay Wiring Diagram: The controller wiring diagrams shall be functional wiring diagrams which show the interconnection of conductors and cables to each controller and to the identified terminals of input and output devices, starters and package equipment. The wiring diagrams shall show necessary jumpers and ground connections. The wiring diagrams shall show the labels of all conductors. Sources of power required for control systems and for packaged equipment control systems shall be identified back to the panel board circuit breaker number, controller enclosures, magnetic starter, or packaged equipment control circuit. Each power supply and transformer not integral to a controller, starter, or packaged equipment shall be shown. The connected volt-ampere load and the power supply volt-ampere rating shall be shown. Wiring diagrams shall be submitted for each HVAC control system.

### 1.5.6 Draft As-Built Drawings

Update the Contractor Design Drawings with all as-built data and submit as specified.

### 1.5.7 Final As-Built Drawings

Update the Draft As-Built Drawings with all final as-built data and submit as specified.

## 1.6 DELIVERY, STORAGE, AND HANDLING

Store products with protection from the weather, humidity, and temperature variations, dirt and dust, and other contaminants, within the storage condition limits published by the equipment manufacturer.

## 1.7 PROJECT/SITE CONDITIONS

All products shall be rated for continuous operation under the following conditions:

a. Pressure: Pressure conditions normally encountered in the installed location.

b. Vibration: Vibration conditions normally encountered in the installed location.

c. Temperature:

(1) Products installed indoors: Ambient temperatures in the range of 32 to 112 degrees F and temperature conditions outside this range normally encountered at the installed location.

(2) Products installed outdoors or in unconditioned indoor spaces: Ambient temperatures in the range of -35 to plus 151 degrees F and temperature conditions outside this range normally encountered at the installed location.

d. Humidity: 10 to 95 percent relative humidity, noncondensing and humidity conditions outside this range normally encountered at the installed location.

1.8 PROJECT SEQUENCING

TABLE I. PROJECT SEQUENCING lists the submittals as specified in paragraph SUBMITTALS (denoted by an 'S' in the 'TYPE' column) and activities as specified in PART 3: EXECUTION (denoted by an 'E' in the 'TYPE' column).

a. Sequencing for submittals: The sequencing specified for submittals is the deadline by which the submittal shall be initially submitted to the Government. Following submission there will be a Government review period as specified in Section 01 33 00 SUBMITTAL PROCEDURES. If the submittal is not accepted by the Government, revise the submittal and resubmit it to the Government within 14 days of notification that the submittal has been rejected. Upon resubmittal there shall be an additional Government review period. If the submittal is not accepted the process repeats until the submittal is accepted by the Government.

b. Sequencing for Activities: The sequencing specified for activities indicates the earliest the activity may begin.

c. Abbreviations: In TABLE I the abbreviation AAO is used for 'after approval of' and 'ACO' is used for 'after completion of'.

TABLE I. PROJECT SEQUENCING

| ITEM # | TYPE | DESCRIPTION | SEQUENCING (START OF ACTIVITY or DEADLINE FOR SUBMITTAL) |
|---|---|---|---|
| 1 | S | Existing Conditions Report | |
| 2 | S | DDC Contractor Design Drawings | |
| 3 | S | Manufacturer's Catalog Data | |
| 4 | S | Network Bandwidth Usage Calculations | |
| 5 | S | Pre-construction QC Checklist | |
| 6 | E | Install Building Control System | AAO #1 thru #5 |
| 7 | E | Start-Up and Start-Up Testing | ACO #6 |
| 8 | S | Post-Construction QC Checklist | [_____] days ACO #7 |
| 9 | S | Programming Software | [_____] days ACO #7 |
| 10 | S | XIF Files | [_____] days ACO #7 |
| 11 | S | LNS Plug-ins | [_____] days ACO #7 |
| 12 | S | Start-Up and Start-Up Testing Report | [_____] days ACO #7 |
| 13 | S | Draft As-Built Drawings | [_____] days ACO #7 |
| 14 | S | PVT Procedures (before schedule) | [_____] days start of #15 and AAO #12 |
| 15 | E | PVT | AAO #13 and #14 |
| 16 | S | PVT Report | [_____] days ACO #15 |
| 17 | S | GPPC Application Programs | [_____] days AAO #16 |
| 18 | S | LNS Database | [_____] days AAO #16 |
| 19 | S | Final As-Built Drawings | [_____] days AAO #16 |
| 20 | S | O&M Instructions | AAO #19 |
| 21 | S | Training Documentation | AAO #12 and [_____] days before scheduled start of #22 |
| 22 | E | Training | AAO #20 and #21 |
| 23 | S | Closeout QC Checklist | ACO #22 |

## 1.9 SCHEDULING

### 1.9.1 System Mode

AHUs shall operate in Occupied, Warm-Up-Cool-Down, or Unoccupied modes as specified. VAV boxes, Fan Coils, and other terminal equipment shall operate in Occupied or Unoccupied modes as specified. Chillers, boilers, and other sources of heating/cooling for hydronic loads do not require scheduling; these systems receive requests for heating/cooling from their loads.

### 1.9.2 System Scheduler Requirements

The System Scheduler functionality shall reside in either a piece of DDC Hardware dedicated to this functionality or in the DDC Hardware controlling the system AHU. A single piece of DDC Hardware may contain multiple System Schedulers. A unique System Scheduler shall be provided for: each AHU including it's associated Terminal Units, and each stand-alone Terminal Unit (those not dependent upon AHU service), or group of stand-alone Terminal Units acting according to a common schedule. Each System Scheduler shall provide the following functionality:

a. Scheduled Occupancy Input: Input shall support the following possible values: OC_STANDBY, OC_OCCUPIED and OC_UNOCCUPIED.

b. Occupancy Override Input: Input shall support the following possible values: OC_STANDBY, OC_OCCUPIED, OC_UNOCCUPIED, and OC_NUL.

c. Space Occupancy Inputs: For systems with multiple occupancy sensors, accept multiple inputs of network variable type SNVT_Occupancy. Input shall support the following possible values: OC_OCCUPIED, OC_UNOCCUPIED, and OC_NUL. For systems with a single occupancy sensor, accept a network variable input of type SNVT_Occupancy or a hardware binary input (BI) indicating the space occupancy status as Occupied or Unoccupied.

d. Air Handler Occupancy Output: For a System Scheduler for a system containing an air handler, output one or more SNVTs indicating the desired occupancy status as one of the following possible values: Warm-Up-Cool-Down (when required by the AHU Sequence of Operation), Occupied and Unoccupied.

e. Default Schedule: Incorporate a 24-hour 7-day default schedule as shown on the drawings which may be activated and deactivated by the System Scheduler Logic.

f. Communication Determination: Determine the time elapsed between receipts of the scheduled occupancy input SNVT, and use this elapsed time to activate and deactivate the Default Schedule as specified. (This provides the capability for the system scheduler to use its Default Schedule if it loses communication with the UMCS).

### 1.9.3 System Scheduler Output Determination

a. Air Handler Occupancy Output: If more than 95 minutes have passed since the last receipt of the Scheduled Occupancy input, the Air Handler Occupancy Output shall be determined by the default schedule and the Space Occupancy Inputs. Otherwise, the output shall be determined as follows:

(1) If the Override Occupancy Input is not OC_NUL, the Air Handler Occupancy Output shall determined as follows:

(a) The output shall be Occupied when the Override Occupancy Input is OC_OCCUPIED.

(b) The output shall be Unoccupied when the Override Occupancy Input is OC_UNOCCUPIED.

(c) If the system Sequence Of Operation specifies Warm-Up-Cool-Down mode, the output shall be Warm-Up-Cool-Down when the Override Occupancy Input is OC_STANDBY.

(2) If the Override Occupancy Input is OC_NUL and the Schedule Occupancy input is OC_OCCUPIED, the Air Handler and Stand-Alone Terminal Unit Occupancy Output shall be OC_OCCUPIED.

(3) If the Override Occupancy Input is OC_NUL, the Schedule Occupancy input is not OC_OCCUPIED, and less than required number of Space Occupancy Inputs (as shown on the Occupancy Schedule Drawing) are OC_OCCUPIED (or the hardware BI is Unoccupied), the Air Handler Occupancy Output shall be determined by the Scheduled Occupancy Input

(a) The output shall be Occupied when the Scheduled Occupancy Input is OC_OCCUPIED.

(b) The output shall be Unoccupied when the Scheduled Occupancy Input is OC_UNOCCUPIED.

(c) If the system Sequence Of Operation specifies Warm-Up-Cool-Down mode the output shall be Warm-Up-Cool-Down when the Scheduled Occupancy Input is OC_STANDBY.

(4) If the Override Occupancy Input is OC_NUL and at least the required number (as shown on the Occupancy Schedule Drawing) of Space Occupancy Inputs are OC_OCCUPIED (or the hardware BI is Occupied), the Air Handler Occupancy Output shall be Occupied.

1.9.4 Air Handler System Scheduling

a. The AHU Occupancy Output SNVT shall be bound from the System Scheduler to the DDC Hardware that executes the Occupancy Mode Determination part of the Air Handler Sequence of Operation

b. For Air Handlers using occupancy sensors, the occupancy sensor output SNVT (of type SNVT_Occupancy) shall be bound to a Space Occupancy Input of the System Scheduler.

c. AHU-Dependent Terminal Units with occupancy sensors shall have their Effective Occupancy SNVT (of type SNVT_Occupancy) bound to a Space Occupancy Input of the System Scheduler.

1.9.5 Stand-Alone Terminal Unit Scheduling

The Terminal Unit Occupancy Output shall be bound from the System Scheduler to the DDC Hardware that executes the Occupancy Mode Determination part of the Terminal Unit Sequence of Operation.

## 1.10 MAINTENANCE

### 1.10.1 General

The HVAC control System Operation and Maintenance (O&m) Instructions shall include:

a. "Manufacturer Data Package 3" as specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA for each piece of control equipment.

b. "Manufacturer Data Package 4" as described in Section 01 78 23 for all air compressors.

c. HVAC control system sequences of operation formatted as specified.

d. Procedures for the HVAC system start-up, operation and shut-down including the manufacturer's supplied procedures for each piece of equipment, and procedures for the overall HVAC system.

e. As-built HVAC control system detail drawings formatted as specified.

f. Printouts of configuration settings for all devices.

g. Routine maintenance checklist. The routine maintenance checklist shall be arranged in a columnar format. The first column shall list all installed devices, the second column shall state the maintenance activity or state no maintenance required, the third column shall state the frequency of the maintenance activity, and the fourth column for additional comments or reference.

h. Qualified service organization list.

i. Start-Up and Start-Up Testing Report.

j. Performance Verification Test (PVT) Procedures and Report.

### 1.10.2 Maintenance Service

Provide services, materials and equipment as necessary to maintain the entire system in an operational state as specified for a period of one year after successful completion and acceptance of the Performance Verification Test. Minimize impacts on facility operations.

#### 1.10.2.1 Description of Work

The adjustment and repair of the system shall include the manufacturer's required sensor and actuator (including transducer) calibration, span and range adjustment.

#### 1.10.2.2 Personnel

Use qualified service personnel to accomplish work promptly and satisfactorily. Advise the Government in writing of the name of the designated service representative, and of any changes in personnel.

#### 1.10.2.3 Scheduled Inspections

Perform two inspections at six-month intervals, and all work required shall

be performed. Inspections shall be scheduled in July and January. These inspections shall include:

a. Visual checks and operational tests of equipment.

b. Fan checks and filter changes for control system equipment.

c. Clean control system equipment including interior and exterior surfaces.

d. Check and calibrate each field device. Check and calibrate 50 percent of the total analog inputs and outputs during the first inspection. Check and calibrate the remaining 50 percent of the analog inputs and outputs during the second major inspection. Certify analog test instrumentation accuracy to be twice the specified accuracy of the device being calibrated. Randomly check at least 25 percent of all digital inputs and outputs for proper operation during the first inspection. Randomly check at least 25 percent of the remaining digital inputs and outputs during the second inspection.

e. Run system software diagnostics and correct diagnosed problems.

f. Resolve any previous outstanding problems.

1.10.2.4 Scheduled Work

This work shall be performed during regular working hours, Monday through Friday, excluding Federal holidays.

1.10.2.5 Emergency Service

The Government will initiate service calls when the system is not functioning properly. Qualified personnel shall be available to provide service to the system. A telephone number where the service supervisor can be reached at all times shall be provided. Service personnel shall be at the site within 24 hours after receiving a request for service. The control system shall be restored to proper operating condition as required in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS.

1.10.2.6 Operation

Scheduled adjustments and repairs shall include verification of the control system operation as demonstrated by the applicable tests of the performance verification test.

1.10.2.7 Records and Logs

Keep dated records and logs of each task, with cumulative records for each major component, and for the complete system chronologically. A continuous log shall be maintained for all devices. The log shall contain initial analog span and zero calibration values and digital points. Complete logs shall be kept and shall be available for inspection onsite, demonstrating that planned and systematic adjustments and repairs have been accomplished for the control system.

1.10.2.8 Work Requests

Record each service call request as received and include its location, date and time the call was received, nature of trouble, names of the service

personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. Submit a record of the work performed within 5 days after work is accomplished.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

Provide materials and equipment which are standard products of Siemens Apogee(R) system. Submit manufacturer's catalog data sheets documenting compliance with product specifications as specified for each product installed under this specification.

### 2.2 ENCLOSURES AND WEATHERSHIELDS

#### 2.2.1 Enclosures

Enclosures shall meet the following minimum requirements:

a. Outdoors: Enclosures located outdoors shall meet NEMA 250 Type 3 or Type 4 requirements.

b. Mechanical and Electrical Rooms: Enclosures located in mechanical or electrical rooms shall meet NEMA 250 Type 2 requirements.

c. Other Locations: Enclosures in other locations including but not limited to occupied spaces, above ceilings, and plenum returns shall meet NEMA 250 Type 1 requirements.

d. Enclosures supplied as an integral (pre-packaged) part of another product are acceptable.

#### 2.2.2 Weathershields

Weathershields for sensors located outdoors shall prevent the sun from directly striking the sensor. Provide the weathershield with adequate ventilation so that the sensing element responds to the ambient conditions of the surroundings. The weathershield shall prevent rain from directly striking or dripping onto the sensor. Install weathershields near outside air intake ducts such that normal outside air flow does not cause rainwater to strike the sensor. Provide weathershields constructed of galvanized steel painted white, unpainted aluminum, aluminum painted white, or white PVC.

### 2.3 TUBING

#### 2.3.1 Copper

Copper tubing shall conform to ASTM B 88 and ASTM B 88M

#### 2.3.2 Stainless Steel

Stainless steel tubing shall conform to ASTM A 269

#### 2.3.3 Plastic

Plastic tubing shall have the burning characteristics of linear low-density polyethylene tubing, shall be self-extinguishing when tested in accordance

with ASTM D 635, shall have UL 94 V-2 flammability classification or better, and shall withstand stress cracking when tested in accordance with ASTM D 1693. Plastic-tubing bundles shall be provided with Mylar barrier and flame-retardant polyethylene jacket.

## 2.4 NETWORK HARDWARE

### 2.4.1 CEA-709.1B Network Hardware

#### 2.4.1.1 CEA-709.1B Routers

CEA-709.1B Routers (including routers configured as repeaters) shall meet the requirements of CEA-709.1B and shall provide connection between two or more CEA-709.3 TP/FT-10 channels.

#### 2.4.1.2 CEA-709.3 Repeaters

CEA-709.3 Repeaters shall be physical layer repeaters in accordance with CEA-709.3.

### 2.4.2 Gateways

Gateways shall perform bi-directional protocol translation from one non-CEA-709.1B protocol to CEA-709.1B. Gateways shall incorporate exactly two network connections: one shall be for connection to a TP/FT-10 network in accordance with CEA-709.3 and the second shall be as required to communicate with the non-CEA-709.1B network.

## 2.5 WIRE AND CABLE

All wire and cable shall meet the requirements of NFPA 70 and NFPA 90A in addition to the requirements of this specification.

### 2.5.1 Terminal Blocks

Terminal blocks which are not integral to other equipment shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, shall be suitable for rail mounting, and shall have end plates and partition plates for separation or shall have enclosed sides.

### 2.5.2 Control Wiring for Binary Signals

Control wiring for binary signals shall be 18 AWG copper and shall be rated for 300-volt service.

### 2.5.3 Wiring for 120-Volt Circuits

Wiring for 120-volt circuits shall be 18 AWG or thicker stranded copper and shall be rated for 600-volt service.

### 2.5.4 Control Wiring for Analog Signals

Control Wiring for Analog Signals shall be 18 AWG, copper, single- or multiple-twisted, minimum 2 inch lay of twist, 100 percent shielded pairs, and shall have a 300-volt insulation. Each pair shall have a 20 AWG tinned-copper drain wire and individual overall pair insulation. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable

insulation.

2.5.5 Transformers

Transformers shall be UL 1585 approved. Transformers shall be sized so that the connected load is no greater than 80 percent of the transformer rated capacity.

2.6 AUTOMATIC CONTROL VALVES

Valves shall have stainless-steel stems and stuffing boxes with extended necks to clear the piping insulation. Valve bodies shall meet ASME B16.34 or ASME B16.15 pressure and temperature class ratings based on the design operating temperature and 150 percent of the system design operating pressure. Unless otherwise specified or shown, valve leakage shall meet FCI 70-2 Class IV leakage rating (0.01 percent of valve Kv). Unless otherwise specified or shown, valves shall have globe-style bodies. Unless otherwise specified:

a. bodies for valves 1.5 inches and smaller shall be brass or bronze, with threaded or union ends

b. bodies for 2 inch valves shall have threaded ends

c. bodies for valves 2 to 3 inches shall be of brass, bronze or iron.

d. bodies for valves 2.5 inches and larger shall be provided with flanged-end connections.

e. for modulating applications, valve Kv (Cv) shall be within 100 to 125 percent of the Kv (Cv) shown.

f. for two position applications (where the two positions are full open and full closed) the Kv (Cv) shall be the largest available for the valve size.

g. valve and actuator combination shall be normally open or normally closed as shown.

2.6.1 Ball Valves

Balls shall be stainless steel or nickel plated brass. Valves shall have blow-out proof stems. In steam and high temperature hot water applications, the valve-to-actuator linkage shall provide a thermal break.

2.6.2 Butterfly

Butterfly valves shall be threaded lug type suitable for dead-end service and modulation to the fully-closed position, with carbon-steel bodies and non-corrosive discs, stainless steel shafts supported by bearings, and EPDM seats suitable for temperatures from -20 to plus 250 degrees F. The rated Kv (Cv) for butterfly valves shall be the value Kv (Cv) at 70 percent (60 degrees) open position. Valve leakage shall meet FCI 70-2 Class VI leakage rating.

2.6.3 Two-Way

Two-way modulating valves used for liquids shall have an equal-percentage characteristic. Two-way modulating valves used for steam shall have a

linear characteristic.

2.6.4 Three-Way

Three-way modulating valves shall provide equal percentage flow control with constant total flow throughout full plug travel.

2.6.5 Chilled-Water and Glycol

Valve internal trim shall be Type 316 stainless steel. Valves 4 inches and larger shall be butterfly valves.

2.7 DAMPERS

2.7.1 Damper Assembly

A single damper section shall have blades no longer than 48 inch and shall be no higher than 72 inch. Maximum damper blade width shall be 8 inch. Larger sizes shall be made from a combination of sections. Dampers shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. Blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section shall not be located directly in the air stream. Damper axles shall be 1/2 inch minimum, plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 0.04 inches water gauge at 1,000 ft/min in the wide-open position. Frames shall not be less than 2 inch in width. Dampers shall be tested in accordance with AMCA 500-D.

2.7.2 Operating Linkages

Operating links external to dampers, such as crank arms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers, shall withstand a load equal to at least 300 percent of the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crank arms shall control the open and closed positions of dampers.

2.7.3 Damper Types

2.7.3.1 Flow Control Dampers

Outside air, return air, relief air, exhaust, face and bypass dampers shall be provided where shown and shall be parallel-blade or opposed blade type as shown on the Damper Schedule. Blades shall have interlocking edges and shall be provided with compressible seals at points of contact. The channel frames of the dampers shall be provided with jamb seals to minimize air leakage. Unless otherwise shown, dampers shall be AMCA 500-D Class 2 and shall not leak in excess of 20 cfm per square foot at 4 inches water gauge static pressure when closed. Outside air damper seals shall be suitable for an operating temperature range of -40 to plus 167 degrees F. Dampers shall be rated at not less than 2000 ft/min air velocity.

2.7.3.2 Mechanical Rooms and Other Utility Space Ventilation Dampers

Utility space ventilation dampers shall be as shown. Unless otherwise shown, dampers shall be AMCA 500-D class 4 and shall not leak in excess of

80 cfm per square foot at 4 inches water gauge static pressure when closed. Dampers shall be rated at not less than 1500 ft/min air velocity.

## 2.8 SENSORS AND INSTRUMENTATION

Unless otherwise specified, sensors and instrumentation shall incorporate an integral transmitter or be provided with a transmitter co-located with the sensor. Sensors and instrumentation, including their transmitters, shall meet the specified accuracy and drift requirements at the input of the connected DDC Hardware's analog-to-digital conversion. Sensors and instrumentation, including their transmitters, shall meet or exceed the specified range.

### 2.8.1 Transmitters

The transmitter shall match the characteristics of the sensor. Transmitters providing analog values shall produce a linear 4-20 mAdc, 0-10 Vdc or SNVT output corresponding to the required operating range and shall have zero and span adjustment. Transmitters providing binary values shall have dry contacts or SNVT output. Transmitters with SNVT output are Application Specific Controllers (ASCs) and shall meet all ASC requirements. (note: ASCs are specified in paragraph DIRECT DIGITAL CONTROL (DDC) HARDWARE)

### 2.8.2 Temperature Sensors

#### 2.8.2.1 Sensor Ranges and Accuracy

Temperature sensors may be provided without transmitters. Temperature sensors, including transmitter if used, shall have minimum operating ranges, minimum accuracy and maximum drift as specified below for the application:

a. Conditioned Space Temperature

(1) Operating Range: 50 to 86 degrees F.

(2) Accuracy: +/- 1 degree F over the operating range.

(3) Drift: Maximum 1 degree F per year.

b. Unconditioned Space Temperature

(1) Operating Range: 20 to 150 degrees F.

(2) Accuracy: +/- 1 degree F over the range of 30 to 131 degrees F and +/- 4 degrees F over the rest of the operating range.

(3) Drift: Maximum 1 degree F per year.

c. Duct Temperature

(1) Operating Range: 40 to 140 degrees F.

(2) Accuracy: +/- 2 degrees F.

(3) Drift: Maximum 2 degrees F per year.

d. Outside Air Temperature

(1) Operating Range: 0 to 120 degrees F.

(2) Accuracy:

(a) +/- 2 degrees F over the range of -30 to plus 130 degrees F.

(b) +/- 1 degreeF over the range of 30 to 100 degrees F.

(3) Drift: Maximum 1 degree F per year.

e. Chilled Water

(1) Operating Range: 30 to 100 degrees F.

(2) Accuracy: +/- 0.8 degrees F over the range of 35 to 65 degrees F and +/- 2 degrees F over the rest of the operating range.

(3) Drift: Maximum 0.8 degrees F per year.

2.8.2.2 Point Temperature Sensors

Point Sensors shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper.

2.8.2.3 Averaging Temperature Sensors

Averaging sensors shall be a continuous element with a minimum length equal to 1 foot/square foot of duct cross-sectional area at the installed location. The sensing element shall have a bendable copper sheath.

2.8.2.4 Thermowells

Thermowells shall be Series 300 stainless steel with threaded brass plug and chain, 2 inch lagging neck and extension type well. Inside diameter and insertion length shall be as required for the application.

2.8.3 Relative Humidity Sensor

Relative humidity sensors shall use bulk polymer resistive or thin film capacitive type non-saturating sensing elements capable of withstanding a saturated condition without permanently affecting calibration or sustaining damage. The sensors shall include removable protective membrane filters. Where required for exterior installation, sensors shall be capable of surviving below freezing temperatures and direct contact with moisture without affecting sensor calibration. When used indoors, the sensor shall be capable of being exposed to a condensing air stream (100 percent RH) with no adverse effect to the sensor's calibration or other harm to the instrument. The sensor shall be of the wall-mounted or duct-mounted type, as required by the application, and shall be provided with any required accessories. Sensors used in duct high-limit applications shall have a bulk polymer resistive sensing element. Duct-mounted sensors shall be provided with a duct probe designed to protect the sensing element from dust accumulation and mechanical damage. Relative humidity (RH) sensors shall measure relative humidity over a range of 0 to 100 percent with an accuracy of +/- 3 percent. RH sensors shall function over a temperature range of 25 to 130 degrees F and shall not drift more than 2 percent per year.

2.8.4 Carbon Dioxide (CO2) Sensors

Carbon dioxide (CO2) sensors shall measure CO2 concentrations between 0 to 2000 parts per million (ppm) using non-dispersive infrared (NDIR) technology with an accuracy of +/- 75 ppm and a maximum response time of 1 minute. The sensor shall be rated for operation at ambient air temperatures within the range of 32 to 122 degrees F and relative humidity within the range of 0 to 95 percent (non-condensing). The sensor shall have a maximum drift of 2 percent. The sensor chamber shall be manufactured with a non-corrosive material (such as gold-plating) that does not affect carbon dioxide sample concentration. Duct mounted sensors shall be provided with a duct probe designed to protect the sensing element from dust accumulation and mechanical damage.

2.8.5 Differential Pressure Instrumentation

2.8.5.1 Differential Pressure Sensors

Differential Pressure Sensor range shall be as shown or as required for the application. Pressure sensor ranges shall not exceed the high end range shown on the Points Schedule by more than 50 percent. The over pressure rating shall be a minimum of 150 percent of the highest design pressure of either input to the sensor. The accuracy shall be +/- 2 percent of full scale.

2.8.5.2 Differential Pressure Switch

The switch shall have a user-adjustable setpoint. The setpoint shall not be in the upper or lower quarters of the range. The over pressure rating shall be a minimum of 150 percent of the highest design pressure of either input to the sensor. The switch shall have two sets of contacts and each contact shall have a rating greater than it's connected load. Contacts shall open or close upon rise of pressure above the setpoint or drop of pressure below the setpoint as shown.

2.8.6 Flow Sensors

2.8.6.1 Annular Pitot Tube

Annular pitot tube shall be made of austenitic stainless steel with an accuracy of +/- 2 percent of full flow and a repeatability of +/- 0.5 percent of measured value. The unit shall have at least one static port and no less than four total head pressure ports with an averaging manifold.

2.8.6.2 Insertion Turbine Flowmeter

Insertion Turbine Flowmeter accuracy shall be +/- 1 percent of reading for a minimum turndown ratio of 1:1 through a maximum turndown ratio of 50:1. Repeatability shall be +/- 0.25 percent of reading. The meter flow sensing element shall operate over a range suitable for the installed location with a pressure loss limited to 1 percent of operating pressure at maximum flow rate. Design of the flowmeter probe assembly shall incorporate integral flow, temperature, and pressure sensors. The turbine rotor assembly shall be constructed of Series 300 stainless steel and use Teflon seals.

2.8.6.3 Vortex Shedding Flowmeter

Vortex Shedding Flowmeter accuracy shall be within +/- 0.8 percent of the actual flow. The flow meter body shall be made of austenitic stainless

steel. The vortex shedding flowmeter body shall not require removal from the piping in order to replace the shedding sensor.

2.8.6.4 Positive Displacement Flow Meter

The flow meter shall be a direct reading, gerotor, nutating disk or vane type displacement device rated for liquid service as shown. A counter shall be mounted on top of the meter, and shall consist of a non-resettable mechanical totalizer for local reading, and a pulse transmitter for remote reading. The totalizer shall have a six digit register to indicate the volume passed through the meter in [liters] [gallons], and a sweep-hand dial to indicate down to 0.25 gallons. The pulse transmitter shall have a hermetically sealed reed switch which is activated by magnets fixed on gears of the counter. The meter shall have a bronze body with threaded or flanged connections as required for the application. Output accuracy shall be +/- 2 percent of the flow range. The maximum pressure drop at full flow shall be 5 psig.

2.8.6.5 Flow Meters, Paddle Type

Sensor shall be non-magnetic, with forward curved impeller blades designed for water containing debris. Sensor accuracy shall be +/- 2 percent of rate of flow, minimum operating flow velocity shall be 1 foot per second. Sensor repeatability and linearity shall be +/- 1 percent. Materials which will be wetted shall be made from non-corrosive materials and shall not contaminate water. The sensor shall be rated for installation in pipes of 3 to 40 inch diameters. The transmitter housing shall be a NEMA 250 Type 4 enclosure.

2.8.6.6 Flow Switch

Flow switch shall have a repetitive accuracy of +/- 10 percent of actual flow setting. Switch actuation shall be adjustable over the operating flow range. The switch shall have Form C snap-action contacts, rated for the application. The flow switch shall have non flexible paddle with magnetically actuated contacts and be rated for service at a pressure greater than the installed conditions. Flow switch for use in sewage system shall be rated for use in corrosive environments encountered.

2.8.7 Occupancy Sensors

Occupancy sensors shall have occupancy-sensing sensitivity adjustment and an adjustable off-delay timer with a range encompassing 30 seconds to 15 minutes. Occupancy sensors shall be rated for operation in ambient air temperatures ranging from 50 to 104 degrees F or temperatures normally encountered in the installed location. Sensors integral to wall mount on-off light switches shall have an auto-off switch. Wall switch sensors shall be decorator style and shall fit behind a standard decorator type wall plate. All occupancy sensors, power packs, and slave packs shall be UL listed. In addition to any outputs required for lighting control, the occupancy sensor shall provide a contact output rated at 1A at 24 Vac or a SNVT output.

2.8.7.1 Passive Infrared (PIR) Occupancy Sensors

PIR occupancy sensors shall have a multi-level, multi-segmented viewing lens and a conical field of view with a viewing angle of 180 degrees and a detection of at least 20 feet unless otherwise shown or specified. PIR Sensors shall provide field-adjustable background light-level adjustment

with an adjustment range suitable to the light level in the sensed area, room or space. PIR sensors shall be immune to false triggering from RFI and EMI.

2.8.7.2 Ultrasonic Occupancy Sensors

Ultrasonic sensors shall operate at a minimum frequency 32 kHz and shall be designed to not interfere with hearing aids.

2.8.7.3 Dual-Technology Occupancy Sensor (PIR and Ultrasonic)

Dual-Technology Occupancy Sensors shall meet the requirements of both PIR and Ultrasonic Occupancy Sensors.

2.8.8 Temperature Switch

2.8.8.1 Duct Mount Temperature Low Limit Safety Switch (Freezestat)

Duct mount temperature low limit switches (Freezestats) shall be manual reset, low temperature safety switches with a minimum element length of 1 foot/square-foot of coverage which shall respond to the coldest 18 inch segment with an accuracy of +/- 3.6 degrees F. The switch shall have a field-adjustable setpoint with a range of at least 30 to 50 degrees F. The switch shall have two sets of contacts, and each contact shall have a rating greater than its connected load. Contacts shall open or close upon drop of temperature below setpoint as shown and shall remain in this state until reset.

2.8.8.2 Pipe Mount Temperature Limit Switch (Aquastat)

Pipe mount temperature limit switches (aquastats) shall have a field adjustable setpoint between 60 and 90 degrees F, an accuracy of +/- 3.6 degrees F and a 10 degrees F fixed deadband. The switch shall have two sets of contacts, and each contact shall have a rating greater than its connected load. Contacts shall open or close upon change of temperature above or below setpoint as shown.

2.8.9 Damper End Switches

Each end switch shall be a hermetically sealed switch with a trip lever and over-travel mechanism. The switch enclosure shall be suitable for mounting on the duct exterior and shall permit setting the position of the trip lever that actuates the switch. The trip lever shall be aligned with the damper blade.

2.9 INDICATING DEVICES

All indicating devices shall display readings in English (inch-pound) units.

2.9.1 Thermometers

Thermometers shall not contain mercury. Unless otherwise specified, thermometers shall have an accuracy of +/- 3 percent of scale range. Thermometers shall have a range suitable for the application with an upper end of the range not to exceed 150 percent of the design upper limit.

2.9.1.1 Piping System Thermometers

Piping system thermometers shall have brass, malleable iron or aluminum

alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale. Piping system thermometers shall have an accuracy of +/- 1 percent of scale range. Thermometers for piping systems shall have rigid stems with straight, angular, or inclined pattern. Thermometer stems shall have expansion heads as required to prevent breakage at extreme temperatures. On rigid-stem thermometers, the space between bulb and stem shall be filled with a heat-transfer medium.

2.9.1.2 Air-Duct Thermometers

Air-duct thermometers shall have perforated stem guards and 45-degree adjustable duct flanges with locking mechanism.

2.9.2 Pressure Gauges

Gauges shall be suitable for field or panel mounting as required, shall have black legend on white background, and shall have a pointer traveling through a 270-degree arc. Gauge range shall be suitable for the application with an upper end of the range not to exceed 150 percent of the design upper limit. Accuracy shall be +/- 3 percent of scale range. Gauges shall meet requirements of ASME B40.100.

2.9.3 Low Differential Pressure Gauges

Gauges for low differential pressure measurements shall be a minimum of 3.5 inch (nominal) size with two sets of pressure taps, and shall have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gauge range shall be suitable for the application with an upper end of the range not to exceed 150 percent of the design upper limit. Accuracy shall be plus or minus two percent of scale range.

2.10 OUTPUT DEVICES

Output Devices with SNVT input are ASCs and shall meet all ASC requirements in addition to the output device requirements. (Note: ASCs are specified in paragraph DIRECT DIGITAL CONTROL (DDC) HARDWARE.)

2.10.1 Actuators

Actuators shall be electric (electronic). All actuators shall be normally open (NO), normally closed (NC) or fail-in-last-position (FILP) as shown. Normally open and normally closed actuators shall be of mechanical spring return type. Electric actuators shall have an electronic cut off or other means to provide burnout protection if stalled. Actuators shall have a visible position indicator. [Electric actuators shall provide position feedback to the controller as shown.] Actuators shall smoothly open or close the devices to which they are applied. Pneumatic actuators shall have a full stroke response time matching the connected Electric to Pneumatic Transducer (EP). Electric actuators shall have a full stroke response time in both directions of 90 seconds or less at rated load. Electric actuators shall be of the foot-mounted type with an oil-immersed gear train or the direct-coupled type. Where multiple electric actuators operate from a common signal, the actuators shall provide an output signal identical to its input signal to the additional devices. [Pneumatic actuators shall be rated for 25 psi operating pressure except for high-pressure cylinder-type actuators.]

2.10.1.1 Valve Actuators

Valve actuators shall provide shutoff pressures and torques as shown on the Valve Schedule.

2.10.1.2 Damper Actuators

Damper actuators shall provide the torque necessary in accordance with damper manufacturer's instructions to modulate the dampers smoothly over its full range of operation and torque shall be at least 6 inch-pounds/1 square foot of damper area for opposed blade dampers and 9 inch-pounds/1 square foot of damper area for parallel blade dampers.

2.10.1.3 Positive Positioners

Positive positioners shall be a pneumatic relay with a mechanical position feedback mechanism and an adjustable operating range and starting point.

2.10.2 Relays

Control relay contacts shall have utilization category and ratings selected for the application, with a minimum of two sets of contacts enclosed in a dust proof enclosure. Each set of contacts shall incorporate a normally open (NO), normally closed (NC) and common contact. Relays shall be rated for a minimum life of one million operations. Operating time shall be 20 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to 150 percent of rated coil voltage.

2.11 USER INPUT DEVICES

User Input Devices, including potentiometers, switches and momentary contact push-buttons with SNVT output are Application Specific Controllers (ASCs) and shall meet all ASC requirements. (Note: ASCs are specified in paragraph DIRECT DIGITAL CONTROL (DDC) HARDWARE). Potentiometers shall be of the thumb wheel or sliding bar type. Momentary Contact Push-Buttons may include an adjustable timer for their output. User input devices shall be labeled for their function.

2.12 MULTIFUNCTION DEVICES

Multifunction devices are products which combine the functions of multiple sensor, user input or output devices into a single product. Unless otherwise specified, the multifunction device shall meet all requirements of each component device. Where the requirements for the component devices conflict, the multifunction device shall meet the most stringent of the requirements.

2.12.1 Current Sensing Relay Command Switch

The Current Sensing Relay portion shall meet all requirements of the Current Sensing Relay input device. The Command Switch portion shall meet all requirements of the Relay output device except that it shall have at least one normally-open (NO) contact.

2.12.2 Thermostats

Thermostats shall be multifunction devices incorporating a temperature sensor and a temperature indicating device. Thermostats shall not contain

mercury (Hg). In addition, the thermostat shall have the following as specified and shown:

a. A User Input Device which shall adjust a temperature setpoint output.

b. A User Input Momentary Contact Button and an output indicating zone occupancy.

c. A three position User Input Switch labeled to indicate heating, cooling and off positions ('HEAT-COOL-OFF' switch) and providing corresponding outputs.

d. A two position User Input Switch labeled with 'AUTO' and 'ON' positions and providing corresponding outputs.

e. A multi-position User Input Switch with 'OFF' and at least two fan speed positions and providing corresponding outputs.

## 2.13 DIRECT DIGITAL CONTROL (DDC) HARDWARE

### 2.13.1 General Requirements

All DDC Hardware shall be the standard product as msnufacturered, serviced, and sold by Siemens APOGEE(R).

### 2.13.2 Hardware Input-Output (I/O) Functions

DDC Hardware incorporating hardware input-output (I/O) functions shall meet the following requirements:

a. Analog Inputs: DDC Hardware analog inputs (AIs) shall perform analog to digital (A-to-D) conversion with a minimum resolution of 8 bits plus sign or better as needed to meet the accuracy requirements specified in paragraph INPUT MEASUREMENT ACCURACY. Signal conditioning including transient rejection shall be provided for each analog input. Analog inputs shall be capable of being individually calibrated for zero and span. The AI shall incorporate common mode noise rejection of at least 50 dB from 0 to 100 Hz for differential inputs, and normal mode noise rejection of at least 20 dB at 60 Hz from a source impedance of 10,000 ohms.

b. Analog Outputs: DDC Hardware analog outputs (AOs) shall perform digital to analog (D-to-A) conversion with a minimum resolution of 8 bits plus sign, and output a signal with a range of 4-20 mAdc or 0-10 Vdc. Analog outputs shall be capable of being individually calibrated for zero and span.

c. Binary Inputs: DDC Hardware binary inputs (BIs) shall accept contact closures and shall ignore transients of less than 5 milli-second duration. Isolation and protection against an applied steady-state voltage up to 180 Vac peak shall be provided.

d. Binary Outputs: DDC Hardware binary outputs (BOs) shall provide relay contact closures or triac outputs for momentary and maintained operation of output devices.

(1) Relay Contact Closures: Closures shall have a minimum duration of 0.1 second. Relays shall provide at least 180V of

isolation. Electromagnetic interference suppression shall be provided on all output lines to limit transients to non-damaging levels. Minimum contact rating shall be one ampere at 24 Vac.

(2) Triac outputs: Triac outputs shall provide at least 180 V of isolation.

e. Pulse Accumulator: DDC Hardware pulse accumulators shall have the same characteristics as the BI. In addition, a buffer shall be provided to totalize pulses. The pulse accumulator shall accept rates of at least 20 pulses per second. The totalized value shall be reset to zero upon operator's command.

2.13.3 Application Specific Controller (ASC)

Application Specific Controllers (ASCs) have a fixed factory-installed application program (i.e. ProgramID) with configurable settings. ASCs shall meet the following requirements in addition to the General DDC Hardware and DDC Hardware Input-Output (I/O) Function requirements:

a. ASCs shall be LonMark Certified.

b. Unless otherwise approved, all necessary Configuration Parameters and network configuration inputs (*ncis*) for the sequence and application in which the ASC is used shall be fully configurable through an LNS plug-in. This plug-in shall be submitted as specified for each type of ASC (manufacturer and model). (Note: configuration accomplished via hardware settings does not require configuration via plug-in)

c. Local Display Panel (LDP): The Local Display Panel shall be an Application Specific Controller (ASC) with a display and navigation buttons. It shall provide display and adjustment of SNVT inputs and SNVT outputs as shown.

2.13.4 General Purpose Programmable Controller (GPPC)

A General Purpose Programmable Controller (GPPC) is not installed with a fixed factory-installed application program. GPPCs shall meet the following requirements in addition to the general DDC Hardware requirements and Hardware Input-Output (I/O) Function:

a. The programmed GPPC shall conform to the LonMark Interoperability Guide.

b. All programming software required to program the GPPC shall be delivered to and licensed to the project site as specified.

c. Copies of the installed GPPC application programs as source code compatible with the supplied programming software shall be submitted as specified. The submitted GPPC application program shall be the complete application necessary for the GPPC to function as installed and be sufficient to allow replacement of the installed controller with a GPPC of the same type.

# PART 3 EXECUTION

## 3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

## 3.2 CONTROL SYSTEM INSTALLATION

### 3.2.1 General Installation Requirements

#### 3.2.1.1 HVAC Control System

The HVAC control system shall be completely installed, tested and ready for operation. Provide dielectric isolation where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exterior shall be made watertight. The HVAC control system installation shall provide clearance for control system maintenance by maintaining access space required to calibrate, remove, repair, or replace control system devices. The control system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance.

#### 3.2.1.2 Device Mounting Criteria

Install all devices in accordance with manufacturer's recommendations and as specified and shown. Provide control devices, to be installed in piping and ductwork, with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements shall not be used except as specified. Install spare thermowells adjacent to each thermowell containing a sensor and as shown. Devices located outdoors shall have a weathershield.

#### 3.2.1.3 Labels and Tags

Key labels and tags to the unique identifiers shown on the As-Built drawings. Label all enclosures and DDC hardware. All sensors and actuators in mechanical rooms shall be tagged. Tag airflow measurement arrays to show flow rate range for signal output range, duct size, and pitot tube AFMA flow coefficient. Duct static pressure taps shall be tagged at the location of the pressure tap. Tags shall be plastic or metal and shall be mechanically attached directly to each device or attached by a metal chain or wire. Labels, outside of protective enclosures, shall be engraved plastic and mechanically attached to the enclosure or DDC Hardware. Labels inside protective enclosures may attached using adhesive, but shall not be hand written.

### 3.2.2 DDC Hardware

Install DDC hardware in an enclosure. Except for DDC hardware used to control Terminal Units, where multiple pieces of DDC hardware are used to execute one sequence, all DDC hardware executing that sequence shall be on a common local control bus and isolated from all other DDC hardware via an CEA-709.1B router or CEA-709.3 repeater.

### 3.2.3 Network Interface Jack

A standard network interface jack shall be provided for each node on the control network. For terminal unit controllers with hardwired thermostats this network interface jack shall be located at the thermostat or within 10 ft of the controller. Locating the interface jack at the thermostat is preferred. For all other nodes the network interface jack shall be located within 10 ft of the node. If the network interface jack is other than a 1/8 inch phone jack, provide an interface cable with a standard 1/8 inch phone jack on one end and a connector suitable for mating with installed network interface jack on the other. No more than one type of interface cable shall be required to access all network interface jacks. Furnish one interface cable.

### 3.2.4 Room Instrument Mounting

Room instruments, including but not limited to wall mounted thermostats and sensors located in occupied spaces shall be mounted 60 inches above the floor unless otherwise shown. Unless otherwise shown on the Thermostat Schedule:

a. All other Thermostats shall be wall mounted.

### 3.2.5 Indication Devices Installed in Piping and Liquid Systems

Gauges in piping systems subject to pulsation shall have snubbers. Gauges for steam service shall have pigtail fittings with cock. Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermowells.

### 3.2.6 Duct Smoke Detectors

Duct smoke detectors will be provided in supply and return air ducts in accordance with Section 28 31 64.00 10 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE. Connect the DDC System to the auxiliary contacts provided on the Smoke Detector as required for system safeties and to provide alarms to the DDC system.

### 3.2.7 Occupancy Sensors

A sufficient quantity of occupancy sensors shall be provided to provide complete coverage of the area (room or space). Occupancy sensors shall be installed in accordance with NFPA 70 requirements and the manufacturer's instructions. Occupancy sensors shall not be located within 6 feet of HVAC outlets or heating ducts. PIR and dual-technology PIR/ultrasonic sensors shall not be installed where they can "see" beyond any doorway. Ultrasonic sensors shall not be installed in spaces containing ceiling fans. Sensors shall detect motion to within 2 feet of all room entrances and shall not trigger due to motion outside the room. The off-delay timer shall be set to 15 minutes unless otherwise shown. All sensor adjustments shall be made prior to beneficial occupancy, but after installation of furniture systems, shelving, partitions, etc. Each controlled area shall have one hundred percent coverage capable of detecting small hand-motion movements, accommodating all occupancy habits of single or multiple occupants at any location within the controlled room.

### 3.2.8 Temperature Limit Switch

A temperature limit switch (freezestat) shall be provided to sense the

temperature at the location shown. A sufficient number of temperature limit switches (freezestats) shall be installed to provide complete coverage of the duct section. Manual reset limit switches shall be installed in approved, accessible locations where they can be reset easily. The temperature limit switch (freezestat) sensing element shall be installed in a serpentine pattern and in accordance with the manufacturer's installation instructions.

3.2.9 Averaging Temperature Sensing Elements

Sensing elements shall be installed in a serpentine pattern located as shown.

3.2.10 Duct Static Pressure Sensors

The duct static pressure sensing tap shall be located at 75 percent to 100 percent of the distance between the first and last air terminal units. If the transmitter is wired in a homerun configuration to an AHU controller, the transmitter shall be located in the same enclosure as the air handling unit (AHU) controller(s) for the AHU serving the terminal units.

3.2.11 Relative Humidity Sensors

Relative humidity sensors in supply air ducts shall be installed at least 10 feet downstream of humidity injection elements.

3.2.12 Flowmeters

The minimum straight unobstructed piping for the flowmeter installation shall be at least 10 pipe diameters upstream and at least 5 pipe diameters downstream and in accordance with the manufacturer's installation instructions.

3.2.13 Dampers

3.2.13.1 Damper Actuators

Actuators shall not be mounted in the air stream. Multiple actuators shall not be connected to a common drive shaft. Actuators shall be installed so that their action shall seal the damper to the extent required to maintain leakage at or below the specified rate and shall move the blades smoothly.

3.2.13.2 Damper Installation

Dampers shall be installed straight and true, level in all planes, and square in all dimensions. Dampers shall move freely without undue stress due to twisting, racking (parallelogramming), bowing, or other installation error. Blades shall close completely and leakage shall not exceed that specified at the rated static pressure. Structural support shall be used for multi-section dampers. Acceptable methods include but are not limited to U-channel, angle iron, corner angles and bolts, bent galvanized steel stiffeners, sleeve attachments, braces, and building structure. Where multi-section dampers are installed in ducts or sleeves, they shall not sag due to lack of support. Jackshafts shall not be used to link more than three damper sections. Blade to blade linkages shall not be used. Outside and return air dampers shall be installed such that their blades direct their respective air streams towards each other to provide for maximum mixing of air streams.

3.2.14 Valves

3.2.14.1 Ball Valves

Two-position (open/closed) ball valves may only be used on chilled water, condenser water, hot water, or steam applications. Modulating ball valves may only be used for chilled water and condenser water applications (modulating ball valves shall not be used on steam or hot water applications). In modulating applications a characterizing equal-percentage disc shall be used.

3.2.14.2 Butterfly Valves

In two-way control applications, valve travel shall be limited to 70 percent (60 degrees) open position.

3.2.15 Local Gauges for Actuators

Pneumatic actuators shall have an accessible and visible pressure gauge installed in the tubing lines at the actuator as shown.

3.2.16 Wire and Cable

Wire and Cable shall be installed without splices between control devices and in accordance with NFPA 70 and NFPA 90A. Instrumentation grounding shall be installed in accordance with the device manufacturer's instructions and as necessary to prevent ground loops, noise, and surges from adversely affecting operation of the system. Ground rods installed by the Contractor shall be tested as specified in IEEE Std 142. Cables and conductor wires shall be tagged at both ends, with the identifier shown on the shop drawings. Electrical work shall be as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and as shown. Wiring external to enclosures shall be run [in raceways][as follows:

a. Wiring other than low-voltage control and low-voltage network wiring shall be installed in raceways.

b. Low-voltage control and low-voltage network wiring not in suspended ceilings over occupied spaces shall be installed in raceways, except that nonmetallic-sheathed cables or metallic-armored cables may be installed as permitted by NFPA 70.

c. Low-voltage control and low-voltage network wiring in suspended ceilings over occupied spaces shall be installed in raceways, except:

(1) nonmetallic-sheathed cables or metallic-armored cables may be installed as permitted by NFPA 70.

(2) plenum rated cable in suspended ceilings over occupied spaces may be run without raceways.]

3.2.17 Copper Tubing

Copper tubing shall be hard-drawn in exposed areas and either hard-drawn or annealed in concealed areas. Only tool-made bends shall be used. Fittings for copper tubing shall be brass or copper solder joint type except at connections to apparatus, where fittings shall be brass compression type.

3.2.18 Plastic Tubing

Plastic tubing shall be run within covered raceways or conduit except when otherwise specified. Plastic tubing shall not be used for applications where the tubing could be subjected to a temperature exceeding 130 degrees F. Fittings for plastic tubing shall be for instrument service and shall be brass or acetal resin of the compression or barbed push-on type. Except in walls and exposed locations, plastic multitube instrument tubing bundle without conduit or raceway protection may be used where a number of air lines run to the same points, provided the multitube bundle is enclosed in a protective sheath, is run parallel to the building lines and is adequately supported as specified.

3.3 HVAC SYSTEMS OPERATION

3.3.1 Alarm Handling

Install and configure DDC Hardware to provide alarm handling functionality for critical alarms as specified and shown, either in a piece of DDC Hardware dedicated to this function or in DDC Hardware performing other functions. The DDC Hardware providing alarm handling functionality shall provide the following capabilities as required:

a. Dial to a pager: The node shall be able to dial a paging service and leave a numeric message.

[b. Dial to an e-mail server: The node shall be able to dial and connect to a remote server and send an e-mail via Simple Mail Transfer Protocol (SMTP).]

[c. Send e-mail over IP Network: The alarm handling node shall be capable of connecting to an IP network and sending e-mail via Simple Mail Transfer Protocol (SMTP).]

[d. Provide network access: The node shall be capable of receiving a connection via the modem to allow a remote computer access to the control network.]

3.3.2 Operation for Air Handling Units

3.3.2.1 Single Zone with Heating and DX Cooling Coils

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs, outputs and alarms as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control shall be proportional-integral (PI) control.

a. HAND-OFF-AUTO switch: Supply fan motor starter shall accept a Fire Alarm Panel (FAP) signal that takes precedence over all other starter inputs and switches and shall start the fan. The fan motor starter shall accept an occupant accessible emergency shutoff switch as shown. The supply fan motor starter shall have an H-O-A switch:

(1) HAND: With the H-O-A switch in HAND position, the supply fan shall start and run continuously, subject to Safeties.

(2) OFF: With the H-O-A switch in OFF position, the supply fan shall stop.

(3) AUTO: With the H-O-A switch in AUTO position, the supply fan shall run subject to the Supply Fan Start/Stop (SF-SS) command and Safeties.

b. Occupancy Modes: The system shall obtain its Occupancy Mode input from the System Scheduler as specified and shown. The system shall operate in one of the following modes: Occupied, Unoccupied.

3.3.2.2 Single Zone with Heating and Cooling Coils

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs, outputs and alarms as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control shall be proportional-integral (PI) control.

a. HAND-OFF-AUTO switch: Supply fan motor starter shall accept a Fire Alarm Panel (FAP) signal that takes precedence over all other starter inputs and switches and shall start the fan. The fan motor starter shall accept an occupant accessible emergency shutoff switch as shown. The supply fan motor starter shall have an H-O-A switch:

(1) HAND: With the H-O-A switch in HAND position, the supply fan shall start and run continuously, subject to Safeties.

(2) OFF: With the H-O-A switch in OFF position, the supply fan shall stop.

(3) AUTO: With the H-O-A switch in AUTO position, the supply fan shall run subject to the Supply Fan Start/Stop (SF-SS) command and Safeties.

b. Occupancy Modes: The system shall obtain its Occupancy Mode input from the System Scheduler as specified and shown. The system shall operate in one of the following modes: Occupied, Unoccupied[, or WarmUp/CoolDown].

c. System Enable and Loop Enable:

(1) Occupied Mode: The supply fan shall be enabled (SYS-ENA) and commanded to run (SF-SS) and all control loops shall be enabled.

(2) Unoccupied mode: While the building temperature (BLDG-T) is above setpoint (BLDG-T-LL-SP) all control loops shall be disabled and the supply fan shall not run. When BLDG-T drops below BLDG-T-LL-SP (with a 5 degrees F deadband) the supply fan shall be enabled (SYS-ENA) and commanded to run (SF-SS) and the Heating Coil Temperature Control loop shall be enabled. All other control loops shall be disabled.

[(3) Warm Up / Cool Down Mode: The supply fan shall be enabled (SYS-ENA) and commanded to run (SF-SS). The Minimum Outside Air Flow Control loop shall be disabled and all other control loops shall be enabled.]

d. Proofs and Safeties:

(1) The supply fan and all DDC Hardware control loops shall be subject to Proofs and Safeties. Safeties shall be direct-hardwire interlocked to the fan starter circuit as shown. DDC Hardware

shall monitor all proofs and safeties and failure of any proof or activation of any safety shall result in all control loops being disabled and the AHU fan being commanded off until reset.

(2) Proofs: Supply fan status (proof) (SF-S)

(3) Safeties:

(a) Heating coil discharge air temperature low limit (freezestat) (HTG-DA-T-LL)

(b) Supply air smoke (SA-SMK)

(c) Return air smoke (RA-SMK)

(4) DDC Hardware reset of all proofs and safeties shall be via a local binary push-button (RST-BUT) input to the DDC Hardware, via a remote command to the DDC Hardware via SNVT or both (where the Contractor provides both reset functions and the operator can use either one to perform the reset), as shown on the Points Schedule drawing.

e. Minimum Outside Air Flow Control: When this loop is enabled the DDC Hardware shall open the 2-position minimum outside air damper to introduce the minimum outside air flow quantity as shown. When this loop is disabled, the minimum outside air damper shall be closed.

f. Heating Coil Control: When this loop is enabled the DDC Hardware shall modulate the heating coil control valve in sequence with the bypass and supply dampers and the economizer dampers as shown to maintain zone temperature (ZN-T) at setpoint (ZN-T-SP) as shown. When this loop is disabled, the heating coil control valve shall be closed.

g. Cooling Coil Control: When this loop is enabled the DDC Hardware shall open the 2-position cooling coil control valve. When this loop is disabled, the 2-position cooling coil control valve shall be closed.

3.3.2.3 Single Zone with Humidity Control

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs, outputs and alarms as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control shall be proportional-integral (PI) control.

a. HAND-OFF-AUTO switch: Supply fan motor starter shall accept a Fire Alarm Panel (FAP) signal that takes precedence over all other starter inputs and switches and shall start the fan. The fan motor starter shall accept an occupant accessible emergency shutoff switch as shown. The supply fan motor starter shall have an H-O-A switch:

(1) HAND: With the H-O-A switch in HAND position, the supply fan shall start and run continuously, subject to Safeties.

(2) OFF: With the H-O-A switch in OFF position, the supply fan shall stop.

(3) AUTO: With the H-O-A switch in AUTO position, the supply fan shall run subject to the Supply Fan Start/Stop (SF-SS)command and Safeties.

b. Occupancy Modes: The system shall obtain its Occupancy Mode input from the System Scheduler as specified and shown. The system shall operate in one of the following modes: Occupied, Unoccupied[, or WarmUp/CoolDown].

c. System Enable and Loop Enable:

(1) Occupied Mode: The supply fan shall be enabled (SYS-ENA) and commanded to run (SF-SS) and all control loops shall be enabled.

(2) Unoccupied mode: While the building temperature (BLDG-T) is above setpoint (BLDG-T-LL-SP) all control loops shall be disabled and the supply fan shall not run. When BLDG-T drops below BLDG-T-LL-SP (with a 5 degrees F deadband) the supply fan shall be enabled (SYS-ENA) and commanded to run (SF-SS), the Preheat Coil Control loop and Reheat Coil Control loop shall be enabled and all other loops shall be disabled.

[(3) Warm Up / Cool Down Mode: The supply fan shall be enabled (SYS-ENA) and commanded to run (SF-SS). The Minimum Outside Air Flow Control loop shall be disabled and all other control loops shall be enabled.]

d. Proofs and Safeties

(1) The supply fan and all DDC Hardware control loops shall be subject to Proofs and Safeties. Safeties shall be direct-hardwire interlocked to the fan starter circuit as shown. DDC Hardware shall monitor all proofs and safeties and failure of any proof or activation of any safety shall result in all control loops being disabled and the AHU fan being commanded off until reset.

(2) Proofs: Supply fan status (proof) (SF-S)

(3) Safeties:
(a) Preheat coil discharge air temperature low limit (freezestat) (PH-DA-T-LL)

(b) Supply air smoke (SA-SMK)

(c) Return air smoke (RA-SMK)

(4) DDC Hardware reset of all proofs and safeties shall be via a local binary push-button (RST-BUT) input to the DDC Hardware, via a remote command to the DDC Hardware via SNVT or both (where the Contractor provides both reset functions and the operator can use either one to perform the reset), as shown on the Points Schedule drawing.

e. Minimum Outside Air Flow Control: When this loop is enabled the DDC Hardware shall open the 2-position minimum outside air damper to introduce the minimum outside air flow quantity as shown. When this loop is disabled, the minimum outside air damper shall be closed.

f. Preheat Coil Control Loop: When this loop is enabled the DDC Hardware shall modulate the preheat coil valve to maintain the preheat coil discharge air temperature (PH-T) at setpoint (PH-T-SP) as shown. When this loop is disabled, the preheat coil valve shall be closed.

g. Cooling-and-Dehumidification Coil Control: When this loop is enabled the DDC Hardware shall modulate the cooling and dehumidification valve to maintain either the zone temperature (ZN-T) at setpoint (ZN-T-SP) or zone relative humidity (ZN-RH) at setpoint (ZN-RH-SP), whichever calls for more chilled water flow. The valve shall be modulated in sequence with the reheat valve and humidification valve as shown to avoid simultaneous cooling and reheating, and simultaneous dehumidification and humidification. When this loop is disabled, the coil valve shall be closed.

h. Reheat Coil Control: When this loop is enabled the DDC Hardware shall modulate the reheat coil valve to maintain the zone temperature (ZN-T) at setpoint (ZN-T-SP) as shown. The valve shall be modulated in sequence with the cooling-and-dehumidification valve as shown to avoid simultaneous cooling and reheating. When this loop is disabled, the coil valve shall be closed.

3.3.2.3 Variable Air Volume System without Return Fan

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs, outputs and alarms as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control shall be proportional-integral (PI) control.

a. HAND-OFF-AUTO switches:
Supply fan variable frequency drive (VFD) unit shall accept a Fire Alarm Panel (FAP) signal that takes precedence over all other VFD inputs and switches and shall cause the VFD to run at 100 percent speed. The VFD shall accept an occupant accessible emergency shutoff switch as shown. The supply fan variable frequency drive (VFD) unit shall have an integral H-O-A switch:

(1) HAND: With the H-O-A switch in HAND position, the supply fan shall start and run continuously, subject to Safeties. Fan speed shall be under manual-operator control.

(2) OFF: With the H-O-A switch in OFF position, the supply fan shall stop.

(3) AUTO: With the H-O-A switch in AUTO position, the supply fan shall run subject to the Supply Fan Start/Stop Signal (SF-SS) and Safeties. Fan speed shall be under control of the DDC Hardware.

b. Occupancy Modes: The system shall obtain its Occupancy Mode input from the System Scheduler as specified and shown. The system shall operate in one of the following modes: Occupied, Unoccupied, or Warm Up/Cool Down.

c. Proofs and Safeties:

(1) The supply fan[, return fan,] and all DDC Hardware control loops shall be subject to Proofs and Safeties. Safeties shall be direct-hardwire interlocked to the VFD as shown. DDC Hardware shall monitor all proofs and safeties and failure of any proof or activation of any safety shall result in all control loops being disabled and the AHU fan being commanded off until reset.

(2) Proofs:

(a) Supply fan status (SF-S)

(3) Safeties:
(a) Cooling coil discharge air temperature low limit (freezestat) (CLG-DA-T-LL)

(b) Supply air duct pressure high limit (SA-P-HL)

(c) Supply air smoke (SA-SMK)

(d) Return air smoke (RA-SMK)

(4) DDC Hardware reset of all proofs and safeties shall be via a local binary push-button (RST-BUT) input to the DDC Hardware, via a remote command to the DDC Hardware via SNVT or both (where the Contractor provides both reset functions and the operator can use either one to perform the reset), as shown on the Points Schedule drawing.

d. System Enable and Loop Enable

(1) Occupied mode: The supply fan shall be enabled (SYS-ENA) and commanded to run (SF-SS). All control loops shall be enabled. The Zone Temperature Control loops for VAV boxes serviced by the AHU shall also be enabled.

(2) Unoccupied mode: While the building temperature (BLDG-T) is above setpoint (BLDG-T-LL-SP) all control loops shall be disabled (except fan-powered VAV box Zone Temperature Control loops) and the supply fan shall not run. When BLDG-T drops below BLDG-T-LL-SP (with a 5 degrees F deadband) the supply fan shall be enabled (SYS-ENA) and commanded to run (SF-SS), the Supply Duct Static Pressure Control[, Return Fan Volume Control][, Preheat Control] loops shall be enabled. The Minimum Outside Air Flow Control, Mixed Air Temperature Control, and Cooling Coil Control loops shall be disabled.

[(3) Warm Up/Cool Down: The supply fan shall be enabled (SYS-ENA) and commanded to run (SF-SS). The Minimum Outside Air Flow Control loop shall be disabled and all other control loops shall be enabled. The Zone Temperature Control loops for VAV boxes serviced by the AHU shall also be enabled.]

e. Fan Capacity Control:

(1) Supply Duct Static Pressure Control. When this loop is enabled the DDC Hardware shall modulate the supply fan variable frequency drive unit to maintain the duct static pressure (SA-P) at setpoint (SA-P-SP) as shown, as measured by the duct static pressure tap and sensor as shown. When this loop is disabled, the DDC Hardware capacity modulation output to the VFD shall be zero percent.

f. Minimum Outside Air Flow Control: When this loop is enabled the DDC Hardware shall modulate the minimum outside air damper to maintain the minimum OA volumetric flow (MINOA-F) at setpoint (MINOA-F-SP) as shown. When this loop is disabled, the minimum outside air damper shall be closed.

g. Cooling Coil Control: When this loop is enabled the DDC Hardware shall modulate the cooling coil valve to maintain the supply air temperature (SA-T) setpoint (SA-T-SP) as shown. When this loop is disabled, the cooling coil valve shall be closed.

h. Preheat Coil Control: When this loop is enabled the DDC Hardware shall energize the duct heater in the outside air duct to maintain the preheat coil discharge air temperature (PH-DA-T) at setpoint (PH-DA-T-SP) as shown.

3.3.3 Operation for Terminal Units

3.3.3.1 Zone Temperature Control - Cooling-Only VAV Box

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs, outputs and alarms as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control shall be proportional-integral (PI) control.

a. Occupancy Modes:

(1) Occupied: The VAV box DDC Hardware shall be in the Occupied Mode when the local space occupancy input(s) (ZN-OCC) indicate that the space is occupied or when the input from the System Scheduler (SYS-OCC) is occupied.

(2) Unoccupied: The VAV box DDC Hardware shall be in the Unoccupied Mode when the local space occupancy input(s) (ZN-OCC) indicate that the space is unoccupied and the input from the System Scheduler (SYS-OCC) is unoccupied.

b. Safeties: This system has no safeties.

c. Zone Temperature Control

(1) In the Occupied Mode the zone temperature setpoint (ZN-T-SP) shall be at the configured setpoint or at the occupant-adjustable setpoint via the wall-mounted thermostat, as shown. The DDC Hardware shall modulate the VAV box damper to maintain VAV box supply air flow (VAV-SA-F) at setpoint as measured by a multi-point flow sensing element at the inlet to the VAV box. Sequencing shall be as shown: Upon a rise in zone temperature (ZN-T) above zone setpoint (ZN-T-SP), subject to the zone temperature setpoint deadband as shown, the airflow setpoint shall be adjusted between minimum and maximum flow based on the difference between zone temperature and zone temperature setpoint as shown.

(2) In the Unoccupied Mode the VAV box damper shall be at its minimum position.

3.3.3.2 Zone Temperature Control - VAV Box with Reheat

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs, outputs and alarms as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control shall be proportional-integral (PI) control.

a. Occupancy Modes:

(1) Occupied: The VAV box DDC Hardware shall be in the Occupied Mode when the local space occupancy input(s) (ZN-OCC) indicate that the space is occupied or when the input from the System Scheduler (SYS-OCC) is occupied.

(2) Unoccupied: The VAV box DDC Hardware shall be in the Unoccupied Mode when the local space occupancy input(s) (ZN-OCC) indicate that the space is unoccupied and the input from the System Scheduler (SYS-OCC) is unoccupied.

b. Safeties: VAV boxes with electric resistance heating elements shall require proof of air flow before activating the heating elements.

c. Zone Temperature Control:

(1) In the Occupied Mode the zone temperature setpoint (ZN-T-SP) shall be at the configured setpoint or at the occupant-adjustable setpoint via the wall-mounted thermostat, as shown.

(2) In the Unoccupied Mode the zone temperature setpoint (ZN-T-SP) shall be at the configured setpoint as shown.

(3) The DDC Hardware shall modulate the VAV box damper to maintain VAV box supply air flow (VAV-SA-F) at setpoint as measured by a multi-point flow sensing element at the inlet to the VAV box. Sequencing shall be as shown: Upon a rise in zone temperature above zone temperature setpoint (ZN-T-SP), subject to the zone temperature setpoint deadband as shown, the airflow setpoint shall be adjusted between minimum and maximum flow based on the difference between zone temperature and zone temperature setpoint as shown. Upon a fall in zone temperature below zone temperature setpoint, subject to the deadband as shown, the airflow shall be maintained at a fixed air flow setpoint (with a setting independent of the cooling minimum air flow), and the heating valve shall modulate towards open or the staged electric resistance heating coil(s) shall cycle on in sequence.

3.3.3.3 Unit Heater

Install DDC hardware to perform this Sequence of Operation and to provide SNVT inputs, outputs and alarms as specified and shown on the Points Schedule. Unless otherwise specified, all modulating control shall be proportional-integral (PI) control.

a. Off-Auto Switch

(1) OFF: With the thermostat OFF-AUTO switch in the OFF position, the DDC Hardware shall stop the fan and close the heating control valve.

(2) AUTO: With the thermostat OFF-AUTO switch in the AUTO position, the DDC Hardware shall control the unit in accordance with its Occupancy Mode.

b. Occupancy Modes

(1) Occupied: The unit heater DDC Hardware shall be in the Occupied Mode when the local space occupancy input(s) indicate

that the space is occupied or when the input from the System Scheduler is occupied.

(2) Unoccupied: The unit heater DDC Hardware shall be in the Unoccupied Mode when the local space occupancy input(s) indicate that the space is unoccupied and when the input from the System Scheduler is unoccupied.

c. Safeties: The unit shall run subject to the unit manufacturer's safeties.

d. Space Temperature Control

(1) In the Occupied Mode the DDC Hardware shall modulate the heating control valve and cycle the multi-speed fan to maintain space temperature at the configured setpoint or at the occupant-adjustable setpoint via the wall-mounted thermostat, as shown.

(2) In the Unoccupied Mode the DDC Hardware shall modulate the heating control valve and cycle the multi-speed fan to maintain space temperature at the configured setpoint as shown.

## 3.4 START-UP AND START-UP TEST

Perform the following startup tests for each control system to ensure that the described control system components are installed and functioning in accordance with this specification.

a. General: Adjust, calibrate, measure, program, configure, set the time schedules, set alarms, and otherwise perform all necessary actions to ensure that the systems function as specified and shown in the sequence of operation and other contract documents.

b. Systems Check: An item-by-item check shall be performed for each HVAC system;

(1) Step 1 - System Inspection: With the system shut down, it shall be verified that power and main air are available where required and that all output devices are in their failsafe and normal positions. Each local display panel [and each M&C Client] shall be inspected to verify that all displays indicate shutdown conditions.

(2) Step 2 - Calibration Accuracy Check: A two-point accuracy check of the calibration of each HVAC control system sensing element and transmitter shall be performed by comparing the SNVT output from the DDC Hardware the sensor is connected to the actual value of the variable measured at the sensing element. Digital indicating test instruments shall be used, such as digital thermometers, motor-driven psychrometers, and tachometers. The test instruments shall be at least twice as accurate as the specified sensor accuracy. The calibration of the test instruments shall be traceable to National Institute Of Standards And Technology standards. The first check point shall be with the HVAC system in the shutdown condition, and the second check point shall be with the HVAC system in an operational condition. Calibration checks shall verify that the sensing element-to-DDC system readout accuracies at two points are within the specified

product accuracy tolerances. If not, the device shall be recalibrated or replaced and the calibration check repeated.

(3) Step 3 - Actuator Range Check: With the system running, a signal shall be applied to each actuator through the DDC Hardware controller. Proper operation of the actuators and positioners for all actuated devices shall be verified and the signal levels shall be recorded for the extreme positions of each device. The signal shall be varied from live zero to full range, and it shall be verified that the actuators travel from zero stroke to full stroke within the signal range. Where applicable, it shall be verified that all sequenced actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other.

c. Weather Dependent Test: Weather dependent test procedures that cannot be performed by simulation shall be performed in the appropriate climatic season. When simulation is used, the actual results shall be verified in the appropriate season.

d. Test Report: Upon completion of the Start-Up Test, prepare and submit a Start-Up and Start-Up Testing Report documenting the results of the tests performed and certifying that the system is installed and functioning in accordance with this specification, and is ready for the Performance Verification Test (PVT).

## 3.5 TRAINING

Conduct a training course for 2 operating staff members designated by the Government in the maintenance and operation of the system, including specified hardware and software. The training period, for a total of 12 hours of normal working time, shall be conducted within 30 days after successful completion of the performance verification test. The training course shall be conducted at the project site and the Government reserves the right to videotape the training sessions for later use. Provide audiovisual equipment and 4 sets of all other training materials and supplies. A training day is defined as 8 hours of classroom instruction, including two 15 minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility.

### 3.5.1 Training Documentation

Prepare training documentation consisting of:

a. Course Attendee List: A List of course attendees which shall be developed in coordination with and signed by the Controls/HVAC shop supervisor.

b. Training Manuals: Training manuals shall include an agenda, defined objectives for each lesson, and a detailed description of the subject matter for each lesson. Where the Contractor presents portions of the course material by audiovisuals, copies of those audiovisuals shall be delivered to the Government as a part of the printed training manuals. Training manuals shall be delivered for each trainee with two additional copies delivered for archival at the project site.

### 3.5.2 Training Course Content

For guidance in planning the required instruction, assume that attendees

will have a high school education or equivalent, and are familiar with HVAC systems. The training course shall cover all of the material contained in the Operating and Maintenance Instructions, the layout and location of each controller enclosure, the layout of one of each type of unitary equipment and the locations of each, the location of each control device external to the panels, the location of the compressed air station, preventive maintenance, troubleshooting, diagnostics, calibration, adjustment, commissioning, tuning, repair procedures, use of LNS Plug-ins, and use of the GPPC Programming software. Typical systems and similar systems may be treated as a group, with instruction on the physical layout of one such system. The results of the performance verification test and the Start-Up and Start-Up Testing Report shall be presented as benchmarks of HVAC control system performance by which to measure operation and maintenance effectiveness.

## 3.6 PERFORMANCE VERIFICATION TEST (PVT)

### 3.6.1 PVT Procedures

The performance verification test procedures shall explain, step-by-step, the actions and expected results that will demonstrate that the control system performs in accordance with the sequences of operation, and other contract documents. The PVT shall include inlet and outlet air temperature measurements for all AHU-dependent terminal units. The PVT Procedure shall describe a methodology to measure and trend the network bandwidth usage on the network backbone and compare it to the Bandwidth Usage Calculation submittal. A control system performance verification test equipment list shall be included that lists the equipment to be used during performance verification testing. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

### 3.6.2 PVT Execution

Demonstrate compliance of the control system with the contract documents. Using test plans and procedures approved by the Government, demonstrate all physical and functional requirements of the project. The performance verification test shall show, step-by-step, the actions and results demonstrating that the control systems perform in accordance with the sequences of operation. The performance verification test shall measure and trend the Network Bandwidth Usage and compare it to the Bandwidth Usage Calculation submittal. The performance verification test shall not be started until after receipt of written permission by the Government, based on Government approval of the Start-Up and Start-Up Testing Report and completion of balancing. The tests shall not be conducted during scheduled seasonal off periods of base heating and cooling systems.

### 3.6.3 PVT Report

Prepare a PVT report documenting all tests performed during the PVT and their results. The PVT report shall include all tests in the PVT Procedures and any other testing performed during the PVT. Failures and repairs shall be documented with test results.

## 3.7 APPENDIX A

APPENDIX A

QC CHECKLIST

This checklist is not all-inclusive of the requirements of this specification and should not be interpreted as such.

This checklist is for (check one:)

Pre-Construction QC Checklist Submittal (Items 1-5) |____|

Post-Construction QC Checklist Submittal (Items 1-12) |____|

Close-out QC Checklist Submittal (Items 1-19) |____|

Initial each item in the space provided (|____|) verifying that requirement has been met.

Items verified for Pre-Construction, Post-Construction and Closeout QC Checklists Submittal:

1 Network bandwidth calculations have been performed, and the backbone type (Ethernet or TP/FT-10) has been determined based on these calculations. |____|

2 All DDC Hardware (nodes) are numbered on Control System Schematic Drawings. |____|

3 Signal lines on Control System Schematic are labeled with the signal type. |____|

4 Local Display Panel (LDP) Locations are shown on Control System Schematic drawings. |____|

5 Points Schedule drawings have been sub-divided by device (DDC Hardware), including DDC Hardware node numbers. |____|

Items verified for Post-Construction and Closeout QC Checklist Submittal:

6 All DDC Hardware is installed on a TP/FT-10 local control bus. |____|

7 All Application Specific Controllers (ASCs) are LonMark certified. |____|

8 Communication between DDC Hardware is only via CEA-709.1B using SNVTs. Other protocols and network variables other than SNVTs have not been used. |____|

9 Explicit messaging has not been used. |____|

10 System Scheduler functionality has been installed for all HVAC systems and default schedules have been configured at each System Scheduler. |____|

11 All sequences are performed as specified using DDC Hardware. |____|

12 Training schedule and course attendee list has been developed and coordinated with shops and submitted. |____|

QC CHECKLIST

Items verified for Closeout QC Checklists Submittal:

| | | |
|---|---|---|
| 13 | Final As-built Drawings, including the Points Schedule drawings accurately represent the final installed system. | \|____\| |
| 14 | LonWorks Network Services (LNS) Database is up-to-date and accurately represents the final installed system. | \|____\| |
| 15 | LNS Plug-ins have been submitted for all ASCs. | \|____\| |
| 16 | Programming software has been submitted for all General Purpose Programmable Controllers (GPPCs). | \|____\| |
| 17 | All software has been licensed to the Government | \|____\| |
| 18 | O&M Instructions have been completed and submitted. | \|____\| |
| 19 | Training course has been completed. | \|____\| |

_____

(QC Representative Signature) (Date)

-- End of Section --

SECTION 23 23 00

REFRIGERANT PIPING
**10/07**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

| | |
|---|---|
| AHRI 710 | (2004) Standard for Performance Rating of Liquid-Line Driers |
| AHRI 720 | (2002) Refrigerant Access Valves and Hose Connectors |
| AHRI 750 | (2007) Thermostatic Refrigerant Expansion Valves |
| AHRI 760 | (2007) Solenoid Valves for Use With Volatile Refrigerants |

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

| | |
|---|---|
| ASHRAE 15 & 34 | WARNING: Text in tags exceeds the maximum length of 300 characters |
| ASHRAE 17 | (2008) Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS A5.8/A5.8M | (2004; Errata 2004) Specification for Filler Metals for Brazing and Braze Welding |
| AWS BRH | (2007) Brazing Handbook |
| AWS Z49.1 | (2005) Safety in Welding, Cutting and Allied Processes |

ASME INTERNATIONAL (ASME)

| | |
|---|---|
| ASME B16.22 | (2001; R 2005) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.26 | (2006) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes |
| ASME B31.1 | (2007; Addenda 2008) Power Piping |

| | |
|---|---|
| ASME B31.5 | (2006) Refrigeration Piping and Heat Transfer Components |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 53/A 53M | (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A 653/A 653M | (2008) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM B 280 | (2008) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service |
| ASTM B 32 | (2008) Standard Specification for Solder Metal |
| ASTM B 62 | (2002) Standard Specification for Composition Bronze or Ounce Metal Castings |
| ASTM B 75 | (2002) Standard Specification for Seamless Copper Tube |
| ASTM B 813 | (2000e1) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube |

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

| | |
|---|---|
| MSS SP-58 | (2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture |
| MSS SP-69 | (2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application |

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Refrigerant Piping System

Manufacturer's standard catalog data, at least 1 week prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Include in the data manufacturer's recommended installation instructions and procedures. Provide data for the following components as a minimum:

a. Piping and Fittings

b. Valves

c. Piping Accessories

SD-06 Test Reports

Refrigerant Piping Tests

Six copies of the report in bound 8 1/2 by 11 inch booklets documenting all phases of the tests performed. The report shall include initial test summaries, all repairs/adjustments made, and the final test results.

1.3 QUALITY ASSURANCE

1.3.1 Qualifications

1.3.2 Contract Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation is the Contractor's responsibility. Replace any materials found to be damaged at the Contractor's expense. During installation, cap piping and similar openings to keep out dirt and other foreign matter.

1.5 MAINTENANCE

1.5.1 General

Operation and maintenance data shall comply with the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

a. Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacturing of such products, that are of a similar material, design and workmanship and that have been in satisfactory commercial or industrial use for 2 years prior to bid opening.

b. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through

advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown.

c. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations.

d. Exposed equipment moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Install safety devices so that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

## 2.2 REFRIGERANT PIPING SYSTEM

Refrigerant piping, valves, fittings, and accessories shall be in accordance with ASHRAE 15 & 34 and ASME B31.5, except as specified herein. Refrigerant piping, valves, fittings, and accessories shall be compatible with the fluids used and capable of withstanding the pressures and temperatures of the service. Refrigerant piping, valves, and accessories used for refrigerant service shall be cleaned, dehydrated, and sealed (capped or plugged) prior to shipment from the manufacturer's plant.

## 2.3 PIPE, FITTINGS AND END CONNECTIONS (JOINTS)

### 2.3.1 Copper Tubing

Copper tubing shall conform to ASTM B 280 annealed or hard drawn as required. Copper tubing shall be soft annealed where bending is required and hard drawn where no bending is required. Soft annealed copper tubing shall not be used in sizes larger than 1-3/8 inches. Joints shall be brazed except that joints on lines 7/8 inchand smaller may be flared. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75. Joints and fittings for brazed joint shall be wrought-copper or forged-brass sweat fittings. Cast sweat-type joints and fittings shall not be allowed for brazed joints. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment.

### 2.3.2 Solder

Solder shall conform to ASTM B 32, grade Sb5, tin-antimony alloy for service pressures up to 150 psig. Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B 813.

### 2.3.3 Brazing Filler Metal

Filler metal shall conform to AWS A5.8/A5.8M, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

## 2.4 VALVES

Valves shall be designed, manufactured, and tested specifically for

refrigerant service. Valve bodies shall be of brass, bronze, steel, or ductile iron construction. Valves 1 inch and smaller shall have brazed or socket welded connections. Valves larger than 1 inch shall have [tongue-and-groove flanged] [butt welded] end connections. Threaded end connections shall not be used, except in pilot pressure or gauge lines where maintenance disassembly is required and welded flanges cannot be used. Internal parts shall be removable for inspection or replacement without applying heat or breaking pipe connections. Valve stems exposed to the atmosphere shall be stainless steel or corrosion resistant metal plated carbon steel. Direction of flow shall be legibly and permanently indicated on the valve body. Control valve inlets shall be fitted with integral or adapted strainer or filter where recommended or required by the manufacturer. Purge, charge and receiver valves shall be of manufacturer's standard configuration.

### 2.4.1 Refrigerant Stop Valves

Valve shall be the globe or full-port ball type with a back-seating stem especially packed for refrigerant service. Valve packing shall be replaceable under line pressure. Valve shall be provided with a [handwheel] [or] [wrench] operator and a seal cap. Valve shall be the straight or angle pattern design as indicated.

### 2.4.2 Liquid Solenoid Valves

Valves shall comply with AHRI 760 and be suitable for continuous duty with applied voltages 15 percent under and 5 percent over nominal rated voltage at maximum and minimum encountered pressure and temperature service conditions. Valves shall be direct-acting or pilot-operating type, packless, except that packed stem, seal capped, manual lifting provisions shall be furnished. Solenoid coils shall be moisture-proof, UL approved, totally encapsulated or encapsulated and metal jacketed as required. Valves shall have safe working pressure of 400 psi and a maximum operating pressure differential of at least 200 psi at 85 percent rated voltage. Valves shall have an operating pressure differential suitable for the refrigerant used.

### 2.4.3 Expansion Valves

Valve shall conform to AHRI 750 and ASHRAE 17. Valve shall be the diaphragm and spring-loaded type with internal or external equalizers, and bulb and capillary tubing. Valve shall be provided with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where flowing refrigerant pressure drop between outlet of the valve and inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the pressure difference corresponding to 2 degrees F of saturated suction temperature at evaporator conditions. Bulb charge shall be determined by the manufacturer for the application and such that liquid will remain in the bulb at all operating conditions. Gas limited liquid charged valves and other valve devices for limiting evaporator pressure shall not be used without a distributor or discharge tube or effective means to prevent loss of control when bulb becomes warmer than valve body. Pilot-operated valves shall have a characterized plug to provide required modulating control. A de-energized solenoid valve may be used in the pilot line to close the main valve in lieu of a solenoid valve in the main liquid line. An isolatable pressure gauge shall be provided in the pilot line, at the main valve. Automatic pressure reducing or constant pressure regulating expansion valves may be used only where indicted or for constant evaporator loads.

### 2.4.4 Safety Relief Valves

Valve shall be the two-way type, unless indicated otherwise. Valve shall bear the ASME code symbol. Valve capacity shall be certified by the National Board of Boiler and Pressure Vessel Inspectors. Valve shall be of an automatically reseating design after activation.

### 2.4.5 Evaporator Pressure Regulators, Direct-Acting

Valve shall include a diaphragm/spring assembly, external pressure adjustment with seal cap, and pressure gauge port. Valve shall maintain a constant inlet pressure by balancing inlet pressure on diaphragm against an adjustable spring load. Pressure drop at system design load shall not exceed the pressure difference corresponding to a 2 degrees F change in saturated refrigerant temperature at evaporator operating suction temperature. Spring shall be selected for indicated maximum allowable suction pressure range.

### 2.4.6 Refrigerant Access Valves

Refrigerant access valves and hose connections shall be in accordance with AHRI 720.

## 2.5 PIPING ACCESSORIES

### 2.5.1 Filter Driers

Driers shall conform to AHRI 710. Sizes 5/8 inch and larger shall be the full flow, replaceable core type. Sizes 1/2 inch and smaller shall be the sealed type. Cores shall be of suitable desiccant that will not plug, cake, dust, channel, or break down, and shall remove water, acid, and foreign material from the refrigerant. Filter driers shall be constructed so that none of the desiccant will pass into the refrigerant lines. Minimum bursting pressure shall be 1,500 psi.

### 2.5.2 Sight Glass and Liquid Level Indicator

#### 2.5.2.1 Assembly and Components

Assembly shall be pressure- and temperature-rated and constructed of materials suitable for the service. Glass shall be borosilicate type. Ferrous components subject to condensation shall be electro-galvanized.

#### 2.5.2.2 Gauge Glass

Gauge glass shall include top and bottom isolation valves fitted with automatic checks, and packing followers; red-line or green-line gauge glass; elastomer or polymer packing to suit the service; and gauge glass guard.

#### 2.5.2.3 Moisture Indicator

Indicator shall be a self-reversible action, moisture reactive, color changing media. Indicator shall be furnished with full-color-printing tag containing color, moisture and temperature criteria. Unless otherwise indicated, the moisture indicator shall be an integral part of each corresponding sight glass.

### 2.5.3 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, guides, and supports shall conform to MSS SP-58 and MSS SP-69.

### 2.5.4 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

## PART 3 EXECUTION

### 3.1 EXAMINATION

After becoming familiar with all details of the work, perform a verification of dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

### 3.2 INSTALLATION

Pipe and fitting installation shall conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the jobsite, and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

### 3.2.1 Directional Changes

Changes in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide weep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees will not be permitted. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted.

### 3.2.2 Functional Requirements

Piping shall be installed 1/2 inch/10 feet of pipe in the direction of flow to ensure adequate oil drainage. Open ends of refrigerant lines or equipment shall be properly capped or plugged during installation to keep moisture, dirt, or other foreign material out of the system. Piping shall remain capped until installation. Equipment piping shall be in accordance with the equipment manufacturer's recommendations and the contract drawings. Equipment and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.

### 3.2.3 Fittings and End Connections

#### 3.2.3.1 Brazed Connections

Brazing shall be performed in accordance with AWS BRH, except as modified herein. During brazing, the pipe and fittings shall be filled with a

pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Brazing flux shall not be used. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Joints in steel tubing shall be painted with the same material as the baked-on coating within 8 hours after joints are made. Tubing shall be protected against oxidation during brazing by continuous purging of the inside of the piping using nitrogen. Piping shall be supported prior to brazing and not be sprung or forced.

3.2.3.2 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

3.2.4 Valves

3.2.4.1 General

Refrigerant stop valves shall be installed on each side of each piece of equipment such as compressors condensers, evaporators, receivers, and other similar items in multiple-unit installation, to provide partial system isolation as required for maintenance or repair. Stop valves shall be installed with stems horizontal unless otherwise indicated. Ball valves shall be installed with stems positioned to facilitate operation and maintenance. Isolating valves for pressure gauges and switches shall be external to thermal insulation. Safety switches shall not be fitted with isolation valves. Filter dryers having access ports may be considered a point of isolation. Purge valves shall be provided at all points of systems where accumulated noncondensible gases would prevent proper system operation. Valves shall be furnished to match line size, unless otherwise indicated or approved.

3.2.4.2 Expansion Valves

Expansion valves shall be installed with the thermostatic expansion valve bulb located on top of the suction line when the suction line is less than 2-1/8 inches in diameter and at the 4 o'clock or 8 o'clock position on lines larger than 2-1/8 inches. The bulb shall be securely fastened with two clamps. The bulb shall be insulated. The bulb shall installed in a horizontal portion of the suction line, if possible, with the pigtail on the bottom. If the bulb must be installed in a vertical line, the bulb tubing shall be facing up.

3.2.4.3 Valve Identification

Each system valve, including those which are part of a factory assembly, shall be tagged. Tags shall be in alphanumeric sequence, progressing in direction of fluid flow. Tags shall be embossed, engraved, or stamped plastic or nonferrous metal of various shapes, sized approximately 1-3/8 inch diameter, or equivalent dimension, substantially attached to a component or immediately adjacent thereto. Tags shall be attached with nonferrous, heavy duty, bead or link chain, 14 gauge annealed wire, nylon cable bands or as approved. Tag numbers shall be referenced in Operation and Maintenance Manuals and system diagrams.

3.2.5 Filter Dryer

A liquid line filter dryer shall be provided on each refrigerant circuit located such that all liquid refrigerant passes through a filter dryer. Dryers shall be sized in accordance with the manufacturer's recommendations for the system in which it is installed. Dryers shall be installed such that it can be isolated from the system, the isolated portion of the system evacuated, and the filter dryer replaced. Dryers shall be installed in the horizontal position except replaceable core filter dryers may be installed in the vertical position with the access flange on the bottom.

3.2.6 Sight Glass

A moisture indicating sight glass shall be installed in all refrigerant circuits down stream of all filter dryers and where indicated. Site glasses shall be full line size.

3.2.7 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Pipe hanger types 5, 12, and 26 shall not be used. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers.

3.2.7.1 Hangers

Type 3 shall not be used on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

3.2.7.2 Inserts

Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they otherwise meet the requirements for Type 18 inserts.

3.2.7.3 C-Clamps

Type 19 and 23 C-clamps shall be torqued in accordance with MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

3.2.7.4 Angle Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

3.2.7.5 Saddles and Shields

Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle, connected to the pipe, shall be used on all pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 40 shields shall be used on all piping less than 4 inches and all piping 4 inches and larger carrying medium less than 60 degrees F. A high density insulation insert of cellular glass shall be used under the Type 40 shield for piping 2 inches and larger.

3.2.7.6 Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. [Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 50 pounds shall have the excess hanger loads suspended from panel points.]

3.2.7.7 Vertical Pipe Supports

Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet not more than 8 feet from end of risers, and at vent terminations.

3.2.7.8 Pipe Guides

Type 35 guides using, steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

3.2.7.9 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Masonry anchors for overhead applications shall be constructed of ferrous materials only. Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material used for support shall be as specified under Section 05 12 00 STRUCTURAL STEEL.

3.2.8 Building Surface Penetrations

Sleeves shall not be installed in structural members except where indicated or approved. Sleeves in nonload bearing surfaces shall be galvanized sheet metal, conforming to ASTM A 653/A 653M, Coating Class G-90, 20 gauge. Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to ASTM A 53/A 53M, [Schedule 30] [Schedule 20] [Standard weight]. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 1/2 inch depth. Sleeves shall not be installed in structural members.

3.2.8.1 General Service Areas

Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall be of such size as to provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed in accordance with Section 07 92 00 JOINT SEALANTS.

3.2.8.2 Waterproof Penetrations

Pipes passing through roof or floor waterproofing membrane shall be installed through a 17 ounce copper sleeve, or a 0.032 inch thick aluminum sleeve, each within an integral skirt or flange. Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 8 inches from the pipe and be set over the roof or floor membrane in a troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 2 inches above the roof or floor penetration. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Penetrations shall be sealed by either one of the following methods.

a. Waterproofing Clamping Flange: Pipes up to and including 10 inches in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.

b. Modular Mechanical Type Sealing Assembly: In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal rubber sealing elements to expand and provide a watertight seal between the pipe/conduit seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals shall provide sleeves of the proper diameters.

3.2.8.3 Fire-Rated Penetrations

Penetration of fire-rated walls, partitions, and floors shall be sealed as specified in Section 07 84 00 FIRESTOPPING.

3.2.8.4 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

3.2.9 Access Panels

Access panels shall be provided for all concealed valves, vents, controls, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

### 3.2.10 Field Applied Insulation

Field installed insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

## 3.3 CLEANING AND ADJUSTING

Clean uncontaminated system(s) by evacuation and purging procedures currently recommended by refrigerant and refrigerant equipment manufacturers, and as specified herein, to remove small amounts of air and moisture. Systems containing moderate amounts of air, moisture, contaminated refrigerant, or any foreign matter shall be considered contaminated systems. Restoring contaminated systems to clean condition including disassembly, component replacement, evacuation, flushing, purging, and re-charging, shall be performed using currently approved refrigerant and refrigeration manufacturer's procedures. Restoring contaminated systems shall be at no additional cost to the Government as determined by the Contracting Officer. Water shall not be used in any procedure or test.

## 3.4 REFRIGERANT PIPING TESTS

After all components of the refrigerant system have been installed and connected, subject the entire refrigeration system to pneumatic, evacuation, and startup tests as described herein. Conduct tests in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Provide all material, equipment, instruments, and personnel required for the test. Provide the services of a qualified technician, as required, to perform all tests and procedures indicated herein. Field tests shall be coordinated with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

### 3.4.1 Preliminary Procedures

Prior to pneumatic testing, equipment which has been factory tested and refrigerant charged as well as equipment which could be damaged or cause personnel injury by imposed test pressure, positive or negative, shall be isolated from the test pressure or removed from the system. Safety relief valves and rupture discs, where not part of factory sealed systems, shall be removed and openings capped or plugged.

### 3.4.2 Pneumatic Test

Pressure control and excess pressure protection shall be provided at the source of test pressure. Valves shall be wide open, except those leading to the atmosphere. Test gas shall be dry nitrogen, with minus 70 degree F dewpoint and less than 5 ppm oil. Test pressure shall be applied in two stages before any refrigerant pipe is insulated or covered. First stage test shall be at 10 psi with every joint being tested with a thick soap or color indicating solution. Second stage tests shall raise the system to the minimum refrigerant leakage test pressure specified in ASHRAE 15 & 34 with a maximum test pressure 25 percent greater. Pressure above 100 psig shall be raised in 10 percent increments with a pressure acclimatizing period between increments. The initial test pressure shall be recorded along with the ambient temperature to which the system is exposed. Final test pressures of the second stage shall be maintained on the system for a minimum of 24 hours. At the end of the 24 hour period, the system pressure

will be recorded along with the ambient temperature to which the system is exposed. A correction factor of 0.3 psi will be allowed for each degree F change between test space initial and final ambient temperature, plus for increase and minus for a decrease. If the corrected system pressure is not exactly equal to the initial system test pressure, then the system shall be investigated for leaking joints. To repair leaks, the joint shall be taken apart, thoroughly cleaned, and reconstructed as a new joint. Joints repaired by caulking, remelting, or back-welding/brazing shall not be acceptable. Following repair, the entire system shall be retested using the pneumatic tests described above. The entire system shall be reassembled once the pneumatic tests are satisfactorily completed.

3.4.3 Evacuation Test

Following satisfactory completion of the pneumatic tests, the pressure shall be relieved and the entire system shall be evacuated to an absolute pressure of 300 micrometers. During evacuation of the system, the ambient temperature shall be higher than 35 degrees F. No more than one system shall be evacuated at one time by one vacuum pump. Once the desired vacuum has been reached, the vacuum line shall be closed and the system shall stand for 1 hour. If the pressure rises over 500 micrometers after the 1 hour period, then the system shall be evacuated again down to 300 micrometers and let set for another 1 hour period. The system shall not be charged until a vacuum of at least 500 micrometers is maintained for a period of 1 hour without the assistance of a vacuum line. If during the testing the pressure continues to rise, check the system for leaks, repair as required, and repeat the evacuation procedure. During evacuation, pressures shall be recorded by a thermocouple-type, electronic-type, or a calibrated-micrometer type gauge.

3.4.4 System Charging and Startup Test

Following satisfactory completion of the evacuation tests, the system shall be charged with the required amount of refrigerant by raising pressure to normal operating pressure and in accordance with manufacturer's procedures. Following charging, the system shall operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. The entire system shall be tested for leaks. Fluorocarbon systems shall be tested with halide torch or electronic leak detectors.

3.4.5 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances shall the refrigerant be discharged into the atmosphere.

3.4.6 Contractor's Responsibility

At all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time shall more than 3 ounces of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in

accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

-- End of Section --

SECTION 23 31 13

METAL DUCTS
**02/09**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

| | |
|---|---|
| AISC 325 | (2005) Manual of Steel Construction |
| AISC 360 | (2005) Specification for Structural Steel Buildings, with Commentary |

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

| | |
|---|---|
| ASHRAE EQUIP IP HDBK | (2004) Handbook, HVAC Systems and Equipment (IP Edition) |
| ASHRAE FUN IP | (2005) Fundamentals Handbook, I-P Edition |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS A5.8/A5.8M | (2004; Errata 2004) Specification for Filler Metals for Brazing and Braze Welding |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 123/A 123M | (2008) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A 36/A 36M | (2008) Standard Specification for Carbon Structural Steel |
| ASTM A 653/A 653M | (2008) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A 924/A 924M | (2008a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 90A | (2008) Standard for the Installation of Air Conditioning and Ventilating Systems |

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

| | |
|---|---|
| SMACNA 1966 | (2005) HVAC Duct Construction Standards Metal and Flexible |
| SMACNA 1987 | (2006) HVAC Duct Systems Inspection Guide |

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

| | |
|---|---|
| SAE AMS 2480 | (2001; Rev G; R 2006) Phosphate Treatment, Paint, Base |

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

| | |
|---|---|
| SSPC-01 | (1993, 3rd Ed) Good Painting Practice Steel Structures Painting Manual, Volume 1 |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 181 | (2005; Rev thru Oct 2008) Standard for Factory-Made Air Ducts and Air Connectors |
| UL 555 | (2006) Standard for Fire Dampers |

## 1.2 DESIGN REQUIREMENTS

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS apply to work specified in this section.

## 1.3 SCOPE OF WORK

Encompass low-pressure systems ductwork and plenums where maximum air velocity is 2,000 feet per minute(fpm) and maximum static pressure is 2 inches water gage (wg), positive or negative.

Encompass high velocity systems ductwork where:

Minimum air velocity exceeds 2,000 feet per minute (fpm) or static pressure exceeds 2 inches water gage (wg).

Medium static pressure ranges from over 2 inches wg through 3 inches wg, positive or negative, or over 3 inches wg through 6 inches wg positive.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit the following in accordance with paragraph entitled, "Drawings," of this section.

Record Drawings

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Galvanized Steel Ductwork Materials
Round Sheet Metal Duct Fittings
Turning Vanes
Flexible Connectors
Flexible Duct Materials
Power Operated Dampers
Fire Dampers and Wall Collars
Gravity Backdraft and Relief Dampers
Manual Volume Dampers

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with paragraph entitled, "Operation and Maintenance," of this section.

Power Operated Dampers
Fire Dampers and Wall Collars

1.5 GENERAL REQUIREMENTS

Include the manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information within Material, Equipment, and Fixture Lists.

1.6 DRAWINGS

Provide Record Drawings with current factual information including deviations from, and amendments to, the drawings and concealed or visible changes in the work, for medium/high pressure ductwork systems.Label drawings "As-Built".

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Galvanized Steel Ductwork Materials

Galvanized steel ductwork sheet metal shall be carbon steel, of lock-forming quality, hot-dip galvanized, with regular spangle-type zinc coating, conforming to ASTM A 924/A 924M and ASTM A 653/A 653M, Designation G90. Treat duct surfaces to be painted by phosphatizing.

Conform to ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966 for sheet metal gages and reinforcement thickness.

Low pressure ductwork minimum standards are as follows:

MINIMUM SHEET METAL GAGE

| DUCT WIDTH INCHES | GAGE |
|---|---|
| 0 - 12 | 26 |
| 13 - 30 | 24 |
| 31 - 60 | 22 |

2.1.2 Brazing Materials

Brazing materials shall be silicon bronze conforming to AWS A5.8/A5.8M.

2.1.3 Mill-Rolled Reinforcing And Supporting Materials

Conform to ASTM A 36/A 36Mfor mill-rolled structural steel and, wherever in contact with sheet metal ducting galvanize to commercial weight of zinc or coated with materials conforming to ASTM A 123/A 123M [SSPC-01].

Equivalent strength, proprietary design, rolled-steel structural support systems may be submitted for approval in lieu of mill-rolled structural steel.

2.2 COMPONENTS

2.2.1 Round Sheet Metal Duct Fittings

Shop fabricate fittings.

Manufacture as separate fittings, not as tap collars welded or brazed into duct sections.

Submit for approval offset configurations.

Miter elbows shall be two-piece type for angles less than 31 degrees, three-piece type for angles 31 through 60 degrees, and five-piece type for angles 61 through 90 degrees. Centerline radius of elbows shall be 1-1/2 times fitting cross section diameter.

Crosses, increasers, reducers, reducing tees, and 90-degree tees shall be conical type.

Cutouts in fitting body shall be equal to branch tap dimension or, where smaller, excess material shall be flared and rolled into smooth radius nozzle configuration.

2.2.2 Fittings

Make divided flow fittings as separate fittings, not tap collars into duct sections, with the following construction requirements:

Sound, airtight, continuous welds at intersection of fitting body and tap

Tap liner securely welded to inner liner, with weld spacing not to exceed 3 inches

Pack insulation around the branch tap area for complete cavity filling.

Carefully fit branch connection to cutout openings in inner liner without spaces for air erosion of insulation and without sharp projections that cause noise and airflow disturbance.

Continuously braze seams in the pressure shell of fittings. Protect galvanized areas that have been damaged by welding with manufacturer's

standard corrosion-resistant coating.

Elbows shall be two-piece type for angles through 35 degrees, three-piece type for angles 36 through 71 degrees, and five-piece type for angles 72 through 90 degrees.

2.2.3 Turning Vanes

Turning vanes shall be double-wall type, commercially manufactured for high-velocity system service. 90-degree radius elbows in lieu of square elbows with turning vanes is permissible.

2.2.4 Dampers

Low pressure drop, high-velocity manual volume dampers, and high-velocity fire dampers shall be constructed in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

2.2.5 Flexible Connectors For Sheet Metal

Connectors shall be UL listed, 30-ounce per square foot, waterproof, fire-retardant, airtight, woven fibrous-glass cloth, double coated with chloroprene. Clear width, not including clamping section, shall be 6 to 8 inches.

2.2.6 Duct Hangers

Duct hangers in contact with galvanized duct surfaces shall be galvanized steel painted with inorganic zinc.

2.2.7 Mill-Rolled Reinforcing And Supporting Materials

Mill-rolled structural steel shall conform to ASTM A 36/A 36M and, whenever in contact with sheet metal ducting, shall be galvanized in accordance with ASTM A 123/A 123M.

Equivalent strength, proprietary-design, rolled-steel structural support systems may be submitted for approval in lieu of mill-rolled structural steel.

2.2.8 Flexible Duct Materials

Flexible duct connectors shall be in accordance with UL 181, Class 1 material and shall comply with NFPA 90A.

Metal duct shall be bendable through 180 degrees without damage, with an inside bend radius not greater than one-half the diameter of duct. Metal shall be aluminum or carbon steel zinc-coated ASTM A 123/A 123M.

Wire-reinforced cloth duct shall consist of a vinyl-impregnated and coated fibrous-glass cloth bonded to and supported by a corrosion-protected spring steel helix. Fabric may be a laminate of metallic film and fibrous glass. Working pressure rating of ducting shall be not less than three times maximum system pressure, and temperature range shall be minus 20 to plus 175 degrees F.]

Wire-reinforced fibrous-glass duct shall consist of a minimum 1 pound/cubic foot density fibrous glass bonded to and supported by corrosion-protected spring helix. Vapor barrier shall be a 4 mil minimum, pigmented

polyvinylchloride film. Duct shall be bendable without damage through 180 degrees with an inside bend radius not greater than two duct diameters. Minimum wall thickness shall be 1 inch. Thermal conductivity shall be not greater than 0.23 Btu per hour per square foot per degrees F at 75 degrees F mean. Permeance shall be not greater than 0.10 perm. Working pressure range shall be from minus 1/2 inch wg to plus 1-1/2 inches wg. Working temperature shall range from minus 20 to plus 250 degrees F. Minimum sustained velocity without delamination shall be 2,400 fpm. Materials shall conform to NFPA 90A.

### 2.2.9 Manual Volume Dampers

Conform to SMACNA 1966 for volume damper construction.

Equip dampers with an indicating quadrant regulator with a locking feature externally located and easily accessible for adjustment and standoff brackets to allow mounting outside external insulation. Where damper rod lengths exceed 30 inches, provide a regulator at each end of damper shaft.

All damper shafts shall have two-end bearings.

Splitter damper shall be 22-gage sheet metal minimum. Hinges shall be 1/16 inch thick door type.

Damper shaft shall be full length and shall extend beyond damper blade. A 3/8 inch square shaft shall be used for damper lengths up to 20 inches and a 1/2 inch square shaft shall be used for damper lengths 20 inches and larger. Where necessary to prevent damper vibration or slippage, adjustable support rods with locking provisions external to duct shall be provided at damper blade end.

Dampers in ducts having a width perpendicular to the axis of the damper that is greater than 12 inches shall be multiblade type having a substantial frame with blades fabricated of 16-gage metal. Blades shall not exceed 10 inches in width and 48 inches in length and shall be pinned or welded to 1/2 inch diameter shafts. Dampers greater than 48 inches in width shall be made in two or more sections with intermediate mullions, each section being mechanically interlocked with the adjoining section or sections. Blades shall have graphite-impregnated nylon bearings and shall be connected so that adjoining blades rotate in opposite directions.

### 2.2.10 Gravity Backdraft And Relief Dampers

Frame shall be constructed of not less than 1-1/2- by 4 inch reinforced 16-gage galvanized carbon steel. Frames and mullions shall be solidly secured in place and sealed with elastomer calking against air bypass.

Maximum blade width shall be 9 inches, and maximum blade length shall be 36 inches. Blade material shall be 16-gage galvanized steel or 14-gage [6063] [5052] alloy aluminum. Blades shall be provided with mechanically retained seals and 90-degree limit stops.

Dampers used for relief service shall have blades linked together to open not less than 30 degrees on 0.05 inch wg differential pressure.

Shaft bearings shall be graphite-impregnated nylon.

Counterbalanced dampers shall be equipped with fixed or adjustable counterbalancing weights.

Gravity backdraft dampers in sizes 18 by 18 inches or smaller, when furnished integral with air moving equipment, may be equipment manufacturer's standard construction.

2.2.11 Power-Operated Dampers

Dampers shall conform to applicable requirements specified under Section 23 09 33.00 40 ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC.

2.2.12 Fire Dampers And Wall Collars

Fire damper locations shall be in accordance with NFPA 90A.

Fire dampers in ductwork shall be provided at firewall barriers.

Fire dampers shall be constructed and labeled in accordance with UL 555 to provide damper and mounting fire-resistance that equals or exceeds fire-resistance of the construction in which installed. For link loads in excess of 20 pound, UL-approved quartzoid links shall be provided.

Wall collars shall be constructed in accordance with UL 555.

PART 3 EXECUTION

3.1 PREPARATION

Provide sheet metal construction in accordance with the recommendations for best practices in ASHRAE EQUIP IP HDBK, Chapter 16, SMACNA 1966, NFPA 90A, and ASHRAE FUN IP, Chapter 32.

Where construction methods for certain items are not described in the referenced standards or herein, perform the work in accordance with recommendations for best practice defined in ASHRAE EQUIP IP HDBK.

Clean free of oil, grease, and deleterious substances sheet metal surfaces to be painted and surfaces to which adhesives are to be applied.

Duct strength shall be adequate to prevent failure under service pressure or vacuum created by fast closure of duct devices. Provide leaktight, automatic relief devices.

Supplementary steel shall be designed and fabricated in accordance with AISC 360and AISC 325.

3.2 INSTALLATION

Fabricate airtight and include reinforcements, bracing, supports, framing, gasketing, sealing, and fastening to provide rigid construction and freedom from vibration, airflow-induced motion and noise, and excessive deflection at specified maximum system air pressure and velocity.

Enclose dampers located behind architectural intake or exhaust louvers by a rigid sheet metal collar and sealed to building construction with elastomers for complete air tightness.

Provide outside air-intake ducts and plenums made from sheet metal with soldered watertight joints.

Provide offsets and transformations as required to avoid interference with the building construction, piping, or equipment.

Wherever ducts pass through firewalls or through walls or floors dividing conditioned spaces from unconditioned spaces, provide a flanged segment in that surface during surface construction.

Clean free of oil, grease, and deleterious substances sheet metal surfaces to be painted or surfaces to which adhesives will be applied.

Where interiors of ducting may be viewed through air diffusion devices, construct the viewed interior with sheet metal and paint flat black.

Make plenum anchorage provisions, sheet metal joints, and other areas airtight and watertight by calking mating galvanized steel and concrete surfaces with a two-component elastomer.

## 3.3 APPLICATION

### 3.3.1 Low Pressure Sheet Metal Ducts

Standard seam joints shall be sealed with an elastomer compound to comply with SMACNA 1966 Seal Class A, B or C as applicable.

Crossbreaking shall be limited to 4 feet and shall be provided on all ducts 12 inches wide and wider. Bead reinforcement shall be provided in lieu of crossbreaking where panel popping may occur. Where rigid insulation will be applied, crossbreaking is not required.

#### 3.3.1.1 Longitudinal Duct Seams

Corner seams shall be Pittsburg lock.

#### 3.3.1.2 Joints and Gaskets

Companion angle flanges shall be bolted together with 1/4 inch diameter bolts and nuts spaced 6 inches on center. Flanged joints shall be gasketed with chloroprene full-face gaskets 1/8 inch thick, with Shore A 40 durometer hardness. Gaskets shall be one piece and vulcanized or dovetailed at joints.

#### 3.3.1.3 Flexible Duct Joints

Joints between flexible duct without sheet metal collars and round metal ductwork connections shall be made by trimming the ends, coating the inside of the flexible duct for a distance equal to depth of insertion with elastomer calk, and by securing with sheet metal screws or binding with a strap clamp.

#### 3.3.1.4 Square Elbows

Provide single-vane duct turns in accordance with SMACNA 1966, and may be used on ducts 12 inches wide and narrower.

Provide double-vane duct turns in accordance with SMACNA 1966.

#### 3.3.1.5 Radius Elbows

Conform to SMACNA 1966 for radius elbows. Provide an inside radius equal

to the width of the duct. Where installation conditions preclude use of standard elbows, the inside radius may be reduced to a minimum of 0.25 times duct width and install turning vanes in accordance with the following schedule.

| WIDTH OF ELBOWS INCHES | RADIUS OF TURNING VANES IN PERCENT OF DUCT WIDTH VANE NO. 1 | VANE NO. 2 | VANE NO. 3 |
|---|---|---|---|
| Up to 16 | 56 | -- | -- |
| 17 to 48 | 43 | 73 | -- |
| 49 and over | 37 | 55 | 83 |

Where two elbows are placed together in the same plane in ducts 30 inches wide and larger, the guide vanes shall be continuous through both elbows rather than spaced in accordance with above schedule.

3.3.1.6 Outlets, Inlets, And Duct Branches

Install branches, inlets, and outlets so that air turbulence will be reduced to a minimum and air volume properly apportioned. Install adjustable splitter dampers at all supply junctions to permit adjustment of the amount of air entering the branch. Wherever an air-diffusion device is shown as being installed on the side, top, or bottom of a duct, and whenever a branch takeoff is not of the splitter type, a commercially manufactured 45 degree side-take-off (STO) fitting with manua; provide volume damper to allow adjustment of the air quantity and to provide an even flow of air across the device or duct it services.

Where a duct branch is to handle 25 percent or less of the air handled by the duct main, the branch connection shall have a 45 degree side take-off entry in accordance with SMACNA 1966.

3.3.1.7 Duct Transitions

Where the shape of a duct changes, the angle of the side of the transition piece shall not exceed 15 degrees from the straight run of duct connected thereto.

Where equipment is installed in ductwork, the angle of the side of the transition piece from the straight run of duct connected thereto shall not exceed 15 degrees on the upstream side of the equipment and 22-1/2 degrees on the downstream side of the equipment.

3.3.1.8 Branch Connections

Construct radius tap-ins in accordance with SMACNA 1966.

3.3.1.9 Access Openings

Install access doors and panels in ductwork adjacent to fire dampers, at controls or at any item requiring periodic inspection, adjustment, maintenance, or cleaning, and where indicated.

Minimum size of access opening shall be 12 by 12 inches , unless precluded by duct dimensions or otherwise indicated.

Construct access door in accordance with SMACNA 1966, except that sliding doors may be used only for special conditions upon prior approval. Insulated doors shall be double-panel type.

Access doors that leak shall be made airtight by adding or replacing hinges and latches or by construction of new doors adequately reinforced, hinged, and latched.

3.3.1.10 Manual Volume Dampers

Balancing dampers of the splitter, butterfly, or multilouver type, shall be provided to balance each respective main and branch duct.

Dampers regulators located above rigid gypsum board or concrete walls or ceilings shall be accesible through a ceiling or wall access panel. Where ceiling is of removable construction, regulators shall be above ceiling, and location shall be marked on ceiling in a manner acceptable to the Contracting Officer.

3.3.1.11 Flexible Connectors For Sheet Metal

Air handling equipment, ducts crossing building expansion joints, and fan inlets and outlets shall be connected to upstream and downstream components by treated woven-cloth connectors.

Connectors shall be installed only after system fans are operative, and vibration isolation mountings have been adjusted. When system fans are operating, connectors shall be free of wrinkle caused by misalignment or fan reaction. Width of surface shall be curvilinear.

3.3.2 Rectangular Sheet Metal Ducts

3.3.2.1 Medium-Pressure Gages, Joints, And Reinforcement

Minimum sheet metal gages, joints, and reinforcements between joints shall be in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

Sheet metal minimum thickness, transverse reinforcement between joints, and joints of ducts shall be in accordance with the following:

| LONGEST SIDE INCHES | SHEET METAL GAGE ALL SIDES | COMPANION ANGLE INCHES | REINFORCEMENT ANGLES INCHES, 24 INCHES ON CENTER MAXIMUM (BACK TO BACK) |
|---|---|---|---|
| 97 to 108 | 16 | 2 by 2 by 1/8, two tie rods along angle | Two 2 by 2 by 1/8, two tie rods along angle |
| 109 to 132 | 16 | 2 by 2 by 3/16, two tie rods along angle | Two 2 by 2 by 3/16, two tie rods along angle |
| 133 and longer | 14 | 2 by 2 by 3/16, with tie rods | Two 2 by 2 by 3/16, with tie rods every |

| LONGEST SIDE INCHES | SHEET METAL GAGE ALL SIDES | COMPANION ANGLE INCHES | REINFORCEMENT ANGLES INCHES, 24 INCHES ON CENTER MAXIMUM (BACK TO BACK) |
|---|---|---|---|
| | | every 48 inches | 48 inches |

3.3.2.2 Medium- And High-Pressure Branches, Inlets, Outlets

Install branches, inlets, and outlets to minimize air turbulence and to ensure proper airflow.

Install dampers so that the amount of air entering duct mains can be adjusted.

Provide commercially manufactured air extractors to allow adjustment of the air quantity and to provide an even flow of air across the device or duct served.

Where a duct branch is to handle over 25 percent of the air handled by the duct main, a complete 90-degree increasing elbow shall be used, with an inside radius of 0.75 times duct branch width. Size of the trailing end of the increasing elbow within the main duct shall be in the same ratio to the main duct size as the ratio of the relative air quantities handled.

Where a duct branch is to handle 25 percent or less of the air handled by the duct main, the branch connection shall have an inside radius of 0.75 times branch duct width, a minimum arc length of 45 degrees, and an outside radius of 1.75 times duct branch width. Arc shall be tangent to duct main.

3.3.2.3 High-Pressure Gages, Joints, And Reinforcement

Sheet metal minimum thickness, joints, and reinforcement between joints shall be in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

The following types of ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966 transverse joints shall be used:

Welded flange joint [with] [without] angle

Companion angle flanged joint

The following types of longitudinal seams shall be used:

Approved lock seams, back brazed, or continuously brazed seams for ducts with largest dimension up to 72 inches

Continuously welded or brazed seams for ducts with largest dimension greater than 72 inches

Sheet metal minimum thickness, transverse reinforcement between joints, and companion angle joints of ducts with longest side greater than 96 inches shall be in accordance with the following:

| LONGEST SIDE INCHES | SHEET METAL GAGE ALL SIDES | COMPANION ANGLE INCHES | REINFORCEMENT ANGLES INCHES, 24 INCHES ON CENTER MAXIMUM (BACK TO BACK) |
|---|---|---|---|
| 97 to 108 | 16 | 2 by 2 by 1/8, two tie rods along angle | *Two 2 by 2 by 1/8, two tie rods along angle |
| 109 to 132 | 16 | 2 by 2 by 3/16, two tie rods along angle | *Two 2 by 2 by 3/16, two tie rods along angle |
| 133 and longer | 14 | 2-1/2 by 2-1/2 by 3/16, with tie rods every 24 inches | *Two 2-1/2 by 2-1/2 by 3/16, with tie rods every 24 inches |

3.3.3 Round Sheet Metal Ducts

3.3.3.1 Duct Gages, Joints, And Reinforcement

Sheet metal minimum thickness, joints, and reinforcement between joints shall be in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

Longitudinal duct joint shall be manufactured by machine, with spiral lockseams to and including 60 inch diameters, and to dimensional tolerances compatible with fittings provided.

Ducts shall have supplemental girth angle supports, riveted with [solid rivets 6 inches on center] [tack welded] [brazed] to duct. Girth angles shall be located as follows:

| DIAMETER, INCHES | REINFORCEMENT-MAXIMUM SPACING, INCHES |
|---|---|
| 25 to 36 | 1-1/4 by 1-1/4, 1/8 thick, 72 inches on center |
| 37 to 50 | 1-1/4 by 1-1/4, 1/8 thick, 60 inches on center |
| 51 to 60 | 1-1/2 by 1-1/2, 1/8 thick, 48 inches on center |

Draw band girth joints are not acceptable.

Slip joints shall be made up by coating the male fitting with elastomer sealing materials, exercising care to prevent mastic from entering fitting bore, leaving only a thin annular mastic line exposed internally. Sheet metal screws shall be used to make assembly rigid, not less than four screws per joint, maximum spacing 6 inches. Pop rivets shall not be used. All joints shall be taped and heat sealed.

Bolt heads and nuts shall be hex-shaped, 5/16 inch diameter for ducts up to

50 inch diameter, and 3/8 inch diameter for 51 inch diameter ducts and larger.

Flanges shall be [continuously welded] [brazed] to duct on outside of duct and intermittently welded with 1 inch welds every 4 inches on inside joint face. Excess filler metal shall be removed from inside face. Galvanized areas that have been damaged by welding shall be protected with manufacturer's standard corrosion-resistant coating.

3.3.3.2 Duct Transitions

Where the shape of a duct changes, the angle of the side of the transition piece shall not exceed 15 degrees from the straight run of duct connected thereto.

Where equipment is installed in ductwork, the angle of the side of the transition piece from the straight run of duct connected thereto shall not exceed 15 degrees on the upstream side of the equipment and 22-1/2 degrees on the downstream side of the equipment.

3.3.4 Round, High Pressure, Sheet Metal Duct Installation

3.3.4.1 Joints

An inner coupling shall be provided to align the inner lining to maintain good airflow conditions equivalent to standard round high-pressure duct joints. Butt joints are not suitable for the inner liner. This alignment shall be accomplished by [extending the liner of the fitting for slip joint into the pipe] [by the use of a double concentric coupling with the two couplings held by spacers for rigidity and wall spacing]. For ducts over 34 inches inside diameter, provide a separate coupling for inner alignment, with the pressure shells joined by angle-ring flanged connections.

3.3.4.2 Insulation Ends

At the end of an uninsulated section or run where internally insulated duct connects to uninsulated spiral duct, fitting, fire damper or flexible duct, install an insulated end-fitting to bring the outer pressure shell down to nominal size.

3.3.5 Transverse Reinforcement Joints

Transverse reinforcements shall be [riveted with solid rivets to duct sides 6 inches on center] [spot welded 4 inches on center]. Transverse reinforcement shall be welded at [all corners] [ends] to form continuous frames.

3.3.6 Joint Gaskets

Flanged joints shall be gasketed with chloroprene full-face gaskets 1/8 inch thick, Shore A 40 durometer hardness. Gaskets shall be one piece, [vulcanized] [dovetailed] at joints.

3.3.7 Radius Elbows

Fabricate elbow proportions and radius elbows in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

### 3.3.8 Access Openings

Install access panels in ductwork adjacent to fire dampers.

Minimum size of access opening shall be 12 by 18 inches, unless precluded by duct dimension.

Access openings shall be framed by welded and ground miter joint, 1/8 inch thick [strap steel] [angle iron], with [1/4] [3/8] inch studs welded to frame. Cover plate shall be not less than [16-gage, reinforced as necessary for larger sizes] [constructed of 12-gage metal].

In lieu of access doors, readily accessible flanged duct sections may be provided upon approval. Provide stable hanger supports for disconnected duct termini.

### 3.3.9 Duct Supports

Install duct support in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966. Duct hangers shall meet the minimum size specified in ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966. Provide two hangers where necessary to eliminate sway. Support attachment to duct surfaces, shall be by [solid rivet] [bolt] [welding] 4 incheson center.

Round, double-wall duct supports shall be as recommended by the manufacturer except that minimum hanger ring and strap size shall be 1-1/2 inches by 1/8 inch.

Selection of hanging system shall be at the Contractor's option, and shall take into account the location and precedence of work under other sections, interferences of various piping and electrical conduit, equipment, building configuration, structural and safety factor requirements, vibration, and imposed loads under normal and abnormal service conditions. Support sizes, configurations, and spacings are given to show the minimal type of supporting components required. If installed loads are excessive for the specified hanger spacing, hangers, and accessories [heavier-duty components shall be provided] [hanger spacing shall be reduced]. After system startup, any duct support device which, due to length, configuration, or size, vibrates or causes possible failure of a member, shall be replaced or the condition shall otherwise be alleviated. Special care shall be exercised to preclude cascade-type failures.

Hanger rods, angles, and straps shall be attached to beam clamps. Concrete inserts, masonry anchors, and fasteners shall be approved for the application.

Hardened high-carbon spring-steel fasteners fitted onto beams and miscellaneous structural steel are acceptable upon prior approval of each proposed application and upon field demonstration of conformance to specification requirements. Fasteners shall be made from steel conforming to AISI Type [1055] [1070], treated and finished in conformance with SAE AMS 2480, Type Z (zinc phosphate base), Class 2 (supplementary treatment). A 72-hour load-carrying capacity shall be verified by a certified independent laboratory.

Hanger spacing shall provide a 20-to-1 safety factor for supported load.

Maximum load supported by any two fasteners shall be 100 pounds.

Friction rod assemblies are not acceptable.

Where support from metal deck systems is involved, support requirements shall be coordinated with installation of metal deck.

Ductwork and equipment shall not be hung from roof deck, piping, or other ducts or equipment. Maximum span between any two points shall be 10 feet, with lesser spans as required by duct assemblies, interferences, and permitted loads imposed.

There shall be not less than one set of hangers for each point of support. Hangers shall be installed on both sides of all duct turns, branch fittings, and transitions.

Hangers shall be sufficiently cross braced to eliminate sway vertically and laterally.

Rectangular ducts up to 36 inches shall be supported by strap-type hangers attached at not less than three places to not less than two duct surfaces in different planes.

Perforated strap hangers are not acceptable.

Rectangular ducting, 36 inches and larger, shall be supported by trapeze hangers. Ducts situated in unconditioned areas and required to have insulation with a vapor-sealed facing shall be supported on trapeze hangers. Hangers shall be spaced far enough out from the side of the duct to permit the duct insulation to be placed on the duct inside the trapeze. Duct hangers shall not penetrate the vapor-sealed facing.

Where trapeze hangers are used, the bottom of the duct shall be supported on angles sized as follows:

| WIDTH OF DUCT, INCHES | MINIMUM BOTTOM ANGLE SIZE, INCHES |
|---|---|
| 30 and smaller | 1-1/4 by 1-1/4 by 1/8 |
| 31 to 48 | 1-1/2 by 1-1/2 by 1/8 |
| 49 to 72 | 1-1/2 by 1-1/2 by 3/16 |
| 73 to 96 | 2 by 2 by 1/4 |
| 97 and wider | 3 by 3 by 1/4 |

Where ductwork system contains heavy equipment, excluding air-diffusion devices and single-leaf dampers, such equipment shall be hung independently of the ductwork by means of rods or angles of sizes adequate to support the load.

Ducting, when supported from roof purlins, shall not be supported at points greater than one-sixth of the purlin span from the roof truss. Load per hanger shall not exceed 400 pounds when support is from a single purlin or 800 pounds when hanger load is applied halfway between purlins by means of auxiliary support steel provided under this section. When support is not halfway between purlins, the allowable hanger load shall be the product of 400 times the inverse ratio of the longest distance to purlin-to-purlin spacing.

When the hanger load exceeds the above limits, provide reinforcing of purlin(s) or additional support beam(s). When an additional beam is used, the beam shall bear on the top chord of the roof trusses, and bearing shall be over gusset plates of top chord. Beam shall be stabilized by connection to roof purlin along bottom flange.

Purlins used for supporting fire-protection sprinkler mains, electrical lighting fixtures, electrical power ducts, or cable trays shall be considered fully loaded, and supplemental reinforcing or auxiliary support steel shall be provided for these purlins.

### 3.3.10 Flexible Connectors For Steel Metal

Air-handling equipment, ducts crossing building expansion joints, and fan inlets and outlets shall be connected to upstream and downstream components by treated woven-cloth connectors.

Install connectors only after system fans are operative and all vibration isolation mountings have been adjusted. When system fans are operating, connectors shall be free of wrinkles caused by misalignment or fan reaction. Width of surface shall be curvilinear.

### 3.3.11 Insulation Protection Angles

Galvanized 20-gage sheet, formed into an angle with a 2 inch exposed long leg with a 3/8 inch stiffening break at outer edge, and with a variable concealed leg, depending upon insulation thickness, shall be provided.

Install angles over all insulation edges terminating by butting against a wall, floor foundation, frame, and similar construction. Fasten angles in place with blind rivets through the protection angle, insulation, and sheet metal duct or plenum. Install angles after final insulation covering has been applied.

### 3.3.12 Duct Probe Access

Provide holes with neat patches, threaded plugs, or threaded or twist-on caps for air-balancing pitot tube access. Provide extended-neck fittings where probe access area is insulated.

### 3.3.13 Openings In Roofs And Walls

Building openings are fixed and provide equipment to suit.

## 3.4 FIELD QUALITY CONTROL

### 3.4.1 Inspection

Ductwork shall be inspected in accordance with SMACNA 1987.

## 3.5 DUCTWORK CLEANING PROVISIONS

Open ducting shall be protected from construction dust and debris in a manner approved by the Contracting Officer. Dirty assembled ducting shall be cleaned by subjecting all main and branch interior surfaces to airstreams moving at velocities two times specified working velocities, at static pressures within maximum ratings. This may be accomplished by: filter-equipped portable blowers which remain the Contractor's property;

wheel-mounted, compressed-air operated perimeter lances which direct the compressed air and which are pulled in the direction of normal airflow; and other means approved by the Contracting Officer. Compressed air used for cleaning ducting shall be water- and oil- free.

-- End of Section --

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLS
**08/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

| | |
|---|---|
| ASHRAE 113 | (2005) Method of Testing for Room Air Diffusion (Repeatable Method of Testing Steady - State Air Diffusion Performance in Occupied Zones of Building Spaces) |
| ASHRAE EQUIP IP HDBK | (2004) Handbook, HVAC Systems and Equipment (IP Edition) |
| ASHRAE FUN IP | (2005) Fundamentals Handbook, I-P Edition |

1.2 GENERAL REQUIREMENTS

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, AND EXHAUST SYSTEMS applies to work specified in this section.

1.3 PERFORMANCE REQUIREMENTS

Certify air diffusion devices s having been tested and rated in accordance with ASHRAE EQUIP IP HDBK, Chapter 17; ASHRAE FUN IP, Chapter 31, and ASHRAE 113, where such certification is required.

Submit Equipment and Performance Data for air-diffusion devices consisting of sound data in terms of Noise Criteria (NC) index for the capacity range of the device. Where space or sound data are not specified or indicated, assume NC40.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit Equipment and Performance Data for air-diffusion devices in accordance with paragraph entitled, "Performance Requirements," of this section.

## PART 2 PRODUCTS

### 2.1 AIR-DIFFUSION DEVICE CONSTRUCTION

Preclude flutter, rattle, or vibration on air-diffusion device construction and mounting. Refer to Section 23 05 48 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT for vibration isolation considerations. Modify devices and provide accessories necessary for mounting in indicated surface construction.

Select color from Manufacturer's Standard Color Chart which indicate the manufacturer's standard color selections and finishes for air-diffusion devices.

Provide supply diffusers with combination damper and equalizing grid. Ensure dampers are extracting-splitter type, except as otherwise indicated.

Ensure air-diffusion device volume and pattern adjustments can be made from the face of the device. Make volume adjustments by removable key or screw driver.

Provide gaskets for supply-terminal air devices mounted in finished surfaces.

### 2.2 TYPES OF AIR-DIFFUSION DEVICES

#### 2.2.1 Type DSA

Provide type DSA supply diffuser, square with four expanding flared members to provide radically diffused discharge air. Arrange flared members to provide a minimum of four air paths which simultaneously diffuse air at 20 to 50 fpm. Include pattern adjustments horizontal, vertical projection, and an intermediate position or range.

Provide a baked enamel finish.

Provide aluminum construction in area subject to moisture or high humidity (showers, etc.).

Provide integral extended surface to fit into module of lay-in ceiling.

#### 2.2.2 Type GR

Provide type GR return grilles, single deflection type with fixed face bars.

Provide grilles installed in vertical surfaces with horizontal face bars set downward at 35 degrees from vertical.

Provide grilles installed in horizontal surfaces with face bars straight and parallel to short dimension.

Provide a baked enamel finish.

Provide aluminum construction in area subject to moisture or high humidity (showers, etc.).

#### 2.2.3 Type RS

Provide type RS supply register, double-deflection type, with adjustable

face bars parallel to short dimension and adjustable rear bars parallel to long dimension with opposed-blade type dampers.

Provide a baked enamel finish.

Provide aluminum construction in area subject to moisture or high humidity (showers, etc.).

2.2.4 Type RR

Provide type RR return register, single-deflection type with fixed face bars with opposed-blade dampers.

Provide registers installed in vertical surfaces with have horizontal face bars set downward at approximately 35 degrees from vertical.

Provide registers installed in horizontal surfaces with face bars set straight and parallel to short dimension.

Provide a baked enamel finish.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment as indicated and specified and in accordance with manufacturer's recommendations.

Mount wall-mounted supply registers 6 inches below ceiling.

-- End of Section --

SECTION 23 64 10

WATER CHILLERS, VAPOR COMPRESSION TYPE
**08/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

| | |
|---|---|
| AHRI 550/590 | (2003) Standard for Water-Chilling Packages Using the Vapor Compression Cycle |

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

| | |
|---|---|
| ASHRAE 15 & 34 | WARNING: Text in tags exceeds the maximum length of 300 characters |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS Z49.1 | (2005) Safety in Welding, Cutting and Allied Processes |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 307 | (2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength |
| ASTM B 117 | (2007a) Standing Practice for Operating Salt Spray (Fog) Apparatus |
| ASTM E 84 | (2008a) Standard Test Method for Surface Burning Characteristics of Building Materials |
| ASTM F 104 | (2003) Standard Classification System for Nonmetallic Gasket Materials |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA MG 11 | (1977; R 2007) Energy Management Guide for Selection and Use of Single Phase Motors |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Water Chiller; G

Manufacturer's standard catalog data, at least highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data shall include manufacturer's recommended installation instructions and procedures. Data shall be adequate to demonstrate compliance with contract requirements as specified within the paragraphs:

a. Water Chiller

b. Chiller Components

c. Accessories

If vibration isolation is specified for a unit, vibration isolator literature shall be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations.

Posted instructions, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions shall be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.]

Manufacturer's Multi-Year Compressor Warranty

Manufacturer's multi-year warranty for compressor(s) in air-cooled water chillers as specified.

SD-07 Certificates

Refrigeration System; G

Where the system, components, or equipment are specified to comply with requirements of AGA, NFPA, ARI, ASHRAE, ASME, or UL, 1 copy of proof of such compliance shall be provided. The label or listing of the specified agency shall be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted. When performance requirements of this project's drawings and specifications vary from standard ARI rating conditions, computer printouts, catalog, or other application data certified by ARI or a nationally recognized laboratory as described above shall be included. If ARI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

SD-08 Manufacturer's Instructions

Water Chiller - Installation Instruction

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

Six complete copies of an operation manual in bound 8 1/2 x 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features. Six complete copies of maintenance manual in bound 8 1/2 x 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

## 1.3 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

## 1.4 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

## 1.5 PROJECT REQUIREMENTS

### 1.5.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

## 1.6 Warranty

In addition to the warranty requirements specification in Division 00, Contract Requirements, the following major components of the chiller shall be covered by a warranty of a duration period of five years: compressor.

## 1.7 MANUFACTURER'S MULTI-YEAR COMPRESSOR WARRANTY

The Contractor shall provide a 5 year parts only (excludes refrigerant) manufacturer's warranty on the chiller compressor(s). This warranty shall be directly from the chiller manufacturer to the Government and shall be in

addition to the standard one-year warranty of construction. The manufacturer's warranty shall provide for the repair or replacement of the chiller compressor(s) that become inoperative as a result of defects in material or workmanship within 5 years after the date of final acceptance. When the manufacturer determines that a compressor requires replacement, the manufacturer shall furnish new compressor(s) at no additional cost to the Government. Upon notification that a chiller compressor has failed under the terms of the warranty, the manufacturer shall respond in no more than 8 hours.

1.7.1 Indexed Notebook

The Contractor shall furnish to the Contracting Officer a bound and indexed notebook containing a complete listing of all water chillers covered by a manufacturer's multi-year warranty. The chiller list shall state the duration of the warranty thereof, start date of the warranty, ending date of the warranty, location of the warranted equipment, and the point of contact for fulfillment of the warranty. This information shall be provided for each chiller and the recorded chiller serial numbers shall identify each chiller. Point of contact shall include the name of the service representative along with the day, night, weekend, and holiday phone numbers for a service call. The completed bound and indexed notebook shall be delivered to the Contracting Office prior to final acceptance of The Contractor shall furnish with each manufacturer's multi-year warranty the name, address, and telephone number (day, night, weekend, and holiday) of the service representative nearest to the location where the equipment is installed. Upon a request for service under the multi-year warranty, the service representative shall honor the warranty during the warranty period, and shall provide the services prescribed by the terms of the warranty.

1.7.2 Equipment Warranty Tags

At the time of installation, each item of manufacturer's multi-year warranted equipment shall be tagged with a durable, oil- and water-resistant tag, suitable for interior and exterior locations, resistant to solvents, abrasion, and fading due to sunlight. The tag shall be attached with copper wire or a permanent, pressure-sensitive, adhesive backing. The tag shall be installed in an easily noticed location attached to the warranted equipment. The tag for this equipment shall be similar to the following in format, and shall contain all of the listed information:

MANUFACTURER'S MULTI-YEAR WARRANTY EQUIPMENT TAG
Equipment/Product Covered: _____
Manufacturer:_____Model No.:_____Serial No.:__
Warranty Period: From _____to _____
Contract No.: _____
Warranty Contact: _____
Name: _____
Address: _____
Telephone: _____
STATION PERSONNEL SHALL PERFORM PREVENTIVE MAINTENANCE AND OPERATIONAL MAINTENANCE

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be standard Commercial cataloged products of

a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship.

These products shall have a two year record of satisfactory field service prior to bid opening. the two year record of service shall include applications of equipment and materials under similar circumstances and of similar size.

Products having less than a two year record of satisfactory field service shall be acceptable if a certified record of satisfactory field service for not less than 6000 hours can be shown. The 6000 hour service record shall not include any manufacturer's prototype or factory testing.

Satisfactory field service shall have been completed by a product that has been, and presently is being sold or offered for sale on the commercial market through the following copyrighted means: advertisements, manufacturer's catalogs, or brochures.

## 2.2 MANUFACTURER'S STANDARD NAMEPLATES

Major equipment including chillers, compressors, compressor drivers, condensers, water coolers, receivers, refrigerant leak detectors, heat exchanges, fans, and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates shall be durable and legible throughout equipment life. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

Nameplates are required on major components if the manufacturer needs to provide specific engineering and manufacturing information pertaining to the particular component. Should replacement of this component be required, nameplate information will insure correct operation of the unit after replacement of this component.

## 2.3 ELECTRICAL WORK

a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Manual or automatic control and protective or signal devices required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers including the required monitors and timed restart.

b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11.

c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system, and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 11.

d. Provide motors in accordance with NEMA MG 11 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow

for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. [Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.]

e. Provide inverter duty premium efficiency motors for use with variable frequency drives.

## 2.4 SELF-CONTAINED WATER CHILLERS, VAPOR COMPRESSION TYPE

Unless necessary for delivery purposes, units shall be assembled, leak-tested, charged (refrigerant and oil), and adjusted at the factory. In lieu of delivery constraints, a chiller may be assembled, leak-tested, charged (refrigerant and oil), and adjusted at the job site by a factory representative. Unit components delivered separately shall be sealed and charged with a nitrogen holding charge. Parts weighing 50 pounds or more which must be removed for inspection, cleaning, or repair, such as motors, gear boxes, cylinder heads, casing tops, condenser, and cooler heads, shall have lifting eyes or lugs. Chiller shall be provided with a single point wiring connection for incoming power supply. Chiller's condenser and water cooler shall be provided with [standard] [marine] water boxes with [grooved mechanical] [flanged] [welded] connections.

### 2.4.1 Scroll, Reciprocating, or Rotary Screw Type

Chiller shall be rated in accordance with AHRI 550/590. Chiller shall conform to ASHRAE 15 & 34. As a minimum, chiller shall include the following components as defined in paragraph CHILLER COMPONENTS.

a. Refrigerant and oil

b. Structural base

c. Chiller refrigerant circuit

d. Controls package

e. Scroll, reciprocating, or rotary screw compressor

f. Compressor driver, electric motor

g. Compressor driver connection

h. Water cooler (evaporator)

i. Air-cooled condenser coil

## 2.5 CHILLER COMPONENTS

### 2.5.1 Refrigerant and Oil

Refrigerants shall be one of the fluorocarbon gases. Refrigerants shall have number designations and safety classifications in accordance with ASHRAE 15 & 34. [Refrigerants shall have an Ozone Depletion Potential (ODP) of 0.055 or less.] [Refrigerants classified by the EPA as Class 2

shall not be allowed with the exception of R-123.] [The ODP shall be in accordance with the "Montreal Protocol On Substances That Deplete The Ozone Layer," September 1987, as amended through 2000, sponsored by the United Nations Environment Programme.]

2.5.2 Structural Base

Chiller and individual chiller components shall be provided with a factory-mounted structural steel base (welded or bolted) or support legs. Chiller and individual chiller components shall be isolated from the building structure by means of [molded neoprene isolation pads.] [vibration isolators with published load ratings. Vibration isolators shall have isolation characteristics as recommended by the manufacturer for the unit supplied and the service intended.]

2.5.3 Chiller Refrigerant Circuit

Chiller refrigerant circuit shall be completely piped and factory leak tested. For multicompressor units, not less than 2 independent refrigerant circuits shall be provided. Circuit shall include as a minimum a [combination filter and drier,] combination sight glass and moisture indicator, liquid-line solenoid valve for reciprocating, an electronic or thermostatic expansion valve with external equalizer, charging ports, compressor service valves for field-serviceable compressors, and superheat adjustment.

2.5.4 Controls Package

Chiller shall be provided with a complete [factory-mounted] [remote-mounted where indicated], prewired electric or microprocessor based operating and safety control system. Controls package shall contain as a minimum a digital display or acceptable gauges, an on-auto-off switch, [motor starters,] [disconnect switches,] power wiring, and control wiring. Controls package shall provide operating controls, monitoring capabilities, programmable setpoints, safety controls, and EMCS interfaces as defined below.

2.5.4.1 Operating Controls

Chiller shall be provided with the following adjustable operating controls as a minimum.

a. Leaving chilled water temperature control

b. Adjustable timer or automated controls to prevent a compressor from short cycling

c. Automatic lead/lag controls (adjustable) for multi-compressor units

d. Load limiting

e. System capacity control to adjust the unit capacity in accordance with the system load and the programmable setpoints. Controls shall automatically re-cycle the chiller on power interruption.

f. Startup and head pressure controls to allow system operation at all ambient temperatures down to 10 degrees F

2.5.4.2 Monitoring Capabilities

During normal operations, the control system shall be capable of monitoring and displaying the following operating parameters. Access and operation of display shall not require opening or removing any panels or doors.

a. Entering and leaving chilled water temperatures

b. Self diagnostic

c. Operation status

d. Operating hours

e. Number of starts

f. Compressor status (on or off)

g. Refrigerant discharge and suction pressures

h. Oil pressure

2.5.4.3 Programmable Setpoints

The control system shall be capable of being reprogrammed directly at the unit. [No parameters shall be capable of being changed without first entering a security access code.] The programmable setpoints shall include the following as a minimum.

a. Leaving Chilled Water Temperature

b. [Time Clock/Calendar Date]

2.5.4.4 Safety Controls with Manual Reset

Chiller shall be provided with the following safety controls which automatically shutdown the chiller and which require manual reset.

a. Low chilled water temperature protection

b. High condenser refrigerant discharge pressure protection

c. Low evaporator pressure protection

d. Chilled water flow detection

e. High motor winding temperature protection

f. Low oil flow protection if applicable

2.5.4.5 Safety Controls with Automatic Reset

Chiller shall be provided with the following safety controls which automatically shutdown the chiller and which provide automatic reset.

a. Over/under voltage protection

b. Chilled water flow interlock

c. Phase reversal protection

2.5.4.6 Remote Alarm

During the initiation of a safety shutdown, a chiller's control system shall be capable of activating a remote alarm bell. In coordination with the chiller, the Contractor shall provide an alarm circuit (including transformer if applicable) and a minimum 4 inch diameter alarm bell. Alarm circuit shall activate bell in the event of machine shutdown due to the chiller's monitoring of safety controls. The alarm bell shall not sound for a chiller that uses low-pressure cutout as an operating control.

2.5.4.7 Energy Management Control System (EMCS) Interface

The control system shall be capable of communicating all data to a remote integrated DDC processor. The data shall include as a minimum all system operating conditions, capacity controls, and safety shutdown conditions. The control system shall also be capable of receiving at a minimum the following operating commands.

a. Remote Unit Start/Stop

b. Remote Chilled Water Reset

2.5.5 Compressor(s)

2.5.5.1 Scroll Compressor(s)

Compressors shall be of the hermetically sealed design. Compressors shall be mounted on vibration isolators to minimize vibration and noise. Rotating parts shall be statically and dynamically balanced at the factory to minimize vibration. Lubrication system shall be centrifugal pump type equipped with a means for determining oil level and an oil charging valve. Crankcase oil heater shall be provided if standard or if available as an option. If provided, the crankcase oil heater shall be controlled as recommended by the manufacturer.

2.5.6 Compressor Driver, Electric Motor

Motors, starters, wiring, etc. shall be in accordance with paragraph ELECTRICAL WORK. Motor starter shall be unit mounted as indicated with starter type, wiring, and accessories coordinated with the chiller manufacturer.

2.5.7 Water Cooler (Evaporator)

Cooler shall be a brazed plate evaporator made of stainless steel with copper as the braze material. Is shall be designed to qithstand a refrigerant side working pressure of 430 psig and a waterside working pressure of 150 psig. Evaporator shall be tested at 1.10 times the maximum allowable refrigerant side working pressure and 1.5 times the maximum allowable waterside working pressure. Evaporator shall be single pass. Immersion heaters shall protect the evaporator to -20 degrees F.

2.5.8 Air-Cooled Condenser Coil

Condenser coil shall be of the extended-surface fin-and-tube type and shall be constructed of seamless copper or aluminum tubes with compatible copper or aluminum fins. Fins shall be soldered or mechanically bonded to the

tubes and installed in a metal casing. Coils shall be circuited and sized for a minimum of 5 degrees F subcooling and full pumpdown capacity. Coil shall be factory leak and pressure tested after assembly in accordance with ASHRAE 15 & 34.

2.5.9 Tools

One complete set of special tools, as recommended by the manufacturer for field maintenance of the system, shall be provided. Tools shall be mounted on a tool board in the equipment room or contained in a toolbox as directed by the Contracting Officer.

2.6 ACCESSORIES

2.6.1 Gaskets

Gaskets shall conform to ASTM F 104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

2.6.2 Bolts and Nuts

Bolts and nuts, except as required for piping applications, shall be in accordance with ASTM A 307. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A 307.

2.7 FABRICATION

2.7.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand [125] [500] hours exposure to the salt spray test specified in ASTM B 117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

2.7.2 Factory Applied Insulation

Chiller shall be provided with factory installed insulation on surfaces subject to sweating including the water cooler, suction line piping, economizer, and cooling lines. Insulation on heads of coolers may be field applied, however it shall be installed to provide easy removal and replacement of heads without damage to the insulation. Where motors are the gas-cooled type, factory installed insulation shall be provided on the cold-gas inlet connection to the motor per manufacturer's standard practice. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E 84. Insulation shall be tested in

the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

## 2.8 SUPPLEMENTAL COMPONENTS/SERVICES

### 2.8.1 Chilled and Condenser Water Piping and Accessories

Chilled and condenser water piping and accessories shall be provided and installed in accordance with Section 23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS.

### 2.8.2 Temperature Controls

Chiller control packages shall be fully coordinated with and integrated into the temperature control system specified in Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM and 23 09 23 DIRECT DIGITAL CONTROL FOR HVAC AND OTHER LOCAL BUILDING SYSTEMS 23 09 23.13 20 BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Installation of water chiller systems including materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with the manufacturer's written installation instructions, including the following:

1. Water chiller - installation instructions

### 3.1.1 Refrigeration System

#### 3.1.1.1 Equipment

Refrigeration equipment and the installation thereof shall conform to ASHRAE 15 & 34. Necessary supports shall be provided for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, cooling towers, condensers, water coolers, and similar items. Compressors shall be isolated from the building structure. If mechanical vibration isolators are not provided, vibration absorbing foundations shall be provided. Each foundation shall include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material. Other floor-mounted equipment shall be set on not less than a 6 inch concrete pad doweled in place. Concrete foundations for floor mounted pumps shall have a mass equivalent to three times the weight of the components, pump, base plate, and motor to be supported. In lieu of concrete pad foundation, concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. Concrete pedestal block shall be of mass not less than three times the combined pump, motor, and base weights. Isolators shall be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Lines connected to pumps mounted on pedestal blocks shall be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations shall be

as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

3.1.2 Field Applied Insulation

Field installed insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.1.3 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 MANUFACTURER'S FIELD SERVICE

The services of a factory-trained representative shall be provided for 1 day. The representative shall advise on the following:

a. Hermetic machines:

(1) Testing hermetic water-chilling unit under pressure for refrigerant leaks; evacuation and dehydration of machine to an absolute pressure of not over 300 microns.

(2) Charging the machine with refrigerant.

(3) Starting the machine.

3.3 CLEANING AND ADJUSTING

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions. At least one week before the official equipment warranty start date, all condenser coils on air-cooled water chillers and split-system water chillers shall be cleaned in accordance with the chiller manufacturer's instructions. This work covers two coil cleanings. The condenser coils shall be cleaned with an approved coil cleaner by a service technician, factory trained by the chiller manufacturer. The condenser coil cleaner shall not have any detrimental affect on the materials or protective coatings on the condenser coils. Testing, adjusting, and balancing shall be as specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING.

3.4 SYSTEM PERFORMANCE TESTS

3.4.1 General Requirements

Before each refrigeration system is accepted, tests to demonstrate the general operating characteristics of all equipment shall be conducted by a

registered professional engineer or an approved manufacturer's start-up representative experienced in system start-up and testing, at such times as directed. Tests shall cover a period of not less than 48 hours for each system and shall demonstrate that the entire system is functioning in accordance with the drawings and specifications. Corrections and adjustments shall be made as necessary and tests shall be re-conducted to demonstrate that the entire system is functioning as specified. Prior to acceptance, service valve seal caps and blanks over gauge points shall be installed and tightened. Any refrigerant lost during the system startup shall be replaced. If tests do not demonstrate satisfactory system performance, deficiencies shall be corrected and the system shall be retested. Tests shall be conducted in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. Field tests shall be coordinated with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING.

3.4.2 Test Report

The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. The report shall also include the following information and shall be taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart:

a. Date and outside weather conditions.

b. The load on the system based on the following:

(1) The refrigerant used in the system.
(2) Condensing temperature and pressure.
(3) Suction temperature and pressure.
(4) Running current, voltage and proper phase sequence for each phase of all motors.
(5) The actual on-site setting of all operating and safety controls.
(6) Chilled water pressure, flow and temperature in and out of the chiller.

3.5 DEMONSTRATIONS

Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total 2 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The field posted instructions shall cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations.

-- End of Section --

# Air-Cooled Scroll

## Job Information

Stennis Riverine Training Facility
New Orleans
(B29)Rob Hoffman

| | | | |
|---|---|---|---|
| Tag | CH-1 | Product Version | 1.0.0.1 |
| Model Number | CGAM040 | Unit nominal tonnage | 40 tons |
| Quantity | 1 | Unit type | High efficiency |

## Unit Information

| | | | |
|---|---|---|---|
| Chilled water system type | Variable primary flow direct | | |
| Capacity | 38.20 tons | NPLV | 14.3 EER |
| Full load efficiency | 10.0 EER | IPLV | 14.3 EER |

## Evaporator Information

| | | | |
|---|---|---|---|
| Evap application | Std cooling | Evap fluid freeze point | 32.00 F |
| Evap entering temp | 54.00 F | Evap fouling factor | 0.00010 hr-ft?-deg F/Btu |
| Evap leaving temp | 44.00 F | Min evap flow rate | 47.20 gpm |
| Evap flow rate | 91.20 gpm | Press drop at min evap flow | 5.60 ft H2O |
| Evap press drop | 19.60 ft H2O | Max evap flow rate | 110.00 gpm |
| Evap fluid type | Water | Press drop at max evap flow | 28.00 ft H2O |

## Condenser Information

| | | | |
|---|---|---|---|
| Unit application | Wide ambient | Total cond airflow | 34348 cfm |
| Cond fin material | Lanced aluminum | Ambient air temp | 95.00 F |
| | | Elevation | 0.00 ft |

## Electrical Information

| | | | | | |
|---|---|---|---|---|---|
| Starter type | Across the line | | Total compressor power | 40.70 kW | |
| Incoming power line connection | Single point | | Number of cond fans | 4 | |
| Unit voltage | 460 volt 3 phases | | Fan motor power | 4.60 kW | |
| Unit hertz | 60 hertz | | FLA - cond fan (each) | 2.90 A | |
| Unit power | 45.60 kW | | | | |
| | RLA | LRA | | MCA | MOP |
| Compressor A | 18.60 A | 130.00 A | Single point power | 91.80 A | 110.00 A |
| Compressor B | 18.60 A | 130.00 A | | | |
| Compressor D | 18.60 A | 130.00 A | | | |
| Compressor E | 18.60 A | 130.00 A | | | |

## General Information

| | | | |
|---|---|---|---|
| Manufacturing plant | Pueblo, USA | Shipping weight | 3359.0 lb |
| Sound attenuator package | Comprehensive acoustic package | Operating weight | 3377.0 lb |
| Full load sound power | 86 dBA | Length | 114.000 in |
| Refrig charge (HFC-410A)-ckt 1 | 29.0 lb | Width | 88.600 in |
| Refrig charge (HFC-410A)-ckt 2 | 29.0 lb | Height | 84.800 in |

# Air-Cooled Scroll

## Job Information

Stennis Riverine Training Facility
New Orleans
(B29)Rob Hoffman

| | | | |
|---|---|---|---|
| Tag | CH-1 | Product Version | 1.0.0.1 |
| Model Number | CGAM040 | Unit nominal tonnage | 40 tons |
| Quantity | 1 | Unit type | High efficiency |

## Information for LEED Projects

| | | | |
|---|---|---|---|
| ASHRAE 90.1/CSA compliance | ASHRAE | Full load efficiency | 10.0 EER |
| Refrig charge (HFC-410A)-ckt 1 | 29.0 lb | IPLV | 14.3 EER |
| Refrig charge (HFC-410A)-ckt 2 | 29.0 lb | Total compressor power | 40.70 kW |
| Rated capacity (ARI) | 38.20 tons | Fan motor power | 4.60 kW |

Note: This product meets the minimum equipment efficiency requirements of ASHRAE Standard 90.1-2004 and -2007 (which are based on ARI standard rating conditions) and, therefore, also meets the LEED " Minimum Energy Performance" prerequisite in the Energy & Atmosphere section. The efficiencies and power data listed above are at actual user-entered conditions. Refer to the product catalog for performance at

The LEED Green Building Rating System™, developed by the U.S. Green Building Council, provides independent, third-party verification that a building project meets green building and performance measures

**General**
Units are constructed of a galvanized steel frame with galvanized steel panels and access doors. Component surfaces are finished with a powder-coated paint. All paint meets the requirement for outdoor equipment of the U.S. Navy and other Federal Government Agencies. This paint finish is durable enough to withstand a 1000-consecutive-hour salt spay application in accordance with standard ASTMB117.

**Compressor and Motor**
The unit is equipped with two or more hermetic, direct-drive, 3600 rpm 60 Hz suction gas-cooled scroll compressors. The simple design has only three major moving parts and a completely enclosed compression chamber which leads to increased efficiency. Overload protection is internal to the compressors. The compressor includes: centrifugal oil pump, oil level sight glass and oil charging valve. Each compressor will have compressor heaters installed and properly sized to minimize the amount of liquid refrigerant present in the oil sump during off cycles.

**Unit-Mounted Starter**
The control panel is designed per UL 1995. The starter is in an across-the-line configuration, factory-mounted and fully pre-wired to the compressor motor and control panel. Typically, Trane scroll compressors are up to full speed in one second when started across-the-line.

A factory-installed, factory-wired 820 VA control power transformer provides all unit control power (120 Vac secondary) and Trane CH530 module power (24 Vac secondary).

Power line connection type is standard with a terminal block.

**Power Connection**
Power connections include main three-phase power and one separate 120V, 15 amp customer provided single phase power connection is required to power the heaters.

**Evaporator**
Braze plate evaporator is made of stainless steel with copper as the braze material. It is designed to withstand a refrigerant side working pressure of 430 psig (29.6 bars) and a waterside working pressure of 150 psig (10.5 bars). Evaporator is tested at 1.1 times maximum allowable refrigerant side working pressure and 1.5 times maximum allowable water side working pressure. It has one water pass. Immersion heaters protect the evaporator to an ambient of -20°F (-29°C). A water strainer and a flow switch are factory installed.

**Condenser**
Air-cooled condenser coils have lanced aluminum fins mechanically bonded to internally-finned copper tubing.

The condenser coil has an integral subcooling circuit. The maximum allowable working pressure of the condenser is 650 psig (44.8 bars). Condensers are factory proof and leak tested at 715 psig (49.3 bars).

Direct-drive vertical discharge condenser fans are balanced and individually protected. Three-phase condenser fan motors with permanently lubricated ball bearings and external thermal overload protection are provided.

A variable speed drive on the first fan of each circuit allows the unit to start and operate with ambient temperatures between 0.0 F and 125.0 F.

**Refrigerant Circuits**
The unit has dual refrigerant circuits. Each refrigerant circuit has Trane scroll compressors piped in parallel with a passive oil management system. A passive oil management system maintains proper oil levels within compressors and has no moving parts. Each refrigerant circuit includes filter drier, electronic expansion valve, liquid line and discharge service valves. Capacity modulation is achieved by turning compressors on and off. The unit has four capacity stages.

**Unit Controls**

The microprocessor-based control panel is factory-installed and factory-tested. The control system is powered by a pre-wired control power transformer, and will turn on and off compressors to meet the load. Microprocessor-based chilled water reset based on return water is standard. The unit comes with a factory installed flow switch.

The Trane CH530 microprocessor automatically acts to prevent unit shutdown due to abnormal operating conditions associated with low evaporator refrigerant temperature and high condensing temperature. If an abnormal operating condition continues and the protective limit is reached, the machine will shut down.

The panel includes machine protection for the following conditions: low evaporator refrigerant temperature and pressure, high condenser refrigerant pressure, critical sensor or detection circuit faults, lost communication between modules, phase loss, phase reversal, over temperature protection, external and local emergency stop, and loss of evaporator water flow.

When a fault is detected, the control system conducts more than 100 diagnostic checks and displays results. The display will identify the fault, indicate date, time, and operating mode at time of occurrence, and provide type of reset required and a help message.

Data contained in available reports includes: water and air temperatures, refrigerant pressures and temperatures, flow switch status, EXV position, and compressor starts and run-time. All necessary settings and setpoints are programmed into the microprocessor-based controller via the operator interface. The controller is capable of receiving signals simultaneously from a variety of control sources, in any combination, and priority order of control sources can be programmed.

**Comprehensive Acoustic Package**
Acoustical treatment for compressors is factory installed.

**Isolators**
Molded elastomeric isolators, sized to reduce vibration transmission to the supporting structure when the unit is installed, ship with the chiller.

SECTION 23 64 26

CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS
**04/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|---|---|
| AWWA C606 | (2006) Grooved and Shouldered Joints |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS A5.8/A5.8M | (2004; Errata 2004) Specification for Filler Metals for Brazing and Braze Welding |
| AWS BRH | (2007) Brazing Handbook |
| AWS D1.1/D1.1M | (2008) Structural Welding Code - Steel |
| AWS Z49.1 | (2005) Safety in Welding, Cutting and Allied Processes |

ASME INTERNATIONAL (ASME)

| | |
|---|---|
| ASME B1.20.1 | (1983; R 2006) Pipe Threads, General Purpose (Inch) |
| ASME B16.1 | (2005) Standard for Gray Iron Threaded Fittings; Classes 125 and 250 |
| ASME B16.11 | (2005) Forged Fittings, Socket-Welding and Threaded |
| ASME B16.18 | (2001; R 2005) Cast Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.21 | (2005) Nonmetallic Flat Gaskets for Pipe Flanges |
| ASME B16.22 | (2001; R 2005) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.26 | (2006) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes |
| ASME B16.3 | (2006) Malleable Iron Threaded Fittings, Classes 150 and 300 |
| ASME B16.39 | (1998; R 2006) Standard for Malleable Iron |

| | |
|---|---|
| | Threaded Pipe Unions; Classes 150, 250, and 300 |
| ASME B16.9 | (2007) Standard for Factory-Made Wrought Steel Buttwelding Fittings |
| ASME B31.9 | (2008) Building Services Piping |
| ASME B40.100 | (2005) Pressure Gauges and Gauge Attachments |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 106/A 106M | (2008) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service |
| ASTM A 183 | (2003) Standard Specification for Carbon Steel Track Bolts and Nuts |
| ASTM A 47/A 47M | (1999; R 2004) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process |
| ASTM A 53/A 53M | (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A 536 | (1984e1; R 2004) Standard Specification for Ductile Iron Castings |
| ASTM A 653/A 653M | (2008) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A 733 | (2003) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples |
| ASTM B 117 | (2007a) Standing Practice for Operating Salt Spray (Fog) Apparatus |
| ASTM B 32 | (2008) Standard Specification for Solder Metal |
| ASTM B 42 | (2002e1) Standard Specification for Seamless Copper Pipe, Standard Sizes |
| ASTM B 62 | (2002) Standard Specification for Composition Bronze or Ounce Metal Castings |
| ASTM B 75 | (2002) Standard Specification for Seamless Copper Tube |
| ASTM B 813 | (2000e1) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube |

| | |
|---|---|
| ASTM B 88 | (2003) Standard Specification for Seamless Copper Water Tube |
| ASTM D 1384 | (2005e1) Corrosion Test for Engine Coolants in Glassware |
| ASTM D 2000 | (2008) Standard Classification System for Rubber Products in Automotive Applications |
| ASTM D 3308 | (2006) PTFE Resin Skived Tape |
| ASTM D 520 | (2000; R 2005) Zinc Dust Pigment |
| ASTM D 596 | (2001; R 2006) Reporting Results of Analysis of Water |
| ASTM E 84 | (2008a) Standard Test Method for Surface Burning Characteristics of Building Materials |
| ASTM F 1007 | (1986; R 2007) Pipeline Expansion Joints of the Packed Slip Type for Marine Application |
| ASTM F 1120 | (1987; R 2004) Standard Specification for Circular Metallic Bellows Type Expansion Joints for Piping Applications |
| ASTM F 1199 | (1988; R 2004) Cast (All Temperatures and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum) |

EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

| | |
|---|---|
| EJMA Stds | (2003) EJMA Standards |

HYDRAULIC INSTITUTE (HI)

| | |
|---|---|
| HI 1.1-1.2 | (2000) Centrifugal Pump Nomenclature |

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

| | |
|---|---|
| MSS SP-110 | (1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends |
| MSS SP-25 | (2008) Standard Marking System for Valves, Fittings, Flanges and Unions |
| MSS SP-58 | (2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture |
| MSS SP-67 | (2002a; R 2004) Standard for Butterfly Valves |
| MSS SP-69 | (2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application |

| | |
|---|---|
| MSS SP-70 | (2006) Standard for Cast Iron Gate Valves, Flanged and Threaded Ends |
| MSS SP-71 | (2005) Standard for Gray Iron Swing Check Valves, Flanged and Threaded Ends |
| MSS SP-72 | (1999) Standard for Ball Valves with Flanged or Butt-Welding Ends for General Service |
| MSS SP-78 | (2005a) Cast Iron Plug Valves, Flanged and Threaded Ends |
| MSS SP-80 | (2008) Bronze Gate, Globe, Angle and Check Valves |
| MSS SP-85 | (2002) Standard for Cast Iron Globe & Angle Valves, Flanged and Threaded Ends |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA 250 | (2003) Enclosures for Electrical Equipment (1000 Volts Maximum) |
| NEMA MG 1 | (2007; Errata 2008) Standard for Motors and Generators |
| NEMA MG 11 | (1977; R 2007) Energy Management Guide for Selection and Use of Single Phase Motors |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 90A | (2008) Standard for the Installation of Air Conditioning and Ventilating Systems |

## 1.2 SYSTEM DESCRIPTION

Provide the water systems having the minimum service (design) temperature-pressure rating indicated. Provision of the piping systems, including materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with the required and advisory provisions of ASME B31.9 except as modified or supplemented by this specification section or design drawings. This specification section covers the water systems piping which is located within, on, and adjacent to building(s) within the building(s) 5 foot line.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Calibrated Balancing Valves

Pump Discharge Valve

Pumps

Combination Strainer and Pump Suction Diffuser

Expansion Tanks

Air Separator Tanks

Water Treatment Systems

Proposed water treatment plan including a layout, control scheme, a list of existing make-up water conditions including the items listed in paragraph "Water Analysis", a list of chemicals, the proportion of chemicals to be added, the final treated water conditions, and a description of environmental concerns for handling the chemicals.

SD-06 Test Reports

Pressure tests reports; G

Report shall be provided in bound 8 1/2 by 11 inch booklets. In the reports, document all phases of the tests performed. Include initial test summaries, all repairs/adjustments made, and the final test results.

SD-07 Certificates

Employer's Record Documents (For Welding)

Welding Procedures and Qualifications

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Fittings
Unions
Flanges
Gaskets
Bolting

SD-10 Operation and Maintenance Data

Requirements for data packages are specified Section 01 78 23 OPERATION AND MAINTENANCE DATA,except as supplemented and modified by this specification section.

Submit spare parts data for each different item of equipment specified, with operation and maintenance data packages. Include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

Submit a list of qualified permanent service organizations with operation and maintenance data packages. Include service organization addresses and service area or expertise. The service

organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

Water Treatment Systems

An operation manual in bound 8 1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown. Include testing procedures used in determining water quality.

A maintenance manual in bound 8 1/2 by 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide.

Calibrated Balancing Valves, Data Package 3

Pump Discharge Valve, Data Package 2

Pumps, Data Package 3

Combination Strainer and Pump Suction Diffuser, Data Package 2

Expansion Tanks, Data Package 2

Air Separator Tanks, Data Package 2

## 1.4 MODIFICATIONS TO REFERENCES

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

### 1.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

### 1.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

## 1.5 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired.

## 1.6 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, cap piping and similar openings to keep out dirt and other foreign matter. Any porous materials found to be contaminated with mold or mildew will be replaced at the Contractor's expense. Non-porous materials found to be contaminated with mold or mildew will be disinfected and cleaned prior to installation.

## 1.7 PROJECT/SITE CONDITIONS

### 1.7.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

### 1.7.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

### 1.7.3 Accessibility

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

# PART 2 PRODUCTS

## 2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening.

The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures.

Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. System components shall be environmentally suitable for the indicated locations.

The equipment items shall be supported by service organizations. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

## 2.2 STEEL PIPING

Water piping shall be steel pipe or copper tubing. Provide steel piping with a ANSI/ASME Class 125 service rating, which for 150 degrees F, the pressure rating is 175 psig.

### 2.2.1 Pipe

Steel pipe, conform to ASTM A 53/A 53M, Schedule 40, Type E or S, Grades A or B. Do not use Type F pipe.

### 2.2.2 Fittings and End Connections (Joints)

Piping and fittings 1 inch and smaller shall have threaded connections. Piping and fittings larger than 1 inch and smaller than 3 inches shall have either threaded, grooved, or welded connections. Piping and fittings 3 inches and larger shall have grooved, welded, or flanged connections. The manufacturer of each fitting shall be permanently identified on the body of the fitting in accordance with MSS SP-25.

#### 2.2.2.1 Threaded Connections

Use threaded valves and pipe connections conforming to ASME B1.20.1. Used threaded fitting conforming to ASME B16.3. Use threaded unions conforming to ASME B16.39. Use threaded pipe nipples conforming to ASTM A 733.

#### 2.2.2.2 Flanged Connections

Flanges shall conform to ASME B16.1, Class 150. Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. These gaskets shall contain aramid fibers bonded with styrene butadeine rubber (SBR) or nitrile butadeine rubber (NBR). Bolts, nuts, and bolt patterns shall conform to ASME B16.1.

#### 2.2.2.3 Welded Connections

Welded valves and pipe connections (both butt-welds and socket-welds types) shall conform to ASME B31.9. Butt-welded fittings shall conform to ASME B16.9. Socket-welded fittings shall conform to ASME B16.11. Welded fittings shall be identified with the appropriate grade and marking symbol.

#### 2.2.2.4 Grooved Mechanical Connections For Steel

Rigid grooved mechanical connections may only be used in serviceable aboveground locations where the temperature of the circulating medium does not exceed 230 degrees F. Flexible grooved connections shall be used only

as a flexible connector with grooved pipe system. Unless otherwise specified, grooved piping components shall meet the corresponding criteria specified for the similar welded, flanged, or threaded component specified herein.

Each grooved mechanical joint shall be a system, including coupling housing, gasket, fasteners, all furnished by the same manufacturer. Joint installation shall be in compliance with joint manufacturer's written instructions.

Use fitting and coupling houses of malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12; or steel conforming ASTM A 106/A 106M, Grade B or ASTM A 53/A 53M. Use gaskets of molded synthetic rubber with central cavity, pressure responsive configuration and conforming to ASTM D 2000 Grade No. 2CA615A15B44F17Z for circulating medium up to 230 degrees F or Grade No. M3BA610A15B44Z for circulating medium up to 200 degrees F. Grooved mechanical connections shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183. Pipe connections and fittings shall be the product of the same manufacturer. Provide joint installation be in compliance with joint manufacturer's written instructions.

2.2.2.5 Dielectric Waterways and Flanges

Provide dielectric waterways with a water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint. When dry, insulation barrier shall be able to withstand a 600-volt breakdown test. Provide dielectric waterways constructed of galvanized steel and have threaded end connections to match connecting piping. Dielectric waterways shall be suitable for the required operating pressures and temperatures. Provide dielectric flanges with the same pressure ratings as standard flanges and provide complete electrical isolation between connecting pipe and/or equipment as described herein for dielectric waterways.

2.3 COPPER TUBING

Provide copper tubing and fittings with a ANSI/ASME Class 125 service rating, which for 150 degrees F., the pressure rating is 175 psig.

2.3.1 Tube

Use copper tube conforming to ASTM B 88, Type L or M for aboveground tubing, and Type K for buried tubing.

2.3.2 Fittings and End Connections (Solder and Flared Joints)

Wrought copper and bronze solder joint pressure fittings, including unions ands flanges, shall conform to ASME B16.22 and ASTM B 75. Provide adapters as required. Cast copper alloy solder-joint pressure fittings , including unions and flanges, shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. ASTM B 42 copper pipe nipples with threaded end connections shall conform to ASTM B 42.

Copper tubing of sizes larger than 4 inches shall have brazed joints.Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment.

Extracted brazed tee joints may be used if produced with an acceptable tool and installed in accordance with tool manufacturer's written procedures.

2.3.3 Grooved Mechanical Connections For Copper

Rigid grooved mechanical connections may only be used in serviceable aboveground locations where the temperature of the circulating medium does not exceed 230 degrees F. Flexible grooved connections shall be used only as a flexible connector with grooved pipe system. Unless otherwise specified, grooved piping components shall meet the corresponding criteria specified for the similar welded, flanged, or threaded component specified herein.

Each grooved mechanical joint shall be a system, including coupling housing, gasket, fasteners, all furnished by the same manufacturer. Joint installation shall be in compliance with joint manufacturer's written instructions.

Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A 536. Provide gaskets for use in grooved joints shall constructed of molded synthetic polymer of pressure responsive design and shall conform to ASTM D 2000 for circulating medium up to 230 degrees F. Provide grooved joints in conformance with AWWA C606.

2.3.4 Solder

Provide solder in conformance with ASTM B 32, grade Sb5, tin-antimony alloy. Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B 813.

2.3.5 Brazing Filler Metal

Filler metal shall conform to AWS A5.8/A5.8M, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

2.4 VALVES

Provide valves with a ANSI/ASME Class 125 service rating, which for 150 degrees F, the pressure rating is 175 psig.

Valves in sizes larger than 1 inch and used on steel pipe systems, may be provided with rigid grooved mechanical joint ends. Such grooved end valves shall be subject to the same requirements as rigid grooved mechanical joints and fittings and, shall be furnished by the same manufacturer as the grooved pipe joint and fitting system.

2.4.1 Gate Valve

Gate valves 2-1/2 inches and smaller shall conform to MSS SP-80 Class 125 and shall be bronze with wedge disc, rising stem and threaded, soldered, or flanged ends. Gate valves 3 inches and larger shall conform to MSS SP-70, Class 125, cast iron with bronze trim, outside screw and yoke, and flanged or threaded ends.

2.4.2 Globe and Angle Valve

Globe and angle valves 2-1/2 inches and smaller shall conform to MSS SP-80,

Class 125. Globe and angle valves 3 inches and larger shall conform to MSS SP-85, Class 125.

2.4.3 Check Valve

Check valves 2-1/2 inches and smaller shall conform to MSS SP-80. Check valves 3 inches and larger shall conform to MSS SP-71, Class 125.

2.4.4 Butterfly Valve

Butterfly valves shall conform to MSS SP-67, Type 1 and shall be either the wafer or lug type. Valves smaller than 8 inches shall have throttling handles with a minimum of [two][seven] locking positions. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators.

2.4.5 Plug Valve

Plug valves 2 inches and larger shall conform to MSS SP-78, have flanged or threaded ends, and have cast iron bodies with bronze trim. Valves 2 inches and smaller shall be bronze with NPT connections for black steel pipe and brazed connections for copper tubing. Valve shall be lubricated, non-lubricated, or tetrafluoroethylene resin-coated type. Valve shall be resilient, double seated, trunnion mounted with tapered lift plug capable of 2-way shutoff. Valve shall operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug. [Valve shall a weatherproof operators with mechanical position indicators.] Valves 8 inches or larger shall be provided with manual gear operators with position indicators.

2.4.6 Ball Valve

Full port design. Ball valves 1/2 inch and larger shall conform to MSS SP-72 or MSS SP-110 and shall be cast iron or bronze with threaded, soldered, or flanged ends. Valves 8 inches or larger shall be provided with manual gear operators with position indicators. Ball valves may be provided in lieu of gate valves.

2.4.7 Square Head Cocks

Provide copper alloy or cast-iron body with copper alloy plugs, suitable for 125 psig water working pressure.

2.4.8 Calibrated Balancing Valves

Copper alloy or cast iron body, copper alloy or stainless internal working parts. Provide valve calibrated so that flow can be determined when the temperature and pressure differential across valve is known. Valve shall have an integral pointer which registers the degree of valve opening. Valve shall function as a service valve when in fully closed position. Valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation.

Provide valve bodies with tapped openings and pipe extensions with positive shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable differential pressure meter connections to verify the pressure differential. Provide metal tag on each valve showing the gallons per minute flow for each differential pressure reading. [In lieu of the balancing valve with

integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing.]

2.4.9 Pump Discharge Valve

Valve shall shall perform the functions of a nonslam check valve, a manual balancing valve, and a shutoff. Valve shall be of cast iron or ductile iron construction with bronze and/or stainless steel accessories. Provide an integral pointer on the valve which registers the degree of valve opening. Flow through the valve shall be manually adjustable from bubble tight shutoff to full flow. Valves smaller than 2 inches shall have NPT connections. Valves 2 inches and larger shall have flanged or grooved end connections. Valve design shall allow the back seat for the stem to be replaced in the field under full line pressure.

2.4.10 Air Venting Valves

Automatic type air venting shall be the ball-float type with brass/bronze or brass bodies, 300 series corrosion-resistant steel float, linkage and removable seat. Air venting valves on water coils shall have not less than 1/8 inch threaded end connections. Air venting valves on water mains shall have not less than 3/4 inch threaded end connections. Air venting valves on all other applications shall have not less than 1/2 inch threaded end connections.

2.5 PIPING ACCESSORIES

2.5.1 Combination Strainer and Pump Suction Diffuser

Angle type body with removable strainer basket and internal straightening vanes, a suction pipe support, and a blowdown outlet and plug. Strainer shall be in accordance with ASTM F 1199, except as modified and supplemented by this specification. Unit body shall have arrows clearly cast on the sides indicating the direction of flow.

Strainer screen shall be made of minimum 22 gauge [brass sheet,] [monel,] [corrosion-resistant steel,] with small perforations numbering not less than 400 per square inchto provide a net free area through the basket of at least 3.30 times that of the entering pipe. Flow shall be into the screen and out through the perforations. Provide an auxiliary disposable fine mesh strainer which shall be removed 30 days after start-up. Provide warning tag for operator indicating scheduled date for removal.

Casing shall have connection sizes to match pump suction and pipe sizes, and be provided with adjustable support foot or support foot boss to relieve piping strains at pump suction. Provide unit casing with blowdown port and plug. Provide a magnetic insert to remove debris from system.

2.5.2 Flexible Pipe Connectors

Provide flexible bronze or stainless steel piping connectors with single braid. Equip flanged assemblies with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Provide covers to protect the bellows where indicated.

### 2.5.3 Pressure and Vacuum Gauges

Gauges, ASME B40.100 with throttling type needle valve or a pulsation dampener and shut-off valve. Provide gauges with 4.5 inch dial, brass or aluminum case, bronze tube, and siphon. Gauge shall have a minimum of with a range from 0 psig to approximately 1.5 times the maximum system working pressure. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.

### 2.5.4 Temperature Gauges

Temperature gauges, shall be the industrial duty type and be provided for the required temperature range. Provide gauges with fixed thread connection, dial face gasketed within the case; and an accuracy within 2 percent of scale range. Gauges shall have Fahrenheit scale in 2 degree graduations scale (black numbers) on a white face. The pointer shall be adjustable. Rigid stem type temperature gauges shall be provided in thermal wells located within 5 feet of the finished floor. Universal adjustable angle type or remote element type temperature gauges shall be provided in thermal wells located 5 to 7 feet above the finished floor or in locations indicated. Remote element type temperature gauges shall be provided in thermal wells located 7 feet above the finished floor or in locations indicated.

#### 2.5.4.1 Stem Cased-Glass

Stem cased-glass case shall be polished stainless steel or cast aluminum, 9 inches long, with clear acrylic lens, and non-mercury filled glass tube with indicating-fluid column.

#### 2.5.4.2 Bimetallic Dial

Bimetallic dial type case shall be not less than 3-1/2 inches, stainless steel, and shall be hermetically sealed with clear acrylic lens. Bimetallic element shall be silicone dampened and unit fitted with external calibrator adjustment.

#### 2.5.4.3 Liquid-, Solid-, and Vapor-Filled Dial

Liquid-, solid-, and vapor-filled dial type cases shall be not less than 3-1/2 inches, stainless steel or cast aluminum with clear acrylic lens. Fill shall be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing shall be double-braided bronze.

#### 2.5.4.4 Thermal Well

Thermal well shall be identical size, 1/2 or 3/4 inch NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 1/2 inch NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Mercury shall not be used in thermometers. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 1 inch.

### 2.5.5 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, guides, and supports: to MSS SP-58 and MSS SP-69.

2.5.6 Escutcheons

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Secure plates in place by internal spring tension or set screws. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

2.5.7 Expansion Joints

2.5.7.1 Slip-Tube Type

Slip-tube expansion joints, ASTM F 1007, Class I or II. Joints shall be provided with internally-externally alignment guides, injected semi-plastic packing, and service outlets. End connections shall be flanged or beveled for welding as indicated. Initial settings shall be made in accordance with the manufacturer's recommendations to compensate for ambient temperature at time of installation. Pipe alignment guides shall be installed as recommended by the joint manufacturer.

2.5.7.2 Flexible Ball Type

Flexible ball expansion joints shall be capable of 360 degrees rotation plus 15 degrees angular flex movement. Joints shall be constructed of carbon steel with the exterior spherical surface of carbon steel balls plated with a minimum 5 mils of hard chrome in accordance with EJMA Stds. Joint end connections shall be threaded for piping 2 inches or smaller. Joint end connections larger than 2 inches shall be grooved, flanged, or beveled for welding. Provide joint with pressure-molded composition gaskets suitable for continuous operation at twice design temperature.

2.5.7.3 Bellows Type

Bellows expansion type joints, ASTM F 1120 with Type 304 stainless steel corrugated bellows, reinforced with equalizing rings, internal sleeves, and external protective covers. Joint end connections shall be grooved, flanged, or beveled for welding. Guiding of piping on both sides of expansion joint shall be in accordance with the published recommendations of the manufacturer of the expansion joint.

2.6 PUMPS

Pumps shall be the electrically driven, non-overloading, centrifugal type which conform to HI 1.1-1.2. Pumps shall be selected at or within 5 percent of peak efficiency. Pump curve shall rise continuously from maximum capacity to shutoff. Pump motor shall conform to NEMA MG 1, be [open] [splash-proof] [totally enclosed], and have sufficient horsepower for the service required. Pump motor shall have the required capacity to prevent overloading with pump operating at any point on its characteristic curve. Pump speed shall not exceed 3,600 rpm, except where the pump head is less than 60 feet of water, the pump speed shall not exceed 1,750 rpm. Pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in the cover.

2.6.1 Construction

Each pump casing shall be designed to withstand the discharge head specified plus the static head on system plus 50 percent of the total, but not less than 125 psig. Pump casing and bearing housing shall be close

grained cast iron. High points in the casing shall be provided with manual air vents; low points shall be provided with drain plugs. Provide threaded suction and discharge pressure gage tapping with square-head plugs.

Impeller shall be statically and dynamically balanced. Impeller, impeller wearing rings, glands, casing wear rings, and shaft sleeve shall be bronze. Shaft shall be carbon or alloy steel, turned and ground. Bearings shall be ball-bearings, roller-bearings, or oil-lubricated bronze-sleeve type bearings, and be efficiently sealed or isolated to prevent loss of oil or entrance of dirt or water.

Pump and motor shall be mounted on a common cast iron base having lipped edges and tapped drainage openings or structural steel base with lipped edges or drain pan and tapped drainage openings.Pump shall be provided with steel shaft coupling guard. Base-mounted pump, coupling guard, and motor shall each be bolted to a fabricated steel base which shall have bolt holes for securing base to supporting surface. Pump shall be accessible for servicing without disturbing piping connections. Shaft seals shall be mechanical-seals or stuffing-box type.

### 2.6.2 Mechanical Shaft Seals

Seals shall be single, inside mounted, end-face-elastomer bellows type with stainless steel spring, brass or stainless steel seal head, carbon rotating face, and tungsten carbide or ceramic sealing face. Glands shall be bronze and of the water-flush design to provide lubrication flush across the face of the seal. Bypass line from pump discharge to flush connection in gland shall be provided, with filter or cyclone particle separator in line.

### 2.6.3 Stuffing-Box Type Seals

Stuffing box shall include minimum 4 rows of square, impregnated TFE (Teflon) or graphite cord packing and a bronze split-lantern ring. Packing gland shall be bronze interlocking split type.

## 2.7 EXPANSION TANKS

Tank shall be welded steel, constructed for, and tested to pressure-temperature rating of 125 psi at 150 degrees F. Provide tanks precharged to the minimum operating pressure. Tank shall have a replaceable polypropylene or butyl lined diaphragm which keeps the air charge separated from the water; shall be the captive air type.

Tanks shall accommodate expanded water of the system generated within the normal operating temperature range, limiting this pressure increase at all components in the system to the maximum allowable pressure at those components. Each tank air chamber shall be fitted with a drain, fill, an air charging valve, and system connections. Tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The only air in the system shall be the permanent sealed-in air cushion contained within the expansion tank.

## 2.8 AIR SEPARATOR TANKS

[External air separation tank shall have an internal design constructed of stainless steel and suitable for creating the required vortex and subsequent air separation. Tank shall be steel, constructed for, and tested to pressure-temperature rating of 125 psi at 150 degrees F.. Tank shall have tangential inlets and outlets connections, threaded for 2 inches

and smaller and flanged for sizes 2 1/2 inches and larger. Air released from a tank shall be [to the atmosphere] [vented as indicated]. Tank shall be provided with a blow-down connection.]

[Design to separate air from water and to direct released air to automatic air vent. Unit shall be of one piece cast-iron construction with internal baffles and two air chambers at top of unit; one air chamber shall have outlet to expansion tank and other air chamber shall be provided with automatic air release device. Tank shall be steel, constructed for, and tested to a ANSI Class 125 pressure-temperature rating.]

## 2.9 WATER TREATMENT SYSTEMS

When water treatment is specified, the use of chemical-treatment products containing equivalent chromium (CPR) is prohibited.

### 2.9.1 Water Analysis

Conditions of make-up water to be supplied to the condenser and chilled water systems were reported in accordance with ASTM D 596 and are as follows:

| | | |
|---|---|---|
| Date of Sample | [_____] | |
| Temperature | [_____] | degrees F. |
| Silica (Sino 2) | [_____] | pp (mg/1) |
| Insoluble | [_____] | pp (mg/1) |
| Iron and Aluminum Oxides | [_____] | pp (mg/1) |
| Calcium (Ca) | [_____] | pp (mg/1) |
| Magnesium (Mg) | [_____] | pp (mg/1) |
| Sodium and Potassium (Nan and AK) | [_____] | pp (mg/1) |
| Carbonate (HO 3) | [_____] | pp (mg/1) |
| Sulfate (SO 4) | [_____] | pp (mg/1) |
| Chloride (JCL) | [_____] | pp (mg/1) |
| Nitrate (NO 3) | [_____] | pp (mg/1) |
| Turbidity | [_____] | unit |
| pH | [_____] | |
| Residual Chlorine | [_____] | pp (mg/1) |
| Total Alkalinity | [_____] | PM (me/1) |
| Non-Carbonate Hardness | [_____] | PM (me/1) |
| Total Hardness | [_____] | PM (me/1) |
| Dissolved Solids | [_____] | pp (mg/1) |
| Fluorine | [_____] | pp (mg/1) |
| Conductivity | [_____] | McMahon/cm |

### 2.9.2 Chilled Water

Water to be used in the chilled water systems shall be treated to maintain the conditions recommended by this specification as well as the recommendations from the manufacturers of the condenser and evaporator coils. Chemicals shall meet all required federal, state, and local environmental regulations for the treatment of evaporator coils and direct discharge to the sanitary sewer.

### 2.9.3 Glycol Solution

A 5 percent concentration by volume of industrial grade ethylene glycol shall be provided in the chilled water. The glycol shall be tested in accordance with ASTM D 1384 with less than 0.5 mils penetration per year for all system metals. The glycol shall contain corrosion inhibitors.

Silicate based inhibitors shall not be used. The solution shall be compatible with pump seals, other elements of the system, and water treatment chemicals used within the system.

2.9.4 Water Treatment Services

The services of a company regularly engaged in the treatment of chilled water systems shall be used to determine the correct chemicals required, the concentrations required, and the water treatment equipment sizes and flow rates required. The company shall maintain the chemical treatment and provide all chemicals required for the chilled water systems for a period of 1 year from the date of occupancy. The chemical treatment and services provided over the 1 year period shall meet the requirements of this specification as well as the recommendations from the manufacturers of the condenser and evaporator coils. Acid treatment and proprietary chemicals shall not be used.

2.9.5 Chilled Water System

A shot feeder shall be provided on the chilled water piping as indicated. Size and capacity of feeder shall be based on local requirements and water analysis. The feeder shall be furnished with an air vent, gauge glass, funnel, valves, fittings, and piping.

2.10 ELECTRICAL WORK

Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers including the required monitors and timed restart.

Provide high efficiency type, single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11.

Provide polyphase, squirrel-cage medium induction motors, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

2.11 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall

be as specified herein, and provided under each individual section.

2.11.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided. The factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test.

Salt-spray fog test shall be in accordance with ASTM B 117, and for that test, the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark. The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen.

If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

2.11.2 Shop Painting Systems for Metal Surfaces

Clean, retreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where hot-dip galvanized steel has been cut, resulting surfaces with no galvanizing shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

b. Temperatures Between120 and 400 egrees F: Metal surfaces subject to temperatures between120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of2 mils.

c. Temperatures Greater Than 400 degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

## 2.12 FACTORY APPLIED INSULATION

Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E 84.

Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

## 2.13 NAMEPLATES

Major equipment including pumps, pump motors, expansion tanks, and air separator tanks shall have the manufacturer's name, type or style, model or serial number on a plate secured to the item of equipment. The nameplate of the distributing agent will not be acceptable. Plates shall be durable and legible throughout equipment life and made of anodized aluminum or stainless steel. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

## 2.14 RELATED COMPONENTS/SERVICES

### 2.14.1 Drain and Make-Up Water Piping

Requirements for drain and make-up water piping and backflow preventer's is specified in Section 22 00 00 PLUMBING SYSTEMS.

### 2.14.2 Field Applied Insulation

Requirements for field applied insulation is specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

### 2.14.3 Field Painting

Requirements for painting of surfaces not otherwise specified, and finish painting of items only primed at the factory, are specified in Section 09 90 00PAINTING, GENERAL.

#### 2.14.3.1 Color Coding

Requirements for color coding for piping identification are specified in Section 09 90 00 PAINTING AND COATINGS.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Cut pipe accurately to measurements established at the jobsite, and work into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation is not permitted without

written approval. Cut pipe or tubing square, remove burrs by reaming, and fashion to permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

Notify the Contracting Officer in writing at least 15 calendar days prior to the date the connections are required. Obtain approval before interrupting service. Furnish materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required. Furnish labor and tools for making actual connections to existing systems.

3.1.1 Welding

Provide welding work specified this section for piping systems in conformance with ASME B31.9, as modified and supplemented by this specification section and the accompanying drawings. The welding work includes: qualification of welding procedures, welders, welding operators, brazers, brazing operators, and nondestructive examination personnel; maintenance of welding records, and examination methods for welds.

3.1.1.1 Employer's Record Documents (For Welding)

Submit for review and approval the following documentation. This documentation and the subject qualifications shall be in compliance with ASME B31.9.

a. List of qualified welding procedures that is proposed to be used to provide the work specified in this specification section.

b. List of qualified welders, brazers, welding operators, and brazing operators that are proposed to be used to provide the work specified in this specification section.

c. List of qualified weld examination personnel that are proposed to be used to provide the work specified in this specification section.

3.1.1.2 Welding Procedures and Qualifications

a. Specifications and Test Results: Submit copies of the welding procedures specifications and procedure qualification test results for each type of welding required. Approval of any procedure does not relieve the Contractor of the responsibility for producing acceptable welds. Submit this information on the forms printed in ASME BPVC SEC IX or their equivalent.

b. Certification: Before assigning welders or welding operators to the work, submit a list of qualified welders, together with data and certification that each individual is performance qualified as specified. Do not start welding work prior to submitting welder, and welding operator qualifications. The certification shall state the type of welding and positions for which each is qualified, the code and procedure under which each is qualified, date qualified, and the firm and individual certifying the qualification tests.

3.1.1.3 Examination of Piping Welds

Conduct non-destructive examinations (NDE) on piping welds and brazing and

verify the work meets the acceptance criteria specified in ASME B31.9. NDE on piping welds covered by ASME B31.9 is visual inspection only. Submit a piping welds NDE report meeting the requirements specified in ASME B31.9.

3.1.1.4 Welding Safety

Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

3.1.2 Directional Changes

Make changes in direction with fittings, except that bending of pipe 4 inches and smaller is permitted, provided a pipe bender is used and wide weep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees is not permitted. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations is not acceptable.

3.1.3 Functional Requirements

Pitch horizontal supply mains down in the direction of flow as indicated. The grade shall not be less than 1 inch in 40 feet. Reducing fittings shall be used for changes in pipe sizes. Cap or plug open ends of pipelines and equipment during installation to keep dirt or other foreign materials out of the system.

Pipe not otherwise specified shall be uncoated. Connections to appliances shall be made with malleable iron unions for steel pipe 2-1/2 inches or less in diameter, and with flanges for pipe 3 inches and above in diameter. Connections between ferrous and copper piping shall be electrically isolated from each other with dielectric waterways or flanges.

Piping located in air plenums shall conform to NFPA 90A requirements. Pipe and fittings installed in inaccessible conduits or trenches under concrete floor slabs shall be welded. Equipment and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance. Electric isolation fittings shall be provided between dissimilar metals.

3.1.4 Fittings and End Connections

3.1.4.1 Threaded Connections

Threaded connections shall be made with tapered threads and made tight with PTFE tape complying with ASTM D 3308 or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is made.

3.1.4.2 Brazed Connections

Brazing, AWS BRH, except as modified herein. During brazing, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Do not use brazing flux. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the

manufacturer's recommendations. Piping shall be supported prior to brazing and not be sprung or forced.

3.1.4.3 Welded Connections

Branch connections shall be made with welding tees or forged welding branch outlets. Pipe shall be thoroughly cleaned of all scale and foreign matter before the piping is assembled. During welding, the pipe and fittings shall be filled with an inert gas, such as nitrogen, to prevent the formation of scale. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.9. Weld defects shall be removed and rewelded at no additional cost to the Government. Electrodes shall be stored and dried in accordance with AWS D1.1/D1.1M or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.4.4 Grooved Mechanical Connections

Prepare grooves in accordance with the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.1.4.5 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

3.1.4.6 Flanges and Unions

Except where copper tubing is used, union or flanged joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. Flanged joints shall be assembled square end tight with matched flanges, gaskets, and bolts. Gaskets shall be suitable for the intended application.

3.1.5 Valves

Isolation gate or ball valves shall be installed on each side of each piece of equipment, at the midpoint of all looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purpose. Isolation valves may be omitted where balancing cocks are installed to provide both balancing and isolation functions. Each valve except check valves shall be identified. Valves in horizontal lines shall be installed with stems horizontal or above.

3.1.6 Air Vents

Air vents shall be provided at all high points, on all water coils, and where indicated to ensure adequate venting of the piping system.

### 3.1.7 Drains

Drains shall be provided at all low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

### 3.1.8 Flexible Pipe Connectors

Connectors shall be attached to components in strict accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the flexible pipe connector manufacturer and shall be provided at the intervals recommended.

### 3.1.9 Temperature Gauges

Temperature gauges shall be located on coolant supply and return piping at each heat exchanger, on condenser water piping entering and leaving a condenser, at each automatic temperature control device without an integral thermometer, and where indicated or required for proper operation of equipment. Thermal wells for insertion thermometers and thermostats shall extend beyond thermal insulation surface not less than 1 inch.

### 3.1.10 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as supplemented and modified in this specification section. Pipe hanger types 5, 12, and 26 shall not be used. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers.

#### 3.1.10.1 Hangers

Type 3 shall not be used on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

#### 3.1.10.2 Inserts

Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they otherwise meet the requirements for Type 18 inserts.

#### 3.1.10.3 C-Clamps

Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

#### 3.1.10.4 Angle Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

3.1.10.5 Saddles and Shields

Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle, connected to the pipe, shall be used on all pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 40 shields shall be used on all piping less than 4 inches and all piping 4 inches and larger carrying medium less than 60 degrees F. A high density insulation insert of cellular glass shall be used under the Type 40 shield for piping 2 inches and larger.

3.1.10.6 Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. [Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 50 pounds shall have the excess hanger loads suspended from panel points.]

3.1.10.7 Vertical Pipe Supports

Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.

3.1.10.8 Pipe Guides

Type 35 guides using, steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

3.1.10.9 Steel Slides

Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle shall be used. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

3.1.10.10 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

3.1.10.11 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floors or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only. Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material used for support

shall be as specified under Section 05 12 00 STRUCTURAL STEEL.

3.1.11 Building Surface Penetrations

Sleeves shall not be installed in structural members except where indicated or approved. Except as indicated otherwise piping sleeves shall comply with requirements specified. Sleeves in nonload bearing surfaces shall be galvanized sheet metal, conforming to ASTM A 653/A 653M, Coating Class G-90, 20 gauge. Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to ASTM A 53/A 53M, [Schedule 30][Schedule 20][Standard weight]. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 1/2 inch depth. Sleeves shall not be installed in structural members.

3.1.11.1 General Service Areas

Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall be of such size as to provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed in accordance with Section 07 92 00 JOINT SEALANTS.

3.1.11.2 Waterproof Penetrations

Pipes passing through roof or floor waterproofing membrane shall be installed through a .17 ounce copper sleeve, or a 0.032 inch thick aluminum sleeve, each within an integral skirt or flange.

Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 8 inches from the pipe and be set over the roof or floor membrane in a troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 2 inches above the roof or floor penetration. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Penetrations shall be sealed by either one of the following methods.

a. Waterproofing Clamping Flange: Pipes up to and including 10 inches in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.

b. Modular Mechanical Type Sealing Assembly: In lieu of a waterproofing clamping flange, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut.

After the seal assembly is properly positioned in the sleeve,

tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal rubber sealing elements to expand and provide a watertight seal between the pipe/conduit seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals shall provide sleeves of the proper diameters.

3.1.11.3 Fire-Rated Penetrations

Penetration of fire-rated walls, partitions, and floors shall be sealed as specified in Section 07 84 00 FIRESTOPPING.

3.1.11.4 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

3.1.12 Access Panels

Access panels shall be provided where indicated for all concealed valves, vents, controls, and additionally for items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in[ Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS][ Section 05 51 33 METAL LADDERS][ Section 05 52 00 METAL RAILINGS][ Section 05 51 00 METAL STAIRS].

3.2 ELECTRICAL INSTALLATION

Install electrical equipment in accordance with NFPA 70 and manufacturers instructions.

3.3 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of all foreign matter. A temporary bypass shall be provided for all water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from all water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed.

3.4 FIELD TESTS

Field tests shall be conducted in the presence of the QC Manager or his designated representative to verify systems compliance with specifications. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor.

3.4.1 Equipment and Component Isolation

Prior to testing, equipment and components that cannot withstand the tests shall be properly isolated.

3.4.2 Pressure Tests

Each piping system shall be hydrostatically tested at a pressure not less than 188 psig for period of time sufficient to inspect every joint in the system and in no case less than 2 hours. Test pressure shall be monitored by a currently calibrated test pressure gauge. Leaks shall be repaired and piping retested until test requirements are met. No leakage or reduction in gage pressure shall be allowed.

Leaks shall be repaired by rewelding or replacing pipe or fittings. Caulking of joints will not be permitted. Concealed and insulated piping shall be tested in place before concealing.

Submit for approval pressure tests reports covering the above specified piping pressure tests; describe the systems tested, test results, defects found and repaired, and signature of the pressure tests' director. Obtain approval from the QC Manager before concealing piping or applying insulation to tested and accepted piping.

3.4.3 Related Field Inspections and Testing

3.4.3.1 Piping Welds

Examination of Piping Welds is specified in the paragraph above entitled "Examination of Piping Welds".

3.4.3.2 HVAC TAB

Requirements for testing, adjusting, and balancing (TAB) of HVAC water piping, and associated equipment is specified in Section 23 05 93 TESTING,ADJUSTING, AND BALANCING. Coordinate with the TAB team, and provide support personnel and equipment as specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING to assist TAB team to meet the TAB work requirements.

3.5 INSTRUCTION TO GOVERNMENT PERSONNEL

Furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the [chilled water,] [chilled-hot water,][ and][ condenser water piping system[s]]. Instructors shall be thoroughly familiar with all parts of the installation and shall be instructed in operating theory as well as practical operation and maintenance work. Submit a lesson plan for the instruction course for approval. The lesson plan and instruction course shall be based on the approved operation and maintenance data and maintenance manuals.

Conduct a training course for the operating staff and maintenance staff selected by the Contracting Officer. Give the instruction during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be one man-day. Use approximately half of the time for classroom instruction and the other time for instruction at the location of equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

-- End of Section --

ITT

**SUBMITTAL**

**B-224.1E**

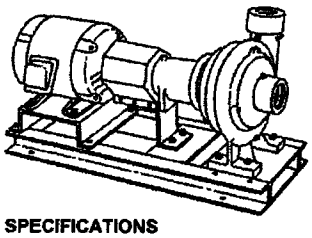
**JOB:** SOF RIVERINE & COMBATANT CRAFT OPER. FAC.

**REPRESENTATIVE:** Hydronic Technology, Inc.

**UNIT TAG:** P-1,2
**ENGINEER:**
**CONTRACTOR:** GALLO MECHANICAL

**ORDER NO.**
**SUBMITTED BY:** BILLY MARTINEZ
**APPROVED BY:**

**DATE:** 5/1/2009
**DATE:**
**DATE:**



# 1-1/2AC
# Series 1510
## Centrifugal Pumps - Base Mounted

**SPECIFICATIONS**

| | | | |
|---|---|---|---|
| FLOW | 91.2 (GPM) | HEAD | 40 (FT) |
| HP | 2 | RPM | 1800 |
| VOLTS | 230/460 | | |
| CYCLE | 60 | PHASE | 3 |
| TEFC Premium Efficiency | | | |
| APPROX. WEIGHT | 172 | | |
| SPECIALS | | | |

**MATERIALS OF CONSTRUCTION**

☒ BRONZE FITTED ☐ ALL IRON

**FEATURES**

- ☒ ANSI/OSHA Coupling Guard
- ☒ Center Drop Out Spacer Coupling
- ☒ Fabricated Heavy Duty Baseplate

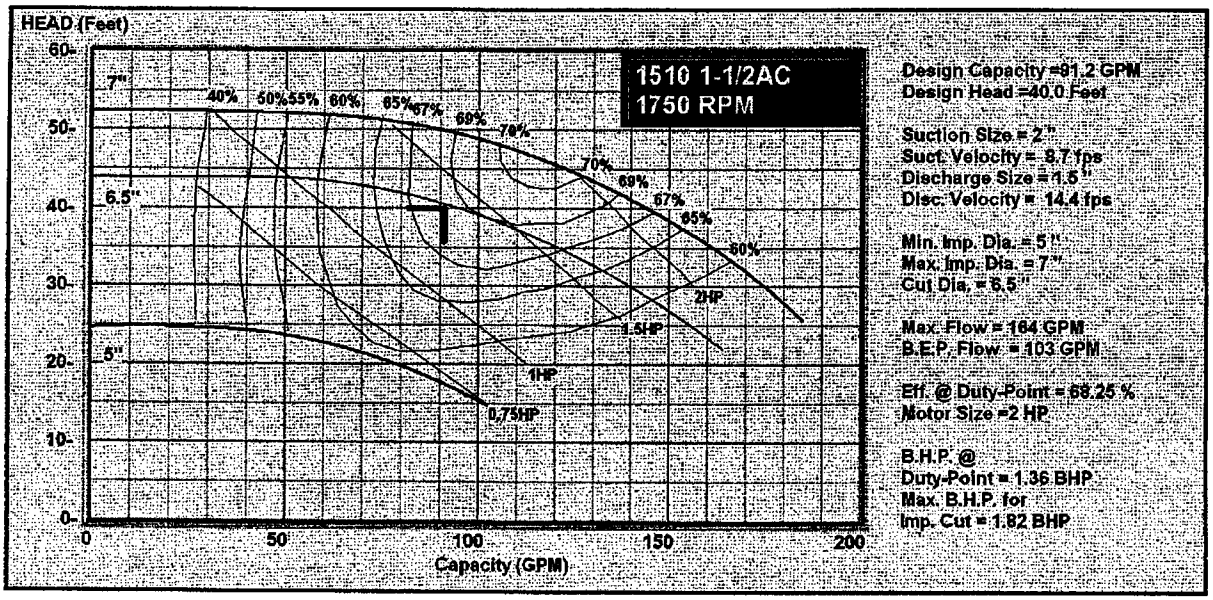
**MAXIMUM WORKING PRESSURE**

☒ 175 psi (12 bar) W.P.

**TYPE OF SEAL**

- ☒ 1510 Standard Seal (Buna-Carbon/Ceramic)
- ☐ 1510 -F Standard Seal w/ Flush Line (Buna-Carbon/Ceramic)
- ☐ 1510 -S Stuffing Box construction w/ Flushed Mechanical Single Seal (EPR-Tungsten Carbide/Carbon)
- ☐ 1510 -D Stuffing Box construction w/ Flushed Double Mechanical Seal (EPR-Carbon/Ceramic) Requires external water source
- ☐ 1510 -PF Stuffing Box Construction w/ Packing (Graphite Impregnated Teflon)

**Note: Equipped with EPDM coupling**

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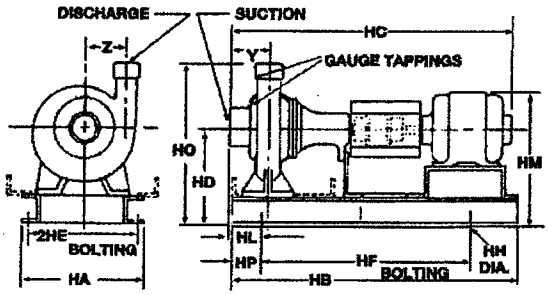
**Bell & Gossett**

# Series 1510 1-1/2AC Centrifugal Pump Submittal

**B-224.1E**




| NOZZLE SIZES | |
|---|---|
| Discharge | 1-1/2" N.P.T. |
| Suction | 2" N.P.T. |

**DIMENSIONS – Inches (mm)**

**STANDARD SEAL 1510, 1510-F**

| MOTOR FRAME | HA | HB | HC MAX | HD | 2HE | HF | HH | HL | HM MAX | HO | HP | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | "S" FRAME | | | | | | | | | | | | |
| 56 | 12 (305) | 28-3/4 (730) | 28-1/4 (718) | 9-3/4 (248) | 10-1/4 (260) | 22-1/2 (572) | 3/4 (19) | 3-1/16 (78) | 13-3/8 (340) | 15-3/4 (400) | 3 (76) | 3-1/8 (79) | 4-5/8 (117) |
| 143T | 12 (305) | 28-3/4 (730) | 28-3/8 (721) | 9-3/4 (248) | 10-1/4 (260) | 22-1/2 (572) | 3/4 (19) | 3-1/16 (78) | 13-1/2 (343) | 15-3/4 (400) | 3 (76) | 3-1/8 (79) | 4-5/8 (117) |
| 145T | 12 (305) | 28-3/4 (730) | 29-3/8 (746) | 9-3/4 (248) | 10-1/4 (260) | 22-1/2 (572) | 3/4 (19) | 3-1/16 (78) | 13-1/2 (343) | 15-3/4 (400) | 3 (76) | 3-1/8 (79) | 4-5/8 (117) |
| 182T | 14-5/8 (371) | 31 (787) | 32-1/8 (816) | 9-3/4 (248) | 12-7/8 (327) | 25 (635) | 3/4 (19) | 1-11/16 (43) | 15 (381) | 15-3/4 (400) | 3 (76) | 3-1/8 (79) | 4-5/8 (117) |
| 184T | 14-5/8 (371) | 31 (787) | 32-7/8 (835) | 9-3/4 (248) | 12-7/8 (327) | 25 (635) | 3/4 (19) | 1-11/16 (43) | 15 (381) | 15-3/4 (400) | 3 (76) | 3-1/8 (79) | 4-5/8 (117) |
| 213T | 14-5/8 (371) | 34-5/8 (879) | 35-3/8 (899) | 9-3/4 (248) | 12-7/8 (327) | 28-5/8 (727) | 3/4 (19) | 1-11/16 (43) | 15-5/8 (397) | 15-3/4 (400) | 3 (76) | 3-1/8 (79) | 4-5/8 (117) |
| 215T | 14-5/8 (371) | 34-5/8 (879) | 36-7/8 (937) | 9-3/4 (248) | 12-7/8 (327) | 28-5/8 (727) | 3/4 (19) | 1-11/16 (43) | 15-5/8 (397) | 15-3/4 (400) | 3 (76) | 3-1/8 (79) | 4-5/8 (117) |
| 254T | 14-5/8 (371) | 39-3/8 (1000) | 40-5/8 (1032) | 10-3/4 (273) | 12-7/8 (327) | 33-3/8 (848) | 3/4 (19) | 1-11/16 (43) | 17-5/8 (448) | 16-3/4 (425) | 3 (76) | 3-1/8 (79) | 4-5/8 (117) |
| 256T | 14-5/8 (371) | 39-3/8 (1000) | 42-3/8 (1076) | 10-3/4 (273) | 12-7/8 (327) | 33-3/8 (848) | 3/4 (19) | 1-11/16 (43) | 17-5/8 (448) | 16-3/4 (425) | 3 (76) | 3-1/8 (79) | 4-5/8 (117) |

**STUFFING BOX 1510-PF, 1510-S, 1510-D**

| MOTOR FRAME | HA | HB | HC MAX | HD | 2HE | HF | HH | HL | HM MAX | HO | HP | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | "S" FRAME | | | | | | | | | | | | |
| 56 | 14-5/8 (371) | 34-5/8 (879) | 31-7/8 (810) | 9-3/4 (248) | 12-7/8 (327) | 28-5/8 (727) | 3/4 (19) | 1-11/16 (43) | 13-3/8 (340) | 15-3/4 (400) | 3 (76) | 3-1/8 (79) | 4-5/8 (117) |
| 143T | 14-5/8 (371) | 34-5/8 (879) | 32 (813) | 9-3/4 (248) | 12-7/8 (327) | 28-5/8 (727) | 3/4 (19) | 1-11/16 (43) | 13-1/2 (343) | 15-3/4 (400) | 3 (76) | 3-1/8 (79) | 4-5/8 (117) |
| 145T | 14-5/8 (371) | 34-5/8 (879) | 33 (838) | 9-3/4 (248) | 12-7/8 (327) | 28-5/8 (727) | 3/4 (19) | 1-11/16 (43) | 13-1/2 (343) | 15-3/4 (400) | 3 (76) | 3-1/8 (79) | 4-5/8 (117) |
| 182T | 14-5/8 (371) | 34-5/8 (879) | 35-3/4 (908) | 9-3/4 (248) | 12-7/8 (327) | 28-5/8 (727) | 3/4 (19) | 1-11/16 (43) | 15 (381) | 15-3/4 (400) | 3 (76) | 3-1/8 (79) | 4-5/8 (117) |
| 184T | 14-5/8 (371) | 34-5/8 (879) | 36-1/2 (927) | 9-3/4 (248) | 12-7/8 (327) | 28-5/8 (727) | 3/4 (19) | 1-11/16 (43) | 15 (381) | 15-3/4 (400) | 3 (76) | 3-1/8 (79) | 4-5/8 (117) |
| 213T | 14-5/8 (371) | 39-3/8 (1000) | 39 (991) | 9-3/4 (248) | 12-7/8 (327) | 33-3/8 (848) | 3/4 (19) | 1-11/16 (43) | 15-5/8 (397) | 15-3/4 (400) | 3 (76) | 3-1/8 (79) | 4-5/8 (117) |
| 215T | 14-5/8 (371) | 39-3/8 (1000) | 40-1/2 (1029) | 9-3/4 (248) | 12-7/8 (327) | 33-3/8 (848) | 3/4 (19) | 1-11/16 (43) | 15-5/8 (397) | 15-3/4 (400) | 3 (76) | 3-1/8 (79) | 4-5/8 (117) |
| 254T | 16 (406) | 46-1/2 (1181) | 44-1/4 (1124) | 12 (305) | 14 (356) | 36-1/2 (927) | 7/8 (22) | 2-13/16 (71) | 18-7/8 (479) | 18 (457) | 5 (127) | 3-1/8 (79) | 4-5/8 (117) |
| 256T | 16 (406) | 46-1/2 (1181) | 46 (1168) | 12 (305) | 14 (356) | 36-1/2 (927) | 7/8 (22) | 2-13/16 (71) | 18-7/8 (479) | 18 (457) | 5 (127) | 3-1/8 (79) | 4-5/8 (117) |

**Dimensions are subject to change. Not to be used for construction purposes unless certified.**

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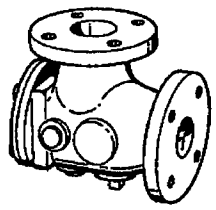
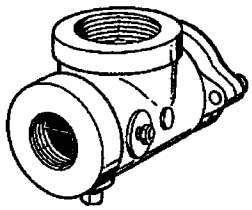
ITT

**SUBMITTAL**

**B-825H**

**JOB:** SOF RIVERINE & COMBATANT CRAFT OPER. FAC.
**REPRESENTATIVE:** Hydronic Technology, Inc.

**UNIT TAG:**
**ENGINEER:**
**CONTRACTOR:** GALLO MECHANICAL
**ORDER NO.**
**SUBMITTED BY:** BILLY MARTINEZ
**APPROVED BY:**
**DATE:** 5/1/2009
**DATE:**
**DATE:**

# B&G Suction Diffuser

## Centrifugal Pump Accessories

**DESCRIPTION**

The Bell & Gossett Suction Diffuser with disposable start-up strainer is designed for direct application to the pump suction and provides ideal flow conditions for the pump providing NPSH requirements are met. The integral orifice cylinder has a free area equal to five times the cross section of the pump suction opening and serves as a strainer protecting the pump.

**OPERATING DATA**

Operating Temperature: 250°F (121°C)
Working Pressure: 175 psi (1,207 kPa)

**MATERIALS OF CONSTRUCTION**

| Type | Body | Inlet Vanes | Orifice Cylinder | Start-Up Strainer |
|---|---|---|---|---|
| X | Cast Iron | Steel | | 16 Mesh Bronze |
| Z | Cast Iron | Stainless Steel | | 16 Mesh Bronze |

**NOTES:** Type X-For Closed Systems.
Type Z-For Domestic Water and Tower Systems.

**SCHEDULE**

| MODEL NUMBER | DIMENSIONS INCHES (mm) | | | | TAGGING INFORMATION | X QUANTITY | Z QUANTITY |
|---|---|---|---|---|---|---|---|
| | SYSTEM SIDE | | PUMP SIDE | | | | |
| BA-3X/BA-3Z | 2 (50.8) | FPT | 1-1/2 (38.1) | FPT | | | |
| BB-3X/BB-3Z | 2 (50.8) | FPT | 2 (50.8) | FPT | | | |
| CB-3X/CB-3Z | 2-1/2 (63.5) | FPT | 2 (50.8) | FPT | | | |
| CC-3X/CC-3Z | 2-1/2 (63.5) | FLG | 2-1/2 (63.5) | FLG | | | |
| DA-3X/DA-3Z | 3 (76.2) | FPT | 1-1/2 (38.1) | FPT | | | |
| DB-3X/DB-3Z | 3 (76.2) | FPT | 2 (50.8) | FPT | P-1,2 | 2 | |
| DC-3X/DC-3Z | 3 (76.2) | FLG | 2-1/2 (63.5) | FLG | | | |
| DD-3X/DD-3Z | 3 (76.2) | FLG | 3 (76.2) | FLG | | | |
| EC-3X/EC-3Z | 4 (101.6) | FLG | 2-1/2 (63.5) | FLG | | | |
| ED-3X/ED-3Z | 4 (101.6) | FLG | 3 (76.2) | FLG | | | |
| EE-3X/EE-3Z | 4 (101.6) | FLG | 4 (101.6) | FLG | | | |
| FE-3X/FE-3Z | 5 (127) | FLG | 4 (101.6) | FLG | | | |
| FF-3X/FF-3Z | 5 (127) | FLG | 5 (127) | FLG | | | |
| GE-3X/GE-3Z | 6 (152.4) | FLG | 4 (101.6) | FLG | | | |
| GF-3X/GF-3Z | 6 (152.4) | FLG | 5 (127) | FLG | | | |
| GG-3X/GG-3Z | 6 (152.4) | FLG | 6 (152.4) | FLG | | | |
| HG-3X/HG-3Z | 8 (203.2) | FLG | 6 (152.4) | FLG | | | |
| HH-3X/HH-3Z | 8 (203.2) | FLG | 8 (203.2) | FLG | | | |
| JH-3X/JH-3Z | 10 (254) | FLG | 8 (203.2) | FLG | | | |
| JJ-3X/JJ-3Z | 10 (254) | FLG | 10 (254) | FLG | | | |

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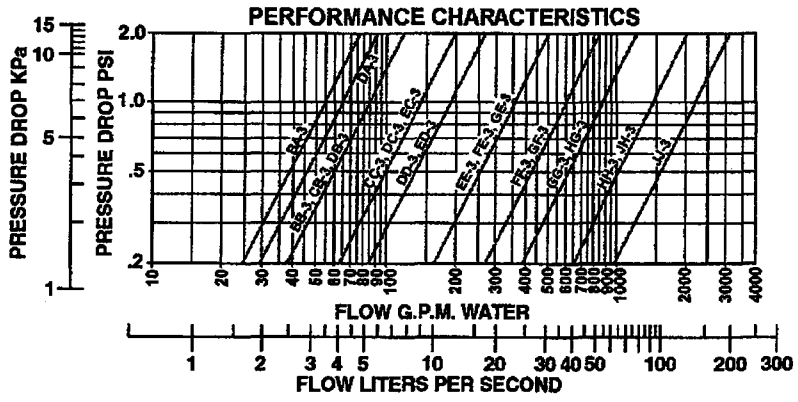
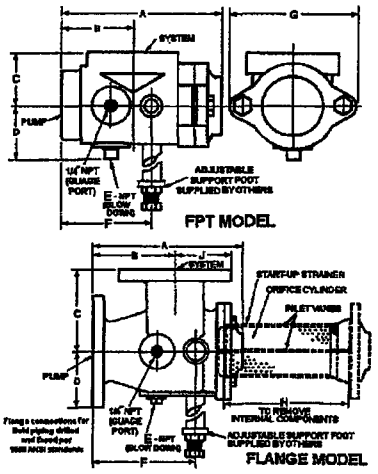
**Bell & Gossett**

## SUCTION DIFFUSER

**B-825H**




### TYPICAL SPECIFICATIONS

Provide at each pump a Suction Diffuser for mechanical coupling systems of the sized noted on drawings. Units shall consist of angle type body, grooved system connection, flanged pump connection, stainless steel inlet vanes and combination Diffuser-Strainer-Orifice Cylinder with 3/16 diameter openings for pump protection. The orifice cylinder shall be equipped with a disposable fine mesh strainer which shall be removed after system start-up.

Orifice cylinder shall be designed to withstand pressure differential equal to pump shut-off head (maximum _____ PSI) and shall have a free area equal to five times cross section area of pump suction opening. Vane length shall be no less than 2-1/2 times the pump connection diameter. Unit shall be provided with adjustable support foot to carry the weight of suction piping.

Each Suction Diffuser to be ITT Bell & Gossett Model No. SDG-_____.

**DIMENSIONS – INCHES (mm)**

| Model No. | System Side | | Pump Side | | A | B | C | D | E | F | G | H | J | Orifice Cylinder Free Area $in^2$ ($cm^2$) | Approx. Shpg. Wt. Lbs. (Kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BA-3 | 2 (50.8) | T | 1-1/2 (38.1) | T | 6-13/16 (173) | 3 (76) | 2-1/4 (57) | 2-3/8 (60) | 3/4 (19) | 3-13/16 (97) | 5-1/4 (133) | 8 (203) | N/A | 11 (71) | 13 (6) |
| BB-3 | 2 (50.8) | T | 2 (50.8) | T | 8-3/8 (213) | 3-7/8 (98) | 2-3/4 (70) | 2-3/4 (70) | 3/4 (19) | 3-7/8 (98) | 5-3/4 (146) | 9 (229) | N/A | 20-1/2 (132) | 14 (6) |
| CB-3 | 2-1/2 (63.5) | T | 2 (63.5) | T | 8-3/8 (213) | 3-7/8 (98) | 2-3/4 (70) | 2-3/4 (70) | 3/4 (19) | 3-7/8 (98) | 5-3/4 (146) | 9 (229) | N/A | 20-1/2 (132) | 16 (7) |
| CC-3 | 2-1/2 (63.5) | F | 2-1/2 (63.5) | F | 9 (229) | 4-3/4 (121) | 4-3/4 (121) | 3-1/2 (89) | 3/4 (19) | 5-5/8 (143) | N/A | 11 (279) | 3-1/2 (89) | 26 (168) | 36 (16) |
| DA-3 | 3 (76.2) | T | 1-1/2 (38.1) | T | 8-3/8 (213) | 3-7/8 (98) | 2-3/4 (70) | 2-3/4 (70) | 3/4 (19) | 3-7/8 (98) | 5-3/4 (146) | 9 (229) | N/A | 20-1/2 (132) | 17 (8) |
| DB-3 | 3 (76.2) | T | 2 (50.8) | T | 8-3/8 (213) | 3-7/8 (98) | 2-3/4 (70) | 2-3/4 (70) | 3/4 (19) | 3-7/8 (98) | 5-3/4 (146) | 9 (229) | N/A | 20-1/2 (132) | 17 (8) |
| DC-3 | 3 (76.2) | F | 2-1/2 (63.5) | F | 9 (229) | 5 (127) | 5 (127) | 3-1/2 (89) | 3/4 (19) | 5-5/8 (143) | N/A | 11 (279) | 3-3/4 (95) | 26 (168) | 44 (20) |
| DD-3 | 3 (76.2) | F | 3 (76.2) | F | 10 (254) | 5-1/2 (140) | 5-1/2 (140) | 3-3/4 (95) | 3/4 (19) | 6-7/8 (175) | N/A | 12 (305) | 3-3/4 (95) | 37-1/2 (242) | 48 (22) |
| EC-3 | 4 (101.6) | F | 2-1/2 (63.5) | F | 9 (229) | 6-1/2 (165) | 6-1/2 (165) | 3-1/2 (95) | 3/4 (19) | 5-5/8 (143) | N/A | 11 (279) | 4-1/2 (114) | 26 (168) | 42 (19) |
| ED-3 | 4 (101.6) | F | 3 (76.2) | F | 10 (254) | 6-1/2 (165) | 6-1/2 (165) | 3-3/4 (95) | 3/4 (19) | 6-7/8 (175) | N/A | 13 (330) | 4-1/2 (114) | 37-1/2 (242) | 55 (25) |
| EE-3 | 4 (101.6) | F | 4 (101.6) | F | 12-5/8 (321) | 6-1/2 (165) | 6-1/2 (165) | 4-1/2 (114) | 3/4 (19) | 7-5/8 (194) | N/A | 14 (356) | 4-1/2 (114) | 65 (419) | 72 (33) |
| FE-3 | 5 (127) | F | 4 (101.6) | F | 12-5/8 (321) | 7-1/2 (191) | 7-1/2 (191) | 4-1/2 (114) | 3/4 (19) | 7-5/8 (194) | N/A | 15 (381) | 5 (127) | 65 (419) | 84 (38) |
| FF-3 | 5 (127) | F | 5 (127) | F | 14-1/4 (362) | 7-1/2 (191) | 7-1/2 (191) | 5 (127) | 3/4 (19) | 9 (229) | N/A | 15 (381) | 5 (127) | 90 (581) | 100 (45) |
| GE-3 | 6 (152.4) | F | 4 (101.6) | F | 12-5/8 (321) | 8 (203) | 8 (203) | 4-1/2 (114) | 3/4 (19) | 7-5/8 (194) | N/A | 15 (381) | 5-1/2 (140) | 65 (419) | 90 (41) |
| GF-3 | 6 (152.4) | F | 5 (127) | F | 14-1/4 (362) | 8 (203) | 8 (203) | 5 (127) | 3/4 (19) | 9 (229) | N/A | 15 (381) | 5-1/2 (140) | 90 (581) | 105 (48) |
| GG-3 | 6 (152.4) | F | 6 (152.4) | F | 16-3/8 (416) | 8 (203) | 8 (203) | 5-1/2 (140) | 3/4 (19) | 10-1/8 (257) | N/A | 17 (432) | 5-1/2 (140) | 127 (819) | 134 (61) |
| HG-3 | 8 (203.2) | F | 6 (152.4) | F | 16-3/8 (416) | 9 (229) | 9 (229) | 5-1/2 (140) | 3/4 (19) | 10-1/8 (257) | N/A | 18 (457) | 6-3/4 (171) | 127 (819) | 150 (68) |
| HH-3 | 8 (203.2) | F | 8 (203.2) | F | 20-1/2 (2553) | 9 (229) | 9 (229) | 6-3/4 (171) | 3/4 (19) | 11 (279) | N/A | 21 (533) | 6-3/4 (171) | 218 (1406) | 250 (113) |
| JH-3 | 10 (254) | F | 8 (203.2) | F | 20-1/2 (521) | 10 (254) | 11 (279) | 6-3/4 (171) | 3/4 (19) | 11 (279) | N/A | 21 (533) | 8 (203) | 218 (1406) | 290 (132) |
| JJ-3 | 10 (254) | F | 10 (254) | F | 25-1/4 (641) | 11 (279) | 11 (279) | 8 (203) | 3/4 (19) | 13-1/2 (343) | N/A | 25 (635) | 8 (203) | 338 (2180) | 415 (188) |

(T) Threaded - FPT (F) Flanged *Dimensions include orifice cylinder + 2-1/2 (64) inch clearance.

**Dimensions are subject to change. Not to be used for construction purposes unless certified.**

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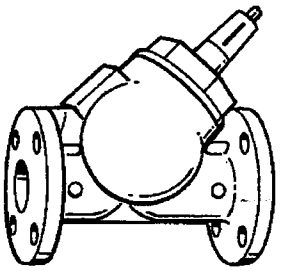
ITT

**SUBMITTAL**

**B-833A**

| | | |
|---|---|---|
| **JOB:** SOF RIVERINE & COMBATANT CRAFT OPER. FAC. | **REPRESENTATIVE:** Hydronic Technology, Inc. | |
| **UNIT TAG:** | **ORDER NO.** | **DATE:** 5/1/2009 |
| **ENGINEER:** | **SUBMITTED BY:** BILLY MARTINEZ | **DATE:** |
| **CONTRACTOR:** GALLO MECHANICAL | **APPROVED BY:** | **DATE:** |



Centrifugal Pump Accessories

# Triple Duty® Valve

## Straight Pattern with Soft Seat Nonslam Check Valve, Throttling Valve, Calibrated Balance Valve and Shutoff Valve

### DESCRIPTION

The Triple Duty Valve is a quiet operating heavy-duty valve which performs all of the functions normally required on the discharge side of hydronic system pumps.

The valve serves as a nonslam check valve as needed for zoned pumping, parallel and standby pumping, and condenser water applications. The spring loaded disk prevents valve chatter, and assures positive shutoff.

Bell & Gossett's Triple Duty Valve has a calibrated nameplate for rough system balance. The Triple Duty Valve is also equipped with Model RV-125A readout valves for more accurate system balance.

The calibrated nameplate allows the valve to be returned to the original balance position after shutoff.

To repack under system pressure, turn the valve stem to the fully open position. Turning the valve stem to the closed position provides shutoff.

### CONSTRUCTION MATERIALS

Body: Cast Iron with Bronze Seat
Disc: Brass with EPDM Seat Insert
Stem: Stainless Steel
Spring: Stainless Steel
Packing: Teflon-Graphite (Asbestos-free)
Gasket: Non-Asbestos
Readout Valve: Brass with EPT Insert, check valve & gasket

### SCHEDULE Maximum Working Pressure 175 PSIG (1,207 kPa) – Maximum Operating Temperature 250°F (121°C)

| MODEL NO. | PART # | *FLANGE SIZE INCHES(mm) | TAGGING INFORMATION | QUANTITY |
|---|---|---|---|---|
| → 3DS-3B | 132160 | 3 (76.2) | P-1,2 | 2 |
| 3DS-4B | 132161 | 4 (101.6) | | |
| 3DS-5B | 132162 | 5 (127.0) | | |
| 3DS-6B | 132163 | 6 (152.4) | | |
| 3DS-8B | 132164 | 8 (203.2) | | |
| 3DS-10B | 132165 | 10 (254.0) | | |
| 3DS-12B | 132166 | 12 (304.8) | | |
| 3DS-14B | 132167 | 14 (355.6) | | |
| 3DS-16B | 132168 | 16 (406.4) | | |

*Standard 125 PSIG (862 kPa) ANSI Flanges

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**Bell & Gossett**

# TRIPLE DUTY® VALVE – STRAIGHT PATTERN

**B-833A**

## PERFORMANCE DATA

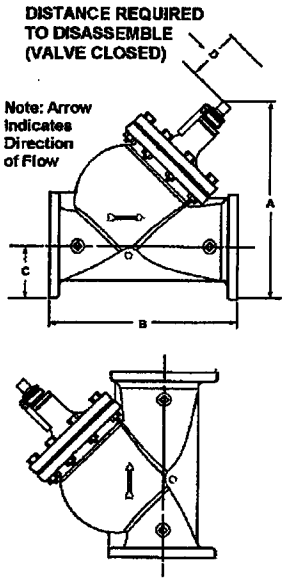
Cv RATING IN GPM ($m^3/hr$) VS. PERCENT OF STEM RISE

| MODEL NO. | 20% | | 30% | | 40% | | 50% | | 60% | | 70% | | 80% | | 90% | | 100% | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | A | B | A | B | A | B | A | B | A | B | A | B | A | B | A | B |
| ➡ 3DS-3B | 28 (6) | 28 (6) | 43 (10) | 43 (10) | 57 (13) | 57 (13) | 70 (16) | 71 (16) | 83 (19) | 83 (19) | 94 (21) | 94 (21) | 105 (24) | 106 (24) | 112 (25) | 113 (26) | 117 (26) | 118 (27) |
| 3DS-4B | 47 (11) | 47 (11) | 71 (16) | 72 (16) | 93 (21) | 95 (21) | 114 (26) | 116 (26) | 132 (30) | 135 (31) | 150 (34) | 152 (35) | 166 (38) | 168 (38) | 178 (40) | 181 (41) | 190 (43) | 191 (43) |
| 3DS-5B | 75 (17) | 76 (17) | 121 (28) | 123 (28) | 165 (38) | 169 (38) | 204 (46) | 209 (47) | 238 (54) | 245 (56) | 276 (63) | 283 (64) | 305 (69) | 312 (71) | 325 (74) | 331 (75) | 357 (81) | 360 (82) |
| 3DS-6B | 110 (25) | 112 (25) | 173 (39) | 175 (40) | 235 (53) | 238 (54) | 291 (66) | 295 (67) | 341 (77) | 348 (79) | 392 (89) | 402 (91) | 443 (101) | 454 (103) | 493 (112) | 508 (115) | 534 (121) | 556 (126) |
| 3DS-8B | 159 (36) | 159 (36) | 273 (62) | 278 (63) | 333 (76) | 341 (77) | 410 (93) | 422 (96) | 486 (110) | 500 (114) | 550 (125) | 569 (129) | 622 (141) | 631 (143) | 684 (155) | 690 (157) | 749 (170) | 748 (170) |
| 3DS-10B | 250 (57) | 253 (57) | 378 (86) | 389 (88) | 513 (117) | 528 (120) | 629 (143) | 652 (148) | 748 (170) | 775 (176) | 854 (194) | 889 (202) | 935 (212) | 983 (223) | 1023 (232) | 1075 (244) | 1117 (254) | 1169 (265) |
| 3DS-12B | 426 (97) | 436 (99) | 663 (151) | 688 (156) | 883 (201) | 923 (210) | 1089 (247) | 1151 (261) | 1277 (290) | 1343 (305) | 1443 (328) | 1539 (350) | 1607 (365) | 1704 (387) | 1765 (401) | 1870 (425) | 1874 (425) | 1992 (452) |
| 3DS-14B | 578 (131) | 594 (135) | 885 (201) | 916 (208) | 1173 (266) | 1219 (277) | 1437 (326) | 1497 (340) | 1710 (388) | 1760 (400) | 1946 (442) | 2017 (458) | 2159 (490) | 2228 (506) | 2399 (545) | 2499 (567) | 2566 (583) | 2669 (606) |
| 3DS-16B | 614 (139) | 619 (141) | 1021 (232) | 1036 (235) | 1422 (323) | 1445 (328) | 1789 (406) | 1798 (408) | 2127 (483) | 2143 (487) | 2412 (548) | 2417 (549) | 2708 (615) | 2715 (616) | 2974 (675) | 2983 (677) | 3283 (746) | 3368 (765) |

A. FLOWMETER Cv FOR BALANCING. MINIMUM READING OF 3 FEET (.9 m) OF PRESSURE DROP REQUIRED FOR ACCURATE FLOW DETERMINATION.

B. Cv FOR CALCULATING PRESSURE DROP ACROSS THE VALVE.

**NOTE:** MAXIMUM RECOMMENDED PRESSURE DROP SHOULD NOT EXCEED 25 FEET (7.6 m).






PROPER INSTALLATION SHOWING STEM UPRIGHT

| MODEL NUMBER | DIMENSIONS IN INCHES (mm) FLANGE SIZE* | A OPEN | A CLOSED | B | C | D | APPROX. SHPG. WT. LBS. (Kg) |
|---|---|---|---|---|---|---|---|
| ➡ 3DS-3B | 3 (76.2) | 11.22 (285.00) | 10.51 (266.90) | 10.00 (254.00) | 3.75 (95.25) | 3.50 (88.90) | 36 (16) |
| 3DS-4B | 4 (101.6) | 13.07 (332.00) | 12.19 (309.60) | 14.50 (368.30) | 4.50 (114.30) | 3.94 (100.00) | 62 (28) |
| 3DS-5B | 5 (127.0) | 17.41 (442.20) | 16.35 (415.20) | 16.00 (406.40) | 5.00 (127.00) | 6.25 (158.80) | 105 (48) |
| 3DS-6B | 6 (152.4) | 19.02 (483.10) | 17.78 (451.60) | 18.00 (457.20) | 5.50 (139.71) | 6.88 (174.80) | 148 (67) |
| 3DS-8B | 8 (203.2) | 21.90 (556.30) | 20.48 (520.30) | 21.50 (546.10) | 6.75 (171.45) | 8.25 (209.60) | 230 (104) |
| 3DS-10B | 10 (254.0) | 26.02 (660.90) | 24.42 (620.40) | 25.50 (647.70) | 8.00 (203.20) | 10.38 (263.70) | 380 (172) |
| 3DS-12B | 12 (304.8) | 30.25 (768.40) | 27.95 (710.00) | 30.00 (762.00) | 9.50 (241.30) | 12.25 (311.20) | 546 (248) |
| 3DS-14B | 14 (355.6) | 34.42 (874.30) | 32.04 (813.70) | 33.75 (857.25) | 10.50 (266.70) | 14.50 (368.30) | 765 (347) |
| 3DS-16B | 16 (406.4) | 38.24 (971.30) | 35.28 (896.00) | 35.00 (889.00) | 11.75 (298.45) | 16.50 (491.10) | 980 (445) |

*STANDARD 125 PSIG (862 kPa) ANSI FLANGES.

**Dimensions are subject to change. Not to be used for construction purposes unless certified.**

## TYPICAL SPECIFICATIONS

Furnish and install as shown on plans, an angle pattern valve designed to perform the functions of a nonslam check valve, throttling valve, shutoff valve and calibration balancing valve.

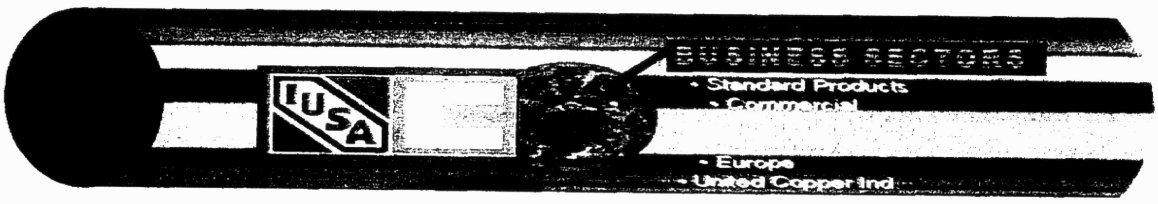
The valve shall be a heavy-duty cast iron construction with standard 125 psig (862 kPa) ANSI flanged connections, and rated for a maximum working pressure of 175 psig (1207 kPa) at 250°F (121°C). The valve shall be fitted with a bronze seat, replaceable brass disc with EPDM seat insert, stainless steel stem, and chatter-preventing spring and calibrated nameplate. The valve design shall permit repacking under full system pressure.

The valve shall be equipped with brass readout valve (with integral check valve) for taking differential pressure readings across the orifice for accurate system balance.

Valve Cv rating at full open position not to be less than _____. (Refer to the 100% stem rise value shown in row "B" for required valve.)

All valves shall be ITT Bell & Gossett Model No. 3D-____S Triple Duty Valve.

ITT
8200 N. Austin Avenue
Morton Grove, IL 60053
Phone (847)966-3700
Facsimile (847)966-9052
www.bellgossett.com






Product Range Print

## COPPER TUBE PRODUCT RANGE

Cambridge-Lee Industries manufactures a wide range of copper tube products for use in the plumbing, refrigeration, air-conditioning, and commercial industries. Described herein is our current product range, but other items and specifications are continuously being added and may be available upon request.

| Product | Application | Temper | Lengths | Color | Specifications |
|---|---|---|---|---|---|
| Water Tube Type K | Domestic Water Service<br>Fire Protection<br>Solar, Fuel Oil<br>HVAC | Hard<br><br>Soft | 10 ft. Straight lgth<br>20 ft. Straight lgth<br>60 ft. Coils<br>100 ft. Coils | Green | C12200, ASTM B-88<br>Federal WW-T-799 |
| Water Tube Type L | Domestic Water Service<br>Fire Protection<br>Solar, Fuel Oil<br>HVAC, Natural Gas | Hard<br><br>Soft | 10 ft. Straight lgth<br>20 ft. Straight lgth<br>60 ft. Coils<br>100 ft. Coils | Blue | C12200, ASTM B-88<br>Federal WW-T-799 |
| Water Tube Type M | Domestic Water Service<br>Fire Protection<br>Solar, Fuel Oil<br>HVAC | Hard | 10 ft. Straight lgth<br>20 ft. Straight lgth | Red | C12200, ASTM B-88<br>Federal WW-T-799 |
| ACR Tube (L cleaned and capped/degreased) | Air Conditioning<br>Refrigeration<br>Natural Gas | Hard | 20 ft. Straight lgth | Blue | C12200, ASTM B-280 |
| OXY/MED Tube (K & L cleaned and capped/degreased) | Medical Gas Systems | Hard | 20 ft. Straight lgth | Blue | C12200, ASTM B-280<br>B-819 |
| Refrigeration Tube | Air Conditioning<br>Refrigeration Service | Soft | 50 ft. Coils<br>100 ft. Coils | Red | C12200, ASTM B-280 |
| DWV Tube | Drainage | Hard | 20 ft. Straight lgth | Yellow | C12200, ASTM B-306 |

Last modified: 06/11/07

DAMIEN W. SERAUSKAS, P.E.
PROFESSIONAL ENGINEERING SERVICES

---

✗ No Exceptions Taken ◊ Rejected
◊ Approved As Noted ◊ Resubmit

Date: 3-18-09 By: _____

Review is for general conformance with the design intent and general compliance with the information given in the Project Documents. The Contractor shall be responsible for confirming all dimensions, quantities, and installation methods.

---

HVAC + PLUMBING + FIRE PROTECTION + SITE UTILITIES

---

15 CYPRESS POINT LANE NEW ORLEANS, LA 70131
VOICE: (504) 866-2600 FAX: (504)-218-8480

CAMBRIDGE-LEE INDUSTRIES, LLC.
Reading Tube Division
P.O. Box 14026, Reading, PA 19612 - 4026
Phone 610 - 926 4141 Fax 610 - 926 7317

| | |
|---|---|
| **Distributor:** | **Customer:** |
| **Address:** | **Address:** |
| **Order No.:** | **P.O. No.:** |
| **Product:** | |

# Standard Tube
# Certificate of Conformance

| Tube Type | Specification No.* | Specification Title |
|---|---|---|
| Type K, L & M | ASTM B 88 | Standard Specification for Seamless Copper Water Tube |
| | NSF 61 | ANSI/NSF Standard 61 Drinking Water System Components Health Effects[1] |
| Coils and Straight Lengths Marked as ACR | ASTM B 280 | Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service |
| Type DWV Drainage | ASTM B 306 | Standard Specification for Copper Drainage Tube (DWV) |
| Type K & L Straight Lengths Marked as OXY/MED | ASTM B 819 | Standard Specification for Seamless Copper Tube for Medical Gas Systems |

Cambridge-Lee Industries, LLC certifies that the copper tube manufactured is grade UNS C12200 and meets the chemical, mechanical, cleanness and eddy current testing requirements of the current specification(s) indicated below.

* Although CLI – RTD strives to meet all requirements specified in ASTM, Standard Tube[2] may not fully meet ASTM dimensional requirements. When specified at order placement and for an additional cost, CLI – RTD can produce Certified Tube to meet all requirements of the current ASTM standard, including dimensions.

Copper tube manufactured by Cambridge-Lee Industries does not contain mercury or come in contact with mercury, mercury compounds or mercury containing devices at any stage in manufacturing, inspection, packaging or shipping.

All of the specifications require a minimum copper plus silver content of 99.9% and a phosphorus content between .015 - .040%. As indicated by the compositional requirements, the copper tube is essentially lead free.

---

[1] Seamless Copper Tube (Alloy C12200) is certified by NSF to NSF/ANSI Standard 61 for public water supplies meeting, or in process of meeting the U.S. EPA Lead and Copper Rule (56FR 26460, June 7, 1991). Water Supplies with pH less than 6.5 may require corrosion control to limit copper solubility in drinking water.

[2] Standard Tube will be provided unless Certified Tube is clearly defined on Purchase Order.

## PRODUCT CERTIFICATION - SOLDER, BRAZED AND THREADED COPPER AND COPPER ALLOY PLUMBING FITTINGS

Elkhart Products Corporation manufactures and/or supplies products which meet the following specifications:

| | | |
|---|---|---|
| MSS | SP73 | Brazing Joints for Copper and Copper Alloy Pressure Fittings |
| MSS | SP104 | Wrought Copper Solder Joint Pressure Fittings |
| MSS | SP106 | Cast Copper Alloy Flanges and Flanged Fittings; Class 125, 150 and 300 |
| MSS | SP123 | Non-Ferrous Threaded and Solder-Joint Unions for use with Copper Water Tube |
| MSS | SP109 | Welded Fabricated Copper Solder Joint Pressure Fittings |
| ASME/ANSI | B16.29-2001: | Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings – DWV |
| ASME/ANSI | B16.18-2001: | Cast Copper Alloy Solder Joint Pressure Fittings |
| ASME/ANSI | B16.15-1994: | Cast Bronze Threaded Fittings |
| ASME/ANSI | B16.26-1988: | Cast Copper Alloy Fittings for Flared Copper Tube |
| ASME/ANSI | B16.23-2002: | Cast Copper Alloy Solder Joint Drainage Fittings – DWV |
| ASME/ANSI | B16.24-2001: | Bronze Pipe Flanges and Flanged Fittings |

EPC's wrot copper solder joint fittings also are manufactured to comply with the material, performance, and installation/joining dimensions of ASME/ANSI B16.22. These fittings are also compliant with the European Union's RoHS (Restrictions of Hazardous Substances) Directive, 2002/95/EC.

The materials used to manufacture these fittings are also in compliance with the following specifications:

| | |
|---|---|
| Tubular Wrought Copper: ASTM B75 Alloy C12200, | Standard specification for Seamless Copper Tube, or |
| Products Made From Sheet: ASTM B152 Alloy C11000, | Standard Specification for Copper Sheet, Strip, Plate and Rolled Bar |
| Cast Products: ASTM B584 Alloy C84400, | Standard Specification for Copper Alloy Sand Castings for General Applications; Federal Specification WW-U-516 For Type III, Class A and B Copper Alloy Unions |

**ELKHART PRODUCTS COPRORATION**
Plumbing Division

Dana Buccicone
Director of Technology

State of Massachusetts product approval
Number P1-0698-46, granted 6/3/98.

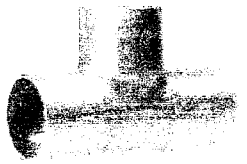
Subscribed and sworn to before me

On this 24th day of July 2006

Vicki A. Vergon

NOTARY PUBLIC
VICKI A VERGON
NOTARY PUBLIC STATE OF INDIANA
ST. JOSEPH COUNTY
MY COMMISSION EXP. FEB 28 2007

an Aalberts Industries company



## RECYCLED MATERIAL FOR "LEED" COMPLIANCE
### Green Building Rating System

"Each year in the United States, nearly as much copper is recovered from recycled material as is derived from newly mined ore. Excluding wire production, more than three-fourths (¾) of the amount used by copper and brass mills, ingot makers, foundries, powder metal plants and other industries comes from recycled scrap copper."

"Almost half of all recycled copper scrap is old post consumer scrap, such as discarded electric cable, automobile radiators and air conditioners."

**Elkhart Products Corporation subscribes to the above facts and encourages its suppliers to do the same.**

The copper tubing and rod used to produce all E.P.C. copper fittings is manufactured from copper cathode which in turn is made up from twenty-five (25) percent post consumer scrap as described above. Another fifty (50) percent is post industrial scrap (turnings, shavings and chips).

Dennis Thompson

Staff Engineer
Elkhart Products Corp.

205/664-3733 Fax: 205/664-3775

Vulcan
THREADED PRODUCTS, INC.

Vulcan Threaded Products
#10 Crosscreek Trail
Pelham, AL 35124
Ph:(205) 620-5100
Fax:(205) 620-5150

Ref: Low Carbon All-Thread Rod

September 14, 2004

This letter is to certify that the All-Thread Rod supplied by Vulcan Threaded Products will meet the minimum physical requirements of ASTM A36 & A307 and produced to a 1A fit. ¼" to 1" All-Thread Rod is produced from 1006/1008/1010 steel. 1-1/8" to 2-1/2" is produced from 1018 steel. The entire threaded rod size range is manufactured in the United States from domestic and foreign raw material.

All Hot-Dip Galvanized threaded rod is plated according to ASTM A153 specifications. All Zinc Threaded Rod is plated according to ASTM B633.

Best Regards,

Jeff Hayes
Purchasing Manager

DAMIEN W. SERAUSKAS, P.E.
PROFESSIONAL ENGINEERING SERVICES

☒ No Exceptions Taken ◇ Rejected
◇ Approved As Noted ◇ Resubmit

Date: 3-18-09 By:

Review is for general conformance with the design intent and general compliance with the information given in the Project Documents. The Contractor shall be responsible for confirming all dimensions, quantities, and installation methods.

HVAC + PLUMBING + FIRE PROTECTION + SITE UTILITIES

15 CYPRESS POINT LANE NEW ORLEANS, LA 70131
VOICE: (504) 866-2600 FAX: (504)-218-8480

1/4" THROUGH 5/8" MANUFACTURED FROM 1006-1010 STEEL
¾" THROUGH 1" MANUFACTURED FROM 1006 – 1010 OR A36 STEEL

ALL ALL-THREAD ROD WILL MEET MINIMUM TENSILE & YIELD REQUIREMENTS OF ASTM A307 GRADE C

| ITEM | MANUFACTURER | MATERIAL AS DESCRIBED ON INVOICE |
|---|---|---|
| 1 | VULCAN THREADED PRODUCTS | 1/4"-20 LOW CARBON STEEL THREADED ROD MELTED DOMESTICALLY AND INTERNATIONALLY MANUFACTURED IN THE UNITED STATES |
| 2 | VULCAN THREADED PRODUCTS | 5/16"-18 LOW CARBON STEEL THREADED ROD MELTED DOMESTICALLY AND INTERNATIONALLY MANUFACTURED IN THE UNITED STATES |
| 3 | VULCAN THREADED PRODUCTS | 3/8"-16 LOW CARBON STEEL THREADED ROD MELTED DOMESTICALLY AND INTERNATIONALLY MANUFACTURED IN THE UNITED STATES |
| 4 | VULCAN THREADED PRODUCTS | 1/2"-13 LOW CARBON STEEL THREADED ROD MELTED DOMESTICALLY AND INTERNATIONALLY MANUFACTURED IN THE UNITED STATES |
| 5 | VULCAN THREADED PRODUCTS | 5/8"-11 LOW CARBON STEEL THREADED ROD MELTED DOMESTICALLY AND INTERNATIONALLY MANUFACTURED IN THE UNITED STATES |
| 6 | VULCAN THREADED PRODUCTS | ¾"-10 LOW CARBON STEEL THREADED ROD MELTED DOMESTICALLY AND INTERNATIONALLY MANUFACTURED IN THE UNITED STATES |
| 7 | VULCAN THREADED PRODUCTS | 7/8"-09 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |
| 8 | VULCAN THREADED PRODUCTS | 1"-08 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |

| ITEM | HEAT# | CARBON | MANG. | PHOS. | SULPHUR | SILICON | CHROM. | NICKEL | MOLY. | COPPER |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 65800 | .06 | .47 | .006 | .010 | .15 | .06 | .09 | .02 | .20 |
| 2 | 64241 | .06 | .45 | .011 | .024 | .12 | .15 | .10 | .03 | .26 |
| 3 | 26863 | .06 | .40 | .016 | .025 | .12 | .13 | .14 | .00 | .26 |
| 4 | 26864 | .07 | .42 | .013 | .02 | .13 | .10 | .11 | .00 | .21 |
| 5 | 1030122 | .04 | .45 | .018 | .034 | .11 | -- | -- | -- | -- |
| 6 | 65197 | .17 | .67 | .014 | .016 | .18 | .14 | .10 | .03 | .32 |
| 7 | 62286 | .22 | .90 | .006 | .025 | .23 | .05 | .07 | .02 | .16 |
| 8 | 62260 | .15 | .72 | .012 | .026 | .19 | .07 | .08 | .02 | .21 |

| ITEM | HEAT # | TENSILE PSI | YIELD PSI | %ELONGATION 8" GAGE | REDUCTION OF AREA | BEND TEST |
|---|---|---|---|---|---|---|
| 1 | 65800 | 62,200 | ---------- | ---------- | ---------- | ---------- |
| 2 | 64241 | 61,500 | ---------- | ---------- | ---------- | ---------- |
| 3 | 26863 | 60,915 | 40,053 | 36.0 | ---------- | ---------- |
| 4 | 26864 | 61,641 | 40,611 | 34.0 | ---------- | ---------- |
| 5 | 1030122 | 58,853 | 39,885 | 40.0 | ---------- | ---------- |
| 6 | 65197 | 73,700 | 51,200 | 32.0 | ---------- | ---------- |
| 7 | 62286 | 78,600 | 50,700 | 31.0 | ---------- | ---------- |
| 8 | 62260 | 69,100 | 45,800 | 27.0 | ---------- | ---------- |

WE HEREBY CERTIFY THAT THE FOREGOING DATA IS A TRUE COPY OF THE DATA FURNISHED BY THE PRODUCING MILL.
ALL DATA SUPPLIED IN THE ABOVE TEST REPORT ARE TYPICAL OF MATERIAL FURNISHED BY VULCAN THREADED PRODUCTS.

DATE: 4/30/2004

BY: _____
AUTHORIZED AGENT
QUALITY CONTROL SUPERVISOR

VULCAN THREADED PRODUCTS
#10 CROSSCREEK TRAIL
PELHAM, AL 35124
205) 620-5100
FAX 205) 620-5150

1-1/8" THROUGH 2" MANUFACTURED FROM 1018 or A36 STEEL
2-1/4" THROUGH 2-1/2" MANUFACTURED FROM 1018 or A36 STEEL

ALL ALL-THREAD ROD WILL MEET MINIMUM PHYSICAL AND CHEMICAL REQUIREMENTS OF ASTM A307 GRADE C

| ITEM | MANUFACTURER | MATERIAL AS DESCRIBED ON INVOICE |
|---|---|---|
| 1 | VULCAN THREADED PRODUCTS | 1-1/8"-7 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |
| 2 | VULCAN THREADED PRODUCTS | 1-1/4"-7 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |
| 3 | VULCAN THREADED PRODUCTS | 1-3/8"-6 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |
| 4 | VULCAN THREADED PRODUCTS | 1-1/2"-6 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |
| 5 | VULCAN THREADED PRODUCTS | 1-3/4"-5 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |
| 6 | VULCAN THREADED PRODUCTS | 2"-4.5 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |
| 7 | VULCAN THREADED PRODUCTS | 2-1/4"-4 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |
| 8 | VULCAN THREADED PRODUCTS | 2-1/2"-4 LOW CARBON STEEL THREADED ROD MELTED AND MANUFACTURED IN THE UNITED STATES |

| ITEM | HEAT# | CARBON | MANG | PHOS. | SULPHUR | SILICON | CHROM. | NICKEL | MOLY. | COPPER |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5899I1120 | .20 | .80 | .015 | .026 | .22 | .10 | .09 | .03 | .43 |
| 2 | 589915771 | .17 | .70 | .02 | .036 | .16 | .12 | .10 | .04 | .41 |
| 3 | 319913248 | .20 | .60 | .012 | .040 | .21 | .11 | .09 | .04 | .37 |
| 4 | 319913251 | .18 | .60 | .012 | .037 | .21 | .13 | .10 | .04 | .33 |
| 5 | 151115 | .14 | .78 | .008 | .023 | .21 | .07 | .15 | .034 | .97 |
| 6 | 151438 | .17 | .82 | .005 | .017 | .23 | .06 | .09 | .016 | .21 |
| 7 | 681952 | .18 | .77 | .01 | .03 | .22 | ——— | ——— | ——— | ——— |
| 8 | 640723 | .18 | .70 | .02 | .04 | .22 | ——— | ——— | ——— | ——— |

| HEAT # | TENSILE PSI MIN | YIELD PSI MIN | %ELONGATION 8" GAGE MIN % | REDUCTION OF AREA MIN % | | |
|---|---|---|---|---|---|---|
| 5899I1120 | 77,400 | 52,100 | 27 | ——— | ——— | ——— |
| 589915771 | 72,400 | 49,600 | 24 | ——— | ——— | ——— |
| 319913248 | 71,338 | 48,408 | 25 | ——— | ——— | ——— |
| 319913251 | 75,796 | 48,408 | 23 | ——— | ——— | ——— |
| 151115 | 68,000 | 46,900 | 27 | ——— | ——— | ——— |
| 151438 | 70,100 | 49,700 | 22 | ——— | ——— | ——— |
| 681952 | 92,300 | 85,400 | 16 | ——— | ——— | ——— |
| 640723 | 89,500 | 80,550 | 15 | ——— | ——— | ——— |

WE HEREBY CERTIFY THAT THE FOREGOING DATA IS A TRUE COPY OF THE DATA FURNISHED BY THE PRODUCING MILL. ALL DATA SUPPLIED IN THE ABOVE TEST REPORT ARE TYPICAL OF MATERIAL FURNISHED BY VULCAN THREADED PRODUCTS.

DATE: 9/12/2007

BY: _____
AUTHORIZED AGENT
QUALITY CONTROL SUPERVISOR

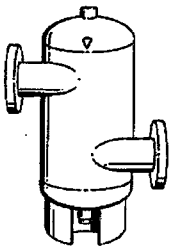
VULCAN THREADED PRODUCTS
#10 CROSSCREEK TRAIL
PELHAM, AL 35124
(205) 620-5100
FAX (205) 620-5150

ITT

**SUBMITTAL**

**A-326.8C**

| | | |
|---|---|---|
| **JOB:** SOF RIVERINE & COMBATANT CRAFT OPER. FAC. | **REPRESENTATIVE:** Hydronic Technology, Inc. | |
| **UNIT TAG:** | **ORDER NO.** | **DATE:** 5/1/2009 |
| **ENGINEER:** | **SUBMITTED BY:** BILLY MARTINEZ | **DATE:** |
| **CONTRACTOR:** GALLO MECHANICAL | **APPROVED BY:** | **DATE:** |



# ROLAIRTROL®

## Air Separator

Flanged Less Strainer

Air Control and Elimination

**DESCRIPTION**

The Rolairtrol Air Separator is an ASME vessel designed with tangential openings to create a low velocity vortex where air is separated and removed from the circulating water.

**CONSTRUCTION MATERIALS**

- Designed and constructed per ASME Section VIII, Division 1
- Shell: Carbon Steel

**MAXIMUM WORKING PRESSURE**

125 PSIG (862 kPa)

**MAXIMUM OPERATING TEMPERATURE**

350°F (177°C)

Consult factory for higher working pressures and temperatures.

| PART NUMBER | MODEL NUMBER | Capacity GPM ($m^3/hr$) | Flanged Tangential Opening in. (mm) | TAGGING INFORMATION | QUANTITY |
|---|---|---|---|---|---|
| ➡ 5363-03F-12-003 | RL-3F | 190 (43.2) | 3 (76.2) | AS-1 | 1 |
| 5363-04F-12-003 | RL-4F | 300 (68.1) | 4 (101.6) | | |
| 5363-05F-12-003 | RL-5F | 530 (120.4) | 5 (127.0) | | |
| 5363-06F-12-003 | RL-6F | 850 (193.0) | 6 (150.0) | | |
| 5363-08F-12-004 | RL-8F | 1,900 (431.5) | 8 (203.2) | | |
| 5363-10F-12-003 | RL-10F | 3,600 (817.6) | 10 (254.0) | | |
| 5363-12F-12-003 | RL-12F | 4,800 (1090.1) | 12 (300.0) | | |
| 5363-03F-12-004 | RL-3FB | 190 (43.2) | 3 (76.2) | | |
| 5363-04F-12-004 | RL-4FB | 300 (68.1) | 4 (101.6) | | |
| 5363-05F-12-004 | RL-5FB | 530 (120.4) | 5 (127.0) | | |
| 5363-06F-12-004 | RL-6FB | 850 (193.0) | 6 (150.0) | | |
| 5363-08F-12-005 | RL-8FB | 1,900 (431.5) | 8 (203.2) | | |
| 5363-10F-12-004 | RL-10FB | 3,600 (817.6) | 10 (254.0) | | |
| 5363-12F-12-004 | RL-12FB | 4,800 (1090.1) | 12 (300.0) | | |

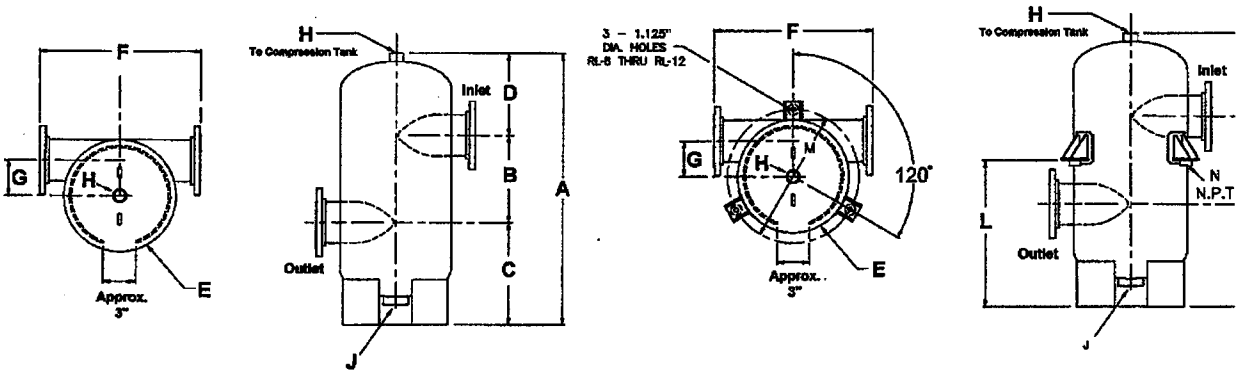
Model numbers with a B suffix include bracket supports.

ESP-REP v2009.02 © COPYRIGHT 2009 ITT Corporation

**Bell & Gossett**

## ROLAIRTROL - Flanged Less Strainer

A-3
F




**DIMENSIONS in Inches (mm) AND WEIGHTS in Lbs (kg.)**

| MODEL NUMBER | A | B | C | D | E | F | G | H | J | L* | M* | N* | Cv | Approx. Volume in Gallons (Ltr.) | Approx. Shpg. Wt. in Lbs. (Kg) | Flood Wt.Less Bracket in Lbs. (Kg) | I |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RL-3F (B) | 26-7/8 (683) | 8 (203) | 10-13/16 (275) | 8-1/16 (205) | 10-3/4 (273) | 22-3/4 (578) | 3-5/8 (92) | 1-1/4 (32) | 2 (51) | 13-3/8 (340) | 14 (356) | 2 (51) | 215 | 7 (26) | 115 (52) | 173 (79) | |
| RL-4F (B) | 31-7/16 (799) | 10 (254) | 11-15/16 (303) | 9-1/2 (241) | 12-3/4 (324) | 20-1/2 (521) | 4-1/8 (105) | 1-1/2 (38) | 2 (51) | 15-3/8 (391) | 16 (406) | 2 (51) | 370 | 13 (49) | 155 (70) | 263 (119) | |
| RL-5F (B) | 37 (940) | 12 (305) | 14-1/16 (357) | 10-15/16 (278) | 16 (406) | 23-3/4 (603) | 5-1/4 (133) | 1-1/2 (38) | 2 (51) | 18-1/2 (470) | 19-3/8 (492) | 2 (51) | 580 | 25 (95) | 205 (93) | 414 (188) | |
| RL-6F (B) | 44-1/16 (1119) | 14 (356) | 16-13/16 (427) | 13-1/4 (337) | 18 (457) | 25-3/4 (654) | 5-11/16 (144) | 1-1/2 (38) | 2 (51) | 22-1/8 (562) | 21-1/4 (540) | 2 (51) | 850 | 34 (129) | 280 (127) | 564 (256) | |
| RL-8F (B) | 54 (1372) | 18 (457) | 19-7/16 (494) | 16-9/16 (421) | 24 (610) | 31-3/4 (806) | 7-11/16 (195) | 2 (51) | 2 (51) | 26 (660) | 29-1/2 (749) | 2 (51) | 1,445 | 90 (341) | 420 (190) | 1,171 (531) | |
| RL-10F (B) | 64-11/16 (1643) | 22 (559) | 22-5/8 (575) | 20-1/16 (510) | 30 (762) | 37-3/4 (959) | 9-5/8 (244) | 2 (51) | 2 (51) | 31-5/8 (803) | 35-1/2 (902) | 2 (51) | 2,340 | 150 (568) | 800 (363) | 2,052 (930) | |
| RL-12F (B) | 76-3/8 (1915) | 27 (686) | 25-3/4 (654) | 22-5/8 (575) | 36 (914) | 46-3/4 (1187) | 11-5/8 (295) | 2 (51) | 2 (51) | 37-5/8 (956) | 41-1/2 (1054) | 2 (51) | 3,300 | 291 (1,101) | 1,110 (503) | 3,538 (1,605) | |

*Indicates measurements for models that have optional support brackets
†Bracket weight should be added to flood weight and approximate shipping weight for models that are being supplied with optional support brackets.

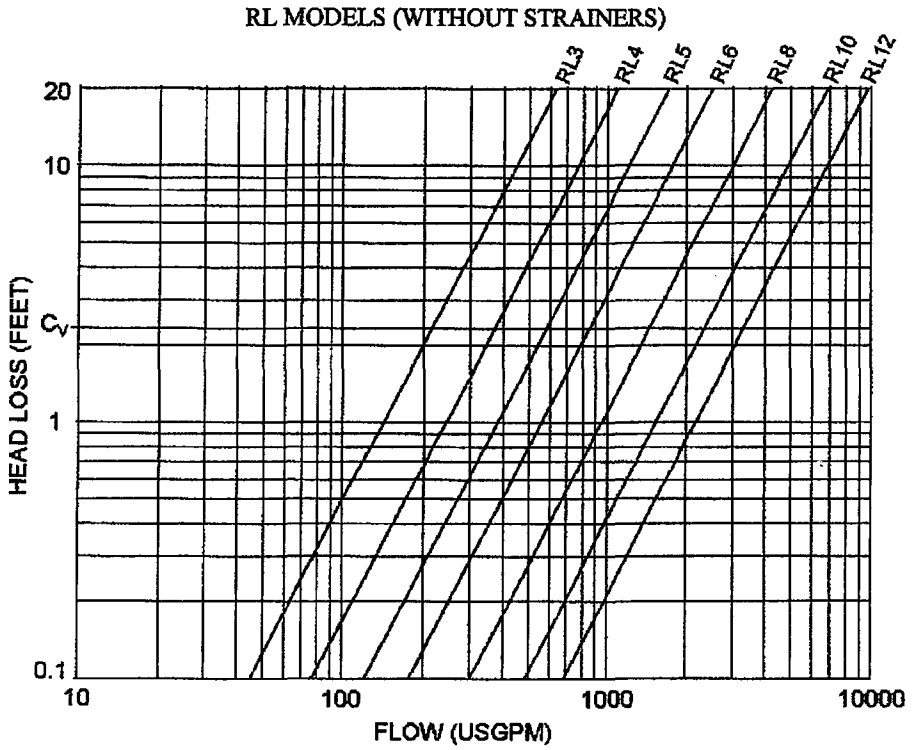
**Important Note: Dimensions not to be used for construction.**

**IMPORTANT NOTES:**

1. Consult IOM A85524 for safety and service instructions.
2. Lifting lugs are for the transportation and installation of the empty vessel, and are not to be used for complete or partial support of the flood vessel.
3. The RL skirt can support flooded vessel weight.
4. Welding to the pressure vessel boundary will void the ASME stamp.
5. Standard Rolairtrol design up to 12" can be hung from the nozzles using hangers. Optional, factory welded, support brackets are available for an additional cost.

ITT
8200 N. Austin Avenue
Morton Grove, IL 60053

**Rolairtrol® Air Separator Performance Coverage Chart**




**Note:** Pressure drops for a range of flow are indicated on this chart. Users should select Rolairtrol using B&G published capacity guidance, and ASHRAE pipe sizing recommendations for optimal performance.

## TYPICAL ROLAIRTROL SPECIFICATIONS

Furnish and install, as shown on plans, a centrifugal type air separator. The unit shall have _____" inlet and outlet flanged connections tangential to the vessel shell. The unit shall have the capability to direct accumulated air to the compression tank (air control system) or air vent (air elimination system) via an NPT vent connection at top of unit.

A blowdown connection shall be provided to facilitate routine cleaning. Specify B&G Model MBV-1 Rolairtrol accessory with appropriate fittings for manual blowdown.

Vessel shell diameter to be three times the nominal inlet/outlet pipe diameter, with a minimum vessel volume for sufficient velocity reduction.

The air separator must be designed, constructed and stamped for 125 psig @ 375°F (862 kPa @ 191°C) in accordance with Section VIII, Division I of the ASME Boiler and Pressure Vessel Code, and registered with the National Board of Boiler and Pressure Vessel Inspectors. The air separator (s) shall be painted with one shop coat of light gray air dry enamel.

Each air separator shall be Bell & Gossett Model No. _____ Rolairtrol Air Separator for _____ GPM ( _____ $m^3$), Shell Dia. _____" (_____ mm) and Min. Vessel Volume _____ Gal (_____ liters).

**Refer to submittal A-329 for information on the MBV-1 manual blowdown valve.**

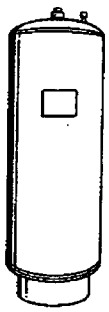
ITT
8200 N. Austin Avenue
Morton Grove, IL 60053
Phone (847)966-3700
Facsimile (847)966-9052
www.bellgossett.com

ITT

**SUBMITTAL**

**A-346F**

| | |
|---|---|
| **JOB:** SOF RIVERINE & COMBATANT CRAFT OPER. FAC. | **REPRESENTATIVE:** Hydronic Technology, Inc. |
| **UNIT TAG:** | **ORDER NO.** |
| **ENGINEER:** | **SUBMITTED BY:** BILLY MARTINEZ |
| **CONTRACTOR:** GALLO MECHANICAL | **APPROVED BY:** |
| | **DATE:** 5/1/2009 |
| | **DATE:** |
| | **DATE:** |



# Series "D" (ASME) Pressurized Expansion Tanks Vertical

## Not For Potable Water Systems

**DESCRIPTION**

Series "D" expansion tanks are ASME rated precharged diaphragm-type pressure vessels. The Series "D" tank is designed to absorb the expansion forces of heating/cooling system water while maintaining proper system pressurization under varying operating conditions. The heavy duty diaphragm separates system water from the tank air charge thereby eliminating waterlogging problems.

**CONSTRUCTION**

Shell: Carbon Steel
Diaphragm: Heavy Duty Butyl Rubber
System Connection: Forged Steel
Designed and Constructed per ASME Section VIII, Division 1

**PERFORMANCE LIMITATIONS**

Maximum Design Pressure: 125 PSI (862kPa)
Design Temperature: 240°F (115°C)

**SCHEDULE**

| PART NUMBER | MODEL NO. | VOLUME GALLONS (LITERS) TANK | VOLUME GALLONS (LITERS) ACCEPTANCE | TAGGING INFORMATION | QUANTITY |
|---|---|---|---|---|---|
| 116491 | D-15V | 8.0 (30.3) | 2.4 (9.1) | | |
| 116492 | D-20V | 10.9 (41.3) | 2.4 (9.1) | | |
| 116493 | D-40V | 21.7 (82.1) | 11.3 (42.8) | | |
| 116525 | D-60V | 33.6 (127.2) | 11.3 (42.8) | | |
| 116526 | D-80V | 44.4 (168.1) | 22.6 (85.5) | CT-1 | 1 |
| 116527 | D-100V | 55.7 (211.8) | 22.6 (85.5) | | |
| 116528 | D-120V | 68.0 (257.4) | 34.0 (128.7) | | |
| 116529 | D-144V | 77.0 (291.5) | 34.0 (128.7) | | |
| 116530 | D-180V | 90.0 (340.7) | 34.0 (128.7) | | |
| 116531 | D-200V | 110.0 (416.4) | 34.0 (128.7) | | |
| 116532 | D-240V | 132.0 (500) | 46.0 (174.1) | | |
| 116780 | D-260V | 159.0 (600) | 56.0 (212.0) | | |
| 116781 | D-280V | 211.0 (800) | 84.0 (318.0) | | |

**TYPICAL SPECIFICATION**

Furnish and install as shown on plans a _____ gallon ( _____ liter) _____" ( _____ mm) diameter x _____" ( _____ mm) high pre-charged vertical steel expansion tank with integral heavy duty Butyl rubber diaphragm. The tank shall have ___" NPT system connection(s), and a .302"-32 charging valve connection (standard tire valve) to facilitate the on-site charging of the tank to meet system requirements.

The tank must be constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code and stamped 125 PSI (862 kPa) working pressure.

Each tank shall be ITT – Bell & Gossett Model No. _____

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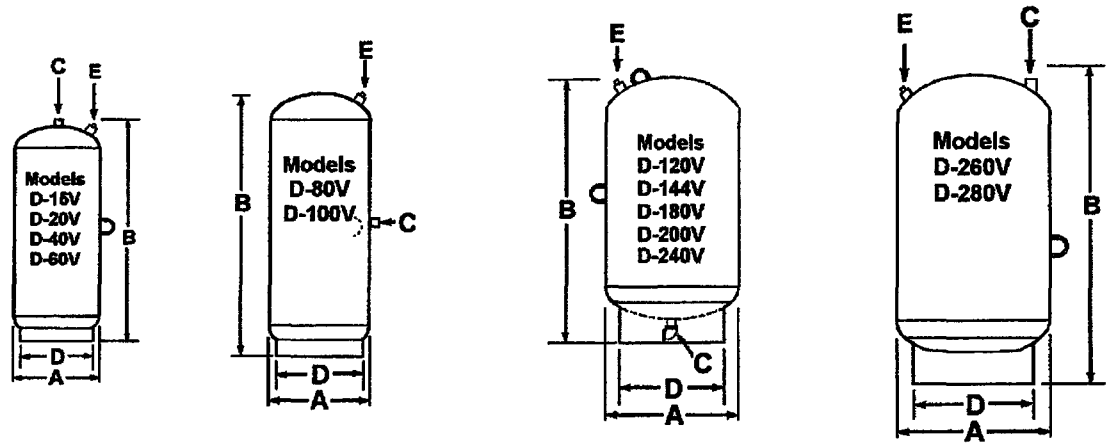
**Bell & Gossett**

# ASME EXPANSION TANKS - PRESSURIZED

**A-346F**




NOTE: Tanks are factory pre-charged at 12 psi (83 kPa)
Sight glass and seismic restraints available.
Tanks can also be installed in the horizontal position.

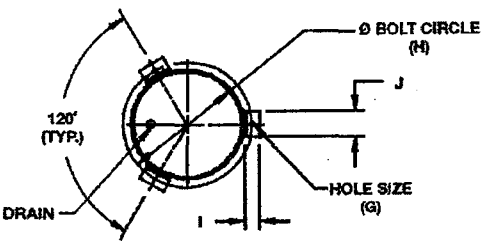
**DIMENSIONS AND WEIGHTS**

| MODEL NUMBER | DIMENSIONS IN INCHES (MM) | | | | | | APPROX. SHPG. WT. LBS. (Kg) | APPROX. WT* 100% FULL LBS. (Kg) |
|---|---|---|---|---|---|---|---|---|
| | A | B | SYSTEM CONNECTION C | SKIRT O.D. D | CHARGING VALVE E | SKIRT THICKNESS | | |
| D-15V** | 12 (305) | 19-1/2 (495) | 1/2 NPTM | 10-3/4 (273) | .302"-32 NC | 3/16 (5) | 43 (20) | 110 (50) |
| D-20V** | 12 (305) | 26-1/2 (673) | 1/2 NPTM | 10-3/4 (273) | .302"-32 NC | 3/16 (5) | 45 (21) | 136 (62) |
| D-40V | 16-1/4 (413) | 29-1/2 (749) | 1/2 NPTM | 12-3/4 (324) | .302"-32 NC | 3/16 (5) | 90 (41) | 271 (123) |
| D-60V | 16-1/4 (413) | 45-1/8 (1146) | 1/2 NPTM | 12-3/4 (324) | .302"-32 NC | 3/16 (5) | 110 (50) | 390 (177) |
| D-80V | 16-1/4 (413) | 56 (1422) | 1/2 NPTM | 12-3/4 (324) | .302"-32 NC | 3/16 (5) | 146 (66) | 517 (234) |
| D-100V | 16-1/4 (413) | 69 (1753) | 1/2 NPTM | 12-3/4 (324) | .302"-32 NC | 3/16 (5) | 167 (76) | 632 (287) |
| D-120V | 24 (610) | 43-7/8 (1114) | 1 NPTF | 16 (406) | .302"-32 NC | 1/4 (6) | 224 (102) | 791 (359) |
| D-144V | 24 (610) | 48-3/4 (1238) | 1 NPTF | 16 (406) | .302"-32 NC | 1/4 (6) | 244 (111) | 887 (402) |
| D-180V | 24 (610) | 56-1/8 (1426) | 1 NPTF | 16 (406) | .302"-32 NC | 1/4 (6) | 266 (121) | 977 (443) |
| D-200V | 24 (610) | 62-5/8 (1591) | 1 NPTF | 16 (406) | .302"-32 NC | 1/4 (6) | 296 (134) | 1214 (551) |
| D-240V | 30 (762) | 53-1/2 (1357) | 1 NPTF | 24 (610) | .302"-32 NC | 3/16 (5) | 427 (194) | 1529 (693) |
| D-260V | 30 (762) | 60-1/2 (1537) | 1-1/4 NPTM | 24 (610) | .302"-32 NC | 3/16 (5) | 476 (216) | 1803 (818) |
| D-280V | 30 (762) | 78-1/4 (1989) | 1-1/4 NPTM | 24 (610) | .302"-32 NC | 3/16 (5) | 745 (338) | 2506 (1137) |

**Dimensions are subject to change. Not to be used for construction purposes unless certified.**
*Approximate weight 100% full occurs if diaphragm fails. **No Lifting Ring

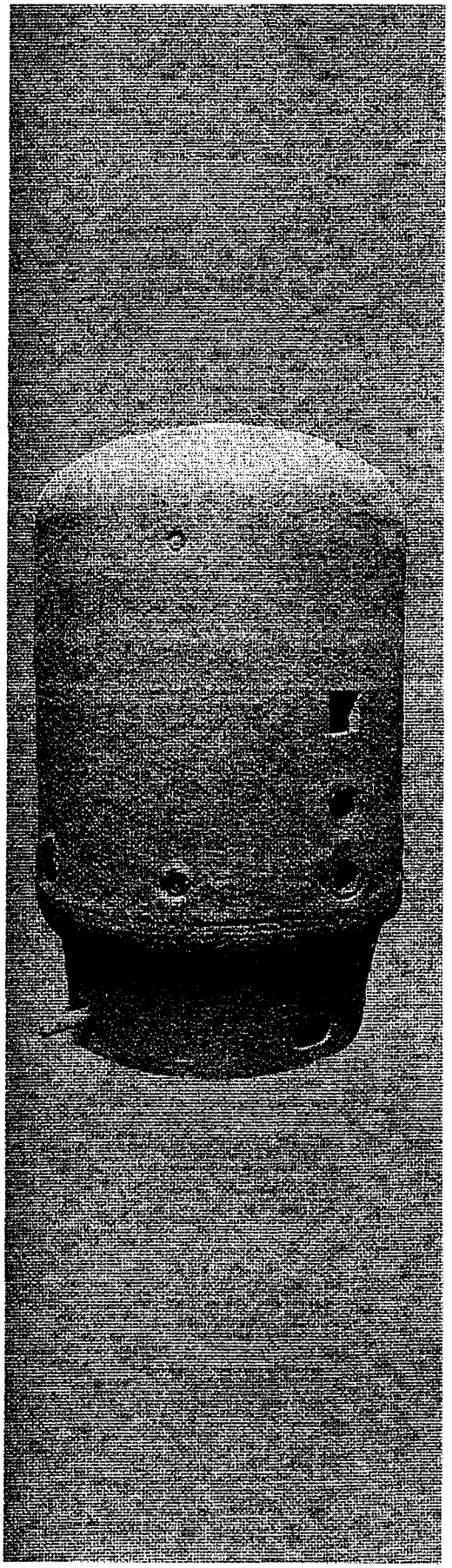
**OPTIONAL SEISMIC RESTRAINTS**
**DIMENSIONS IN INCHES (MM)**

| TANK DIAMETER A | G | H | I | J |
|---|---|---|---|---|
| 12 (305) | 9/16 (14) | 12-3/4 (324) | 2 (51) | 2 (51) |
| 16-1/4 (413) | 9/16 (14) | 14-3/4 (375) | 2 (51) | 2 (51) |
| 24 (610) | 9/16 (14) | 18 (457) | 2 (51) | 2 (51) |
| 30 (762) | 7/8 (22) | 28 (771) | 3 (76) | 3 (76) |



LAARS®
Heating Systems Company
A subsidiary of BRADFORD WHITE® Corporation

# LAARS® Hot Water Custom Storage Tanks with Sprayed-on Rigid Polyurethane Foam (SPF) with Acrylic Top-Coat



- Laars Heating Systems Tanks sprayed-on rigid insulation with acrylic topcoat exceeds ASHREE 90.1 requirements with 2.25" of high-density polyurethane foam with an "R" value of R-16. SPF meets requirements for California Title 24. Laars spray foam insulation has the best fire spread rating with a class I foam with less than a 25-flame spread rating suitable for boiler room applications.
- The 100% acrylic topcoat is formulated for applications over spray polyurethane foam and is designed to withstand extreme weather and a full range of environmental conditions.
- The 2-component polyurethane foam is applied at ambient temperatures, directly to the vessel in the desired thickness. The 2-coat topcoat is then applied from a high-pressure spray gun and allowed to dry between applications.
- Alternative for insulated and steel jacket.
- Any tank size or shape can be insulated.
- Field repairable.

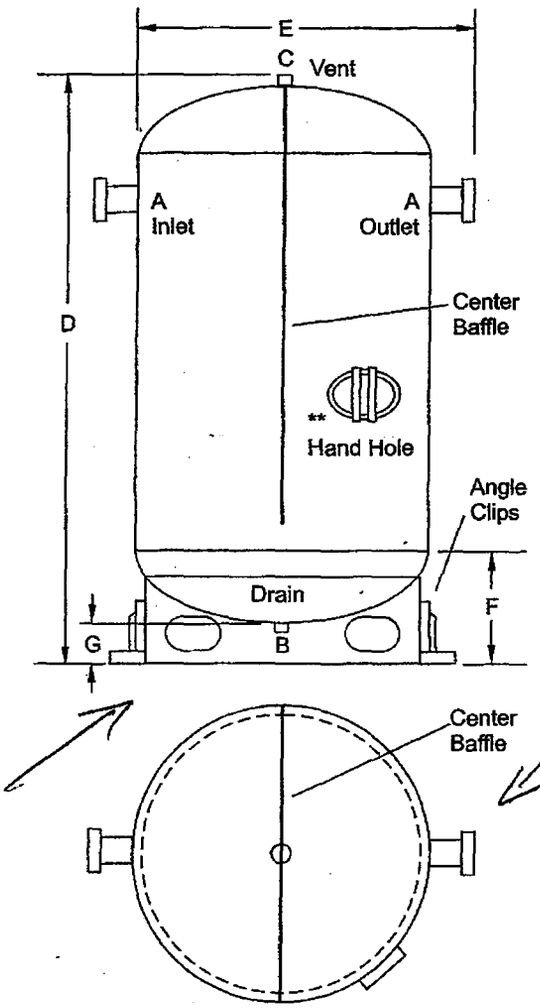
**SPRAY POLYURETHANE FOAM:**

| | |
|---|---|
| Specific Gravity: | 1.17 – 1.19 |
| Viscosity: | 800 – 1300 |
| Density: | @ 2" 2.10 – 2.35<br>@ 4" 1.88 – 1.99 |
| Closed Cell Content: | >90% |
| K-Factor, Initial: | 0.155 – 0.170 |
| Permeance: | 2.91 (perms)<br>2.99 (perm inch) |
| Dimensional Stability: | +3.3 to +8.2 - Dry Age 28 days (158°F, Dry)<br>-0.37 to –0.96 – Freeze 14 day (-20°F) |
| Flame Spread: | 25 - ASTM E-84 |
| Smoke Development: | 450 |
| R Value: | 7.2/ inch |
| Max. Thickness: | 4" |

**ACRYLIC COATING**

| | |
|---|---|
| Topcoat: | 2 coats white, 25 mils |
| Texture: | Smooth |
| Grade: | Spray or Roll |
| Base: | 100% Acrylic |
| Solids by weight: | 66% (+/-3) |
| Solids by volume: | 55% (+/-3) |
| Weight per gallon: | 11.65 (+/-.2) |
| Tensile Strength: | 300 psi (+/-25) |
| Elongation: | 260% (+/-25) |
| Durometer hardness: | 62 Shore A (+/-2) |
| Tear Resistance: | 85 lbs/ in. |
| Permeance: | 11 U.S. Perms @ 20 mils |
| Viscosity: | 110 K.U. (+/-8) |
| Codes/ Approvals: | Energy Star, ICC, UL, ASTM D6083 |
| Reflectivity: | New 85%, Aged 78% |
| Emmisivity: | .89 |

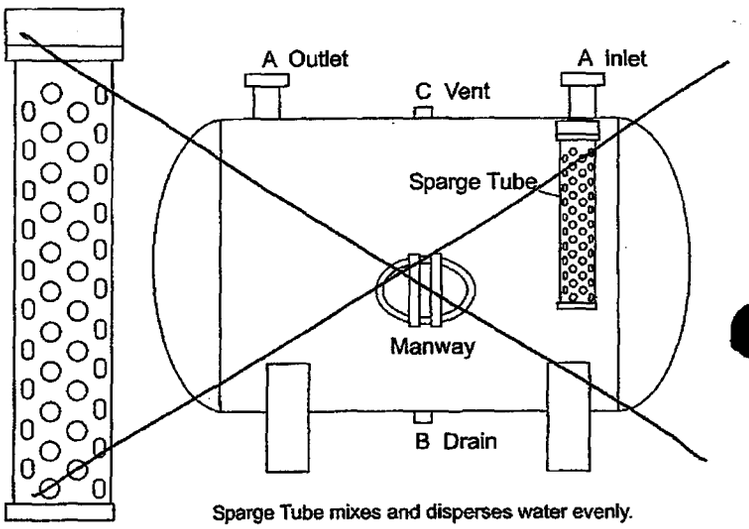
# Chilled Water Buffer Tanks




** Hand Holes required on tanks above 36" diameter.

***Standard Features***

- Tanks constructed and certified in accordance with ASME Section VIII, Div. I Code
- Exterior is red oxide shop primer
- Spray foam insulation available (R-16 value)
- Custom sizes available upon request
- ~~Horizontal tanks are supplied with sparging tube~~
- ~~Horizontal tanks are same size as vertical tanks~~
- Vertical tanks are welded into a 6" base ring
- Vertical tanks are supplied with center baffle




Sparge Tube mixes and disperses water evenly.

| Model | Cap. Gal. | A | B in | C in | D in | E in | F in | G in | Weight lbs |
|---|---|---|---|---|---|---|---|---|---|
| BT VNB 24 078 XASX XX | 130 | 2 NPT | 1 | 1 | 78 | 24 | 20 | 6 | 375 |
| BT VNB 30 083 XFSX XX | 210 | 3 FLG | 1 | 1 | 83 | 30 | 24 | 6 | 425 |
| BT VNB 36 078 XFSX XX | 300 | 4 FLG | 1 | 1 | 78 | 36 | 24 | 6 | 633 |
| BT VNB 36 100 XFSX XX | 400 | 4 FLG | 1 | 1 | 100 | 36 | 30 | 6 | 715 |
| BT VNB 48 083 HFSX XX | 528 | 6 FLG | 1 | 1 | 83 | 48 | 31 | 6 | 1150 |
| BT VNB 54 102 HFSX XX | 850 | 6 FLG | 1 | 1 | 102 | 54 | 32 | 6 | 1630 |
| BT VNB 60 102 HFSX XX | 1040 | 8 FLG | 1 | 1 | 102 | 60 | 32 | 6 | 2280 |

SECTION 23 73 13

MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS
**11/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

| | |
|---|---|
| AMCA 99 | (2003) Standards Handbook |

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

| | |
|---|---|
| AHRI 430 | (1999) Standard for Central-Station Air-Handling Units |
| AHRI 880 | (1998; Addendum 2002) Standard for Air Terminals |

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

| | |
|---|---|
| ASHRAE 52.1 | (1992; Interpretation 1 2007) Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 653/A 653M | (2008) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM B 117 | (2007a) Standing Practice for Operating Salt Spray (Fog) Apparatus |

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

| | |
|---|---|
| ISO 1940-1 | (2003; Corrigendum 2005) Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerance - International Restrictions |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA MG 1 | (2007; Errata 2008) Standard for Motors and Generators |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 90A | (2008) Standard for the Installation of Air Conditioning and Ventilating Systems |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 900 | (2004; Rev thru Nov 2007) Standard for Air Filter Units |

1.2 GENERAL REQUIREMENTS

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section.

Submit Equipment and Performance Data for air handling units in accordance with the specification. Provide data that consists of use life, total static pressure and coil face area classifications, and performance ratings.

Submit drawings and manuals that include a spare parts data sheet, with manufactures recommended stock levels.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit Equipment and Performance Data for air handling units in accordance with paragraph entitled, "General Requirements," of this section.

Submit Manufacturer's catalog data for the following items:

Unit Cabinet
Fan
Drain Pans
Insulation
Plenums

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals for air handling units in accordance with paragraph entitled, "Operation and Maintenance," of this section.

PART 2 PRODUCTS

2.1 AIR HANDLING UNIT (AHU)

Provide central-station type, factory fabricated, and sectionally assembled air handling unit (AHU). Provide AHU that includes components and auxiliaries in accordance with AHRI 430. Balance AHU fan and motor to ISO 1940-1-2005.

Provide total static pressure and coil face area classification that

conform to AMCA 99.

Fans with enlarged outlets are not permitted.

## 2.2 UNIT CABINET

Provide AHU cabinet that is suitable for pressure class shown and that has leaktight joints, closures, penetrations, and access provisions. Provide cabinet that does not expand or contract perceptibly during starting and stopping of fans and that does not pulsate during operation. Reinforce cabinet surfaces with deflections in excess of 0.004167 of unsupported span prior to acceptance. Stiffen pulsating panels, which produce low frequency noise due to diaphragming of unstable panel walls, to raise natural frequency to an easily attenuated level. Fabricate enclosure from continuous hot-dipped galvanized steel no lighter than 20 gage thickness, to match industry standard. Provide mill-galvanized sheet metal that conforms to ASTM A 653/A 653M and that is coated with not less than 1.25 ounces of zinc per square foot of two-sided surface. Provide mill-rolled structural steel that is hot-dip galvanized or primed and painted. Corrosion protect cut edges, burns, and scratches in galvanized surfaces. Provide primed and painted black carbon steel cabinet construction that complies with this specification.

Provide removable panels to access the interior of the unit cabinet. Provide seams that are welded, bolted or gasketed and sealed with a rubber-based mastic. Make entire floor as well as ceiling unit hot-dipped galvanized steel. Provide removable access doors on both sides of all access, filter, and fan sections for inspection and maintenance.

Provide AHU cabinet suitable for pressure class indicated with leaktight joints, closures, penetrations, and access provisions. Provide cabinet that does not expand or contract perceptibly during starting and stopping of fans and that does not pulsate during operation. Reinforce cabinet surfaces with deflections in excess of 0.002778 of unsupported span prior to acceptance by the Contracting Officer. Stiffen pulsating panels, which produce low frequency noise due to diaphragming of unstable panel walls, to raise natural frequency to an easily attenuated level. Provide enclosure that is fabricated from mill-galvanized or primed and painted carbon steel sheet of required thickness. Provide mill-galvanized sheet metal that conforms to ASTM A 653/A 653M and that is coated with not less than 1.25 ounces of zinc per square foot of two-sided surface. Provide mill-rolled structural steel that is hot-dip galvanized or primed and painted. Corrosion protect edges, burns, and scratches in galvanized surfaces. Provide primed and painted black carbon steel cabinet construction that complies with this specification.

Provide removable panels to access the interior of the unit cabinet. Provide seams that are welded, bolted or gasketed and sealed with a rubber-based mastic. Make entire floor as well as ceiling unit hot-dipped galvanized steel. Provide removable access doors on both sides of all access, filter, and fan sections for inspection and maintenance.

Where cabinet size is such that personnel access is possible, strengthen cabinet floor to permit entry without damage to any component. Hinge and latch access doors and panels at a spacing sufficiently close to preclude leaks caused by distortion, and effectively gasket.

Black carbon steel cabinet construction is acceptable when the following conditions are met:

Coat all interior and exterior surfaces, including lapped contacting surfaces, with a corrosion-protective coating.

Certify coating as passing a 500-hour exposure salt-spray fog test in accordance with ASTM B 117.

Immediately after completion of the test, provide a specimen that shows no signs of wrinkling, cracking or loss of adherence, and no signs of rust creepage beyond 1/8 inch on either side of the scratch mark.

Ensure inspection of interior and exterior cabinet surfaces will pass examination for the same defects as the salt-spray fog test specimen, after 11 months of service and prior to expiration of guarantee.

Interior surfaces of cabinets constructed of intact mill-galvanized steel require no further protection.

Provide cabinets with exterior surfaces constructed of mill-galvanized steel that are [left unpainted] [painted] [prepared by a phosphatizing treatment, and painted with two coats of manufacturer's standard enamel finish in color selected by the Contracting Officer].

Provide cabinets and casings that are double walled with 2 inch insulation. Provide interior wall that is galvanized.

Dynamically and statically balance fan wheels at the factory. Provide fan with RPM that is 25 percent less than the first critical speed. Provide fan shaft that is solid, ground and polished steel and coated with a rust inhibitor. Provide V-belt driven fans that are designed for 50 percent overload capacity. For variable air volume air handling units that are provided with variable frequency drives, have their fans balanced over the entire range of operation (20 percent - 100 percent RPM). Balancing fans of only 100 percent design of RPM is not acceptable for air handling units to be used with variable frequency drives.

Mount fans on isolation bases. Internally mount motors on same isolation bases and internally isolate fans and motors with 2-inch. Install flexible canvas ducts or vibration absorbent fan discharge seal between fan and casings to ensure complete isolation. Provide flexible canvas ducts that comply with NFPA 90A.

Weigh fan and motor assembly at air handling unit manufacturer's factory for isolator selection. Statically and dynamically balance fan section assemblies. Fan section assemblies include fan wheels, shafts, bearings, drives, belts, isolation bases and isolators. Allow isolators to free float when performing fan balance. Measure vibration at each fan shaft bearing in horizontal, vertical and axial directions.

Factory install all motors on slide bases to permit adjustment of belt tension.

Provide heavy duty, open drip-proof, operable at 460 volts, 60 hertz, 3-phase fan motors. Provide high efficiency motors. Refer to specification Section 26 05 70.00 40 HIGH-VOLTAGE OVERCURRENT PROTECTIVE DEVICES and Section 26 05 71.00 40 LOW-VOLTAGE OVERCURRECT PROTECTIVE DEVICES.

Provide a marine-type, vapor proof service light in the fan segment. Provide 100 watt service light that is wired to an individual switch. Light requires 115 Volt, single phase, 60 Hertz service that is separate from the main power to the AHU. Provide a single 115 volt outlet at the light switch.

## 2.3 FAN

Provide an overall fan-section depth that is equal to or greater than the manufacturer's free-standing fan.

Locate fan inlet where it provides not less than one-half fan-wheel diameter clearance from cabinet wall or adjacent fan inlet where double wheels are permitted.

Install AHU fan motor and drive inside fan cabinet. Provide motor that conforms to NEMA MG 1 and is installed on an adjustable base. Provide an access door of adequate size for servicing motor and drive. Provide a belt guard inside the cabinet, or interlock the access door with the supply fan so that power to the fan is interrupted when the access door is opened.

## 2.4 DRAIN PANS

Provide intermediate-coil, 3-inch deep drip pans for each tiered coil bank.

Extend top pan 12 inches beyond face of coil, and extend bottom pan not less than 24 inches beyond face of coil. Where more than two pans are used, make pan extension proportional. Make adequate supports from the same type material as pans or hot-dip galvanized angle iron with isolation at interface. Provide pan material that is 22-gage AISI Type 304 corrosion-resistant steel with silver-soldered joints. Minimum size of drain opening is 1-1/4 inches. Pipe pan to drain.

Extend integral cabinet drain pan under all areas where condensate must be collected and make watertight with welded or brazed joints, piped to drain, corrosion protect in condensate collection area, and insulate against sweating. Provide minimum 14-gage sheet metal, except that 16-gage double-drain-pan construction is acceptable.

Provide cooling coil ends that are enclosed by cabinet and are factory insulated against sweating or drain to a drain pan.

Provide drain pans that are double pan construction, thermally isolated from the exterior casing with 1-inch thick fiberglass insulation. Provide drain pans that slope to drain and drain substantially dry by gravity alone when drains are open.

Provide pans that have a double slope to the drain point.

## 2.5 COILS

### 2.5.1 Coil Section

Provide coil section that encases cooling coils and drain pipes. Arrange coils for horizontal air flow. Provide intermediate drain pans for multiple coils installation. Completely enclose coil headers with the insulated casing with only connections extended through the cabinet.

2.5.2 Coil Pressure and Temperature Ratings

Provide coils that are designed for the following fluid operating pressures and temperatures:

| SERVICE | PRESSURE | TEMPERATURE |
|---|---|---|
| Chilled Water | 200 PSI | 40 degrees F |

Provide coils that are air-pressure tested under water at the following minimum pressures:

| SERVICE | PRESSURE |
|---|---|
| Water (hot and chilled) | 250 PSI |

2.5.3 Coil Casings

Provide stainless steel casings. Provide cast iron, brass, or copper coil headers. Fit water coil headers with .25 inch ops spring-loaded plug drains and vent petcocks. Provide automatic air vents with ball type isolation valves for each coil piped to the drain pan.

Provide coils that are factory tested, dehydrated, vacuum tested, purged with inert gas, and sealed prior to shipment to the job site.

2.5.4 Chilled Water coils

Provide 0.625 inch outside diameter copper tubing for coils. Provide fins that are aluminum mechanically bonded by tubing expansion with a maximum spacing of 12 fins per 1 inch unless otherwise noted. Provide coils that have supply and return connections on the same end. Provide a maximum of four coil rows.

2.5.5 Drainable Coils

Provide drainable coils that are capable of being purged free of water with compressed air.

Provide self-draining coils that have a drain point at the end of every tube and are pitched to that point. Provide drain provisions that include: drained headers; U-bends with integral plugs; or nonferrous plugs in cast-iron headers. Provide tubes that drain substantially dry by gravity alone when drains and vents are open.

2.6 FILTERS

2.6.1 Filter Housing

Provide factory fabricated filter section of the same construction and finish as unit casings. Provide filter sections that have filter guides and full height, double wall, hinged and removable access doors for filter removal. Provide air sealing gaskets to prevent air bypass around filters. Provide visible identification on media frames showing model number and airflow direction. Where filter bank is indicated or required, provide means of sealing to prevent bypass of unfiltered air. Performance in accordance with ASHRAE 52.1.

2.6.2 Replaceable Air Filters

UL 900, Class 1, those which, when cleaned, do not contribute fuel when attacked by flame and emit only negligible amount of smoke. Permanent frames with replaceable media, 1-inch thickness and size as indicated.

2.6.3 Disposable Cartridge Air Filters

UL 900, Class 2, UL classified, and factory assembled. Provide media of ultra-fine glass fibers having 50-55 percent average dust spot efficiencies with maximum final resistance 0.75 inch water gage and maximum face velocity of 500 feet per minute. Construct filter frame of 18 gage galvanized steel or aluminum with welded or riveted joints. Caulk or gasket entire assembly to prevent air leakage around frames. Ensure minimum efficiency of filter is 60 percent per ASHRAE 52.1

2.6.4 Air Filter Gauges

Provide manometer air filter gauges of the inclined tube differential type, of solid acrylic plastic construction with built-in level vial and with an adjustable mirror-polished scale. Equip gauges with vent valves for zeroing and over-pressure safety traps. Provide adequate gauge range for the particular installation. Provide gauges manufactured by Dwyer or approved equal.

Provide one (1) air filter gauge at each filter bank.

PART 3 EXECUTION

3.1 AHU EQUIPMENT INSTALLATION

Install equipment in accordance with manufacturer's recommendations.

Provide Installation drawings in accordance with referenced standards in this section.

Submit Listing of Product Installations for air handling units showing a minimum of 5 installed units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. Provide list that includes purchaser, address of installation, service organization, and date of installation.

3.2 ACCEPTANCE

Prior to final acceptance, use dial indicator gages to demonstrate that fan and motor are aligned as specified.

3.3 AHU TESTING

Perform air handling unit start-up in the presence of the Contracting Officer.

3.4 OPERATION AND MAINTENANCE

Submit Operation and Maintenance Manuals prior to testing the air handling units. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

## 3.5 COORDINATION

Coordinate the size and location of concrete equipment pads, variable frequency drives, control and electrical requirements.

## 3.6 TEMPORARY CONSTRUCTION FILTERS

Have temporary construction filters in place during normal building construction whenever the air handling units are run for general ventilation, building dehumidification, and for other purposes during construction. Install two (2) layers of blanket filter at a time. Replace temporary construction filters as required during construction and after completion of duct system cleaning.

After systems have been cleaned and temporary construction filers are removed, and before test and balance operations are started, install set of final filters. Do not have final filters in place while general building construction is taking place, to avoid unnecessary loading with construction dust. Clean permanent filter bank before testing and balancing.

Submit all required installation, Fabrication and Connection drawings and obtain approval prior to the start of work detailed on these drawings.

Maximum number of coil rows is four (8). Maximum number of fins per inch is ten (12).

Provide VAV terminal units that are AHRI 880 certified and UL listed.

-- End of Section --

# Indoor M-Series Climate Changer air handler

| | |
|---|---|
| **Job Name** | Stennis Riverine Training Facility |
| **User Name** | (B29)Rob Hoffman |
| **Address** | New Orleans |

Indoor M-Series Climate Changer air handler — AHU-1 (Cages)

**Quantity** 1

**Job Comments**

**Unit level selections** — **Module Position:** 0

| | | | |
|---|---|---|---|
| Actual airflow | 2000 cfm | Single or front discharge - 1 kHz | 75 dB |
| Unit elevation | 0.00 ft | Single or front discharge - 2 kHz | 72 dB |
| Size criteria component | Largest 1/2" coil | Single or front discharge - 4 kHz | 70 dB |
| Target face velocity | 500 ft/min | Single or front discharge - 8 kHz | 62 dB |
| Unit split | Factory splits | Inlet and casing - 63 Hz | 79 dB |
| Unit size | 06 | Inlet and casing - 125 Hz | 77 dB |
| Unit base | 6" mounting leg | Inlet and casing - 250 Hz | 72 dB |
| Inlet type | Ducted | Inlet and casing - 500 Hz | 55 dB |
| Run acoustics | Yes | Inlet and casing - 1 kHz | 58 dB |
| Largest 1/2" coil-max face vel | 600 ft/min | Inlet and casing - 2 kHz | 59 dB |
| Largest 1/2" coil-min face vel | 250 ft/min | Inlet and casing - 4 kHz | 54 dB |
| Largest 5/8" coil-max face vel | 600 ft/min | Inlet and casing - 8 kHz | 41 dB |
| Largest 5/8" coil-min face vel | 250 ft/min | Casing - 63 Hz | 77 dB |
| Face & bypass coil-max face velocity | 600 ft/min | Casing - 125 Hz | 75 dB |
| Face & bypass coil-min face velocity | 250 ft/min | Casing - 250 Hz | 71 dB |
| Flat filter - max face vel | 625 ft/min | Casing - 500 Hz | 54 dB |
| Flat filter - min face vel | 0 ft/min | Casing - 1 kHz | 57 dB |
| Angled filter - max face vel | 625 ft/min | Casing - 2 kHz | 53 dB |
| Angled filter - min face vel | 0 ft/min | Casing - 4 kHz | 44 dB |
| Bag/cartridge-max face vel | 625 ft/min | Casing - 8 kHz | 32 dB |
| Bag/cartridge-min face vel | 0 ft/min | Ducted inlet - 63 Hz | 74 dB |
| HEPA filter - max face vel | 500 ft/min | Ducted inlet - 125 Hz | 66 dB |
| HEPA filter - min face vel | 0 ft/min | Ducted inlet - 250 Hz | 60 dB |
| UL listed unit | UL listed | Ducted inlet - 500 Hz | 46 dB |
| Single or front discharge - 63 Hz | 88 dB | Ducted inlet - 1 kHz | 48 dB |
| Single or front discharge - 125 Hz | 83 dB | Ducted inlet - 2 kHz | 50 dB |
| Single or front discharge - 250 Hz | 82 dB | Ducted inlet - 4 kHz | 45 dB |
| Single or front discharge - 500 Hz | 75 dB | Ducted inlet - 8 kHz | 32 dB |

**Unit control module** — **Module Position:** 0

| | | | |
|---|---|---|---|
| Factory controls package | No factory mount | Controller type | No controller |
| Low limit interlock wiring | No | LCD screen & keypad | No LCD |
| Controller mounting | No mount | Design sequence | G |
| Automatic selection | No auto selection | | |

Coil performance data is certified in accordance with ARI standard 410. Propylene glycol and calcium chloride, or mixtures thereof, are not covered under the scope of ARI 410.

Air-handling performance data is certified in accordance with ARI standard 430. Air handlers with Q-fans, air handlers with plenum fans, and vertical draw-thru air handlers where the coil is mounted immediately below the fan module are not covered under the scope of ARI 430.

All weights and dimensions are approximate. Certified prints on request.

# Indoor M-Series Climate Changer air handler

**Filter module** — **Module Position:** 1

| | | | |
|---|---|---|---|
| Module type | Filter | Design sequence | C |
| Filter type | Flat | Filter airflow | 2000 cfm |
| Insulation | 1.5 lb insulation | Filter condition | Mid-life |
| Panel wall type | Solid double wall | Mid-life prefilter PD | 0.59 in H2O |
| Access/inspection door | Right | Prefilter PD | 0.59 in H2O |
| Filter frame | 2" & 4" comb | Filter area | 5.60 sq ft |
| Prefilter type | Pleated media - MERV 8 | Filter module PD | 1.43 in H2O |
| Primary filter type | 4" high eff - 85% eff - MERV 13 | Mid-life filter PD | 0.84 in H2O |
| Primary filter type - 2nd set | 4" High eff - 85% eff - MERV 13 | | |

**Coil module** — **Module Position:** 2

**Coil mo [2]-1**

| | | | |
|---|---|---|---|
| Module type | Vertical coil | Coil fouling factor | 0.00000 hr-sq ft-deg F/Btu |
| Module size | Large | Fluid type | Water |
| Insulation | 1.5 lb insulation | Max fluid PD | 20.00 ft H2O |
| Panel wall type | Solid double wall | Location | Draw through |
| Drain pan | Stainless steel | Coil type | UW |
| Drain pan connection side | Right side | Coil rows | 6 |
| Coil application | Cooling | Coil fin type | Delta-Flo H |
| System type | Chilled water | Coil fin material | Aluminum |
| Coil supply side | Right | Tube diameter | 1/2" tube (12.7 mm) |
| Coil casing | Galvanized | Coil tube material | .016" copper |
| Coil height | Unit | Corrosion resistant coating | None |
| Design sequence | H | Face velocity | 342 ft/min |
| Apply ARI ranges | Yes | Air pressure drop | 0.44 in H2O |
| Coil design airflow | 2000 cfm | Leaving fluid temperature | 54.00 F |
| Elevation | 0.00 ft | Fluid pressure drop | 3.05 ft H2O |
| EDB | 87.10 F | Fluid volume | 3.88 gal |
| EWB | 73.90 F | Fluid velocity | 2.48 ft/sec |
| LDB | 54.60 F | Nominal height stacked coil #1 | 23" (584 mm) |
| LWB | 54.46 F | Face area | 5.86 sq ft |
| Sensible capacity | 72.14 MBh | Dry coil weight | 100.2 lb |
| Total capacity | 130.74 MBh | Wet coil weight | 132.6 lb |
| Fin spacing | 119 Per Foot | Coil module PD | 0.44 in H2O |
| Entering fluid temperature | 44.00 F | Module length | 28.750 in |
| Fluid temperature rise | 10.00 F | Module weight | 281.6 lb |
| Standard fluid flow rate | 26.05 gpm | | |

Coil performance data is certified in accordance with ARI standard 410. Propylene glycol and calcium chloride, or mixtures thereof, are not covered under the scope of ARI 410.

Air-handling performance data is certified in accordance with ARI standard 430. Air handlers with Q-fans, air handlers with plenum fans, and vertical draw-thru air handlers where the coil is mounted immediately below the fan module are not covered under the scope of ARI 430.

All weights and dimensions are approximate. Certified prints on request.

# Indoor M-Series Climate Changer air handler

**Fan module** **Module Position:** 3

| **Fan mod [3]-1** | | | |
|---|---|---|---|
| Module type | Supply fan | Single or front discharge - 63 Hz | 88 dB |
| Inlet location | Bottom inlet | Single or front discharge - 125 Hz | 83 dB |
| Insulation | 1.5 lb insulation | Single or front discharge - 250 Hz | 82 dB |
| Panel wall type | Solid double wall | Single or front discharge - 500 Hz | 75 dB |
| Access/inspection door | Right | Single or front discharge - 1 kHz | 75 dB |
| Fan discharge | Top back | Single or front discharge - 2 kHz | 72 dB |
| Drive location | Right | Single or front discharge - 4 kHz | 70 dB |
| Design sequence | L | Single or front discharge - 8 kHz | 62 dB |
| Motor hp | 2 HP | Inlet and casing - 63 Hz | 79 dB |
| Motor RPM | 1800 RPM | Inlet and casing - 125 Hz | 77 dB |
| Motor class | ODP EPACT high efficiency | Inlet and casing - 250 Hz | 72 dB |
| Motor voltage | 460/3 | Inlet and casing - 500 Hz | 55 dB |
| Cycle | 60 cycles/sec | Inlet and casing - 1 kHz | 58 dB |
| Drive service factor & type | 1.5 fixed | Inlet and casing - 2 kHz | 59 dB |
| Fan airflow | 2000 cfm | Inlet and casing - 4 kHz | 54 dB |
| ESP | 0.60 in H2O | Inlet and casing - 8 kHz | 41 dB |
| Elevation | 0.00 ft | Ducted inlet - 63 Hz | 74 dB |
| Min temperature | 10.00 F | Ducted inlet - 125 Hz | 66 dB |
| Design temperature | 70.00 F | Ducted inlet - 250 Hz | 60 dB |
| Max BHP | 1.688 hp | Ducted inlet - 500 Hz | 46 dB |
| Fan size and type | 6B - 10.5" FC | Ducted inlet - 1 kHz | 48 dB |
| Extended grease lines | w/ both bearings | Ducted inlet - 2 kHz | 50 dB |
| BHP | 1.497 hp | Ducted inlet - 4 kHz | 45 dB |
| TSP | 2.48 in H2O | Ducted inlet - 8 kHz | 32 dB |
| Speed | 1566 rpm | Casing - 63 Hz | 77 dB |
| Outlet area | 1.41 sq ft | Casing - 125 Hz | 75 dB |
| Fan module PD | 0.60 in H2O | Casing - 250 Hz | 71 dB |
| Height | 28.750 in | Casing - 500 Hz | 54 dB |
| Length | 41.000 in | Casing - 1 kHz | 57 dB |
| Width | 44.000 in | Casing - 2 kHz | 53 dB |
| Weight | 369.5 lb | Casing - 4 kHz | 44 dB |
| Unit controller | No | Casing - 8 kHz | 32 dB |
| Low limit interlock wiring | No LLT wired to starter,vfd | | |

Coil performance data is certified in accordance with ARI standard 410. Propylene glycol and calcium chloride, or mixtures thereof, are not covered under the scope of ARI 410.

Air-handling performance data is certified in accordance with ARI standard 430. Air handlers with Q-fans, air handlers with plenum fans, and vertical draw-thru air handlers where the coil is mounted immediately below the fan module are not covered under the scope of ARI 430.

All weights and dimensions are approximate. Certified prints on request.

# Indoor M-Series Climate Changer air handler

| | |
|---|---|
| **Job Name** | Stennis Riverine Training Facility |
| **User Name** | (B29)Rob Hoffman |
| **Address** | New Orleans |

Indoor M-Series Climate Changer air handler AHU-2 1st/2nd

**Quantity** 1

**Job Comments**

**Unit level selections** **Module Position:** 0

| | | | |
|---|---|---|---|
| Actual airflow | 6000 cfm | Single or front discharge - 1 kHz | 87 dB |
| Unit elevation | 0.00 ft | Single or front discharge - 2 kHz | 79 dB |
| Size criteria component | Largest 1/2" coil | Single or front discharge - 4 kHz | 70 dB |
| Target face velocity | 500 ft/min | Single or front discharge - 8 kHz | 65 dB |
| Unit split | Factory splits | Inlet and casing - 63 Hz | 92 dB |
| Unit size | 12 | Inlet and casing - 125 Hz | 89 dB |
| Unit base | 6" mounting leg | Inlet and casing - 250 Hz | 81 dB |
| Inlet type | Ducted | Inlet and casing - 500 Hz | 82 dB |
| Run acoustics | Yes | Inlet and casing - 1 kHz | 74 dB |
| Largest 1/2" coil-max face vel | 600 ft/min | Inlet and casing - 2 kHz | 67 dB |
| Largest 1/2" coil-min face vel | 250 ft/min | Inlet and casing - 4 kHz | 59 dB |
| Largest 5/8" coil-max face vel | 600 ft/min | Inlet and casing - 8 kHz | 49 dB |
| Largest 5/8" coil-min face vel | 250 ft/min | Casing - 63 Hz | 82 dB |
| Face & bypass coil-max face velocity | 600 ft/min | Casing - 125 Hz | 84 dB |
| Face & bypass coil-min face velocity | 250 ft/min | Casing - 250 Hz | 73 dB |
| Flat filter - max face vel | 625 ft/min | Casing - 500 Hz | 73 dB |
| Flat filter - min face vel | 0 ft/min | Casing - 1 kHz | 62 dB |
| Angled filter - max face vel | 625 ft/min | Casing - 2 kHz | 56 dB |
| Angled filter - min face vel | 0 ft/min | Casing - 4 kHz | 50 dB |
| Bag/cartridge-max face vel | 625 ft/min | Casing - 8 kHz | 41 dB |
| Bag/cartridge-min face vel | 0 ft/min | Ducted inlet - 63 Hz | 92 dB |
| HEPA filter - max face vel | 500 ft/min | Ducted inlet - 125 Hz | 88 dB |
| HEPA filter - min face vel | 0 ft/min | Ducted inlet - 250 Hz | 81 dB |
| UL listed unit | UL listed | Ducted inlet - 500 Hz | 81 dB |
| Single or front discharge - 63 Hz | 96 dB | Ducted inlet - 1 kHz | 73 dB |
| Single or front discharge - 125 Hz | 95 dB | Ducted inlet - 2 kHz | 67 dB |
| Single or front discharge - 250 Hz | 94 dB | Ducted inlet - 4 kHz | 58 dB |
| Single or front discharge - 500 Hz | 90 dB | Ducted inlet - 8 kHz | 48 dB |

**Unit control module** **Module Position:** 0

| | | | |
|---|---|---|---|
| Factory controls package | No factory mount | Controller type | No controller |
| Low limit interlock wiring | No | LCD screen & keypad | No LCD |
| Controller mounting | No mount | Design sequence | G |
| Automatic selection | No auto selection | | |

Coil performance data is certified in accordance with ARI standard 410. Propylene glycol and calcium chloride, or mixtures thereof, are not covered under the scope of ARI 410.

Air-handling performance data is certified in accordance with ARI standard 430. Air handlers with Q-fans, air handlers with plenum fans, and vertical draw-thru air handlers where the coil is mounted immediately below the fan module are not covered under the scope of ARI 430.

All weights and dimensions are approximate. Certified prints on request.

# Indoor M-Series Climate Changer air handler

**Filter module** — **Module Position:** 1

| | | | |
|---|---|---|---|
| Module type | Filter | Design sequence | C |
| Filter type | Flat | Filter airflow | 6000 cfm |
| Insulation | 1.5 lb insulation | Filter condition | Mid-life |
| Panel wall type | Solid double wall | Mid-life prefilter PD | 0.63 in H2O |
| Access/inspection door | Right | Prefilter PD | 0.63 in H2O |
| Filter frame | 2" & 4" comb | Filter area | 13.30 sq ft |
| Prefilter type | Pleated media - MERV 8 | Filter module PD | 1.57 in H2O |
| Primary filter type | 4" high eff - 85% eff - MERV 13 | Mid-life filter PD | 0.94 in H2O |

**Access/turning module** — **Module Position:** 2

| | | | |
|---|---|---|---|
| Module type | Access/blank | Door swing | Outward |
| Access/inspection/blank size | Medium | Front opening | Yes |
| Insulation | 1.5 lb insulation | Back opening | Yes |
| Panel wall type | Solid double wall | Design sequence | D |
| Access/inspection door | Right | ASP | 0.00 in H2O |

**Coil module** — **Module Position:** 3

**Coil mo [3]-1**

| | | | |
|---|---|---|---|
| Module type | Horizontal coil | Coil fouling factor | 0.00000 hr-sq ft-deg F/Btu |
| Module size | Medium | Fluid type | Water |
| Insulation | 1.5 lb insulation | Max fluid PD | 20.00 ft H2O |
| Panel wall type | Solid double wall | Location | Draw through |
| Drain pan | Stainless steel | Coil type | UW |
| Drain pan connection side | Right side | Coil rows | 6 |
| Coil application | Cooling | Coil fin type | Delta-Flo H |
| System type | Chilled water | Coil fin material | Aluminum |
| Coil supply side | Right | Tube diameter | 1/2" tube (12.7 mm) |
| Coil casing | Galvanized | Coil tube material | .016" copper |
| Coil height | Unit | Corrosion resistant coating | None |
| Design sequence | H | Face velocity | 488 ft/min |
| Apply ARI ranges | Yes | Air pressure drop | 0.73 in H2O |
| Coil design airflow | 6000 cfm | Leaving fluid temperature | 54.00 F |
| Elevation | 0.00 ft | Fluid pressure drop | 8.84 ft H2O |
| EDB | 83.60 F | Fluid volume | 8.06 gal |
| EWB | 69.40 F | Fluid velocity | 4.03 ft/sec |
| LDB | 54.20 F | Nominal height stacked coil #1 | 32" (813 mm) |
| LWB | 53.87 F | Face area | 12.30 sq ft |
| Sensible capacity | 194.79 MBh | Dry coil weight | 192.4 lb |
| Total capacity | 294.52 MBh | Wet coil weight | 259.8 lb |
| Fin spacing | 116 Per Foot | Coil module PD | 0.73 in H2O |
| Entering fluid temperature | 44.00 F | Module length | 15.500 in |
| Fluid temperature rise | 10.00 F | Module weight | 398.4 lb |
| Standard fluid flow rate | 58.69 gpm | | |

Coil performance data is certified in accordance with ARI standard 410. Propylene glycol and calcium chloride, or mixtures thereof, are not covered under the scope of ARI 410.

Air-handling performance data is certified in accordance with ARI standard 430. Air handlers with Q-fans, air handlers with plenum fans, and vertical draw-thru air handlers where the coil is mounted immediately below the fan module are not covered under the scope of ARI 430.

All weights and dimensions are approximate. Certified prints on request.

# Indoor M-Series Climate Changer air handler

**Fan module** **Module Position: 4**

| **Fan mod [4]-1** | | | |
|---|---|---|---|
| Module type | Supply fan | Low limit interlock wiring | No LLT wired to starter,vfd |
| Inlet location | Back inlet | Single or front discharge - 63 Hz | 96 dB |
| Insulation | 1.5 lb insulation | Single or front discharge - 125 Hz | 95 dB |
| Panel wall type | Solid double wall | Single or front discharge - 250 Hz | 94 dB |
| Access/inspection door | Right | Single or front discharge - 500 Hz | 90 dB |
| Fan discharge | Top back | Single or front discharge - 1 kHz | 87 dB |
| Drive location | Right | Single or front discharge - 2 kHz | 79 dB |
| Fan wheel balance | Inverter balance | Single or front discharge - 4 kHz | 70 dB |
| Design sequence | L | Single or front discharge - 8 kHz | 65 dB |
| Motor hp | 7.5 HP | Inlet and casing - 63 Hz | 92 dB |
| Motor RPM | 1800 RPM | Inlet and casing - 125 Hz | 89 dB |
| Motor class | ODP EPACT high efficiency | Inlet and casing - 250 Hz | 81 dB |
| Motor voltage | 460/3 | Inlet and casing - 500 Hz | 82 dB |
| Cycle | 60 cycles/sec | Inlet and casing - 1 kHz | 74 dB |
| Drive service factor & type | 1.5 fixed | Inlet and casing - 2 kHz | 67 dB |
| Fan airflow | 6000 cfm | Inlet and casing - 4 kHz | 59 dB |
| ESP | 2.00 in H2O | Inlet and casing - 8 kHz | 49 dB |
| Elevation | 0.00 ft | Ducted inlet - 63 Hz | 92 dB |
| Min temperature | 10.00 F | Ducted inlet - 125 Hz | 88 dB |
| Design temperature | 70.00 F | Ducted inlet - 250 Hz | 81 dB |
| Max BHP | 7.235 hp | Ducted inlet - 500 Hz | 81 dB |
| Fan size and type | D12 - 18" AF | Ducted inlet - 1 kHz | 73 dB |
| Extended grease lines | w/ both bearings | Ducted inlet - 2 kHz | 67 dB |
| BHP | 6.416 hp | Ducted inlet - 4 kHz | 58 dB |
| TSP | 4.30 in H2O | Ducted inlet - 8 kHz | 48 dB |
| Speed | 1996 rpm | Casing - 63 Hz | 82 dB |
| Outlet area | 2.86 sq ft | Casing - 125 Hz | 84 dB |
| Fan module PD | 2.00 in H2O | Casing - 250 Hz | 73 dB |
| Height | 39.000 in | Casing - 500 Hz | 73 dB |
| Length | 39.000 in | Casing - 1 kHz | 62 dB |
| Width | 64.000 in | Casing - 2 kHz | 56 dB |
| Weight | 669.0 lb | Casing - 4 kHz | 50 dB |
| Unit controller | No | Casing - 8 kHz | 41 dB |

Coil performance data is certified in accordance with ARI standard 410. Propylene glycol and calcium chloride, or mixtures thereof, are not covered under the scope of ARI 410.

Air-handling performance data is certified in accordance with ARI standard 430. Air handlers with Q-fans, air handlers with plenum fans, and vertical draw-thru air handlers where the coil is mounted immediately below the fan module are not covered under the scope of ARI 430.

All weights and dimensions are approximate. Certified prints on request.

SECTION 23 82 43

ELECTRIC DUCT HEATERS
**08/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

UNDERWRITERS LABORATORIES (UL)

UL 1996 (2004; Rev Dec 2006) Standard for Electric Duct Heaters

1.2 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit Manufacturer's Instructions for duct heaters including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit Equipment and Performance Data for duct heaters in accordance with paragraph entitled, "General Requirements," of this section.

Submit manufacturer's catalog data for the following items:

Duct Heaters

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions for duct heaters in accordance with paragraph entitled, "General Requirements," of this section.

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

Duct heaters shall conform to the requirements of UL 1996.

2.2 DESCRIPTION

Duct heaters shall have the capacity indicated, plus or minus 5 percent.

Duct heaters shall be factory prewired, ready for field terminal connections.

## 2.3 HEATING ELEMENTS AND ENCLOSURES

Install heating elements with a framework complete with terminal, and construct junction boxes of mill-aluminized or galvanized carbon steel. A magnetic contactor shall be provided in a separate enclosure insulated from the duct at duct heater location or at a separate, remote location.

Gasketing shall be 1/16-inch thick non-asbestos woven-cloth tape.

Flange depth shall be suitable for duct insulation provided. Insulate terminal junction box to prevent elevated temperatures.

Sheathed heating-element construction shall consist of a resistance wire insulated by highly compacted refractory insulation protected by a sealed metallic-finned sheath. Component materials shall be as follows:

Resistance wire shall be a helix-wound alloy approximately 80 percent nickel and 20 percent chromium.

Refractory insulation shall be magnesium oxide. Subject element to a dielectric test of twice the element rated voltage plus 1,000 volts applied between terminal and sheath for a period of 1 minute.

Sheathing shall consist of aluminum fins cast around an internal steel sheath containing refractory insulation and resistance wire or carbon-steel fins permanently attached to a tubular carbon-steel or corrosion-resistant steel sheath containing refractory insulation and resistance wire and with all external surfaces porcelainized.

Wattage density shall not exceed 90 watts per linear inch of heated element length or not greater than 22 watts per square inch.

Open heating-element construction shall consist of a helix-wound resistance wire alloy approximately 80 percent nickel and 20 percent chromium. Wattage density shall not exceed 50 watts per linear inch of heated element. Element support shall minimize abrasion and sagging. Safety screens shall be provided on both upstream and downstream sides of heater elements.

Provide dummy elements or include other provisions similar to open area perforated screens if required to uniformly distribute airflow across heater face.

## 2.4 CONTROLS

Furnish units with integral overheat cutouts for primary and secondary protection. Automatic-reset primary cutout shall be the disk type and suitable for the electrical service scheduled.

Disk type manual-reset secondary cutouts shall be provided and wired in series with each circuit.

Bulb type manual-reset secondary cutouts shall be provided and actuate integral magnetic backup contactors.

Bulb type manual-reset secondary cutouts shall be provided and deenergize each circuit directly.

Provide indicating light(s) to show:

Heater on

Each circuit on

Heater assemblies rated at 45 amperes and larger shall have the heater assembly subdivided and fused. Fuse each subdivided 45-ampere heater load section. In circuits of less than 45 amperes, fuse appropriate sections.

Magnetic contactors other than integral overheat-cutout associated units shall be remotely located as indicated and shall be UL-approved.

Construct step controllers for sequencing heater loads of UL-approved components and include the following:

Delay to prevent line surge when energizing loads

Individual fusing of each step

Intercomponent wiring to terminals for field connection

Cabinet

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install duct heaters in accordance with the manufacturer's instructions and locate duct heaters to permit access to the heater after installation.

### 3.2 FIELD TESTING

Demonstrate that duct heaters operate satisfactorily in the presence of the Contracting Officer.

Duct heaters shall be cycled five times, from start to operating thermal conditions to off, to verify adequacy of construction, system controls, and component performance.

-- End of Section --

SECTION 23 82 46

ELECTRIC UNIT HEATERS
**08/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1996 | (2004; Rev Dec 2006) Standard for Electric Duct Heaters |

1.2 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Include with the Manufacturer's Instructions for electric heaters the special provisions required to install equipment components and system packages. Detail impedances, hazards and safety precautions within the special notices.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit Equipment and Performance Data in accordance with paragraph entitled, "General Requirements," of this section.

Submit manufacturer's catalog data for the following items:

Electric Unit Heaters

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions in accordance with paragraph entitled, "General Requirements," of this section.

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

Conform to the requirements of UL 1996 for electric unit heaters.

2.2 DESCRIPTION

Use Suspended electric unit heaters and arrange for discharge of air as

indicated.

Provide Electric unit heaters with not less than the indicated capacity and conform to requirements specified herein.

Factory prewire Electric unit heaters, ready for field terminal connections.

## 2.3 CASINGS

Construct casings with smoothly contoured propeller orifice rings of not less than 20-gage cold-rolled carbon steel. Provide casing surface finish with phosphate pretreatment, prime coating, and baked-enamel finish.

## 2.4 AIR DISTRIBUTION

Provide horizontal units with adjustable single- or double-deflection louvers.

## 2.5 HEATING ELEMENT

Construct heating element of a resistance wire insulated by highly compacted refractory insulation protected by a sealed metallic-finned sheath. Component materials are as follows:

Provide resistance wire not less than 20-helix wound alloy approximately 80-percent nickel and 20-percent chromium.

Provide refractory insulation of magnesium oxide with a resistance of not less than 50,000-ohms after exposure to an ambient temperature and humidity of 90 degrees F and 85 plus or minus 5-percent relative humidity, respectively, for not less than 24 hours.

Provide sheathing consisting of aluminum fins cast around an internal steel sheath containing refractory insulation and resistance wire or carbon-steel fins permanently attached to a tubular carbon-steel sheath containing refractory insulation and resistance wire and with external surfaces porcelainized.

## 2.6 CONTROLS

Fit units up to and including 5 kilowatts with integral controls including thermal overload cutout switches, necessary transformers, liquid-vapor system, and low-mass bimetal thermostat as required. Provide automatically resettable cutout switch.

Provide unit with a remote unfused disconnect switch that opens ungrounded conductors in the OFF position and a thermostat with integral controls including thermal overload cutout switches, magnetic contactors, necessary transformers, and thermostat protection as required. Provide automatically resettable cutout switches.

Provide wall-mounted thermostats complete with thermometer, mechanical high-limit stop, calibrated operator, and an adjustable heater to effect anticipation and to prevent override of space temperature with a range between 55 and 105 degrees F and a differential not exceeding 1.5 degrees F. Rate thermostat for operation at 24 volts, 60 hertz. Provide transformers, wiring, and devices necessary to meet this requirement. Finish cases in brushed or satin chrome.

## 2.7 PROPELLERS AND MOTORS

Provide propellers with mill-aluminized,galvanized-steel, or all-aluminum blades and be statically and dynamically balanced to within 0.5 percent. Provide units with fan-inlet safety guards.

AMCA certify propellers and motors for air performance and noise level.

Protect motors against damage by the heating element and resilient mount.

Conform to Section 26 60 13.00 40 LOW-VOLTAGE MOTORS for motors except that load-matched and custom-designed motors may be used and be so identified on the shop drawings. For motors not so identified conform to the requirements specified.

Subfractional and fractional custom-designed or applied motors may deviate from the preceding motor requirements as follows:

Shaded-pole motors rated less than 1/6-horsepower may be used for direct-drive service.

Permanent split-capacitor, split-phase, and capacitor-start motors rated 1/4-horsepower and less may be used for direct-drive service.

Split-phase and capacitor-start motors, rated 1/4-horsepower and less, may be used for belt-drive service.

Motor bearings may be manufacturer's standard prelubricated sleeve type except provide motor with antifriction thrust bearings, when specified. Lubricant provisions shall be extended service requiring replenishment not more than twice per year of continuous operation.

Provide motor identification plate per manufacturer's standard.

Provide motor speed and control per unit-heater manufacturer's standard.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Install unit heaters in accordance with the manufacturer's instructions at the mounting heights indicated.

## 3.2 FIELD TESTING

Demonstrate in the presence of the Contracting Officer that the unit heaters operate satisfactorily.

Cycle unit heaters five times, from start to operating thermal conditions to off, to verify adequacy of construction, system controls, and component performance.

Conduct an operational test for a minimum of 6 hours.

-- End of Section --

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS
**07/06**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D 709 | (2001; R 2007) Laminated Thermosetting Materials |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C2 | (2007; Errata 2007; INT 2008) National Electrical Safety Code |
| IEEE C57.12.28 | (2005) Standard for Pad-Mounted Equipment - Enclosure Integrity |
| IEEE Std 100 | (2000) The Authoritative Dictionary of IEEE Standards Terms |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA 250 | (2003) Enclosures for Electrical Equipment (1000 Volts Maximum) |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 11, EQUIPMENT,and Divisions 22 and 23, PLUMBING and HEATING VENTILATING AND AIR CONDITIONING. This section applies to all sections of Division 26 and 33, ELECTRICAL and UTILITIES, of this project specification unless specified otherwise in the individual sections. This section has been incorporated into, and thus, does not apply to, and is not referenced in the following sections.

Section 26 12 19.10 THREE-PHASE PAD MOUNTED TRANSFORMERS
Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM
Section 26 51 00 INTERIOR LIGHTING
Section 26 56 00 EXTERIOR LIGHTING
Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM
Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION
Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 13.8 kV primary, three phase, three wire, 60 Hz, and 480 volts secondary, three phase, four wire. Final connections to the power distribution system at the existing overhead lines shall be made by the Government.

1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.5.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.6 QUALITY ASSURANCE

1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers

regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's

name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.11 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

1.12 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.13 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section.

PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.2 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

-- End of Section --

SECTION 26 05 71.00 40

LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES
**11/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI C39.1 | (1981; R 1992) Requirements for Electrical Analog Indicating Instruments |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D 877 | (2002; R 2007) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes |

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

| | |
|---|---|
| EIA 443 | (1979) Standard for Solid-State Relay Service, EIA/NARM |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C37.17 | (1997) Standard for Trip Devices for AC and General-Purpose DC Low-Voltage Power Circuit Breakers |
| IEEE C37.90 | (2005) Standard for Relays and Relay Systems Associated With Electric Power Apparatus |
| IEEE C57.13 | (2008) Standard Requirements for Instrument Transformers |
| IEEE C63.2 | (1996) Standard for Electromagnetic Noise and Field Strength Instrumentation, 10 Hz to 40 GHz - Specifications |
| IEEE C63.4 | (2003) American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |

IPC - ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES (IPC)

| | |
|---|---|
| IPC D330 | (1992) Switches |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA 107 | (1998; R 1993) Methods of Measurement of Radio Influence Voltage (RIV) of High-Voltage Apparatus |
| NEMA 250 | (2003) Enclosures for Electrical Equipment (1000 Volts Maximum) |
| NEMA AB 1 | (2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures |
| NEMA AB 3 | (2001) Molded Case Circuit Breakers and Their Application |
| NEMA C12.1 | (2008) Electric Meters; Code for Electricity Metering |
| NEMA FU 1 | (2002; R 2007) Low Voltage Cartridge Fuses |
| NEMA ICS 1 | (2000; R 2005) Standard for Industrial Control and Systems General Requirements |
| NEMA ICS 2 | (2000; Errata 2002; R 2005; Errata 2006) Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment |
| NEMA ICS 6 | (1993; R 2006) Standard for Industrial Controls and Systems Enclosures |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 20 | (2000 ; Rev thru Dec 2004) Standard for General-Use Snap Switches |
| UL 489 | (2002; Rev thru Jun 2006) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures |
| UL 508 | (1999; Rev thru Sep 2008) Standard for Industrial Control Equipment |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Prior to the beginning of construction, submit manufactures equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details..

Fuses

SD-02 Shop Drawings

Submit Connection Diagrams and Fabrication Drawings for the following items in accordance with paragraph entitled, "General Requirements," of this section.

Submit Installation drawings for the following items in accordance with the paragraph entitled, "Installation," of this section.

Control Devices
Protective Devices

SD-03 Product Data

Submit manufacturer's equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details.

Motor Control
Instrument Transformers
Enclosures
Circuit Breakers
Control Devices
Time Switches
Protective Relays
Indicating Instruments

SD-07 Certificates

Submit certificates for Circuit Tests on similar motor-control or submit motor-circuit protector (MCP) units under actual conditions in lieu of factory tests on the actual units provided. Also include dielectric tests.

SD-08 Manufacturer's Instructions

Submit manufacturer's instructions for the following items, including special provisions required to install equipment components and system packages. Provide detail on resistance impedances, hazards and safety precautions within the special notices.

Control Devices
Protective Devices

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals for the following

equipment:

Manual Motor Controllers
Magnetic Motor Controllers
Combination Motor Controllers
Circuit Breakers
Time Switches
Protective Relays
Indicating Instruments

1.3 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit Connection Diagrams showing the relations and connections of control devices and protective devices by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit Fabrication Drawings for control devices and protective devices consisting of fabrication and assembly details to be performed in the factory.

PART 2 PRODUCTS

2.1 MOTOR CONTROL

Conform to NEMA ICS 1, NEMA ICS 2, and UL 508 for motor controllers. Provide controllers that have thermal overload protection in each phase.

2.1.1 Manual Motor Controllers

Provide full-voltage, manually operated manual motor controllers for the control and protection of single-phase 60-hertz ac fractional-horsepower squirrel-cage induction motors.

Provide single-throw, single- or double-pole, three-position controllers rated at not more than 1 horsepower at 115- and 230-volts single phase. Include a supporting base or body of electrical insulating material with enclosed switching mechanism, yoke, thermal overload relay, and terminal connectors. Provide controllers that clearly indicate operating condition: on, off, or tripped.

Provide toggle- or key-operated type manual motor controllers as indicated and arrange so that they are lockable with a padlock in the "OFF" position.

Provide recessed manual motor controllers for single-speed, fractional-horsepower squirrel-cage induction motors, that include a single controller and indicating light in a 4-inch square wall outlet box, for flush-wiring devices with matching corrosion-resistant steel flush cover plate. Provide surface-mounted manual motor controllers for single-speed, fractional-horsepower squirrel cage induction motors that include a single controller and indicating light in a NEMA 250, Type 1 general-purpose enclosure.

Provide recessed and surface-mounted manual motor controllers for two-speed, fractional-horsepower squirrel-cage induction motors, that include two controllers, two indicating lights, and a selector switch in a

multiple-gang wall outlet box for flush-wiring devices, with matching corrosion-resistant steel flush-cover plate. Provide surface-mounted manual motor controllers for two-speed fractional-horsepower squirrel-cage induction motors, that include two controllers, two indicating lights, and a selector switch in a NEMA 250, Type 1 general-purpose enclosure.

### 2.1.2 Magnetic Motor Controllers

#### 2.1.2.1 Full-Voltage Controllers

Provide full-voltage, full magnetic devices in accordance with NEMA ICS 1, NEMA ICS 2, and UL 508for magnetic motor controllers for the control and protection of single- and three-phase, 60-hertz, squirrel-cage induction motors.

Provide operating coil assembly that operates satisfactorily between 85 and 110 percent of rated coil voltage. Provide 120 volts, 60 hertz motor control circuits.

Provide controller with two normally open and two normally closed auxiliary contacts rated per NEMA ICS 1 and NEMA ICS 2 in addition to the sealing-in contact for control circuits.

Provide solderless pressure wire terminal connectors for line-and load-connections to controllers.

Include three manual reset thermal overload devices for overcurrent protection, one in each pole of the controller. Provide thermal overload relays of melting-alloy or bimetallic nonadjustable type with continuous current ratings and service-limit current ratings, and with a plus or minus 15 percent adjustment to compensate for ambient operating conditions.

Provide an externally operable manual-reset button to re-establish control power to the holding coil of the electromagnet. After the controller has tripped from overload, ensure that resetting the motor-overload device does not restart the motor.

Provide enclosure in accordance with NEMA 250, Type 1.

#### 2.1.2.2 Reduced-Voltage Starters

Conform to the requirements for full-voltage controllers for reduced-voltage starters, except for voltage, and to the following additional requirements.

Fully protect the motor during all phases of motor starting with an overload device in each motor leg. Rate starter contacts to withstand the switching surges during selector to full voltage. Provide starter that contains the necessary sensing and timing devices to monitor motor operation and select the correct time for selector to full voltage.

Adequately ventilate resistors and autotransformers used for starting. Ventilate solid-state starters for starting cycles as well as any follow-on restart-run cycles. Operate external control circuits or solid-state starters at a maximum of 120 volts ac.

For solid-state starters, provide adjustable starting torque from 0 to 50 percent of applied voltage, minimum. Provide autotransformer starters with a minimum of three taps above 50 percent reduced voltage.

### 2.1.3 Combination Motor Controllers

Following requirements are in addition to the requirements specified for magnetic motor controller:

Provide combination motor controllers for the control and protection of single-and three-phase 60-hertz alternating-current squirrel-cage induction motors with branch-circuit disconnecting and protective devices in accordance with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.

For combination motor controllers include magnetic motor controllers and molded-case circuit breakers or MCP in metal enclosures in accordance with NEMA 250 or motor-control center draw-out assemblies with control-power transformers, selector switches, pushbuttons, and indicating lights as follows:

Provide full-voltage, full-magnetic devices as specified in this section under paragraph entitled, "Remote-Control Station Enclosures." for magnetic motor controllers and enclosures.

Provide thermal-magnetic breakers as specified in paragraph entitled, "Manual Motor Controllers."for molded-case circuit breakers. Manufacturer's standard MCP may be used in lieu of molded-case circuit breakers.

Provide control-power transformers 120-volt ac maximum, selector switches, pushbuttons, and pilot lights as required.

Identify combination motor controllers with identification plates affixed to front cover of the controller.

#### 2.1.3.1 Nonreversing Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For nonreversing combination motor controllers for the control and protection of single-speed squirrel-cage induction motors, include a magnetic controller with molded-case circuit breaker or MCP with selector switch or start/stop pushbutton and indicating light in the cover of the enclosure.

Provide rating of single and three-phase single-speed full-voltage magnetic controllers for nonplugging and nonjogging duty in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide wiring and connections for full-voltage single-speed magnetic controllers in accordance with NEMA ICS 1 and NEMA ICS 2.

#### 2.1.3.2 Reversing Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For reversing combination motor controllers for the control and protection of single-speed squirrel-cage induction motors, include two interlocked magnetic controllers with molded-case circuit breaker or MCP, with selector switch or forward/reverse/stop pushbutton and two indicating lights in the

cover of the enclosure. Indicate with indicating lights the forward and reverse running connection of the motor controller.

Provide rating of single and three-phase single-speed full-voltage magnetic controllers for plug-stop, plug-reverse, or jogging duty in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide wiring and connections for full-voltage single-speed magnetic controllers in accordance with NEMA ICS 1 and NEMA ICS 2.

2.1.3.3 Two-Speed Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For two-speed combination motor controllers for the control and protection of single- and two-winding, two-speed, three-phase, squirrel-cage induction motors, include two magnetic controllers with molded-case circuit breaker or MCP, with selector switch or fast/slow/stop pushbutton and two indicating lights in the cover of the enclosure. Indicate with indicating lights the high- and low-speed running connection of the motor controller.

Provide rating of three-phase, two-speed, full-voltage, magnetic controllers for nonplugging and nonjogging duty for constant- and variable-torque motors in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide rating of three-phase, two-speed, full-voltage, magnetic controllers for nonplugging and nonjogging duty for constant-horsepower motors in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide rating of three-phase, two-speed, full-voltage, magnetic controllers for plug-stop, plug-reverse, or jogging duty for constant-torque, variable-torque, and constant horsepower motors in accordance with NEMA ICS 1 and NEMA ICS 2.

2.2 INSTRUMENT TRANSFORMERS

Comply with the interference requirements listed below, measured in accordance with IEEE C63.2, IEEE C63.4, and NEMA 107 for Instrument transformers.

| Insulation Class, kV | Basic Insulation Level, kV | Preferred Nominal System Voltage, kV | Test Voltage for Potential Transformers, kV | Test Voltage for Current Transformers, kV | Radio Influence Voltage Level, Microvolts Dry Type | Oil Filled |
|---|---|---|---|---|---|---|
| 0.6 | 10 | ..... | ..... | 0.76 | 250 | 250 |
| 1.2 | 30 | 0.208<br>0.416<br>0.832<br>1.04 | 0.132<br>0.264<br>0.528<br>0.66 | 0.76 | 250 | 250 |
| 2.5 | 45 | 2.40 | 1.52 | 1.67 | 250 | 250 |
| 5.0 | 60 | 4.16<br>4.80 | 2.64<br>3.04 | 3.34 | 250 | 250 |

| Insulation Class, kV | Basic Insulation Level, kV | Preferred Nominal System Voltage, kV | Test Voltage for Potential Transformers, kV | Test Voltage for Current Transformers, kV | Radio Influence Voltage Level, Microvolts Dry Type | Radio Influence Voltage Level, Microvolts Oil Filled |
|---|---|---|---|---|---|---|
| 8.7 | 75 | 7.20<br>8.32 | 4.57<br>5.28 | 5.77 | 250 | 250 |
| 15L or 15H | 95-110 | 12.00<br>12.47<br>14.40 | 7.62<br>7.92<br>9.14 | 9.41 | 1000 | 250 |
| 25 | 150 | 23.00 | 14.60 | 15.70 | 2500 | 650 |
| 34.5 | 200 | 34.50 | 21.90 | 23.0 | .... | 650 |
| 46 | 250 | 46.00 | 29.20 | 29.30 | .... | 1250 |
| 69 | 350 | 69.00 | 43.80 | 44.00 | .... | 1250 |
| 92 | 450 | 92.00 | 58.40 | 58.40 | .... | 2500 |
| 115 | 550 | 115.00 | 73.40 | 73.40 | .... | 2500 |
| 138 | 650 | 138.00 | 88.00 | 88.00 | .... | 2500 |

2.2.1 Current Transformers

Provide current transformers that conform to IEEE C57.13 for installation in metal-clad switchgear. Use standard 3-A secondary transformer.

Provide wound bushing bar window type transformers.

Provide transformers that have single secondary winding.

Provide transformers that are complete with secondary short-circuiting device.

For window-type current transformers, provide indoor dry type construction with secondary current ratings as indicated with specified burden, frequency, and accuracy.

2.2.2 Potential Transformers

For potential transformers, conform to IEEE C57.13 for installation in metal-clad switchgear. Use standard 120-volt secondary transformers.

Provide transformers that have single tapped secondary.

Provide burden, frequency, and accuracy as required.

For disconnecting potential transformers with integral fuse mountings and current-limiting fuses, provide indoor dry type two-winding construction with primary and secondary voltage ratings as required.

## 2.3 ENCLOSURES

### 2.3.1 Equipment Enclosures

Provide enclosures for equipment in accordance with NEMA 250.

Contain equipment installed inside, clean, dry locations in a NEMA Type 1, general-purpose sheet-steel enclosure.

Contain equipment installed in wet locations in a NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosure, constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 for Type 4 enclosures.

### 2.3.2 Remote-Control Station Enclosures

Provide remote-control station enclosures for pushbuttons, selector switches, and indicating lights in accordance with the appropriate articles of NEMA ICS 6 and NEMA 250.

Contain remote-control stations installed in indoor, clean, dry locations in NEMA Type 1 general-purpose, sheet-steel enclosures. Contain recessed remote-control stations in standard wall outlet boxes with matching corrosion-resistant steel flush cover plate.

Contain remote-control stations installed in wet locations in NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosures constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 and NEMA 250 for Type 4 enclosures.

Install remote-control stations with the centerline 66 inches above the finished floor.

## 2.4 CIRCUIT BREAKERS

Provide circuit breakers that conform to UL 489, NEMA AB 1, and NEMA AB 3.

### 2.4.1 Molded-Case Circuit Breakers

Provide molded case, manually operated, trip-free, circuit breakers, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection as required. Completely enclose circuit breakers in a molded case, with the calibrated sensing element factory-sealed to prevent tampering.

Locate thermal-magnetic tripping elements in each pole of the circuit breaker, and provide inverse-time-delay thermal overload protection and instantaneous magnetic short-circuit protection. Provide instantaneous magnetic tripping element, that is adjustable and accessible from the front of the breaker on frame sizes larger than 100 amperes.

Size breaker as required for the continuous current rating of the circuit. Provide breaker class as required.

Provide sufficient interrupting capacity of the panel and lighting branch circuit breakers, to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Provide circuit breaker interrupting capacities with a minimum of 10,000 amperes and that conform to NEMA AB 3.

Provide the common-trip type multipole circuit breakers having a single operating handle and a two-position on/off indication. Provide circuit breakers with temperature compensation for operation in an ambient temperature of 104 degrees F. Provide circuit breakers that have root mean square (rms) symmetrical interrupting ratings sufficient to protect the circuit being supplied. Interrupting ratings may have selective type tripping (time delay, magnetic, thermal, or ground fault).

Provide phenolic composition breaker body capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required.

Provide circuit breakers used for meter circuit disconnects that meet the applicable requirements of NFPA 70 and that are of the motor-circuit protector type.

For circuit breakers used for service disconnection, provide an enclosed circuit-breaker type with external handle for manual operation. Provide sheet metal enclosures with a hinged cover suitable for surface mounting.

### 2.4.2 Enclosed Molded-Case Circuit Breakers

For enclosed circuit breakers, provide thermal-magnetic molded-case circuit breakers in surface-mounted, nonventilated enclosures conforming to the appropriate articles of NEMA 250 and NEMA AB 1.

Provide enclosed circuit breakers in nonhazardous locations as follows:

Contain circuit breakers installed inside clean, dry locations in NEMA Type 1, general purpose sheet steel enclosures.

Contain circuit breakers installed in unprotected outdoor locations, in NEMA Type 3R, weather-resistant sheet steel enclosures that are splashproof, weatherproof, sleetproof, and moisture resistant.

Contain circuit breakers installed in wet locations, in NEMA Type 4, watertight corrosion-resistant sheet steel enclosures constructed to prevent entrance of water.

## 2.5 FUSES

Provide a complete set of fuses for all switches and switchgear. Rate fuses that have a voltage rating of not less than the circuit voltage.

Make no change in continuous-current rating, interrupting rating, and clearing or melting time of fuses unless written permission has first been secured.

Provide nonrenewable cartridge type fuses for ratings 30 amperes, 125 volts or less. Provide renewable cartridge type fuses for ratings above 30 amperes 600 volts or less with time-delay dual elements, except where otherwise indicated. Conform to NEMA FU 1 for fuses.

Install special fuses such as extra-high interrupting-capacity fuses, fuses for welding machines, and capacitor fuses where required. Plug fuses are not permitted.

Label fuses showing UL class, interrupting rating, and time-delay characteristics, when applicable. Additionally, clearly list fuse

information on equipment drawings.

Provide porcelain fuse holders when field-mounted in a cabinet or box. Do not use fuse holders made of such materials as ebony asbestos, Bakelite, or pressed fiber for field installation.

## 2.6 CONTROL DEVICES

### 2.6.1 Magnetic Contactors

Provide magnetic contactors in accordance with NEMA ICS 1 and NEMA ICS 2 as required for the control of low-voltage, 60-hertz, tungsten-lamp loads, fluorescent-lamp loads, resistance-heating loads, and the primary windings of low-voltage transformers.

Provide core-and-coil assembly that operates satisfactorily with coil voltage between 85 and 110 percent of its voltage rating.

Provide contactor that is designed with a normally open holding circuit auxiliary contact for control circuits, with a rating in accordance with NEMA ICS 1 and NEMA ICS 2.

Furnish solderless pressure wire terminal connectors, or make available for line-and-load connections to contactors in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide magnetic contactors with a rating in accordance with NEMA ICS 1and NEMA ICS 2.

### 2.6.2 Control-Circuit Transformers

Provide control-circuit transformers within the enclosure of magnetic contactors and motor controllers when the line voltage is in excess of 120 volts. Provide encapsulated dry type, single-phase, 60-hertz transformer, with a 120-volt (or 24-volt) isolated secondary winding.

Do not provide a transformer with a rated primary voltage less than the rated voltage of the controller, or a rated secondary current less than the continuous-duty current of the control circuit.

Provide voltage regulation of the transformer such that, with rated primary voltage and frequency, the secondary voltage is not less than 95 percent nor more than 105 percent of rated secondary voltage.

Provide source of supply for control-circuit transformers at the load side of the main disconnecting device. Protect secondary winding of the transformer and control-circuit wiring against overloads and short circuits, with fuses selected in accordance with NEMA ICS 6. Ground secondary winding of the control-circuit transformer in accordance with NEMA ICS 6.

### 2.6.3 Magnetic Control Relays

Provide magnetic control relays for energizing and de-energizing the coils of magnetic contactors or other magnetically operated devices, in response to variations in the conditions of electric control devices in accordance with NEMA ICS 1, and NEMA ICS 2.

Provide core-and-coil assembly that operates satisfactorily with coil

voltages between 85 and 110 percent of their voltage rating.

Provide relays that are designed to accommodate normally open and normally closed contacts.

Provide 120-volt, 60-hertz, Class AIB magnetic control relays with a continuous contact rating of 10 amperes, and with current-making and -breaking ability in accordance with NEMA ICS 1 and NEMA ICS 2, two normally open and two normally closed.

2.6.4 Pushbuttons and Switches

2.6.4.1 Pushbuttons

For pushbuttons for low-voltage ac full-voltage magnetic controllers, provide heavy-duty oiltight NEMA 250, Type 12, momentary-contact devices rated 600 volts, with pilot light, and with the number of buttons and the marking of identification plates as shown. Furnish pushbutton color code in accordance with NEMA ICS 6.

Provide pushbuttons that are designed with normally open, circuit-closing contacts; normally closed circuit-opening contacts; and two-circuit normally open and normally closed circuit-closing and -opening contacts. Provide pushbutton-contact ratings in accordance with NEMA ICS 1 and NEMA ICS 2 with contact designation A600.

Identify pushbuttons in remote control stations with identification plates affixed to front cover in a prominent location. Carry the identification of the system being controlled on the identification plate.

2.6.4.2 Selector Switches

Provide heavy-duty oiltight maintained-contact selector switches for low-voltage control circuits, with the number of positions and the marking of identification plates in accordance with NEMA ICS 1 and NEMA ICS 2.

Identify selector switches in remote control stations with engraved identification plates affixed to front cover in a prominent location. Carry the identification of the system being controlled on the identification plate.

2.6.4.3 Ammeter Selector Switches

Provide rotary multistage snap-action type ammeter selector switches for switchgear in accordance with UL 20 with silver-plated contacts rated for 600 volts ac or dc. Provide a manually operated, four-position selector switch rated for 600 volts, 20 amperes, minimum, and designed to permit current readings on each bus of the main bus from a single indicating instrument. Mount ammeter switch on the hinged front panel of the switchgear compartment and completely isolate it from high-voltage circuits, with engraved escutcheon plate.

Provide a pistol-grip type selector switch handle.

2.6.4.4 Voltmeter Selector Switches

Provide rotary snap-action type voltmeter selector switches for switchgear in accordance with UL 20 with silver-plated contacts rated for 600 volts ac or dc. Provide manually operated, four-position switch designed to permit

voltage readings on each phase of the main bus from a single indicating instrument. Mount voltmeter switch on the hinged front panel of the switchgear compartment and completely isolate from high-voltage circuits, and with engraved escutcheon plate.

Provide a pistol-grip type selector switch handle.

2.6.4.5 Miscellaneous Switches

Provide float, limit, door, pressure, proximity, and other types of switches in accordance with IPC D330 and of the types and classes indicated.

## 2.7 TIME SWITCHES

Provide time switches for the control of tungsten-lamp loads, fluorescent-lamp loads, resistive-heating loads, motors, and magnetically operated devices, consisting of a motor-driven time dial and switch assembly in a NEMA 250, Type 1 general-purpose enclosure.

Provide motor drives consisting of 120-volt, single-phase, 60-hertz, heavy-duty, self-starting synchronous motors, directly connected to the time dial through a geartrain operating mechanism. Provide a spring-wound stored-energy source of reserve power that will automatically operate the mechanism for a period of not less than 12 hours in case of electric power failure. Provide spring that automatically rewinds electrically in not more than 3 hours of time after electric power is restored.

Include a heavy-duty general-purpose precision snap-action switch in accordance with UL 20 for switch mechanism, with provision for a manual "OFF" and "ON" operation of the switch.

Provide time switches for the control of 120/240-volt, 2- and 3-wire, single-phase, 60-hertz circuits and 120/208-volt, three-phase, 4-wire, 60-hertz circuits, with a continuous-current tungsten-lamp load rating of 35 amperes.

## 2.8 PROTECTIVE RELAYS

### 2.8.1 Overcurrent Relays

Conform to IEEE C37.90 for overcurrent relays.

For protection against phase and ground faults, provide single-phase nondirectional removable induction type overcurrent relays with built-in testing facilities designed for operation on the dc or ac control circuit indicated.

Provide ground-fault overcurrent relays with short-time inverse time characteristics with adjustable current tap range as required.

Provide phase-fault overcurrent relays with varied inverse-time characteristics with adjustable current tap range as required, and indicating instantaneous-trip attachments with adjustable current range as required.

Semiflush-mount case with matching cover to the hinged instrument panel.

Provide solid-state static-type trips for low-voltage power circuit breakers in accordance with EIA 443 and IEEE C37.17.

Provide a trip unit that employs a combination of discreet components and integrated circuits to provide the time-current protection functions required in a modern selectively coordinated distribution system.

Provide complete system selective coordination by utilizing a combination of the following time-current curve-shaping adjustments: ampere setting; long-time delay; short-time pickup; short-time delay; instantaneous pickup; and ground fault.

Provide switchable or easily defeatable instantaneous and ground fault trips.

Make all adjustments using non-removable, discrete step, highly reliable switching plugs for precise settings. Provide a sealable, transparent cover over the adjustments to prevent tampering.

Furnish trip devices with three visual indicators to denote the automatic tripping mode of the breaker including: overload; short circuit; and ground fault.

Wire trip unit to appropriate terminals whereby an optional remote automatic trip accessory can be utilized to provide the same indication.

Make available for use a series of optional automatic trip relays for use with the trip unit to provide remote alarm and lockout circuits.

Provide all trip units with test jacks for in-service functional testing of the long-time instantaneous and ground fault circuits using a small hand-held test kit.

### 2.8.2 Directional Overcurrent Relays

Provide directional overcurrent relays in accordance with IEEE C37.90.

For directional overcurrent relays for protection against reverse-power faults, provide single-phase induction type with adjustable time-delay and instantaneous trip attachments. Provide removable type relays with inverse-time directional and overcurrent units with built-in testing facilities.

Semi-flush mount case with matching cover to the hinged instrument panel.

### 2.8.3 Undervoltage Relays

For undervoltage relays conform to IEEE C37.90.

Provide three-phase induction type undervoltage relays, including inverse timing with adjustable high- and low-voltage contacts and calibrated scale for protection against loss of voltage, undervoltage, and overvoltage. Equip relays with indicating contactor and voltage switches to provide electrically separate contact circuits. Provide relays that are removable with built-in testing facilities and that are suitable for operation on 120-volt ac circuits, with contacts that are suitable for operation on dc or ac control circuits.

Semi-flush mount case with matching cover to the hinged instrument panel.

## 2.9 INDICATING INSTRUMENTS

### 2.9.1 Ammeters

For ammeters, conform to ANSI C39.1.

Provide switchboard indicating ammeters of approximately 4-1/2 inches square with 250-degree scale and recessed cases suitable for flush mounting. Furnish white dials with black figures and black pointers. Mount instruments on the hinged front panel of the switchgear compartment completely isolated from high-voltage circuits. Provide standard 5-ampere type meter for a zero to full-scale normal movement, 60 hertz.

### 2.9.2 Voltmeters

For voltmeters, conform to ANSI C39.1.

Provide a switchboard indicating voltmeters that is approximately 4-1/2-inches square with 250-degree scale and recessed cases suitable for flush mounting. Furnish white dials with black figures and black pointers. Mount instruments on the hinged front panel of the switchgear compartment completely isolated from high-voltage circuits. Provide standard 120-volt type voltmeter for a zero to full-scale normal movement, 60 hertz.

### 2.9.3 Watt-Hour Meters/Wattmeters

For watt-hour meters, wattmeters, and pulse initiation meters, conform to NEMA C12.1.

Provide three-phase induction type switchboard wattmeters for use with instrument transformers with two stators, each equipped with a current and potential coil. Provide meter that is rated for 5 amperes at 120 volts and is suitable for connection to three-phase, 3- and 4-wire circuits. Provide instrument complete with potential indicating lamps, light-load and full-load adjustments, phase balance, power-factor adjustments, four-dial clock register, ratchets to prevent reverse rotation, and built-in testing facilities.

Provide pulse initiating meters for use with demand meters or pulse recorders, that are suitable for use with mechanical or electrical pulse initiators. Provide mechanical load imposed on the meter by the pulse initiator that is within the limits of the pulse meter. Provide load as constant as practical throughout the entire cycle of operation to ensure accurate meter readings. Provide pulse initiating meter that is capable of measuring the maximum number of pulses at which the pulse device is nominally rated. Consider pulse initiating meter to be operating properly when a kilowatt hour check indicates that the demand meter kilowatthours are within limits of the watthour meter kilowatthours.

Locate pulse initiating meters such that components sensitive to moisture and temperature conditions are minimized. Take precautions to protect sensitive electronic metering circuitry from electromagnetic and electrostatic induction.

Furnish removable meters with draw out test plug and furnish contact devices to operate remote impulse-totalizing graphic demand meters.

Semi-flush mount case with matching cover to the hinged instrument panel.

## 2.10 FACTORY TESTING

Perform factory tests on control and low voltage protective devices in accordance with the manufacturer's recommendations.

Conduct short-circuit tests in accordance with Section 2 of NEMA ICS 1.

## 2.11 FINISH

Protect metallic materials against corrosion. Provide equipment with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section 09 96 00 HIGH-PERFORMANCE COATINGS.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Install Control devices and protective devices that are not factory installed in equipment, in accordance with the manufacturer's recommendations and field adjusted and operation tested. Conform to NFPA 70, NEMA ICS 1 and NEMA ICS 2 requirements for installation of control and protective devices.

## 3.2 FIELD TESTING

Demonstrate to operate as indicated control and protective devices not factory installed in equipment.

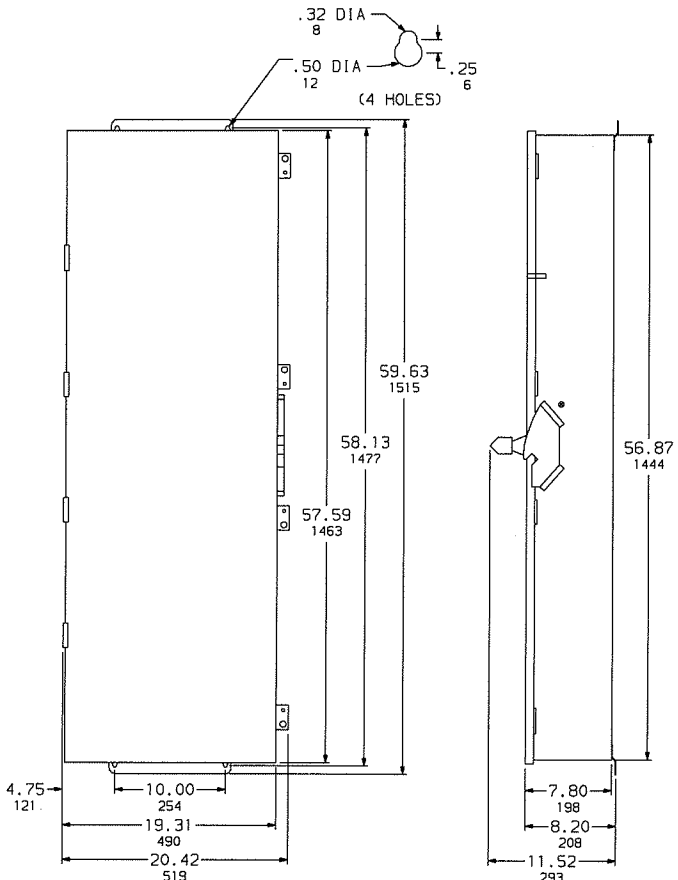
Ratio and verify tap settings of instrumentation, potential, and current transformers.

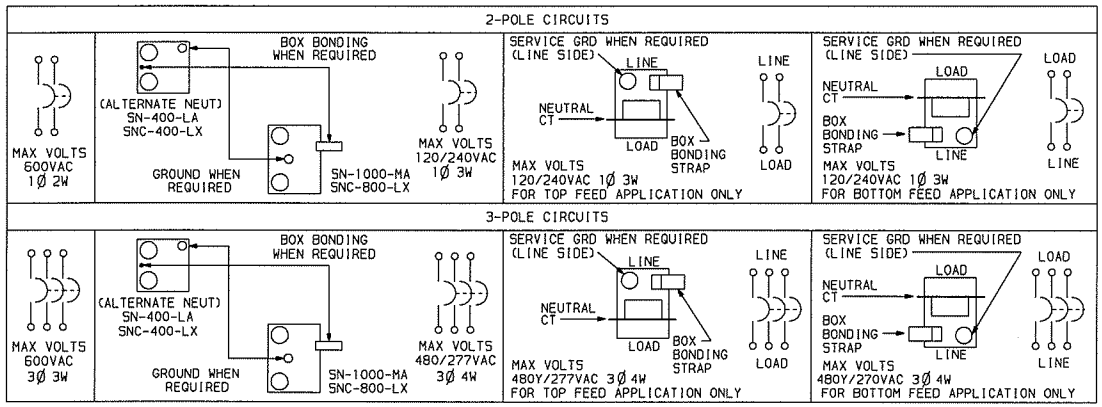
Perform dielectric tests on insulating oil in oil circuit breakers before the breakers are energized. Test oil in accordance with ASTM D 877, and provide breakdown voltage that is not less than 25,000 volts. Provide manufacturer certification that the oil contains no PCB's, and affix a label to that effect on each breaker tank and on each oil drum containing the insulating oil.

Field adjust reduced-voltage starting devices to obtain optimum operating conditions. Provide test meters and instrument transformers that conform to NEMA C12.1 and IEEE C57.13.

Do not energize control and protective devices until recorded test data has been approved. Provide final test reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --




| FIELD INSTALLABLE SOLID NEUTRAL ASSEMBLIES AND GROUND BAR KIT ✱ | | | | | | |
|---|---|---|---|---|---|---|
| CATALOG NUMBER | AMPERE RATING | NUMBER OF TERMINALS | CONDUCTORS PER TERMINAL | WIRE SIZE (AWG/KCMIL) MAX. | WIRE SIZE (AWG/KCMIL) MIN. | TYPE |
| SN-400-LA | 100-400A | 2 | 1 OR 2 | 600<br>250 | 1<br>1 | AL OR CU |
| SNC-400-LX | 100-400A | 2 | 1 | 600 | 2 | CU |
| ▲ SNC-800-LX | 200-800A | 4 | 1 | 600 | 2 | CU |
| ▲ SN-1000-MA | 200-1000A | 2 | 3 | 500 | 3/0 | AL OR CU |
| ✱ PKOGTA4 | - | 4 | 1 | 250 | 6 | AL OR CU |

**LX-600-AWK**

DUAL DIMENSIONS; INCHES MILLIMETERS

| CIRCUIT BREAKER TERMINAL LUG DATA | | | | | |
|---|---|---|---|---|---|
| CIRCUIT BREAKER CATALOG NO. PREFIX | AMPERE RATING | CONDUCTORS PER PHASE | WIRE SIZE (AWG/KCMIL) MAX. | WIRE SIZE (AWG/KCMIL) MIN. | TYPE |
| LCL,LIL | 300-600A | 2 | 500 | 4/0 | AL OR CU |
| LEL,LXL,LXIL | 100-250A | 2 | 350 | 1 | |
| LEL,LXL,LXIL | 300-600A | 2 | 500 | 4/0 | |

| FIELD INSTALLED CIRCUIT BREAKER DATA | | | | | | | |
|---|---|---|---|---|---|---|---|
| CIRCUIT BREAKER CATALOG NO. PREFIX | NUMBER POLES | AMPERE RATING | UL LISTED INTERRUPTING RATING RMS SYMMETRICAL AMPERES AC VOLTAGE 240 | 480Y/277 | 480 | 600 | FEDERAL SPECS. W-C-375B/ GEN |
| LCL | 2<br>3 | 300-600<br>300-600 | 100K<br>100K | 65K<br>65K | 65K<br>65K | 35K<br>35K | 23A<br>23A |
| LEL | 3 | 100-600 | 100K | 65K | 65K | 35K | 23A |
| LXL | 3 | 100-600 | 100K | 65K | 65K | 35K | 23A |
| LIL | 2<br>3 | 300-600<br>300-600 | 200K<br>200K | 200K<br>200K | 200K<br>200K | 100K<br>100K | 23A<br>23A |
| LXIL | 3 | 100-600 | 200K | 200K | 200K | 100K | 23A |

NOTES:
FINISH - GRAY BAKED ENAMEL ELECTRODEPOSITED OVER CLEANED PHOSPHATIZED STEEL.
NEUTRAL - INSULATED GROUNDABLE. UL LISTED - FILE E-136861.
SUITABLE FOR USE AS SERVICE EQUIPMENT WHEN NEUTRAL ASSEMBLY IS INSTALLED.
▲ NEUTRAL ASSEMBLY IS SUITABLE FOR USE WITH NEUTRAL CURRENT TRANSFORMERS; CATALOG NUMBER LE25CT2,LE4CT2 AND LE6CT2.
LCL,LIL,LXL AND LXIL CIRCUIT BREAKERS ARE 80% RATED WHEN INSTALLED IN THIS ENCLOSURE.
LEL CIRCUIT BREAKERS ARE 100% RATED WHEN INSTALLED IN THIS ENCLOSURE EXCEPT FOR THE 600A LEL, WHICH IS 80% RATED.
THE SHORT CIRCUIT CURRENT RATING OF THIS ENCLOSED CIRCUIT BREAKER IS EQUAL TO THE INTERRUPTING RATING INDICATED ON THE CHART ABOVE, MAY BE LESS THAN THE AIR RATING INDICATED ON THE INSTALLED CIRCUIT BREAKER.

CIRCUIT BREAKER ENCLOSURES
100-600 AMPERE
ENCLOSURE - NEMA TYPE 1,3,3R,5 OR 12

SQUARE D COMPANY

DWG. NO. 3079

JULY 1998

REF DWG #3079

SECTION 26 08 00

APPARATUS INSPECTION AND TESTING
**08/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (2003) Acceptance Testing Specifications

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Acceptance tests and inspections; G

SD-07 Certificates

Qualifications of organization, and lead engineering technician; G

Acceptance test and inspections procedure; G

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Contractor shall engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph entitled "Acceptance Tests and Inspections" herein. Organization shall be independent of the supplier, manufacturer, and installer of the equipment. The organization shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.

a. Submit name and qualifications of organization. Organization shall have been regularly engaged in the testing of electrical materials, devices, installations, and systems for a minimum of 5 years. The organization shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS.

b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

1.4.2 Acceptance Tests and Inspections Reports

Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

1.4.3 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization shall perform acceptance tests and inspections. Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results have been completed. Contractor shall supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. Contracting Officer shall be notified at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

a. Section 26 32 13.00 20 SINGLE-OPERATION GENERATOR SETS. Functional engine shutdown tests, vibration base-line test, and load bank test shall not be performed by the testing organization. These tests shall be performed by the start-up engineer.

b. Section 26 12 19.10 THREE-PHASE PAD-MOUNTED TRANSFORMERS

c. Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION

d. Section 26 36 23.00 20 AUTOMATIC TRANSFER SWITCHES

3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion of acceptance tests and inspections.

3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present when equipment tested by the organization is initially energized and placed in service.

-- End of Section --

SECTION 26 12 19.10

THREE-PHASE PAD-MOUNTED TRANSFORMERS
**11/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI C12.7 | (2005) Requirements for Watthour Meter Sockets |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 167 | (1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |
| ASTM D 117 | (2002) Standard Guide for Sampling, Test Methods, Specifications and Guide for Electrical Insulating Oils of Petroleum Origin |
| ASTM D 1535 | (2008) Specifying Color by the Munsell System |
| ASTM D 3487 | (2000; R 2006) Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C2 | (2007; Errata 2007; INT 2008) National Electrical Safety Code |
| IEEE C37.47 | (1981) Distribution Fuse Disconnecting Switches, Fuse Supports, and Current-Limiting Fuses** |
| IEEE C57.12.00 | (2006) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers |
| IEEE C57.12.28 | (2005) Standard for Pad-Mounted Equipment - Enclosure Integrity |
| IEEE C57.12.34 | (2004; Errata 2005) Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 2500 kVA and Smaller—High-Voltage: 34 500 GrdY/19 920 Volts and Below; Low Voltage: |

480 Volts and Below

| | |
|---|---|
| IEEE C57.12.80 | (2002) Standard Terminology for Power and Distribution Transformers |
| IEEE C57.12.90 | (2006) Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers |
| IEEE C57.13 | (2008) Standard Requirements for Instrument Transformers |
| IEEE C57.98 | (1993; R 1999) Guide for Transformer Impulse Tests |
| IEEE C62.11 | (2005; Amendment A 2008) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV) |
| IEEE Std 100 | (2000) The Authoritative Dictionary of IEEE Standards Terms |
| IEEE Std 386 | (2006) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V |

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

| | |
|---|---|
| NETA ATS | (2003) Acceptance Testing Specifications |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA C12.1 | (2008) Electric Meters; Code for Electricity Metering |
| NEMA C12.10 | (2004) Physical Aspects of Watthour Meters |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 467 | (2007) Standard for Grounding and Bonding Equipment |

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Code 074, Southern Division, Naval Facilities Engineering Command will review and approve all submittals in this section requiring Government approval. As an exception to this paragraph, transformers manufactured by ABB in Jefferson City, MO; by Cooper Power Systems in Waukesha, WI; by ERMCO in Dyersburg, TN; or by Howard Industries in Laurel, MS need not submit the entire submittal package requirements of this contract. Instead, the following items shall be submitted:

a. A certification, from the manufacturer, that the technical requirements of this specification shall be met.

b. An outline drawing of the transformer with devices identified (paragraph entitled "Pad-Mounted Transformer Drawings", item a).

c. ANSI nameplate data of the transformer (paragraph entitled "Pad-Mounted Transformer Drawings", item b).

d. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuses (paragraph entitled "Pad-Mounted Transformer Drawings", item e).

e. Routine and other tests (in PART 2, see paragraph entitled "Routine and Other Tests"), shall be conducted by the manufacturer and may be witnessed by the government (in Part 2, see paragraph entitled "Source Quality Control"). Provide transformer test schedule required by submittal item "SD-11 Closeout Submittals". Provide certified copies of the tests.

f. Provide acceptance test reports required by submittal item "SD-06 Test Reports".

g. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data".

SD-02 Shop Drawings

Pad-mounted transformer drawings; G

SD-03 Product Data

Pad-mounted transformers; G

Submittal shall include manufacturer's information for each component, device, and accessory provided with the transformer.

SD-06 Test Reports

Acceptance checks and tests; G

SD-07 Certificates

Transformer losses; G

Submit certification from the manufacturer indicating conformance with the paragraph entitled "Specified Transformer Losses."

SD-09 Manufacturer's Field Reports

Pad-mounted transformer design tests; G

Pad-mounted transformer routine and other tests; G

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5; G

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

SD-11 Closeout Submittals

Transformer test schedule; G

Submit report of test results as specified by paragraph entitled "Field Quality Control."

1.5 QUALITY ASSURANCE

1.5.1 Pad-Mounted Transformer Drawings

Drawings shall indicate, but not be limited to the following:

a. An outline drawing, with front, top, and side views.

b. ANSI nameplate data.

c. Elementary diagrams and wiring diagrams with terminals identified of watthour meter and current transformers.

d. One-line diagram, including switch(es), current transformers, meters, and fuses.

e. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuses.

1.5.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.3 Standard Products

Provide materials and equipment that are products of manufacturers

regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6 MAINTENANCE

1.6.1 Additions to Operation and Maintenance Data

In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

a. An instruction manual with pertinent items and information highlighted

b. An outline drawing, front, top, and side views

c. Prices for spare parts and supply list

d. Routine and field acceptance test reports

e. Fuse curves for primary fuses

f. Information on watthour demand meter, CT's, and fuse block

g. Actual nameplate diagram

h. Date of purchase

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in Section 33 71 02.00 20 UNDERGROUND

ELECTRICAL DISTRIBUTION, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2 THREE-PHASE PAD-MOUNTED TRANSFORMERS

IEEE C57.12.34, IEEE C57.12.28 and as specified herein.

2.2.1 Compartments

The high- and low-voltage compartments shall be separated by steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.1.1 High Voltage, Dead-Front

High-voltage compartment shall contain the incoming line, insulated high-voltage load-break connectors, bushing well inserts, six high-voltage bushing wells configured for loop feed application, load-break switch handle(s), access to oil-immersed fuses, dead-front surge arresters, tap changer handle, connector parking stands, protective caps, and ground pad.

a. Insulated high-voltage load-break connectors: IEEE Std 386, rated 15 kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector shall have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

b. Bushing well inserts: IEEE Std 386, 200 amperes, 15 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise.

c. Load-break switch

Loop feed sectionalizer switches: Provide three, two-position, oil-immersed type switches to permit closed transition loop feed and sectionalizing. Each switch shall be rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handles in the high-voltage compartment. Operation of switches shall be as follows:

| ARRANGEMENT NO. | DESCRIPTION OF SWITCH ARRANGEMENT | SWITCH POSITION LINE A SW. OPEN | LINE A SW. CLOSE | LINE B SW OPEN | LINE B SW CLOSE | XFMR. SW OPEN | XFMR. SW CLOSE |
|---|---|---|---|---|---|---|---|
| 1 | Line A connected to Line B and both lines connected to transformer | | X | | X | | X |
| 2 | Transformer connected to Line A only | | X | X | | | X |
| 3 | Transformer connected to Line B only | X | | | X | | X |

| ARRANGEMENT NO. | DESCRIPTION OF SWITCH ARRANGEMENT | SWITCH POSITION LINE A SW. OPEN | LINE A SW. CLOSE | LINE B SW OPEN | LINE B SW CLOSE | XFMR. SW OPEN | XFMR. SW CLOSE |
|---|---|---|---|---|---|---|---|
| 4 | Transformer open and loop closed | | X | | X | X | |
| 5 | Transformer open and loop open | X | | X | | X | |

d. Provide bayonet type, oil-immersed, expulsion fuses in series with oil-immersed, partial-range, current-limiting fuses. Bayonet fuse links shall sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. In order to eliminate or minimize oil spills, the bayonet fuse assembly shall include an oil retention valve inside the housing which closes when the fuse holder is removed and an external drip shield. Warning shall be conspicuously displayed within the high-voltage compartment cautioning against removing or inserting fuses unless the load-break switch is in the open position and the tank pressure has been released.

Bayonet fuse assembly: 150 kV BIL.

Oil-immersed current-limiting fuses: IEEE C37.47; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified.

e. Surge arresters: IEEE C62.11, rated 18 kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap, suitable for plugging into inserts. Provide three arresters for loop feed circuits.

f. Parking stands: Provide a parking stand near each bushing well.

g. Protective caps: IEEE Std 386, 200 amperes, 15 kV Class. Provide insulated protective caps (not shipping caps) for insulating and sealing out moisture from unused bushing well inserts.

2.2.1.2 Low Voltage

Low-voltage compartment shall contain low-voltage bushings with NEMA spade terminals, accessories, metering, stainless steel or laser-etched anodized aluminum diagrammatic transformer nameplate, and ground pad.

a. Accessories shall include drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator.

b. Metering: NEMA C12.10. Provide a socket-mounted electronic programmable outdoor watthour meter, surface mounted flush against the side of the low-voltage compartment as indicated. Meter shall either be programmed at the factory or shall be programmed in the field. When

field programming is performed, turn field programming device over to the Contracting Officer at completion of project. Meter shall be coordinated to system requirements.

1. Design: Provide meter designed for use on a 3-phase, 4-wire, 480Y/277 volt system with 3 current transformers. Include necessary KYZ pulse initiation hardware for Energy Monitoring and Control System (EMCS).

2. Coordination: Provide meter coordinated with ratios of current transformers and transformer secondary voltage.

3. Class: 20; Form: 9S; Accuracy: +/- 1.0 percent; Finish: Class II

4. Cover: Polycarbonate and lockable to prevent tampering and unauthorized removal.

5. Kilowatt-hour Register: 5 digit electronic programmable type

6. Demand Register:

   (a) Provide solid state

   (b) Meter reading multiplier:

      (1) Indicate multiplier on the meter face.

   (c) Demand interval length: shall be programmed for 15 minutes with rolling demand up to six subintervals per interval.

7. Meter fusing: Provide a fuse block mounted in the secondary compartment containing one fuse per phase to protect the voltage input to the watthour meter. Size fuses as recommended by the meter manufacturer.

8. Socket: ANSI C12.7. Provide NEMA Type 3R, box-mounted socket having automatic circuit-closing bypass and having jaws compatible with requirements of the meter. Cover unused hub openings with blank hub plates. Paint box Munsell 7GY3.29/1.5 green to match the pad-mounted transformer to which the box-mounted socket is attached. The Munsell color notation is specified in ASTM D 1535.

9. Current transformers: IEEE C57.13. Provide butyl-molded window type current transformers with 600-volt insulation, 10 kV BIL and mount on the low-voltage bushings. Route current transformer leads in a location as remote as possible from the power transformer secondary cables to permit current measurements to be taken with hook-on-ammeters. Provide three current transformers per power transformer with characteristics listed in the following table.

| kVA | Sec. Volt | CT Ratio | RF | Meter Acc. Class |
|---|---|---|---|---|
| 300 | 480Y/277 | 300/5 | 3.0 | 0.3 thru B-0.2 |

2.2.2 Transformer

a. Oil-insulated, two winding, 60 hertz, 65 degrees C rise above a 30

degrees C average ambient, self-cooled type.

b. Transformer shall be rated 300 kVA, 95 kV BIL.

c. Transformer voltage ratings: 13800 V - 480/277 V.

d. Tap changer shall be externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Tap changers shall clearly indicate which tap setting is in use.

e. Minimum tested impedance shall not be less than 3.88 percent at 85 degrees C.

f. Audible sound levels shall comply with the following:

| kVA | DECIBELS (MAX) |
|---|---|
| 300 | 55 |

g. Transformer shall include lifting lugs and provisions for jacking under base. The transformer base construction shall be suitable for using rollers or skidding in any direction. Provide transformer top with an access handhole. Transformer shall have its kVA rating conspicuously displayed on its enclosure. The transformer shall have an insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.

2.2.2.1 Specified Transformer Losses

No-load losses (NLL) shall be 438 watts at 20 degrees C and load losses (LL) shall be 1718 watts at 85 degrees C. The values for the specified losses shall be used for comparison with the losses determined during the routine tests. If the routine test values for no-load losses exceed the specified no-load losses by more than 10 percent, or the total losses exceed the specified total losses (sum of no-load and load losses) by more than 6 percent, the transformer is unacceptable.

2.2.3 Insulating Liquid

a. Mineral oil: ASTM D 3487, Type II, tested in accordance with ASTM D 117. Provide identification of transformer as "non-PCB" and "Type II mineral oil" on the nameplate.

2.2.3.1 Liquid-Filled Transformer Nameplates

Distribution transformers shall be provided with nameplate information in accordance with IEEE C57.12.00 and as modified or supplemented by this section.

2.2.4 Corrosion Protection

Bases and cabinets of transformers shall be corrosion resistant and shall be fabricated of stainless steel conforming to ASTM A 167, Type 304 or 304L. Base shall include any part of pad-mounted transformer that is within 3 inches of concrete pad. Paint bases, cabinets, and tanks Munsell 7GY3.29/1.5 green. Paint coating system shall comply with IEEE C57.12.28. The Munsell color notation is specified in ASTM D 1535.

## 2.3 WARNING SIGNS

Provide warning signs for the enclosures of pad-mounted transformers having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

## 2.4 GROUNDING AND BONDING

UL 467. Provide grounding and bonding as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION.

## 2.5 PADLOCKS

Padlocks shall be provided for pad-mounted equipment. Padlocks shall be keyed as directed by the Contracting Officer. Padlocks shall comply with Section 08 71 00 DOOR HARDWARE.

## 2.6 CAST-IN-PLACE CONCRETE

Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise. All concrete shall conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

## 2.7 SOURCE QUALITY CONTROL

### 2.7.1 Transformer Test Schedule

The Government reserves the right to witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

1. The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.

3. Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.

4. Dated calibration labels shall be visible on all test equipment.

5. Calibrating standard shall be of higher accuracy than that of the instrument tested.

6. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

   (a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

   (b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.7.2 Design Tests

IEEE C57.12.00, and IEEE C57.12.90. Section 5.1.2 in IEEE C57.12.80 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for the specified transformer. Design tests shall have been performed prior to the award of this contract.

a. Tests shall be certified and signed by a registered professional engineer.

b. Temperature rise: "Basically the same design" for the temperature rise test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (ONAN), the same temperature rise rating, and the same insulating liquid as the transformer specified.

c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests shall include the primary windings only of that transformer.

   1. IEEE C57.12.90, paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.

   2. State test voltage levels.

   3. Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

d. Lifting and moving devices: "Basically the same design" requirement for the lifting and moving devices test means a test report confirming that the lifting device being used is capable of handling the weight of the specified transformer in accordance with IEEE C57.12.34.

e. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

f. Short circuit: "Basically the same design" for the short circuit test

means a pad-mounted transformer with the same kVA as the transformer specified.

2.7.3 Routine and Other Tests

IEEE C57.12.00. Routine and other tests shall be performed by the manufacturer on the actual transformer prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence shall be as follows:

a. Cold resistance measurements (provide reference temperature)

b. Phase relation

c. Ratio

d. No-load losses (NLL) and excitation current

e. Load losses (LL) and impedance voltage

f. Dielectric

1. Impulse

2. Applied voltage

3. Induced voltage

g. Leak

h. Dissolved gas analysis (DGA)

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 TRANSFORMER GROUNDING

Provide a 1/0 bare copper-ground girdle around transformer. Girdle shall be buried one foot deep and placed 3 feet laterally from the transformer enclosure. Connect girdle to enclosure at two opposite places using 1/0 copper. Exothermically weld joints.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Meters and Current Transformers

NEMA C12.1.

## 3.4 FIELD APPLIED PAINTING

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

## 3.5 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on concrete slab. Top of concrete slab shall be flush with adjoining apron with gradual slope for drainage. Edges above grade shall have 1/2 inch chamfer. Slab shall be of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

## 3.6 FIELD QUALITY CONTROL

### 3.6.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

#### 3.6.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection

1. Compare equipment nameplate information with specifications and approved shop drawings.

2. Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.

3. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

4. Verify correct liquid level in tanks.

5. Perform specific inspections and mechanical tests as recommended by manufacturer.

6. Verify correct equipment grounding.

7. Verify the presence of transformer surge arresters.

b. Electrical tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter.

2. Verify that the tap-changer is set at specified ratio.

3. Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

3.6.1.2 Current Transformers

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify correct connection.

4. Verify that adequate clearances exist between primary and secondary circuit.

5. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

6. Verify that required grounding and shorting connections provide good contact.

b. Electrical tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

2. Perform insulation-resistance test.

3. Perform a polarity test.

4. Perform a ratio-verification test.

3.6.1.3 Watthour Meter

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify tightness of electrical connections.

b. Electrical tests

1. Calibrate watthour meters according to manufacturer's published data.

2. Verify that correct multiplier has been placed on face of meter, where applicable.

3. Verify that current transformer secondary circuits are intact.

3.6.1.4 Grounding System

a. Visual and mechanical inspection

1. Inspect ground system for compliance with contract plans and

specifications.

3.6.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

QUOTE # 264036-00
*RE-PRINT* CUSTOMER COPY QUOTED DATE 5/12/09

BILL TO:
MISC. CUSTOMER ACCT.
MISC. CUSTOMER ST

MISC CUSTOMER CITY TN 00000

SHIP TO:
I&C MARKET - ASPEN POWER
DISTRIBUTOR
REF: RIVERINE PROJECT
STENNIS, MS
DENVER CO80234

| DESCRIPTION | PRODUCT NUMBER |
|---|---|
| LOSSES DATA FOR TRANSFORMER IS BASED ON: | |
| LOSS GRT: REF TEMP BASIS: A VOLT% : 100 | |
| FREIGHT PREPAID AND ALLOWED FOB: STENNIS, MS | |
| LEAD TIME 6 WEEKS ARO | |
| *QUOTED PER SECTION 26 12 19.10 | |
| REFERENCE 1.4, 1.5.1, 1.6.1: WILL BE PROVIDED ARO. | |
| REFERENCE 2.2.1: WILL BE NEMA ICS TYPE 3X AND FABRICATED OF 304 STAINLESS STEEL. | |
| REFERENCE 2.2.2.1: ERMCO WILL NOT PROVIDE LOAD-BREAK CONNECTORS. | |
| REFERENCE 2.2.1.2.B.: ERMCO WILL NOT INSTALL OR PROGRAM METERING. METERING PACKAGE WILL BE SHIPPED WITH UNIT. | |
| *REFERENCE 2.2.2.1: ERMCO WILL PROVIDE THE MOST OPTIMUM DESIGN AVAILABLE FOR REQUESTED LOSSES. | |
| REFERENCE 2.4, 2.5, 2.6: ERMCO WILL NOT PROVIDE. | |
| REFERENCE 2.7.1.: DUE TO SCHEDULING CONSTRAINTS, ERMCO WILL NOT PROVIDE TEST SCHEDULE BUT CUSTOMER MAY WITNESS TESTS WITH PROIR NOTIFICATION. | |
| REFERENCE PART 3 EXECUTION:ERMCO WILL NOT PROVIDE. | |
| PRICES ARE FIRM FOR RECEIPT OF AN ORDER WITHIN 30 DAYS FROM 5/12/09 AND DELIVERY WITHIN THE QUOTED LEAD TIME. DELIVERIES BEYOND THE QUOTED LEAD TIME WILL BE SUBJECT TO ESCALATION BASED ON THE ERMCO MATERIAL PRICE INDEX AT THE TIME OF SHIPMENT. THE BASE ERMCO MATERIAL PRICE INDEX FOR THIS QUOTATION IS -12.33%. | |

ITEM 1
ERMCO 3 PHASE PAD TRANSFORMER 3PH-PAD
ITEM# : 1.00
PROTECTIVE CAPS
OPTIONS BEGIN.....

| | |
|---|---|
| ERMCO | ERMCO STD 3PH TRANSFORMER |
| 0300 | 300 KVA |
| D | DELTA |
| 522 | 13800 95 BIL |
| N | NO NEUTRAL GROUND |
| 003 | 2 TAPS 2.5% ABOVE & BELOW |
| 003 | 480Y/277 LHL |
| S5 | ANSI SPECIFIC K DIM=5.0 |
| L | LOOP FEED |
| 01 | TIKA NO LOCKING SUPPORT ARM |
| 000 | ERMCO STD FIXED STUD WELL |

QUOTE # 264036-00

*RE-PRINT* CUSTOMER COPY QUOTED DATE 5/12/09

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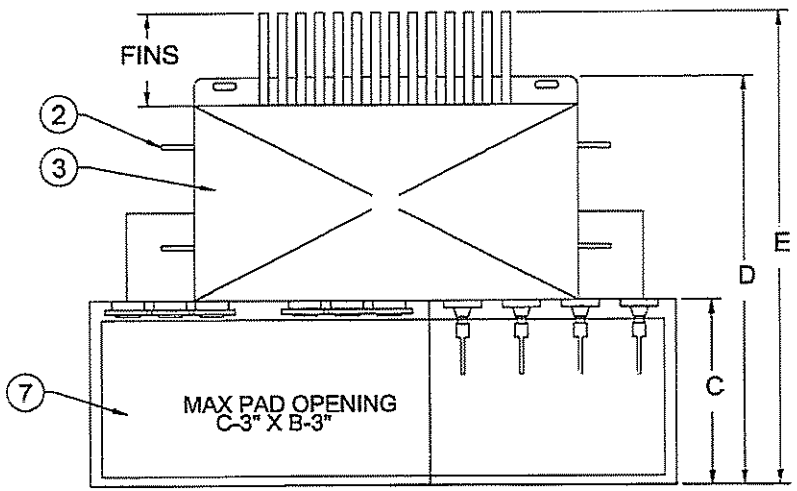
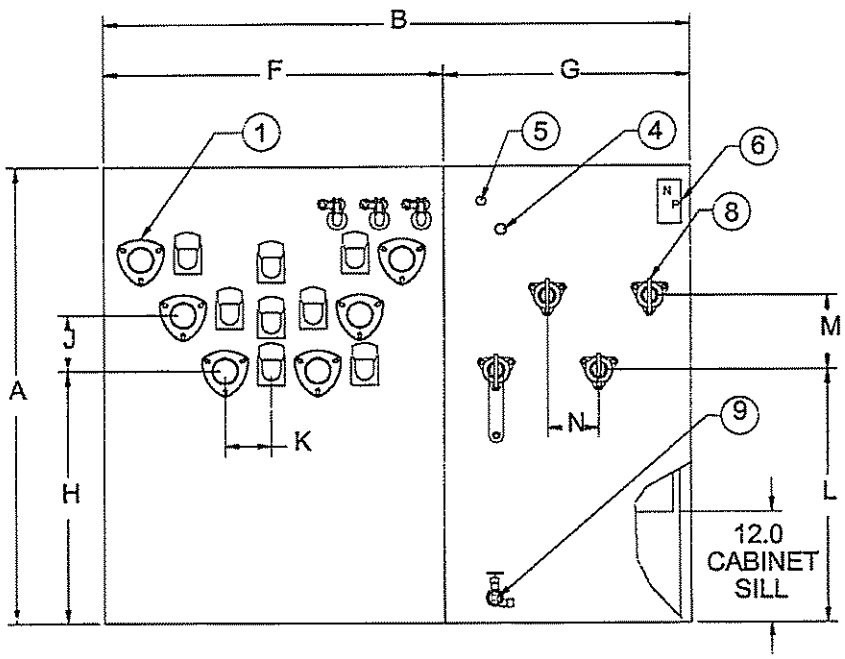
MISC CUSTOMER CITY TN 00000

SHIP TO:
I&C MARKET - ASPEN POWER
DISTRIBUTOR
REF: RIVERINE PROJECT
STENNIS, MS
DENVER CO80234

| DESCRIPTION | PRODUCT NUMBER |
|---|---|
| G15 | STD INSERT SYSTEM SELECT |
| A18 | ELBOW ARRESTERS GENERIC 18KV |
| S | STAGGERED LV BUSHING ARRANGEMENT |
| 000 | ERMCO STD STUD LV BUSHINGS |
| 600 | 6 HOLE NEMA SPADES |
| F58 | DUAL SENSING BAYO W/ELSP (GENERIC) |
| CLA | GENERIC BACKUP CL FUSE |
| F | GENERIC FLAPPER BAYONET HOLDER |
| 304 | 304L STAINLESS TANK & PEDESTAL |
| 4 | SS TANK COVER W/RECT. HANDHOLE |
| 304 | 304L STAINLESS CABNET & SILL |
| 0 | STD CABINET PARTITION |
| 0 | PADMOUNT GREEN FINISH |
| 2 | SS HARDWARE W/BRONZE NUTS |
| 11 | SILICON BRONZE PENTABOLT |
| 1 | S.S. 2HOLE GRD PAD IN PRI & SEC |
| 00 | GENERIC PR VALVE .25 10PSI 35SCFM |
| 5 | HJ DV1000-001 1NPT W/S |
| 0 | 1"NPT FILL PLUG |
| Z | ERMCO STD LEVEL GAGE |
| Z | ERMCO STD VACUUM GAGE |
| Z | ERMCO STD TEMPERATURE GAGE |
| 23 | 3 TWO POS. 38KV ERMCO STD LBOR |
| H | HOT STICK STYLE SWITCH HANDLE |
| 0 | STD TX OIL |
| A | STANDARD TWO NAMEPLATES |
| 00 | STD KVA DECAL OUTSIDE |
| 00 | DOES NOT REQUIRE PCB DECAL. |
| 01 | "DANGER HIGH VOLTAGE" 7 X 10 |
| 02 | WARNING "MR OUCH" GENERIC |
| 99 | STD PRIMARY DECAL INSIDE(HV) |
| 00 | NO SECONDARY VOLTAGE DECALS |
| 00 | STD ERMCO "E" LOGO DECAL |
| 3 | PLASTIC DRIP SHIELD (ECI) |

OPTIONS END.....




CUSTOMER: RIVERINE PROJECT

RFQ/Spec:

ERMCO Quote#: 264036

For detail information about the transformer, refer to the ERMCO quote documents.

Quote

| Item | A | B | C | D | E | F | G | H | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 57 | 63.5 | 24 | 54.5 | 61.5 | 36.5 | 26.5 | 27 | 6 | 5 | 31 | 8 | 6.33 |

## STANDARD FEATURES

1 HV Bushing
2 Lifting Lugs
3 Bolted Cover
4 1" Upper Fill Plug
5 Pressure Relief Valve
6 Nameplate
7 Hinged Top Cabinet
8 LV Bushing
9 Drain Valve w/Sampler

Quote

| Item | Wt(lbs) | Oil(gn) |
|---|---|---|
| 1 | 5220 | 253 |

3 Phase Quote Drawing

ERMCO

| ISSD BY: | DATE: |
|---|---|
| GS | 05/12/09 |
| REV ISSUE DATE: | SCALE: NTS |

SECTION 26 18 23.00 40

MEDIUM-VOLTAGE SURGE ARRESTERS
**08/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 123/A 123M | (2008) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A 153/A 153M | (2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C62.11 | (2005; Amendment A 2008) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV) |
| IEEE Std 386 | (2006) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA LA 1 | (1992; R 1999) Standard for Surge Arresters |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |

1.2 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit Equipment and Performance Data for surge arresters including life, test, system functional flows, safety features, and mechanical automated details.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Provide the following shop drawings according to requirements set forth in this section:

Fabrication Drawings
Installation Drawings

SD-03 Product Data

Submit Equipment and Performance Data for surge arresters in accordance with paragraph entitled, "General Requirements," of this section.

Submit Manufacturer's product data for the following items:

Surge Arresters
Mounting Brackets

SD-08 Manufacturer's Instructions

Installation Instructions
Surge Arresters

SD-10 Operation and Maintenance Data

O & M Manuals
Surge Arresters

PART 2 PRODUCTS

2.1 EQUIPMENT

Provide design, fabrication, testing, and performance of arresters that complies with IEEE C62.11, NEMA LA 1.

Provide arresters that utilize metal oxide varistor and gapped arrester technologies.

Provide arresters that are contained within a polymer housing. Provide arrester that is designed to be non-fragmenting to provide extra safety to personnel and equipment. For arresters utilizing a hanger frame type mounting bracket, provide a frame that is non-corrosive track resistant glass filled polyester or other suitable non-corrosive/non-conductive material providing high mechanical strength. Provide arrester mounting hardware that is designed for installation in severe salt-spray atmosphere and that is of a corrosion-resistant metal or zinc-coated in accordance with ASTM A 123/A 123M ASTM A 153/A 153M accordingly.

The arrester housing is molded of EPDM insulating rubber which provides deadfront safety and overvoltage system protection in an insulated, fully shielded, submersible, deadfront device that conforms to IEEE Std 386.

2.2 FABRICATION DRAWINGS

Submit fabrication drawings in accordance with paragraph entitled, "Equipment," of this section. Provide drawings that show assembly and fabrication details performed in the factory.

## 2.3 SURGE ARRESTERS

### 2.3.1 O & M Manuals, Surge Arresters

Provide O & M Manuals for surge arresters specified within these plans and specifications.

### 2.3.2 Distribution

Provide combination spark gap and metal oxide varistor type distribution arresters. Provide corrosion resistant mounting hardware.

#### 2.3.2.1 Distribution - Riser-Pole Class

Distribution - Provide combination spark gap and metal oxide varistor type riser-pole class. Provide corrosion resistant mounting hardware.

#### 2.3.2.2 Distribution - Underground

Provide arresters that are combination spark gap and metal oxide varistor type technology in a premolded rubber elbow.

### 2.3.3 Intermediate

Provide single-phase, single-pole, self-supporting type arresters for pedestal, platform, or bracket mounting.

### 2.3.4 Station

Provide single-phase, single-pole, self-supporting type arresters for pedestal, platform, or bracket mounting.

## 2.4 SURGE PROTECTION FOR ROTATING AC MACHINES

Provide arresters installed on rotating alternating current equipment that are the type and rating as recommended by the manufacturer of the equipment.

## 2.5 MOUNTING BRACKETS

Provide arresters that are equipped with suitable mounting brackets for the applicable method of mounting.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Install and connect arresters in accordance with the manufacturer's installation instructions.

Make ground connection to a driven ground rod, counterpoise, or station grounding system and meet the intent of the National Electrical Code, NFPA 70.

Connect lightning arresters as close as practicable to the apparatus being protected. When connecting arresters to overhead conductors, use a hot line clamp. Provide a hot line clamp that is designed to be compatible to the type of conductor material being used, i.e. aluminum or copper.

3.1.1 Installation Instructions, Surge Arresters

Submit Manufacturer's instructions for surge arresters including special provisions required to install equipment components and system packages. Provide special notices that detail impedances, hazards and safety precautions.

3.1.2 Installation Drawings

Submit installation drawings in accordance with paragraph entitled, "Installation," of this section.

3.2 ARRESTERS

3.2.1 Distribution Type

Install distribution class arresters on all overhead lines, riser poles, pad mounted transformers and where applicable installed on distribution load break switches, sectionalizers and fault interrupters.

3.2.1.1 Distribution - Riser-Pole Class

Distribution - Install riser-pole class arrestors on all riser poles.

3.2.2 Intermediate Type

Install intermediate type arrestors on grounded support brackets/structures suitable to adequately support the weight of the arrestor.

3.2.3 Station Type

Install station type arrestors on grounded structures suitable to adequately support the weight of the arrestor.

-- End of Section --

SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM
**08/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM B 1 | (2001; R 2007) Standard Specification for Hard-Drawn Copper Wire |
| ASTM B 8 | (2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft |
| ASTM D 709 | (2001; R 2007) Laminated Thermosetting Materials |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C2 | (2007; Errata 2007; INT 2008) National Electrical Safety Code |
| IEEE Std 100 | (2000) The Authoritative Dictionary of IEEE Standards Terms |
| IEEE Std 81 | (1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)Normal Measurements |

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

| | |
|---|---|
| NETA ATS | (2003) Acceptance Testing Specifications |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA 250 | (2003) Enclosures for Electrical Equipment (1000 Volts Maximum) |
| NEMA C12.1 | (2008) Electric Meters; Code for Electricity Metering |
| NEMA C80.1 | (2005) Standard for Electrical Rigid Steel Conduit (ERSC) |
| NEMA C80.3 | (2005) Standard for Electrical Metallic Tubing (EMT) |
| NEMA FU 1 | (2002; R 2007) Low Voltage Cartridge Fuses |

| | |
|---|---|
| NEMA ICS 1 | (2000; R 2005) Standard for Industrial Control and Systems General Requirements |
| NEMA ICS 2 | (2000; Errata 2002; R 2005; Errata 2006) Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment |
| NEMA ICS 4 | (2005) Industrial Control and Systems: Terminal Blocks |
| NEMA ICS 6 | (1993; R 2006) Standard for Industrial Controls and Systems Enclosures |
| NEMA KS 1 | (2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum) |
| NEMA MG 1 | (2007) Standard for Motors and Generators |
| NEMA MG 10 | (2001; R 2007) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors |
| NEMA MG 11 | (1977; R 2007) Energy Management Guide for Selection and Use of Single Phase Motors |
| NEMA RN 1 | (2005) Standard for Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit |
| NEMA ST 20 | (1992; R 1997) Standard for Dry-Type Transformers for General Applications |
| NEMA TC 2 | (2003) Standard for Electrical Polyvinyl Chloride (PVC) Tubing and Conduit |
| NEMA TC 3 | (2004) Standard for Polyvinyl Chloride PVC Fittings for Use With Rigid PVC Conduit and Tubing |
| NEMA TP 1 | (2002) Guide for Determining Energy Efficiency for Distribution Transformers |
| NEMA VE 1 | (2002) Standard for Metallic Cable Tray Systems |
| NEMA WD 1 | (1999; R 2005) Standard for General Requirements for Wiring Devices |
| NEMA WD 6 | (2002; R 2008) Standard for Wiring Devices - Dimensional Requirements |
| NEMA Z535.4 | (2007; Errata 2007) Product Safety Signs |

and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |
| NFPA 70E | (2008) Electrical Safety in the Workplace |

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

| | |
|---|---|
| TIA J-STD-607-A | (2002) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications |
| TIA/EIA-568-B.1 | (2001 Addendums 2001, 2003, 2003, 2003, 2004, 2007) Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements |
| TIA/EIA-569-A | (1998; Addenda 2000, 2001) Commercial Building Standards for Telecommunications Pathways and Spaces |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1910.147 | Control of Hazardous Energy (Lock Out/Tag Out) |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1 | (2005; Rev thru Jul 2007) Standard for Flexible Metal Conduit |
| UL 1063 | (2006) Standard for Safety Machine-Tools Wires and Cables |
| UL 1242 | (2006; Rev thru Jul 2007) Standard for Electrical Intermediate Metal Conduit -- Steel |
| UL 1449 | (2006) Surge Protective Devices |
| UL 198M | (2003; Rev thru Oct 2007) Mine-Duty Fuses |
| UL 20 | (2000 ; Rev thru Dec 2004) Standard for General-Use Snap Switches |
| UL 360 | (2003; Rev thru Jul 2007) Liquid-Tight Flexible Steel Conduit |
| UL 44 | (2005; Rev thru Nov 2005) Thermoset-Insulated Wires and Cables |
| UL 467 | (2007) Standard for Grounding and Bonding Equipment |
| UL 486A-486B | (2003; Rev thru Aug 2006) Standard for Wire Connectors |

| | |
|---|---|
| UL 486C | (2004; Rev thru Aug 2006) Standard for Splicing Wire Connectors |
| UL 489 | (2002; Rev thru Jun 2006) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures |
| UL 498 | (2001; Rev thru Nov 2007) Attachment Plugs and Receptacles |
| UL 5 | (2004; Rev thru May 2007) Surface Metal Raceways and Fittings |
| UL 50 | (2007) Standard for Enclosures for Electrical Equipment |
| UL 508 | (1999; Rev thru Sep 2008) Standard for Industrial Control Equipment |
| UL 510 | (2005; Rev thru Aug 2005) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape |
| UL 512 | (1993; Rev thru Jan 2008) Fuseholders |
| UL 514A | (2004; Rev thru Aug 2007) Standard for Metallic Outlet Boxes |
| UL 514B | (2004; Rev thru Aug 2007) Standard for Conduit, Tubing and Cable Fittings |
| UL 514C | (1996; Rev thru Jul 2008) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers |
| UL 6 | (2007) Standard for Electrical Rigid Metal Conduit-Steel |
| UL 651 | (2005; Rev thru May 2007) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings |
| UL 67 | (1993; Rev thru Jul 2008) Standard for Panelboards |
| UL 797 | (2007) Standard for Electrical Metallic Tubing -- Steel |
| UL 817 | (2001; Rev thru May 2007) Cord Sets and Power-Supply Cords |
| UL 83 | (20086) Standard for Thermoplastic-Insulated Wires and Cables |
| UL 854 | (2004; Rev thru Oct 2007) Service-Entrance Cables |
| UL 869A | (2006) Reference Standard for Service |

| | |
|---|---|
| | Equipment |
| UL 870 | (1995; Rev thru Jul 2003) Standard for Wireways, Auxiliary Gutters, and Associated Fittings |
| UL 943 | (2006; Rev thru Feb 2008) Ground-Fault Circuit-Interrupters |
| UL 984 | (1996; Rev thru Sept 2005) Hermetic Refrigerant Motor-Compressors |

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval only. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Panelboards; G

Transformers; G

Cable trays; G

Wireways; G

Marking strips drawings; G

SD-03 Product Data

Receptacles; G

Circuit breakers; G

Switches; G

Transformers; G

Enclosed circuit breakers; G

Motor controllers; G

Manual motor starters; G

Telecommunications Grounding Busbar; G

Surge protective devices; G

Submittals shall include performance and characteristic curves.

SD-06 Test Reports

600-volt wiring test; G

Grounding system test; G

Transformer tests; G

Ground-fault receptacle test; G

SD-07 Certificates

Fuses; G

SD-09 Manufacturer's Field Reports

Transformer factory tests

SD-10 Operation and Maintenance Data

Electrical Systems, Data Package 5; G

Submit operation and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein.

## 1.4 QUALITY ASSURANCE

### 1.4.1 Fuses

Submit coordination data as specified in paragraph, FUSES of this section.

### 1.4.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

### 1.4.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

#### 1.4.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable

if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5 MAINTENANCE

1.5.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

a. Single line diagram of the "as-built" building electrical system.

b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.6 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

Shall conform to the following:

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit

NEMA C80.1, UL 6.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, and EPC-80 in accordance with NEMA TC 2,UL 651.

2.2.3 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.2.4 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797, NEMA C80.3.

2.2.5 Plastic-Coated Rigid Steel and IMC Conduit

NEMA RN 1, Type 40( 40 mils thick).

2.2.6 Flexible Metal Conduit

UL 1.

2.2.6.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.7 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.2.7.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.7.2 Fittings for EMT

Steel compression type.

2.2.8 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC, and UL 514B.

2.3 SURFACE RACEWAY

2.3.1 Surface Metal Raceway

UL 5, two-piece painted steel, totally enclosed, snap-cover type. Provide multiple outlet-type raceway with grounding-type receptacle where indicated. Receptacles shall be as specified herein and shall be spaced minimum of one every 24 inches.

2.4 CABLE TRAYS

NEMA VE 1. Cable trays shall form a wireway system, and shall be of nominal depth as indicated. Cable trays shall be constructed of aluminum. Trays shall include splice and end plates, dropouts, and miscellaneous hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius. Radius of bends shall be 12 inches.

2.4.1 Ladder-Type Cable Trays

Provide size as indicated with maximum rung spacing of 9 inches.

2.4.2 Channel-Type Cable Trays

Provide size as indicated. Trays shall be one-piece construction having

slots spaced not more than 4 1/2 inches on centers.

2.4.3 Cantilever

Cantilever-type, center-hung cable trays may be provided at the Contractor's option in lieu of other cable tray types specified.

2.5 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

2.5.1 Floor Outlet Boxes

Boxes shall be adjustable and concrete tight, and sized as required for power and telecommunications receptacles. Each box shall consist of cast-metal body with threaded openings for conduits, a recessed pocket for cord-and-plug access, and hinged cover with cord opening and floor tile insert. Telecommunications outlets shall consist of appropriate bezels and plates with jacks as specified.

2.5.2 Outlet Boxes for Telecommunications System

Provide standard type 4 inches square by 2 1/8 inches deep. Depth of boxes shall be large enough to allow manufacturers' recommended conductor bend radii.

2.6 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.7 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.7.1 Conductors

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and capacities shown are based on copper, unless indicated otherwise. Conductors indicated to be No. 6 AWG or smaller diameter shall be copper. Conductors indicated to be No. 4 AWG and larger diameter shall be either copper or aluminum, unless type of conductor material is specifically indicated, or specified, or required by equipment manufacturer.

2.7.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.7.1.2 Aluminum Conductors

Aluminum conductors shall be AA-8000 series electrical grade aluminum alloy conductors. Type EC/1350 aluminum is not acceptable. Should Contractor choose to provide aluminum for conductors No. 4 AWG and larger diameter, Contractor shall be responsible for increasing conductor size to have same ampacity as copper size indicated; increasing conduit and pull box sizes to accommodate larger size aluminum conductors in accordance with NFPA 70; ensuring that pulling tension rating of aluminum conductor is sufficient; providing panelboards that are UL listed for use with aluminum, and so labeled; relocating equipment, modifying equipment terminations, resizing equipment; and resolving problems that are direct results of providing aluminum conductors in lieu of copper.

2.7.1.3 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. 22 AWG.

2.7.2 Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutrals shall be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 208/120 volt, three-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, three-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

2.7.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.7.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger

diameter.

2.7.4.1 Telecommunications Bonding Backbone (TBB)

Provide a copper conductor TBB in accordance with TIA J-STD-607-A. The TBB shall be a minimum No. 6 AWG and be sized at 2 kcmil per linear foot of conductor length up to a maximum size of 3/0 AWG. Provide insulated TBB with insulation as specified in the paragraph INSULATION and meeting the fire ratings of its pathway.

2.7.4.2 Bonding Conductor for Telecommunications

Provide a copper conductor Bonding Conductor for Telecommunications between the telecommunications main grounding busbar (TMGB) and the electrical service ground in accordance with TIA J-STD-607-A. The bonding conductor for telecommunications shall be sized the same as the TBB.

2.7.5 Service Entrance Cables

Service Entrance (SE) and Underground Service Entrance (USE) Cables, UL 854.

2.7.6 Cord Sets and Power-Supply Cords

UL 817.

2.8 SPLICES AND TERMINATION COMPONENTS

UL 486A-486B for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A-486B or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.9 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. For nonmetallic boxes and fittings, other suitable plates may be provided. Plates on finished walls shall be satin finish stainless steel or brushed-finish aluminum, minimum 0.03 inch thick. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations."

2.10 SWITCHES

2.10.1 Toggle Switches

NEMA WD 1, UL 20, single pole, double pole, three-way, and four-way, totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Handles shall be white thermoplastic. Wiring terminals shall be screw-type, side-wired. Contacts shall be silver-cadmium and contact arm shall be one-piece copper alloy. Switches shall be rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.10.2 Switch with Red Pilot Handle

NEMA WD 1. Provide pilot lights that are integrally constructed as a part

of the switch's handle. The pilot light shall be red and shall illuminate whenever the switch is closed or "on". The pilot lighted switch shall be rated 20 amps and 120 volts or 277 volts as indicated. Provide the circuit's neutral conductor to each switch with a pilot light.

2.10.3 Breakers Used as Switches

For 120- and 277-Volt fluorescent fixtures, mark breakers "SWD" in accordance with UL 489.

2.10.4 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Switches serving as motor-disconnect means shall be horsepower rated. Provide switches in NEMA 1 or 3R enclosure as indicated per NEMA ICS 6.

2.11 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices shall be coordinated for proper operation. Submit coordination data for approval. Fuses shall have voltage rating not less than circuit voltage.

2.11.1 Fuseholders

Provide in accordance with UL 512.

2.11.2 Cartridge Fuses, Current Limiting Type (Class R)

UL 198M, Class RK-1, RK-5, or time-delay type as indicated. Associated fuseholders shall be Class R only.

2.11.3 Cartridge Fuses, High-Interrupting Capacity, Current Limiting Type (Classes J, L, and CC)

UL 198M, Class J for zero to 600 amperes, Class L for 601 to 6,000 amperes, and Class CC for zero to 30 amperes.

2.11.4 Cartridge Fuses, Current Limiting Type (Class T)

UL 198M, Class T for zero to 1,200 amperes, 300 volts; and zero to 800 amperes, 600 volts.

2.12 RECEPTACLES

UL 498, hard use, heavy-duty, grounding-type. Ratings and configurations shall be as indicated. Bodies shall be of white as per NEMA WD 1. Face and body shall be thermoplastic supported on a metal mounting strap. Dimensional requirements shall be per NEMA WD 6. Provide screw-type, side-wired wiring terminals. Connect grounding pole to mounting strap. The receptacle shall contain triple-wipe power contacts and double or triple-wipe ground contacts.

2.12.1 Switched Duplex Receptacles

Provide separate terminals for each ungrounded pole. Top receptacle shall be switched when installed.

2.12.2 Weatherproof Receptacles

Provide in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations with plug in use."

2.12.3 Ground-Fault Circuit Interrupter Receptacles

UL 943, duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFCI devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

2.12.4 Special Purpose Receptacles

Special purpose receptacles serving specific equipment shall be provided with ratings as indicated by the NEMA configuration on the drawings. Verify requirements with equipment provider prior to purchase and installation. Provide matching cord and plug where necessary.

2.12.5 Plugs

Provide heavy-duty, rubber-covered cord of required size and conductor quantity, install plugs thereon, and attach to equipment. Plugs shall be UL listed with receptacles, complete with grounding blades. Where equipment is not available, turn over plugs and cord assemblies to the Government.

2.12.6 Dryer Receptacles

NEMA 14-30 configuration, rated 30 amperes, 125/250 volts. Furnish one matching plug with each receptacle.

2.13 PANELBOARDS

UL 67 and UL 50. Panelboards for use as service disconnecting means shall additionally conform to UL 869A. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. Where "space only" is indicated, make provisions for future installation of breaker sized as indicated. Directories shall indicate load served by each circuit of panelboard. Directories shall also indicate source of service (upstream panel, switchboard, motor control center, etc.) to panelboard. Type directories and mount in holder behind transparent protective covering. Panelboard shall have nameplates in accordance with paragraph FIELD FABRICATED NAMEPLATES.

2.13.1 Enclosure

Enclosures shall meet the requirements of UL 50. All cabinets shall be fabricated from sheet steel of not less than No. 10 gauge if flush-mounted or mounted outdoors, and not less than No. 12 gauge if surface-mounted

indoors, with full seam-welded box ends. Cabinets mounted outdoors or flush-mounted shall be hot-dipped galvanized after fabrication. Cabinets shall be painted in accordance with paragraph PAINTING. Outdoor cabinets shall be of NEMA 3R raintight with conduit hubs welded to the cabinet. Front edges of cabinets shall be form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front. All cabinets shall be so fabricated that no part of any surface on the finished cabinet shall deviate from a true plane by more than 1/8 inch. Holes shall be provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 1/2 inch clear space between the back of the cabinet and the wall surface. Flush doors shall be mounted on hinges that expose only the hinge roll to view when the door is closed. Each door shall be fitted with a combined catch and lock, except that doors over 24 inches long shall be provided with a three-point latch having a knob with a T-handle, and a cylinder lock. Two keys shall be provided with each lock, and all locks shall be keyed alike. Finished-head cap screws shall be provided for mounting the panelboard fronts on the cabinets.

### 2.13.2 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.

### 2.13.3 Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Where indicated on the drawings, provide circuit breakers with shunt trip devices. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

#### 2.13.3.1 Multipole Breakers

Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

#### 2.13.3.2 Circuit Breaker With GFCI

UL 943 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater per requirements of UL 943 for Class A GFCI devices, for personnel protection, and 20 milliamperes or greater per requirements of UL 943 for Class B GFCI per equipment protection.

#### 2.13.3.3 Circuit Breakers for HVAC Equipment

Circuit breakers for HVAC equipment having motors (group or individual) shall be marked for use with HACR type and UL listed as HACR type.

## 2.14 ENCLOSED CIRCUIT BREAKERS

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. Enclosure type as indicated. Provide solid neutral where required.

## 2.15 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors, also called motor circuit protectors (MCPs); shall conform to UL 508 and UL 489 and shall be provided as shown. MSCPs shall consist of an adjustable instantaneous trip circuit breaker used only in conjunction with a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection. MSCPs shall be rated in accordance with the requirements of NFPA 70.

## 2.16 TRANSFORMERS

NEMA ST 20, general purpose, dry-type, self-cooled, ventilated. Provide transformers in NEMA 1 enclosure. Transformer shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding 150 degrees C under full-rated load in maximum ambient of 40 degrees C. Transformer of 150 degrees C temperature rise shall be capable of carrying continuously 100 percent of nameplate kVA without exceeding insulation rating.

### 2.16.1 Specified Transformer Efficiency

Transformers, indicated and specified with: 480V primary, 80 degrees C or 115 degrees C temperature rise, kVA ratings of 37.5 to 100 for single phase or 30 to 500 for three phase, shall be energy efficient type. Minimum efficiency, based on factory test results, shall not be less than NEMA Class 1 efficiency as defined by NEMA TP 1.

## 2.17 MOTORS

NEMA MG 1; hermetic-type sealed motor compressors shall also comply with UL 984. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 208-volt, 3-phase circuits shall have terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits shall have terminal voltage rating of 460 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating. Unless otherwise indicated, motors rated 1 HP and above shall be continuous duty type.

Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.

### 2.17.1 High Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to

meet the overall system rating indicated.

2.17.2 Premium Efficiency Polyphase Motors

Polyphase motors shall be selected based on high efficiency characteristics relative to typical characteristics and applications as listed in NEMA MG 10. In addition, continuous rated, polyphase squirrel-cage medium induction motors shall meet the requirements for premium efficiency electric motors in accordance with NEMA MG 1, including the NEMA full load efficiency ratings. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.17.3 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

2.17.4 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment as specified herein. Power wiring and conduit shall conform to the requirements specified herein. Control wiring shall be provided under, and conform to the requirements of the section specifying the associated equipment.

2.18 MOTOR CONTROLLERS

UL 508, NEMA ICS 1, and NEMA ICS 2. Controllers shall have thermal overload protection in each phase and shall have one spare normally open and one spare normally closed auxiliary contact. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay. Magnetic-type motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram. For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually

operated, lockable, nonfused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position.

2.18.1 Control Wiring

All control wire shall be stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44, or Type MTW meeting UL 1063, and shall pass the VW-1 flame tests included in those standards. Hinge wire shall have Class K stranding. Current transformer secondary leads shall be not smaller than No. 10 AWG. The minimum size of control wire shall be No. 14 AWG. Power wiring for 480-volt circuits and below shall be of the same type as control wiring and the minimum size shall be No. 12 AWG. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.18.2 Control Circuit Terminal Blocks

NEMA ICS 4. Control circuit terminal blocks for control wiring shall be molded or fabricated type with barriers, rated not less than 600 volts. The terminals shall be removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts. The terminals shall be not less than No. 10 in size and shall have sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to each terminal. The terminal arrangement shall be subject to the approval of the Contracting Officer and not less than four (4) spare terminals or 10 percent, whichever is greater, shall be provided on each block or group of blocks. Modular, pull apart, terminal blocks will be acceptable provided they are of the channel or rail-mounted type. The Contractor shall submit data showing that the proposed alternate will accommodate the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts.

2.18.2.1 Types of Terminal Blocks

a. Short-Circuiting Type: Short-circuiting type terminal blocks shall be furnished for all current transformer secondary leads and shall have provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks shall meet the requirements of paragraph CONTROL CIRCUIT TERMINAL BLOCKS above.

b. Load Type: Load terminal blocks rated not less than 600 volts and of adequate capacity shall be provided for the conductors for NEMA Size 3 and smaller motor controllers and for other power circuits, except those for feeder tap units. The terminals shall be of either the stud type with contact nuts and locking nuts or of the removable screw type, having length and space for at least two indented terminals of the size required on the conductors to be terminated. For conductors rated more than 50 amperes, screws shall have hexagonal heads. Conducting parts between connected

terminals shall have adequate contact surface and cross-section to operate without overheating. Each connected terminal shall have the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

2.18.3 Control Circuits

Control circuits shall have maximum voltage of 120 volts derived from a separate control source. Provide terminals and terminal boards. Provide separate control disconnect switch within controller. One secondary lead shall be fused; other shall be grounded.

2.18.4 Enclosures for Motor Controllers

NEMA ICS 6.

2.18.5 Multiple-Speed Motor Controllers and Reversible Motor Controllers

Across-the-line-type, electrically and mechanically interlocked. Multiple-speed controllers shall have compelling relays and shall be multiple-button, station-type with pilot lights for each speed.

2.18.6 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations shall be heavy duty, oil-tight design.

2.18.7 Pilot and Indicating Lights

Provide transformer, resistor, or diode type.

2.19 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

Single pole designed for surface mounting with overload protection and pilot lights.

2.19.1 Pilot Lights

Provide yoke-mounted, candelabra-base sockets rated 125 volts and fitted with glass or plastic jewels. Provide clear, 6 watt lamp in each pilot switch. Jewels for use with switches controlling motors shall be green; jewels for other purposes shall be white, red, or amber.

2.20 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 23, "Mechanical."

2.21 TELECOMMUNICATIONS SYSTEM

Provide system of telecommunications wire-supporting structures (pathway), including: outlet boxes, conduits with pull wires, cable trays, and other accessories for telecommunications outlets and pathway in accordance with TIA/EIA-569-A and as specified herein. Additional telecommunications requirements are specified in Section 27 10 00, BUILDING TELECOMMUNICATIONS

CABLING SYSTEM.

2.22 COMMUNITY ANTENNA TELEVISION (CATV) SYSTEM

Additional CATV requirements are specified in Section 27 54 00.00 20, COMMUNITY ANTENNA TELEVISION (CATV) SYSTEMS.

2.22.1 Backboards

Coordinate CATV backboard requirements with telecommunications backboard requirements as specified in Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLING.

2.23 GROUNDING AND BONDING EQUIPMENT

2.23.1 Ground Rods

UL 467. Ground rods shall be sectional type, copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

2.23.2 Telecommunications and CATVGrounding Busbar

Provide corrosion-resistant grounding busbar suitable for indoor installation in accordance with TIA J-STD-607-A. Busbars shall be plated for reduced contact resistance. If not plated, the busbar shall be cleaned prior to fastening the conductors to the busbar, and an anti-oxidant shall be applied to the contact area to control corrosion and reduce contact resistance. Provide a telecommunications main grounding busbar (TMGB) in the telecommunications entrance facility. The telecommunications main grounding busbar (TMGB) shall be sized in accordance with the immediate application requirements and with consideration of future growth. Provide telecommunications grounding busbars with the following:

a. Predrilled copper busbar provided with holes for use with standard sized lugs;

b. Minimum dimensions of 0.25 in thick x 4 in wide for the TMGB with minimum length of 24 inches;

c. Listed by a nationally recognized testing laboratory.

2.24 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.25 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

## 2.26 WARNING SIGNS

Provide warning signs for flash protection in accordance with NFPA 70E and NEMA Z535.4 for switchboards, panelboards, industrial control panels, and motor control centers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized. Provide field installed signs to warn qualified persons of potential electric arc flash hazards when warning signs are not provided by the manufacturer. The marking shall be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

## 2.27 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations in accordance with Section 07 84 00, FIRESTOPPING .

## 2.28 WIREWAYS

UL 870. Material shall be steel epoxy painted 16 gauge for heights and depths up to 6 by 6 inches, and 14 gauge for heights and depths up to 12 by 12 inches. Provide in length required for the application with screw-cover NEMA 1 enclosure per NEMA ICS 6.

## 2.29 SURGE PROTECTIVE DEVICES

Provide parallel type surge protective devices which comply with UL 1449 at the service entrance and distribution panelboards as indicated. Provide surge protectors in a NEMA 1 enclosure per NEMA ICS 6. Provide the following modes of protection:

FOR SINGLE PHASE AND THREE PHASE WYE CONNECTED SYSTEMS-
Each phase to neutral ( L-N )
Neutral to ground ( N-G )
Phase to ground ( L-G )

Surge protective devices at the service entrance shall have a minimum surge current rating of 80,000 amperes per mode minimum and downstream protectors shall be rated 40,000 amperes per mode minimum. The maximum line to neutral (L-N) Suppressed Voltage Rating (SVR) shall be:

500V for 208Y/120V, three phase system
900V for 480Y/277V, three phase system

The minimum MCOV (Maximum Continuous Operating Voltage) rating shall be:

300/150V for 208Y/120V, three phase system
600/320V for 480Y/277V, three phase system

EMI/RFI filtering shall be provided for each mode with the capability to attenuate high frequency noise. Minimum attenuation shall be 20db.

## 2.30 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test and the additional requirements as specified herein. Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment

prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish. Equipment located indoors shall be ANSI Light Gray, and equipment located outdoors shall be ANSI Light Gray. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

## 2.31 SOURCE QUALITY CONTROL

### 2.31.1 Transformer Factory Tests

Submittal shall include routine NEMA ST 20 transformer test results on each transformer and also contain the results of NEMA "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces, shall conform to requirements of NFPA 70 and IEEE C2 and to requirements specified herein.

### 3.1.1 Underground Service

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

### 3.1.2 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

#### 3.1.2.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph FIELD FABRICATED NAMEPLATES. Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by NFPA 70.

### 3.1.3 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size shall be 1/2 inch in diameter for low voltage lighting and power circuits. Vertical

distribution in multiple story buildings shall be made with metal conduit in fire-rated shafts. Metal conduit shall extend through shafts for minimum distance of 6 inches. Conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors shall be firestopped in accordance with Section 07 84 00, FIRESTOPPING.

3.1.3.1 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.4 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.4.1 Restrictions Applicable to EMT

a. Do not install underground.

b. Do not encase in concrete, mortar, grout, or other cementitious materials.

c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.

d. Do not use in hazardous areas.

e. Do not use outdoors.

f. Do not use in fire pump rooms.

g. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.4.2 Restrictions Applicable to Nonmetallic Conduit

a. PVC Schedule 40 and PVC Schedule 80

(1) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.

(2) Do not use in hazardous (classified) areas.

(3) Do not use in fire pump rooms.

(4) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.

(5) Do not use above grade, except where allowed in this section for rising through floor slab or indicated otherwise.

(6) Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.4.3 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph FLEXIBLE CONNECTIONS. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.4.4 Service Entrance Conduit, Underground

PVC, Type-EPC 40, galvanized rigid steel or steel IMC. Underground portion shall be encased in minimum of 3 inches of concrete and shall be installed minimum 18 inches below slab or grade.

3.1.4.5 Underground Conduit Other Than Service Entrance

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40. Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to plastic-coated rigid, or IMC, steel conduit before rising through floor slab. Plastic coating shall extend minimum 6 inches above floor.

3.1.4.6 Conduit Installed Under Floor Slabs

Conduit run under floor slab shall be located a minimum of 12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier. support conduits using 1/4" stainless steel rods spaced maximum 10 feet on centers. Rods shall be wrapped around conduits individually and turned at right angles over reinforcing steel in slab. Where conduits are grouped in parallel runs, entire group may wrapped with both ends of rods turned at right angles over reinforcing steel in slab.

3.1.4.7 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finished slab.

3.1.4.8 Conduit Installed in Concrete Floor Slabs

PVC, Type EPC-40, unless indicated otherwise. Locate so as not to adversely affect structural strength of slabs. Install conduit at bottom of first floor concrete slab, but above vapor barrier. Do not stack conduits. Any conduit crossings withing slab shall be approved by structural engineer prior to installation. Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends shall not be visible above finish slab. Increase slab thickness as necessary to provide minimum one inch cover over conduit. Where embedded conduits cross building and/or expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings shall allow horizontal and vertical movement of raceway. Maximum size allowable in slab shall be 3/4" trade size.

3.1.4.9 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches

above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.4.10 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems shall be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Where conduit crosses building expansion joints, provide suitable expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.4.11 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.4.12 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.4.13 Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 1/2 inch diameter. Provide liquidtight flexible metal conduit in wet and damp locations for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible

connections.

3.1.4.14 Telecommunications and Signal System Pathway

Install telecommunications pathway in accordance with TIA/EIA-569-A.

a. Horizontal Pathway: Telecommunications pathways from the work area to the telecommunications room shall be installed and cabling length requirements in accordance with TIA/EIA-568-B.1. Size conduits, wireways, and cable trays in accordance with TIA/EIA-569-A and as indicated.

3.1.5 Cable Tray Installation

Install and ground telecommunications cable tray in accordance with TIA/EIA-569-A, and TIA J-STD-607-A. Install cable trays parallel with or at right angles to ceilings, walls, and structural members. Support in accordance with manufacturer recommendations but at not more than 10 foot intervals. Adjacent cable tray sections shall be bonded together by connector plates of an identical type as the cable tray sections. Terminate cable trays 10 inches from both sides of smoke and fire partitions. Conductors run through smoke and fire partitions shall be installed in 4 inch rigid steel conduits with grounding bushings, extending 12 inches beyond each side of partitions. Seal conduit on both ends to maintain smoke and fire ratings of partitions. Penetrations shall be firestopped in accordance with Section 07 84 00, FIRESTOPPING. Provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.6 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 feet above floors and walkways, and when specifically indicated. Boxes in other locations shall be sheet steel, and nonmetallic boxes may be used with nonmetallic conduit system. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.6.1 Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet. Telecommunications outlets shall be a minimum of 4 inches square by 2 1/8 inches deep, except for wall mounted telephones and outlet boxes for handicap telephone stations. Mount outlet boxes flush in finished walls.

3.1.6.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.7 Mounting Heights

Mount panelboards, enclosed circuit breakers, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches 48 inches above finished floor. Mount receptacles and telecommunications outlets 18 inches above finished floor, unless otherwise indicated. Wall-mounted telecommunications outlets shall be mounted at height 60 inches above finished floor or as indicated. Mount other devices as indicated. Measure mounting heights of wiring devices and outlets in non-hazardous areas to center of device or outlet.

3.1.8 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with Section 23 09 53.00 20, SPACE TEMPERATURE CONTROL SYSTEMS. Provide telecommunications system conductor identification as specified in Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLING SYSTEMS.

3.1.8.1 Marking Strips

White or other light-colored plastic marking strips, fastened by screws to each terminal block, shall be provided for wire designations. The wire numbers shall be made with permanent ink. The marking strips shall be reversible to permit marking both sides, or two marking strips shall be furnished with each block. Marking strips shall accommodate the two sets of wire numbers. Each device to which a connection is made shall be assigned a device designation in accordance with NEMA ICS 1 and each device terminal to which a connection is made shall be marked with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, additional wire and cable designations for

identification of remote (external) circuits shall be provided for the Government's wire designations. Prints of the marking strips drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

3.1.9 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.9.1 Splices of Aluminum Conductors

Make with solderless circumferential compression-type, aluminum-bodied connectors UL listed for AL/CU. Remove surface oxides from aluminum conductors by wire brushing and immediately apply oxide-inhibiting joint compound and insert in connector. After joint is made, wipe away excess joint compound, and insulate splice.

3.1.10 Terminating Aluminum Conductors

3.1.10.1 Termination to Copper Bus

Terminate aluminum conductors to copper bus either by: (a) inline splicing a copper pigtail, of ampacity at least that of aluminum conductor, or (b) utilizing circumferential, compression-type, aluminum-bodied terminal lug UL listed for AL/CU, and steel Belleville cadmium-plated hardened steel spring washers, flat washers, bolts, and nuts. Carefully install Belleville spring washers with crown up toward nut or bolt head, with concave side of Belleville bearing on heavy-duty, wide series flat washer of larger diameter than Belleville. Tighten nuts sufficiently to flatten Belleville, and leave in position. Lubricate hardware with joint compound prior to making connection. Wire brush and apply joint compound to conductor prior to inserting in lug.

3.1.10.2 Termination to Aluminum Bus

Terminate aluminum conductors to aluminum bus by using aluminum nuts, bolts, washers, and compression lugs. Wire brush and apply joint compound to conductor prior to inserting in lug. Lubricate hardware with joint compound prior to making connection. When bus contact surface is unplated, scratch-brush and coat with joint compound, without grit.

3.1.11 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.12 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07 84 00, FIRESTOPPING.

### 3.1.13 Grounding and Bonding

Provide In accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telecommunications system grounds, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. Interconnect all grounding media in or on the structure to provide a common ground potential. This shall include lightning protection, electrical service, telecommunications system grounds, as well as underground metallic piping systems. Use main size lightning conductors for interconnecting these grounding systems to the lightning protection system. In addition to the requirements specified herein, provide telecommunications grounding in accordance with TIA J-STD-607-A. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

#### 3.1.13.1 Ground Rods

Provide cone pointed ground rods. The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, provide additional rods not less than 10 feet on centers. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the Contracting Officer who will decide on the number of ground rods to add.

#### 3.1.13.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, excepting specifically those connections for which access for periodic testing is required, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

#### 3.1.13.3 Ground Bus

A copper ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends

terminating approximately 4 inches above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment.

3.1.13.4 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.1.13.5 Telecommunications System

Provide telecommunications grounding in accordance with the following:

a. Telecommunications Grounding Busbars: Provide a telecommunications main grounding busbar (TMGB) in the telecommunications entrance facility. The TMGB shall be as close to the electrical service entrance grounding connection as practicable. Telecommunications grounding busbars shall be installed to maintain clearances as required by NFPA 70 and shall be insulated from its support. A minimum of 2 inches separation from the wall is recommended to allow access to the rear of the busbar and the mounting height shall be adjusted to accommodate overhead or underfloor cable routing.

c. Telecommunications Grounding Connections: Telecommunications grounding connections to the TMGB shall utilize listed compression two-hole lugs, exothermic welding, suitable and equivalent one hole non-twisting lugs, or other irreversible compression type connections. All metallic pathways, cabinets, and racks for telecommunications cabling and interconnecting hardware located within the same room or space as the TMGB shall be bonded to the TMGB. In a metal frame (structural steel) building, where the steel framework is readily accessible within the room; each TMGB shall be bonded to the vertical steel metal frame using a minimum No. 6 AWG conductor. Where the metal frame is external to the room and readily accessible, the metal frame shall be bonded to the TMGB with a minimum No. 6 AWG conductor. All connectors used for bonding to the metal frame of a building shall be listed for the intended purpose.

3.1.14 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.15 Government-Furnished Equipment

Contractor shall make connections to Government-furnished equipment to make equipment operate as intended, including providing miscellaneous items such as plugs, receptacles, wire, cable, conduit, flexible conduit, and outlet boxes or fittings.

3.1.16 Watthour Meters

NEMA C12.1.

3.1.17 Surge Protective Devices

Connect the surge protective devices in parallel to the power source, keeping the conductors as short and straight as practically possible.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.

3.4 FIELD APPLIED PAINTING

Where field painting of enclosures for panelboards, or the like is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance to manufacturer's instructions.

3.5 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior to each test.

3.5.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.5.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.5.3 Transformer Tests

Perform the standard, not optional, tests in accordance with the Inspection and Test Procedures for transformers, dry type, air-cooled, 600 volt and below; as specified in NETA ATS. Measure primary and secondary voltages for proper tap settings. Tests need not be performed by a recognized independent testing firm or independent electrical consulting firm.

3.5.4 Ground-Fault Receptacle Test

Test ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.5.5 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

3.5.6 Watthour Meter

a. Visual and mechanical inspection

(1) Examine for broken parts, shipping damage, and tightness of connections.

(2) Verify that meter type, scales, and connections are in accordance with approved shop drawings.

b. Electrical tests

(1) Determine accuracy of meter.

(2) Calibrate watthour meters to one-half percent.

(3) Verify that correct multiplier has been placed on face of meter, where applicable.

-- End of Section --

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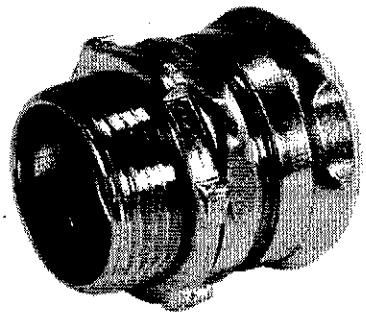
## Thinwall Conduit Fittings (EMT)



- ½" – 4" Concrete Tight
- Zinc Plated

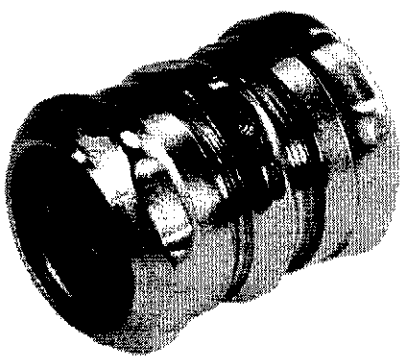
### Compression Connectors, Steel – Non-Insulated

| "A" Cat# | Conduit Size | Inner Pack | Outer Pack |
|---|---|---|---|
| TC111A | ½" | 50 | 500 |
| TC112A | ¾" | 50 | 250 |
| TC113A | 1" | 25 | 100 |
| TC114A | 1¼" | – | 25 |
| TC115A | 1½" | – | 25 |
| TC116A | 2" | – | 25 |
| TC117A | 2½" | – | 10 |
| TC118A | 3" | – | 5 |
| TC119A | 3½" | – | 5 |
| TC1110A | 4" | – | 5 |

### Compression Connectors, Steel – Insulated

| "A" Cat# | Conduit Size | Inner Pack | Outer Pack |
|---|---|---|---|
| TC711A | ½" | 50 | 500 |
| TC712A | ¾" | 50 | 250 |
| TC713A | 1" | 25 | 100 |
| TC714A | 1¼" | – | 25 |
| TC715A | 1½" | – | 25 |
| TC716A | 2" | – | 25 |
| TC717A | 2½" | – | 10 |
| TC718A | 3" | – | 5 |
| TC719A | 3½" | – | 5 |
| TC7110A | 4" | – | 5 |

U.L. File No. E-16592



- ½" – 4" Concrete Tight
- Zinc Plated

### Compression Couplings – Steel

| "A" Cat# | Conduit Size | Inner Pack | Outer Pack |
|---|---|---|---|
| TK111A | ½" | 50 | 250 |
| TK112A | ¾" | 50 | 250 |
| TK113A | 1" | 25 | 100 |
| TK114A | 1¼" | – | 25 |
| TK115A | 1½" | – | 25 |
| TK116A | 2" | – | 25 |
| TK117A | 2½" | – | 10 |
| TK118A | 3" | – | 5 |
| TK119A | 3½" | – | 5 |
| TK1110A | 4" | – | 5 |

U.L. File No. E-16592



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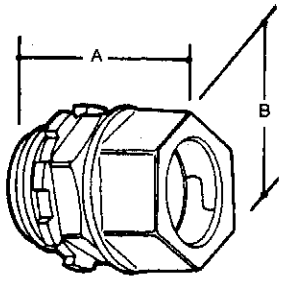
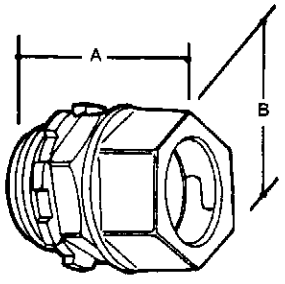



• ½" – 4" Concrete Tight

## Compression Connectors – Die Cast Zinc, Noninsulated

| Cat. No. | Conduit Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| TC-211-SC | ½" | 1¼" | 1" | 500 |
| TC-212-SC | ¾" | 1 11/32" | 1 5/32" | 250 |
| TC-213-SC | 1" | 1 25/64" | 1 15/32" | 200 |
| TC-214-SC | 1¼" | 1 13/16" | 1 27/32" | 100 |
| TC-215-SC | 1½" | 1⅞" | 2 1/16" | 40 |
| TC-216-SC | 2" | 2 3/32" | 2 17/32" | 20 |
| TC-217-SC | 2½" | 2 45/64" | 3¼" | 12 |
| TC-218-SC | 3" | 2⅞" | 3 15/16" | 12 |
| TC-219-SC | 3½" | 2 47/64" | 4 7/16" | 10 |
| TC-2110-SC | 4" | 2 13/16" | 4 15/16" | 6 |

U.L. File No. E-16592 – ½"-4"
CSA File No. LR-12798 – ½"-2

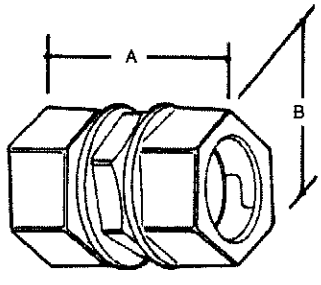



• ½" – 4" Concrete Tight

## Compression Connectors – Die Cast Zinc, Insulated

| Cat. No. | Conduit Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| TC-811-SC | ½" | 1 23/64" | 63/64" | 500 |
| TC-812-SC | ¾" | 1 15/32" | 15/16" | 250 |
| TC-813-SC | 1" | 1 35/64" | 1 15/32" | 200 |
| TC-814-SC | 1¼" | 1 23/32" | 1 27/32" | 100 |
| TC-815-SC | 1½" | 1 31/32" | 2 1/16" | 40 |
| TC-816-SC | 2" | 2¼" | 2 17/32" | 20 |
| TC-817-SC | 2½" | 2 25/32" | 3¼" | 12 |
| TC-818-SC | 3" | 2 31/32" | 3 15/16" | 12 |
| TC-819-SC | 3½" | 2 27/32" | 4 7/16" | 10 |
| TC-8110-SC | 4" | 2 29/32" | 4 15/16" | 6 |

U.L. File No. E-16592 – ½"-4"
CSA File No. LR-12798 – ½"-2

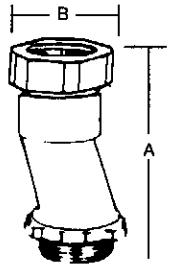



• ½" – 4" Concrete Tight

## Compression Couplings – Die Cast Zinc

| Cat. No. | Conduit Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| TK-211-SC | ½" | 1½" | 1 3/32" | 500 |
| TK-212-SC | ¾" | 1⅝" | 1 5/16" | 250 |
| TK-213-SC | 1" | 1⅞" | 1 45/64" | 200 |
| TK-214-SC | 1¼" | 1 13/16" | 2 3/32" | 100 |
| TK-215-SC | 1½" | 2 3/32" | 2 21/64" | 40 |
| TK-216-SC | 2" | 2 11/32" | 2 29/32" | 20 |
| TK-217-SC | 2½" | 3 13/64" | 3 11/64" | 12 |
| TK-218-SC | 3" | 3 7/32" | 4½" | 12 |
| TK-219-SC | 3½" | 3 39/64" | 5 1/16" | 10 |
| TK-2110-SC | 4" | 3 3/16" | 5 41/64" | 6 |

U.L. File No. E-16592 – ½"-4"
CSA File No. LR-12798 – ½"-1¼", 2½"-4"




## Offset Compression Connectors – Die Cast Zinc

| Cat. No. | | Conduit Size | A | B | Std. Ctn. |
|---|---|---|---|---|---|
| TO-211SC | ⅛" offset | ½" | 2 13/64" | 1" | 200 |
| TO-212 | ¾" offset | ¾" | 2.98" | 1.16" | 100 |

U.L. File No. E-16592

E

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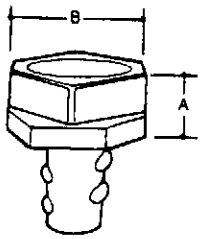



## Combination Couplings – EMT to Flex
## Compression to Screw-In Type – Die Cast Zinc

| Cat. No. | Trade Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| TX-201 | ½" | 0.84 | 1.10 | 500 |
| TX-202 | ¾" | 0.95 | 1.30 | 250 |

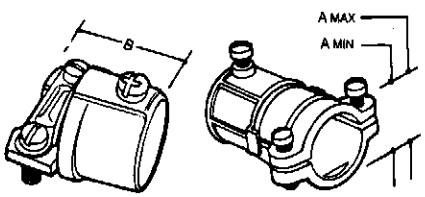
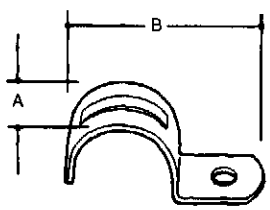



Fig. "1" ½"–⅜"

Fig. "2" ½"–½" ¾"–¾"

## Combination Couplings – EMT to Flex
## Set Screw Type – Die Cast Zinc

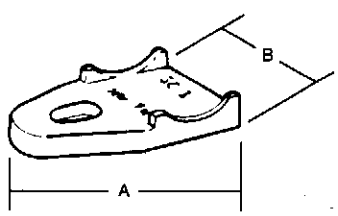
| Cat. No. | Fig. # | Trade Size | A-Min | A-Max | B | Std. Ctn. |
|---|---|---|---|---|---|---|
| TX-210 | 1 | ½" - ⅜" | 0.15 | 0.61 | 1.16 | 250 |
| TX-211 | 2 | ½" - ½" | 0.60 | 1.00 | 1.71 | 250 |
| TX-212 | 2 | ¾" - ¾" | 0.78 | 1.20 | 1.93 | 200 |




- *Steel*
- *Zinc Plated*

## One Hole Snap-Straps – Steel

| Cat. No. | Conduit Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| TS-101 | ½" | 0.57" | 1.79" | 1000 |
| TS-102 | ¾" | 0.62" | 1.96" | 500 |
| TS-103 | 1" | 0.75" | 2.25" | 500 |
| TS-104 | 1¼" | 0.88" | 2.85" | 250 |
| TS-105 | 1½" | 0.99" | 3.16" | 100 |
| TS-106 | 2" | 1.10" | 3.93" | 50 |
| HS-107 | 2½" | 1.28" | 5.00" | 25 |
| HS-108 | 3" | 1.28" | 5.55" | 25 |
| HS-109 | 3½" | 1.28" | 6.37" | 10 |
| HS-110 | 4" | 1.28" | 6.87" | 10 |




## Pipe Spacers for Thinwall or Heavywall – Die Cast

| Cat. No. | Conduit Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| CB-201 | ½" | 2" | 1" | 1000 |
| CB-202 | ¾" | 2⅜" | 1 1/16" | 500 |
| CB-203 | 1" | 2¾" | 1 5/16" | 500 |
| CB-204 | 1⅛" | 2⅜" | 1½" | 250 |
| CB-205 | 1½" | 3 13/16" | 1⅝" | 100 |
| CB-206 | 2" | 4½" | 2" | 50 |



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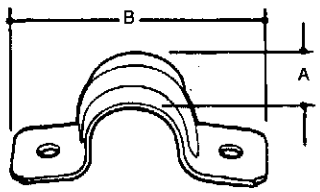
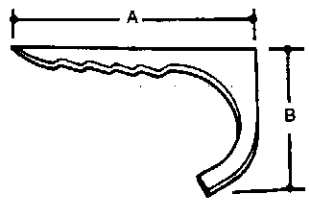



- *Steel*
- *Zinc Plated*

## Two Hole EMT Straps – Steel

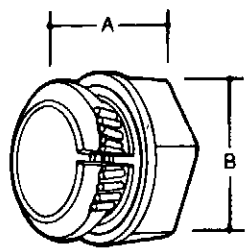
| Cat. No. | Conduit Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| TS-901 | ½" | 0.56" | 2.20" | 250 |
| TS-902 | ¾" | 0.62" | 2.67" | 200 |
| TS-903 | 1" | 0.68" | 2.97" | 100 |
| TS-904 | 1¼" | 0.75" | 3.67" | 50 |
| TS-905 | 1½" | 0.88" | 4.22" | 200 |
| TS-906 | 2" | 1.00" | 4.91" | 25 |




- *Stamped Steel*
- *Zinc Plated*

## Nail Strap – Steel

| Cat. No. | Rigid/MC Size | EMT Size | Flex Size | A | B | Std. Ctn. |
|---|---|---|---|---|---|---|
| N-101-SC | – | ½" | ⅜" | 1 15/16" | 1 5/64" | 1000 |
| N-102-SC | ½" | ¾" | ½" | 2 3/16" | 1 17/32" | 1000 |
| N-103-SC | ¾" | 1" | – | 2 3/8" | 1 15/32" | 1000 |

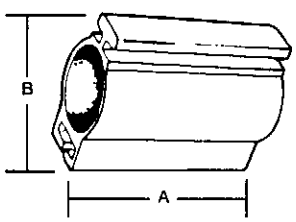



EMT Connector

## EMT Connectors – Two Piece Type – Die Cast Zinc

| Cat. No. | Trade Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| TC-201-SC | ½" | 0.68 | 1.05 | 1000 |

UL File No. E16592




Space Cap

## Space Caps – Plastic

| Cat. No. | Conduit Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| BT-501 | ½" | 2 15/32" | 1 33/64" | 100 |
| BT-502 | ¾" | 2 15/32" | 1 47/64" | 100 |
| BT-503 | 1" | 2 15/32" | 1 31/32" | 100 |
| BT-504 | 1¼" | 2 15/32" | 2 31/64" | 100 |
| BT-505 | 1½" | 2 15/32" | 3 1/32" | 100 |



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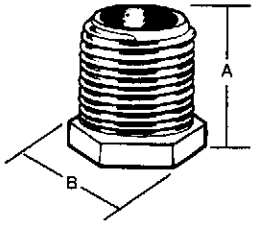
# Steel City®

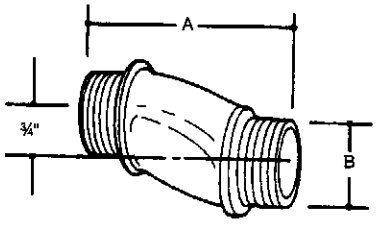
## Rigid/Intermediate Grade Conduit Fittings




### Conduit Nipples – Die Cast Zinc 1" Long

| Cat. No. | Conduit Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| HA-211 | ½" | 1" | 15/16" | 1000 |
| HA-212 | ¾" | 1" | 1 3/16" | 500 |
| HA-213 | 1" | 1" | 1 7/16" | 250 |

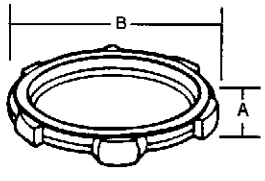
U.L. File No. E-1275 ½" & ¾" only




### Offset Nipples – Die Cast Zinc

| Cat. No. | Conduit Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| HO-221 | ½" | 2.60" | 1.00" | 100 |
| HO-222 | ¾" | 2.62" | 1.32" | 100 |
| HO-223 | 1" | 2.68" | 1.51" | 100 |
| HO-224 | 1¼" | 2.85" | 1.85" | 50 |
| HO-225 | 1½" | 2.88" | 2.08" | 50 |
| HO-226 | 2" | 3.19" | 2.71" | 20 |

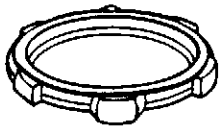
¾ offset.
U.L. File No. E-1275




### Locknuts – Steel/Zinc Plated

| Cat. No. | Conduit Size | Dimensions (in.) A (min.) | Dimensions (in.) B (max.) | Std. Ctn. |
|---|---|---|---|---|
| LN-100-SC | 3/8" | – | – | 1000 |
| LN-101-SC | ½" | 0.125" | 1.140" | 1000 |
| LN-102 | ¾" | 0.140" | 1.420" | 1000 |
| LN-103 | 1" | 0.170" | 1.770" | 500 |
| LN-104 | 1¼" | 0.170" | 2.281" | 200 |
| LN-105 | 1½" | 0.170" | 2.598" | 100 |
| LN-106 | 2" | 0.187" | 3.175" | 50 |
| LN-107 | 2½" | 0.375" | 3.562" | 30 |
| LN-108 | 3" | 0.375" | 4.250" | 25 |
| LN-109 | 3½" | 0.438" | 4.803" | 25 |
| LN-110 | 4" | 0.438" | 5.402" | 25 |
| LN-111 | 5" | 0.500" | 6.674" | 10 |
| LN-112 | 6" | 0.561" | 7.934" | 10 |

U.L. File No. E-1275



### Thin Construction Locknuts–Steel/Zinc Plated

| Cat. No. | Conduit Size | Unit Qty. | Std. Ctn. |
|---|---|---|---|
| SPLN-107 | 2½" | 30 | 30 |
| SPLN-108 | 3" | 25 | 25 |
| SPLN-109 | 3½" | 25 | 25 |
| SPLN-110 | 4" | 25 | 25 |

*Not U.L. Listed

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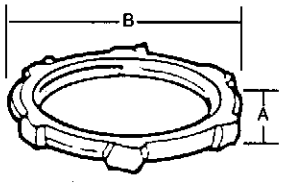
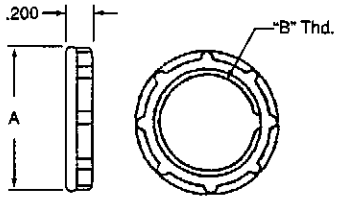



### Locknuts – Die Cast Zinc

| Cat. No. | Conduit Size | Dimensions (in.) A (min.) | Dimensions (in.) B (max.) | Std. Ctn. |
|---|---|---|---|---|
| LN-201 | ½" | 0.125" | 1.140" | 2000 |
| LN-202 | ¾" | 0.140" | 1.420" | 1000 |
| LN-203 | 1" | 0.170" | 1.770" | 1000 |
| LN-204 | 1¼" | 0.170" | 2.281" | 500 |
| LN-205 | 1½" | 0.170" | 2.598" | 500 |
| LN-206 | 2" | 0.187" | 3.175" | 200 |
| LN-207 | 2½" | 0.375" | 3.562" | 100 |
| LN-208 | 3" | 0.375" | 4.250" | 100 |
| LN-209 | 3½" | 0.438" | 4.803" | 40 |
| LN-210 | 4" | 0.438" | 5.402" | 40 |

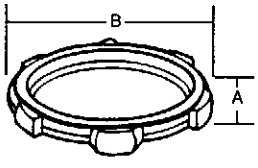
CSA File No. LR-12798
U.L. File No. E-1275




### Locknuts–Nonmetallic

| Cat. No. | Trade Size | "A" Dia. | "B" Thd. | Std. Ctn. |
|---|---|---|---|---|
| LN-501 | ½" | 1.3 | ½-14 | 100 |
| LN-502 | ¾" | 1.4 | ¾-14 | 100 |
| LN-503 | 1" | 1.7 | 1-11½ | 50 |

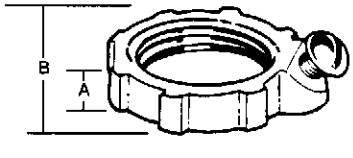
Material: Nylon 6/6
Color: Gray




### Sealing Locknuts – Steel/Zinc Plated

| Cat. No. | Conduit Size | Dimensions (in.) A (min.) | Dimensions (in.) B (max.) | Std. Ctn. |
|---|---|---|---|---|
| LS-101 | ½" | 0.26" | 1.12" | 1000 |
| LS-102 | ¾" | 0.27" | 1.37" | 1000 |
| LS-103 | 1" | 0.28" | 1.75" | 500 |
| LS-104 | 1¼" | 0.32" | 2.06" | 200 |
| LS-105 | 1½" | 0.32" | 2.37" | 100 |
| LS-106 | 2" | 0.32" | 2.87" | 50 |
| LS-107 | 2½" | 0.32" | 3.43" | 50 |
| LS-108 | 3" | 0.32" | 4.12" | 50 |
| LS-109 | 3½" | 0.32" | 4.62" | 50 |
| LS-110 | 4" | 0.32" | 5.18" | 25 |

U.L. File No. E-1275




### Grounding Locknuts – Malleable Iron/Zinc Plated

| Cat. No. | Conduit Size | Dimensions (in.) A (min.) | Dimensions (in.) B (max.) | Std. Ctn. |
|---|---|---|---|---|
| LG-401 | ½" | 0.125" | 1.140" | 100 |
| LG-402 | ¾" | 0.140" | 1.420" | 100 |
| LG-403 | 1" | 0.170" | 1.770" | 50 |
| LG-404 | 1¼" | 0.170" | 2.281" | 50 |
| LG-405 | 1½" | 0.170" | 2.598" | 50 |
| LG-406 | 2" | 0.187" | 3.175" | 25 |
| LG-407 | 2½" | 0.375" | 3.562" | 10 |
| LG-408 | 3" | 0.375" | 4.250" | 10 |
| LG-409 | 3½" | 0.438" | 4.803" | 50 |
| LG-410 | 4" | 0.438" | 5.402" | 5 |

U.L. File No. E-1275





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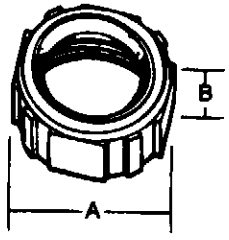
# Steel City®

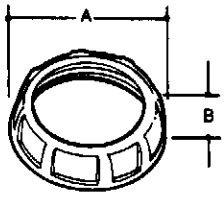
## Rigid/Intermediate Grade Conduit Fittings




- *105°C thermoplastic liners.*
- *Heavy reinforced ribs.*

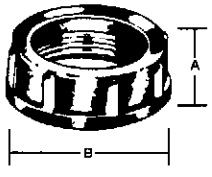
### Conduit Bushings Die Cast Zinc – Insulated Metallic

| Cat. No. | Conduit Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| BU-801 | ½" | 1.06 | 0.43 | 1000 |
| BU-802 | ¾" | 1.31 | 0.43 | 1000 |
| BU-803 | 1" | 1.59 | 0.48 | 500 |
| BU-804 | 1¼" | 1.96 | 0.56 | 250 |
| BU-805 | 1½" | 2.18 | 0.60 | 250 |
| BU-806 | 2" | 2.68 | 0.56 | 250 |
| BU-807 | 2½" | 3.25 | 0.90 | 50 |
| BU-808 | 3" | 3.87 | 0.85 | 25 |
| BU-809 | 3½" | 4.37 | 0.93 | 25 |
| BU-810 | 4" | 5.00 | 0.93 | 10 |




### Conduit Bushings Die Cast Zinc – Heavy Reinforced Ribs

| Cat. No. | Conduit Size | Dimensions (in.) A (min.) | Dimensions (in.) B (max.) | Std. Ctn. |
|---|---|---|---|---|
| BU-201 | ½" | 1.05 | 0.37 | 1000 |
| BU-202 | ¾" | 1.32 | 0.37 | 1000 |
| BU-203 | 1" | 1.58 | 0.47 | 500 |
| BU-204 | 1¼" | 1.94 | 0.50 | 250 |
| BU-205 | 1½" | 2.20 | 0.52 | 250 |
| BU-206 | 2" | 2.69 | 0.52 | 250 |
| BU-207 | 2½" | 3.23 | 0.85 | 50 |
| BU-208 | 3" | 3.84 | 0.85 | 25 |
| BU-209 | 3½" | 4.35 | 0.85 | 25 |
| BU-210 | 4" | 5.02 | 0.85 | 10 |




### Insulated Bushings – Thermoplastic

| Cat. No. | Conduit Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| BU-501 | ½" | 1³⁄₃₂" | 1 3⁄16" | 400 |
| BU-502 | ¾" | 1³⁄₃₂" | 1 19⁄64" | 400 |
| BU-503 | 1" | 5⁄16" | 1 9⁄16" | 200 |
| BU-504 | 1¼" | 9⁄16" | 1 29⁄32" | 100 |
| BU-505 | 1½" | 9⁄16" | 2 3⁄16" | 100 |
| BU-506 | 2" | 5⁄8" | 2 1⁄16" | 60 |
| BU-507 | 2½" | 23⁄32" | 3 1⁄16" | 20 |
| BU-508 | 3" | 47⁄64" | 3 27⁄32" | 20 |
| BU-509 | 3½" | ¾" | 4 23⁄64" | 5 |
| BU-510 | 4" | 25⁄32" | 4 27⁄32" | 5 |
| BU-511 | 5" | 1" | 6 5⁄16" | 5 |
| BU-512 | 6" | 1" | 7 7⁄16" | 5 |

U.L. File No. E-1275 ½"–4" only
Rated 105°C

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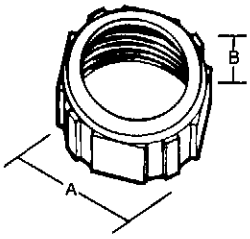
# Steel City®

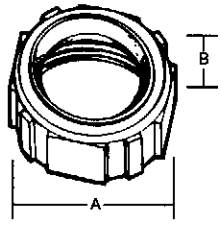
## Rigid/Intermediate Grade Conduit Fittings




### Bushings – Iron/Zinc Plated

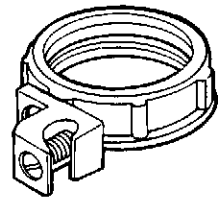
| Cat. No. | Conduit Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| BU-401 | ½" | 1 1/32" | 7/16" | 1000 |
| BU-402 | ¾" | 1 1/4" | 7/16" | 1000 |
| BU-403 | 1" | 1 9/16" | ½" | 500 |
| BU-404 | 1 1/4" | 1 15/16" | 17/32" | 200 |
| BU-405 | 1½" | 2 13/64" | 9/16" | 100 |
| BU-406 | 2" | 2 45/64" | 9/16" | 50 |
| BU-407 | 2½" | 3 3/16" | 19/32" | 30 |
| BU-408 | 3" | 3 5/8" | 25/32" | 25 |
| BU-409 | 3½" | 4 1/16" | 27/32" | 25 |
| BU-410 | 4" | 4 21/32" | 15/16" | 25 |
| BU-411 | 5" | 4 31/32" | 15/16" | 10 |

U.L. File No. E-1275




### Insulated Bushings – Iron/Zinc Plated

| Cat. No. | Conduit Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| BI-901 | ½" | 1 1/32" | ½" | 1000 |
| BI-902 | ¾" | 1 1/4" | ½" | 1000 |
| BI-903 | 1" | 1 9/16" | 9/16" | 500 |
| BI-904 | 1 1/4" | 1 15/16" | 19/32" | 200 |
| BI-905 | 1½" | 2 13/64" | 5/8" | 100 |
| BI-906 | 2" | 2 45/64" | 5/8" | 50 |
| BI-907 | 2½" | 3 3/32" | 47/64" | 30 |
| BI-908 | 3" | 3 27/32" | 47/64" | 25 |
| BI-909 | 3½" | 4 7/16" | 7/8" | 25 |
| BI-910 | 4" | 4 31/32" | 2 9/32" | 25 |



### Grounding Bushings Die Cast Zinc – Insulated Metallic – With Aluminum Lay in Type Lug

| Cat. No. | Trade Size | Grounding Lug Wire size min. | Grounding Lug Wire size max | Std. Ctn. |
|---|---|---|---|---|
| BG-201 | ½" | 14 | 4 | 500 |
| BG-202 | ¾" | 14 | 4 | 500 |
| BG-203 | 1" | 14 | 4 | 250 |
| BG-204A | 1¼" | 14 | 4 | 200 |
| BG-204 | 1¼" | 8 | 1/0 | 200 |
| BG-205A | 1½" | 11 | 4 | 100 |
| BG-205 | 1½" | 8 | 1/0 | 50 |
| BG-206A | 1" | 14 | 4 | 100 |
| BG-206 | 2" | 8 | 1/0 | 50 |
| BG-207 | 2½" | 8 | 1/0 | 50 |
| BG-207A | 2½" | 6 | 250 MCM | 50 |
| BG-208 | 3" | 8 | 1/0 | 50 |
| BG-208A | 3" | 6 | 250 MCM | 50 |
| BG-209 | 3½" | 8 | 1/0 | 10 |
| BG-209A | 3½" | 6 | 250 MCM | 10 |
| BG-210 | 4" | 8 | 1/0 | 10 |
| BG-210A | 4" | 6 | 250 MCM | 10 |

- *105°C Thermoplastic liners.*
- *Heavy reinforced ribs.*



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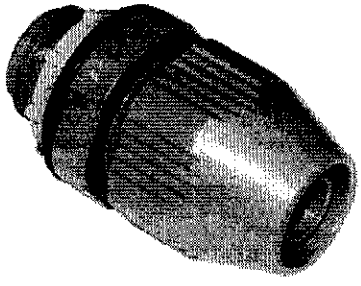
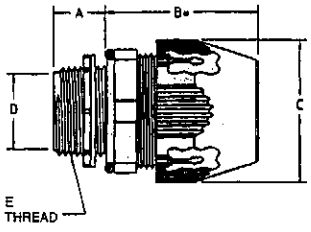
# Steel City®

## Liquidtight Flexible Nonmetallic Conduit Connectors and Tubing



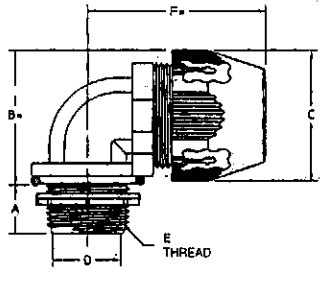
### Connectors – Liquidtight Flex for Nonmetallic Conduit

| Cat. No. | Trade Size | A± .015 (0.40) Inch (mm) | B* ±.35 (0.90) Inch (mm) | C ±.015 (0.40) Across Corners Inch (mm) | Min. Throat Dia. D. Inch (mm) | E Thread NPT. | F Inch (mm) Approx. | Std. Ctn. |
|---|---|---|---|---|---|---|---|---|
| LT-500 | ⅜" | .570 | 1.595 (40.51) | 1.364 | .417 | ½-14 | 1.880 (47.75) | 100 |
| LT-501 | ½" | .570 | 1.636 (41.55) | 1.448 | .550 | ½-14 | 1.986 (50.44) | 100 |
| LT-502 | ¾" | .582 | 1.757 (44.63) | 1.740 | .740 | ¾-14 | 2.212 (56.18) | 50 |
| LT-503 | 1" | .726 | 1.923 (48.84) | 2.068 | .940 | 1-11/12 | 2.508 (63.70) | 50 |



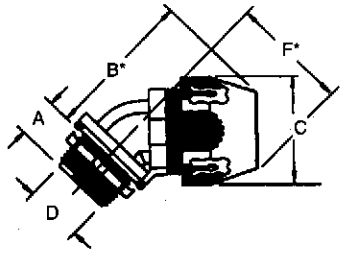

### 90° Connectors – Liquidtight Flex for Nonmetallic Conduit

| Cat. No. | Trade Size | A± .015 (0.40) Inch (mm) | B* ±.35 (0.90) Inch (mm) | C ±.015 (0.40) Across Corners Inch (mm) | Min. Throat Dia. D. Inch (mm) | E Thread NPT. | F Inch (mm) Approx. | Std. Ctn. |
|---|---|---|---|---|---|---|---|---|
| LT-590 | ⅜" | (14.48) | 1.380 (35.05) | (34.39) | (10.59) | ½-14 | 1.880 (47.75) | 50 |
| LT-591 | ½" | (14.48) | 1.489 (37.82) | (36.78) | (13.97) | ½-14 | 1.986 (50.44) | 50 |
| LT-592 | ¾" | (14.78) | 1.790 (45.47) | (44.20) | (18.80) | ¾-14 | 2.212 (56.18) | 50 |
| LT-593 | 1" | (18.44) | 2.104 (53.44) | (52.53) | (23.88) | 1-11/12 | 2.508 (63.70) | 25 |




### 45° Connectors – Liquidtight Flex for Nonmetallic Conduit

| Cat. No. | Trade Size | A± .015 (0.40) Inch (mm) | B* ±.35 (0.90) Inch (mm) | C ±.015 (0.40) Across Corners Inch (mm) | Min. Throat Dia. D. Inch (mm) | E Thread NPT. | F Inch (mm) Approx. | Std. Ctn. |
|---|---|---|---|---|---|---|---|---|
| LT-540 | ⅜" | (14.48) | 2.012 (51.10) | (34.39) | (10.59) | ½-14 | 1.534 (38.95) | 50 |
| LT-541 | ½" | (14.48) | 2.092 (53.14) | (36.78) | (13.97) | ½-14 | 1.590 (40.39) | 50 |
| LT-542 | ¾" | (14.78) | 2.452 (62.28) | (44.20) | (18.80) | ¾-14 | 1.821 (46.25) | 50 |
| LT-543 | 1" | (18.44) | 2.684 (68.17) | (52.53) | (23.88) | 1-11/12 | 2.034 (51.66) | 25 |




***Standard Material/Finish***

- *Body/Gland–Nylon-Grey*
- *"O" Ring–Nitrate (Black)*
- *Locknut–Nylon*
- *Temp. Rating–80°C*
- *Material Flammability Rating: UL94-V2*

***Listed/Certified by:***

- *U.L. Listed (File # E23018)*
- *C.S.A. (File # LR52391)*

***Conforms To:***

- *Watertight requirements for Type 4*

E

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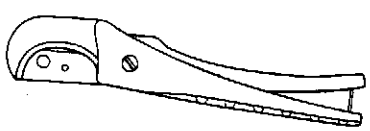
### Liquidtight Flexible Nonmetallic Conduit (Type B) Outdoor XTRAFLEX® Raceway System

| Cat. No. Series | Trade Size | I.D. IN. Min. | I.D. IN. Max. | O.D.IN. Min. | O.D.IN. Max. | Std. Ctn. |
|---|---|---|---|---|---|---|
| LTC038GY | ⅜" | .484 | .504 | .690 | .710 | 100 |
| LTC050GY | ½" | .622 | .642 | .820 | .840 | 100 |
| LTC075GY | ¾" | .820 | .840 | 1.030 | 1.050 | 100 |
| LTC100GY | 1" | 1.041 | 1.066 | 1.290 | 1.315 | 100 |
| LTC125GY | 1¼" | 1.380 | 1.410 | 1.630 | 1.660 | 100 |
| LTC150GY | 1½" | 1.575 | 1.600 | 1.865 | 1.900 | 50 |
| LTC200GY | 2" | 2.020 | 2.045 | 2.340 | 2.375 | 50 |

Color: Gray
Length: 100 ft. for LTC038GY thru LTC125GY 50 ft. for LTC150GY and LTC200GY
U.L. Listed: File E95745
U.L. Temperature Rating: 80°C dry, 60°C wet, 70°C oil. res. sunlight resistant, outdoor, direct burial.
CSA Certified: File LR 80349-2
CSA Temperature Rating: 75°C to-18°C
For use with Thomas & Betts LT38P, LT38M, LT500 series and Liquidtight Flexible Metal Conduit Fittings.
Material: PVC Helix reinforcement surrounded with flexible PVC.
Voltage Rating: 600V

### Liquidtight Whip Assembly

| Cat. No. | Conduit Size | Length | Wire Gauge | Std. Ctn. |
|---|---|---|---|---|
| LTWHIP 12-6-10 | ½" | 6' | #10 | 6 |
| LTWHIP 12-4-10 | ½" | 4' | #10 | 6 |
| LTWHIP 34-6-8 | ¾" | 6' | #8 | 6 |
| LTWHIP 34-4-8 | ¾" | 4' | #8 | 6 |
| **Whip with metallic fittings – one straight, one 90°** | | | | |
| LTWM 12-6-10 | ½" | 6' | #10 | 6 |
| LTWM 12-4-10 | ½" | 4' | #10 | 6 |
| LTWM 34-6-8 | ¾" | 6' | #8 | 6 |
| LTWM 34-4-8 | ¾" | 4' | #8 | 6 |



### Conduit Cutter – For Nonmetallic Flexible Conduit

| Cat. No. | Description |
|---|---|
| XF-CUT | For cutting NM flexible conduit up to 1" |
| XF-BLADE | Replacement blade for XF-CUT |

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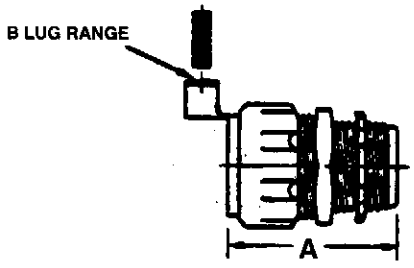
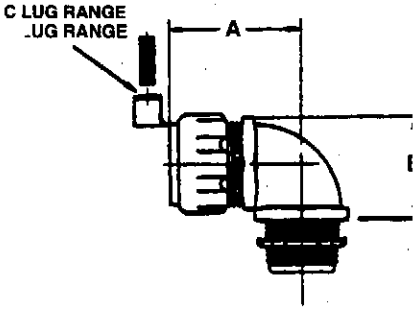


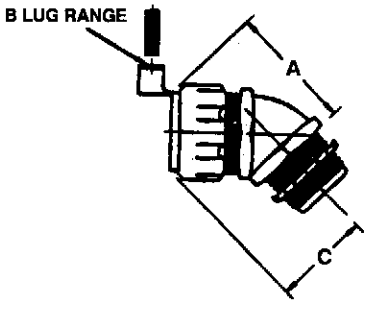

## Versa Ground™ Liquidtight Fittings

| Cat. No. | Trade Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| 5331GR | ⅜ | 1½" | 14-4 | 100 |
| 5332GR | ½ | 1⁹⁄₁₆" | 14-4 | 100 |
| 5333GR | ¾ | 1⅝" | 14-4 | 25 |
| 5334GR | 1 | 2¹⁄₁₆" | 14-4 | 50 |
| 5231GR | ⅜ | 1½" | 14-4 | 100 |
| 5232GR | ½ | 1⁹⁄₁₆" | 14-4 | 100 |
| 5233GR | ¾ | 1⅝" | 14-4 | 25 |
| 5234GR | 1 | 2¹⁄₁₆" | 14-4 | 50 |
| 5231ALGR | ⅜ | 1½" | 14-4 | 100 |
| 5232ALGR | ½ | 1⁹⁄₁₆" | 14-4 | 100 |
| 5233ALGR | ¾ | 1⅝" | 14-4 | 50 |
| 5234ALGR | 1 | 2¹⁄₁₆" | 14-4 | 50 |



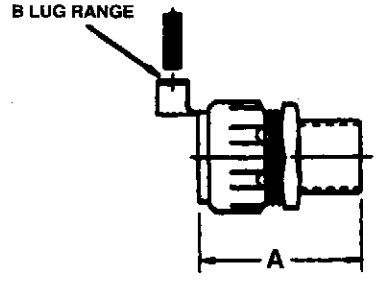

## Versa Ground™ Liquidtight Fittings – 90° Type

| Cat. No. | Trade Size | A | B | C | Std. Ctn. |
|---|---|---|---|---|---|
| 5351GR | ⅜ | 1⅜" | 1¼" | 14-4 | 50 |
| 5352GR | ½ | 1⁹⁄₁₆" | 1 ⁷⁄₁₆" | 14-4 | 50 |
| 5353GR | ¾ | 1¾" | 1¹³⁄₁₆" | 14-4 | 50 |
| 5354GR | 1 | 2³⁄₁₆" | 2¹⁄₁₆" | 14-4 | 25 |
| 5251GR | ⅜ | 1⅜" | 1¼" | 14-4 | 50 |
| 5252GR | ½ | 1⁹⁄₁₆" | 1 ⁷⁄₁₆" | 14-4 | 50 |
| 5253GR | ¾ | 1¾" | 1¹³⁄₁₆" | 14-4 | 50 |
| 5254GR | 1 | 2³⁄₁₆" | 2¹⁄₁₆" | 14-4 | 25 |
| 5251ALGR | ⅜ | 1⅜" | 1¼" | 14-4 | 50 |
| 5252ALGR | ½ | 1⁹⁄₁₆" | 1 ⁷⁄₁₆" | 14-4 | 50 |
| 5253ALGR | ¾ | 1¾" | 1¹³⁄₁₆" | 14-4 | 50 |
| 5254ALGR | 1 | 2³⁄₁₆" | 2¹⁄₁₆" | 14-4 | 25 |




## Versa Ground™ Liquidtight Fittings

| Cat. No. | Trade Size | A | B | C | Std. Ctn. |
|---|---|---|---|---|---|
| 5341GR | ⅜ | 1⁹⁄₁₆" | 14-4 | 1¹⁄₁₆" | 50 |
| 5342GR | ½ | 1⅞" | 14-4 | 1⅜" | 50 |
| 5343GR | ¾ | 2⅛" | 14-4 | 1¾₁₆" | 50 |
| 5344GR | 1 | 2¼" | 14-4 | 1¾" | 25 |
| 5241GR | ⅜ | 1⁹⁄₁₆" | 14-4 | 1¹⁄₁₆" | 50 |
| 5242GR | ½ | 1⅞" | 14-4 | 1⅜" | 50 |
| 5243GR | ¾ | 2⅛" | 14-4 | 1¾₁₆" | 50 |
| 5244GR | 1 | 2¼" | 14-4 | 1¾" | 25 |




## Liquidtight to Rigid External Ground Adapter

| Cat. No. | Trade Size | A | B | Std. Ctn. |
|---|---|---|---|---|
| 5271GR | ⅜ | 1⁵⁄₃₂" | 14-4 | 50 |
| 5272GR | ½ | 1⅜ | 14-4 | 50 |
| 5273GR | ¾ | 1²¹⁄₃₂" | 14-4 | 50 |
| 5274GR | 1 | 1⅞" | 14-4 | 25 |



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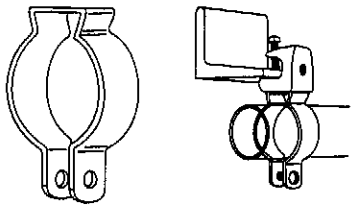
# Steel City®

## Conduit and Pipe Hangers





Without Bolt

All Steel City 6H Hanger Bolts include a combination Slot-Phillips Head.

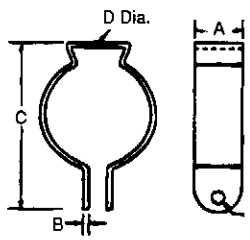
***For hanging conduit (rigid or EMT) and pipe. The 6H series hangers are fast, easy and economical to use. May be fastened directly to a #500 beam clamp through a hole in the base of the hanger by means of a ¼-20 stove bolt or suspended on ¼" hanger rod.***

## 6H Series Conduit and Pipe Hangers – Without Bolt

| Cat. No. | Size (in.) Rigid Conduit or Pipe | EMT | Dimensions (in.) A | B | C | D (dia.) | Load Rating | Std. Ctn. |
|---|---|---|---|---|---|---|---|---|
| **6H0** | ⅜ - ½ | ½ | ¾ | .045 | 1 1/32 | 9/32 | 500 | 100 |
| **6H0-T** | ⅜ - ½ | ½ | ¾ | .045 | 1 7/32 | 9/32 | 500 | 100 |
| **6H1** | ¾ | ¾ | ⅞ | .045 | 1 11/32 | 9/32 | 500 | 100 |
| **6H1-T** | ¾ | ¾ | ⅞ | .045 | 2 9/32 | 9/32 | 500 | 100 |
| **6H2** | 1 | 1 | ⅞ | .045 | 2 3/8 | 9/32 | 500 | 100 |
| **6H2-1/2** | – | 1¼ | ⅞ | .045 | 2 23/32 | 9/32 | 500 | 100 |
| **6H3-SC** | 1¼ | 1½ | ⅞ | .045 | 2 7/8 | 9/32 | 500 | 100 |
| **6H4** | 1½ | – | 1 | .071 | 3 3/8 | 11/32 | 500 | 100 |
| **6H5** | 2 | 2 | 1¼ | .071 | 3 29/32 | 11/32 | 500 | 50 |
| **6H6** | 2½ | – | 1¼ | .071 | 4 9/32 | 11/32 | 500 | 50 |
| **6H7** | 3 | – | 1¼ | .071 | 5 5/16 | 11/32 | 500 | 25 |
| **6H8** | 3½ | – | 1¼ | .071 | 5 7/16 | 11/32 | 500 | 25 |
| **6H9** | 4 | 4 | 1¼ | .071 | 5⅞ | 11/32 | 500 | 10 |

* Add SS suffix to part number for stainless steel.

Load rating is 500 lbs. with a safety factor of 3. Available with or without closure bolt. Standard finishes: electrogalvanized and Type 302 Stainless Steel.



**6H**
Without bolt.

**6H-B**
With bolt and hex nut.

**6H-T**
Threaded without bolt.

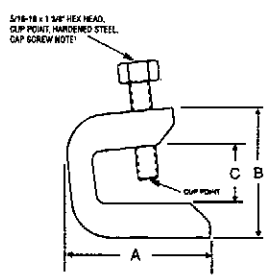
**6H-TB**
Threaded with bolt.

## 6H Series Conduit and Pipe Hangers – With Bolt

| Cat. No. | Size (in.) Rigid Conduit or Pipe | EMT | Dimensions (in.) A | B | C | D (dia.) | Load Rating | Std. Ctn. |
|---|---|---|---|---|---|---|---|---|
| **6H0-B** | ⅜ - ½ | ½ | ¾ | .045 | 1 1/32 | 9/32 | 500 | 100 |
| **6H0-TB** | ⅜ - ½ | ½ | ¾ | .045 | 1 7/32 | 9/32 | 500 | 100 |
| **6H1-B** | ¾ | ¾ | ⅞ | .045 | 1 11/32 | 9/32 | 500 | 100 |
| **6H1-TB** | ¾ | ¾ | ⅞ | .045 | 2 9/32 | 9/32 | 500 | 100 |
| **6H2-B** | 1 | 1 | ⅞ | .045 | 2 3/8 | 9/32 | 500 | 100 |
| **6H2-1/2-B** | – | 1¼ | ⅞ | .045 | 2 23/32 | 9/32 | 500 | 100 |
| **6H3-SC-B** | 1¼ | 1½ | ⅞ | .045 | 2 7/8 | 9/32 | 500 | 100 |
| **6H4-B** | 1½ | – | 1 | .071 | 3 3/8 | 11/32 | 500 | 100 |
| **6H5-B** | 2 | 2 | 1¼ | .071 | 3 29/32 | 11/32 | 500 | 50 |
| **6H6-B** | 2½ | – | 1¼ | .071 | 4 9/32 | 11/32 | 500 | 50 |
| **6H7-B** | 3 | – | 1¼ | .071 | 5 5/16 | 11/32 | 500 | 25 |
| **6H8-B** | 3½ | – | 1¼ | .071 | 5 7/16 | 11/32 | 500 | 25 |
| **6H9-B** | 4 | 4 | 1¼ | .071 | 5⅞ | 11/32 | 500 | 10 |

* Add SS suffix to part number for stainless steel. (not UL listed.)

Load rating is 500 lbs. with a safety factor of 3. Available with or without closure bolt. Standard finishes: electrogalvanized and Type 302 Stainless Steel.




## Beam Clamp

| Cat. No. | Size | Tapped | Std. Ctn. |
|---|---|---|---|
| **BC1-TB** | 1 | ¼-20 | 250 |
| **BC2-TB** | 2 15/16 | ⅜-16 | – |

Material: Steel
Finish: Zinc Plated

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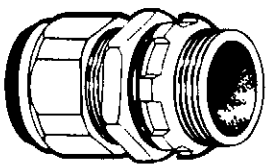
# Steel City

## Liquidtight Flexible Metal Conduit Connectors

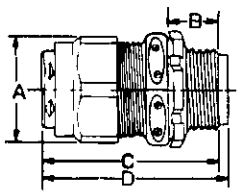


- ¾"-1" – Steel.
- 1¼"-2" – Malleable Iron/Zinc Plated.

### Straight Connectors

| Cat. No. | Conduit Size | Diameter A | B | C | Std. Ctn. |
|---|---|---|---|---|---|
| LT-100 | ⅜" | 1 1/16" | ½" | 1 13/16" | 100 |
| LT-101 | ½" | 1 3/16" | 39/64" | 1⅞" | 100 |
| LT-102 | ¾" | 1 7/16" | 49/64" | 2 1/32" | 50 |
| LT-103 | 1" | 1¾" | 59/64" | 2 29/32" | 50 |
| LT-104 | 1¼" | 2 7/16" | 1 11/16" | 2 19/32" | 25 |
| LT-105 | 1½" | 2¾" | 2 5/32" | 2 25/32" | 10 |
| LT-106 | 2" | 3 17/32" | 2 5/32" | 3 3/32" | 5 |

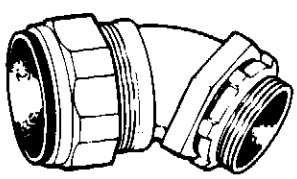
CSA File No. LR-12798
U.L. File No. E-1275 -⅜"-4"




- ¾"-1" – Steel.
- 1¼"-2" – Malleable Iron/Zinc Plated (with insulated throat).

### Straight Connectors

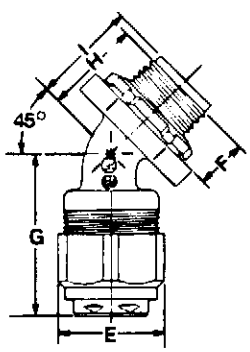
| Cat. No. | Conduit Size | Diameter A | B | C | Std. Ctn. |
|---|---|---|---|---|---|
| LT-700 | ⅜" | 1 1/16" | ½" | 1 29/32" | 100 |
| LT-701 | ½" | 1 3/16" | 39/64" | 1 31/32" | 100 |
| LT-702 | ¾" | 1 7/16" | 49/64" | 2⅛" | 50 |
| LT-703 | 1" | 1¾" | 59/64" | 2⅜" | 50 |
| LT-704 | 1¼" | 2 7/16" | 1 11/16" | 2 11/16" | 25 |
| LT-705 | 1½" | 2¾" | 2 5/32" | 2⅞" | 10 |
| LT-706 | 2" | 3 17/32" | 2 5/32" | 3 5/16" | 5 |



### 45° Connectors – Malleable Iron/Zinc Plated

| Cat. No. | Conduit Size | Dimensions E | F | G | H | Std. Ctn. |
|---|---|---|---|---|---|---|
| LT-450 | ⅜" | 1 1/16" | ½" | 1 9/16" | 81/32" | 50 |
| LT-451 | ½" | 1 3/16" | ½" | 1⅝" | 1" | 50 |
| LT-452 | ¾" | 1 7/16" | 49/64" | 1⅞" | 1 13/32" | 50 |
| LT-453 | 1" | 1¾" | ⅝" | 2⅛" | 1 29/32" | 25 |

CSA File No. LR-12798
U.L. File No. E-1275




### 45° Connectors – Malleable Iron/Zinc Plated (with insulated throat)

| Cat. No. | Conduit Size | Dimensions E | F | G | I | Std. Ctn. |
|---|---|---|---|---|---|---|
| LT-950 | ⅜" | 1 1/16" | ½" | 1 9/16" | 1 1/16" | 50 |
| LT-951 | ½" | 1 3/16" | ½" | 1⅝" | 1 13/32" | 50 |
| LT-952 | ¾" | 1 7/16" | 49/64" | 1⅞" | 1 3/16" | 50 |
| LT-953 | 1" | 1¾" | ⅝" | 2⅛" | 1⅜" | 25 |

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# Steel City®

## Grounding Clamps/Connectors

*Two-screw ground connection for armored ground wire.*

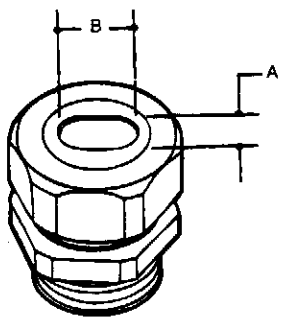
### Ground Clamps – Die Cast Zinc Alloy for Armored Ground Wire

| Cat. No. | Conduit Conduit Size | Std. Ctn. |
|---|---|---|
| GA-203 | ½", ¾", 1" | 250 |

U.L. File No. E-10661

### Ground Clamps – Die Cast Zinc, Brass Colored

| Cat. No. | Conduit Conduit Size | Std. Ctn. |
|---|---|---|
| GC-203-B | ½", 1" | 200 |




*• For Type SE, Style U, Flat; 2 Insulating Conductors, 1 Bare.*

### Water-Tight Connectors

| Cat. No. | Trade Size | Fits Cable | Rubber Grommet Opening A | Rubber Grommet Opening B | Std. Ctn. |
|---|---|---|---|---|---|
| WT-203A | 1" | 3#8 | .500 | .750 | 100 |
| WT-203B | 1" | 3#6 | .563 | .844 | 100 |
| WT-203C | 1" | 3#4 | .625 | .938 | 100 |
| WT-204A | 1¼" | 3#3 | .625 | 1.000 | 50 |
| WT-204B | 1¼" | 3#2 | .580 | .960 | 50 |
| WT-204C | 1¼" | 3#1 | .660 | 1.090 | 50 |
| WT-204D | 1¼" | 3#1/0 | .750 | 1.125 | 50 |
| WT-205A | 1½" | 3#1/0 & 3#2/0 | .735 | 1.240 | 20 |
| WT-205B | 1½" | 3#2/0 & 3#3/0 | .875 | 1.375 | 20 |
| WT-205C | 1½" | 3#2/0 & 3#3/0 | .938 | 1.438 | 20 |
| WT-206A | 2" | 3#1/0 & 3#2/0 | .735 | 1.240 | 20 |
| WT-206B | 2" | 3#2/0 & 3#3/0 | .875 | 1.375 | 20 |
| WT-206C | 2" | 3#2/0 & 3#3/0 | .938 | 1.438 | 20 |
| WT-206D | 2" | 3#4/0 | .890 | 1.550 | 20 |
| WT-206E | 2" | 3#4/0 | 1.063 | 1.688 | 20 |
| **For Underground Feeder Cable** | | | | | |
| UF-201 | ½" | 2#14 | .210 | .440 | 250 |
| UF-202 | ¾" | 3#14 | .220 | .660 | 250 |





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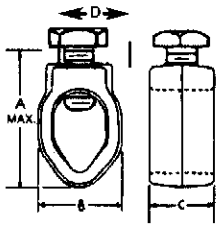
# Ground Rod Clamps



## UL Listed for both copper-clad and galvanized ground rods.

## Type JWR — Wide-Range Ground Rod Clamp



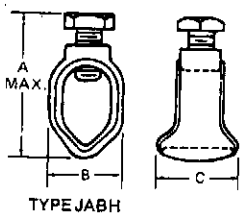

- UL Listed for direct burial in earth/concrete
- Constructed from bronze alloy and high-performance stainless steel bolt
- Provides wide range of connection sizes
- More than 300 lbs. torque capacity

| CAT. NO. | NOMINAL ROD DIA. (IN.) | NOMINAL ROD DIA. (MM.) | WIRE RANGE MAX. | WIRE RANGE MIN. | WIRE RANGE MAX. ($MM^2$) | DIMENSIONS (IN.) MIN. ($MM^2$) | A (MAX.) BOLT | B | C | D |
|---|---|---|---|---|---|---|---|---|---|---|
| JWR | ⅜* | 9.5 | 1/0 Str. | 10 Sol. | 53.4 | 5.2 | 1.535 | 1.050 | .812 | .652 |
| | ½ | 12.7 | 1/0 Str. | 10 Sol. | 53.4 | 5.2 | 1.535 | 1.050 | .812 | .652 |
| | ⅝ | 15.8 | 1/0 Str. | 10 Sol. | 53.4 | 5.2 | 1.535 | 1.050 | .812 | .652 |
| | ¾ | 19.0 | 1/0 Str. | 8 Sol. | 53.4 | 8.3 | 1.535 | 1.050 | .812 | .652 |

*"⅜" rod not recognized/listed by UL.

## Long bearing surface of clamp on ground wire secures ground connection.

## Type JAB — Ground Rod Clamps



TYPE JABH

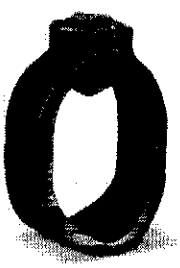
- Cast of high-strength corrosion-resistant copper alloy
- Both hex head bolts and socket set screws available
- UL Listed for direct burial

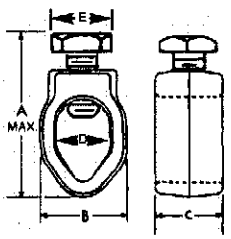
| CAT. NO. SOCKET SET SCREW | CAT. NO. HEX HEAD BOLT | NOMINAL ROD DIA. (IN.) | NOMINAL ROD DIA. (MM) | WIRE RANGE MAX. | WIRE RANGE MIN. | WIRE RANGE MAX. ($MM^2$) | WIRE RANGE MIN. ($MM^2$) | DIMENSIONS (IN.) A (MAX.) SOCKET SCREW | A (MAX.) HEX BOLT | SCREW THREAD SIZE UNC-2A | B | C | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JAB12* | JAB12H | ½ | 12.7 | 2 Str. | 10 Sol. | 33.6 | 5.2 | 1 19/32 | 2 3/32 | 7/16–14 | 27/32 | ⅜ | 19/32 |
| JAB58 | JAB58H | ⅝ | 15.8 | 1/0 Str. | 8 Sol. | 53.4 | 8.3 | 1 27/32 | 2 15/16 | ½–14 | 29/32 | 1 | 1 1/16 |
| JAB34 | JAB34H | ¾ | 19.0 | 1/0 Str. | 8 Sol. | 53.4 | 8.3 | 2 | 2 1/32 | 7/16–14 | 1 1/16 | 1 | 1 5/64 |
| — | JAB34C | ¾ + ⅜ | 15.8 to 19.0 | 4/0 Str. | 8 Sol. | 95.0 | 8.3 | — | 2 1/32 | ½–14 | 1⅛ | 1 1/32 | 1 3/16 |
| JAB1 | JAB1H | 1 | 25.0 | 4/0 Str. | 8 Sol. | 107.1 | 8.3 | 2¼ | 3 | 7/16–14 | 1 11/32 | 1 1/16 | 1 |

* Not CSA listed  Add suffix P to Cat. No. for tin-plated clamp.

## A dependable ground connection offered at a substantial savings.

## Type G — Budget-Line Ground Clamps






- Cast of high-strength corrosion-resistant copper alloy
- Furnished with hex head bolts
- Simplified, compact design makes lasting, trouble-free connection
- UL Listed for direct burial

| CAT. NO. | NOMINAL ROD DIA. (IN.) | NOMINAL ROD DIA. (MM.) | WIRE RANGE MAX. | WIRE RANGE MIN. | WIRE RANGE MAX. ($MM^2$) | WIRE RANGE MIN. ($MM^2$) | DIMENSIONS (IN.) A (MAX.) BOLT | SCREW THREAD SIZE UNC-2A | B | C | D | E |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G3* | ⅜ | 9.5 | 4 Str. | 10 Sol. | 21.1 | 5.2 | 1⅜ | 5/16–18 | 11/16 | ½ | 21/64 | ⅜ |
| G4 | ½ | 12.7 | 2 Str. | 10 Sol. | 33.6 | 5.2 | — | ⅜–16 | 27/32 | ⅝ | 37/64 | ½ |
| G5† | ⅝ | 15.8 | 2 Str. | 10 Sol. | 33.6 | 5.2 | — | ⅜–16 | 29/32 | ⅝ | 45/64 | ½ |
| G6 | ¾ | 19.0 | 2 Str. | 10 Sol. | 33.6 | 5.2 | — | ⅜–16 | 1 1/16 | ¾ | 13/16 | ½ |

*Not UL Listed  †RUS Listed  Add suffix P to Cat. No. for tin-plated clamp.



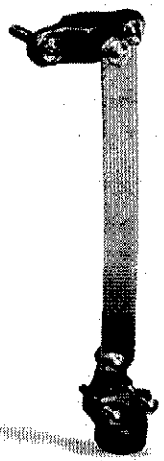
Thomas&Betts
www.tnb.com
United States
Tel: 901.252.8000
800 816 7809
Fax: 901.252.1354
Canada
Tel: 450.347.5318
Fax: 450 347 1976
Technical Services
Tel: 888.862.3289

# Ground Clamps



## Flexible copper strap makes alignment easy.

- For grounding rigid conduit systems
- Same features as "JP" clamp plus flexible copper strap
- Strap helps protect conduit system from water system vibrations
- Furnished with zinc-plated screws



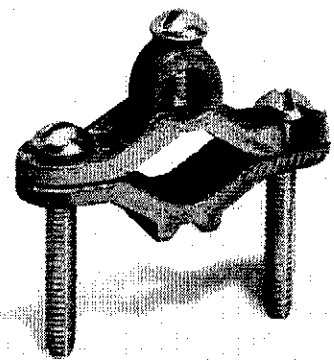
### Cast Bronze Clamps with Copper Strap

| CAT. NO. | CONDUIT SIZE | WATER PIPE SIZE | CONDUCTOR RANGE | |
|---|---|---|---|---|
| | | | MAX. | MIN. |
| JPS-12 | ½" | ½"–1" | 6 sol. | 10 sol. |
| JPS-34 | ¾" | ½"–1" | 2/0 str. | 10 sol. |
| JPS-1 | 1" | ½"–1" | 3/0 str. | 10 sol. |

*Add suffix C to Cat. No. to specify plating.*

## Connects copper ground wire to water pipe, copper tubing or ground rods.

- High strength, high conductivity copper alloy (over 80% copper)
- UL467 Listed for direct burial

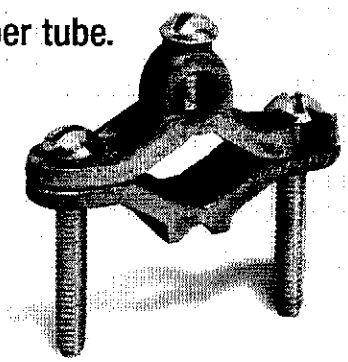


### Cast Bronze Ground Clamps

| CAT. NO. | WATER PIPE SIZE | CONDUCTOR RANGE |
|---|---|---|
| JD | ½"–1" | #2 str.–#10 str. |
| J2D | 1¼"–2" | #2 str.–#10 str. |

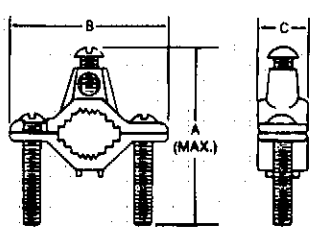
## For connecting grounding conductor to water pipe or copper tube.

- Cast of high-strength, highly conductive copper alloy
- Screws plated for corrosion resistance
- UL Listed



### Type J — Cast Bronze Ground Clamps

| CAT. NO. | WATER PIPE SIZE | CONDUCTOR RANGE | | DIMENSIONS (IN.) | | |
|---|---|---|---|---|---|---|
| | | MAX. | MIN. | A (MAX.) | B | C |
| J | ⅜ to 1 | 2 str. | 10 sol. | 2¾ | 2 1⁵⁄₁₆ | ⁵⁄₈ |
| J2BB | 1¼ to 2 | 2 str. | 10 sol. | 3¾ | 3½ | ¹⁵⁄₁₆ |
| J2124 | 2½ to 4 | 4 str. | 10 sol. | 6 | 6⅛ | 1 |
| J6 | 4¼ to 6 | 4 str. | 10 sol. | 7¼ | 8⅛ | 1 |



# Carlon® Rigid Nonmetallic Conduit (RNC), Fittings & Accessories

Carlon® manufactures the most complete line of nonmetallic conduits and fittings in the electrical industry. Carlon Schedule 40 and Schedule 80 conduits are designed for use aboveground and underground as described in the National Electrical Code. Specify only Carlon conduits and fittings to insure raceway system integrity.

## Features

**Ease of Installation** Nonmetallic conduits are 1/4 to 1/5 the weight of metallic systems, can be installed in less than half the time, and are easily fabricated on the job.

**Safety** Nonmetallic conduits are nonconductive, assuring a safe system.

**Impact Resistant** Carlon Schedule 40 and Schedule 80 nonmetallic conduits are resistant to sunlight and are listed for exposed or outdoor usage. The use of expansion fittings allows the system to expand and contract with temperature variations.

**Corrosion Resistant** Carlon conduits and fittings are nonmetallic and will not rust or corrode.

Carlon nonmetallic Schedule 40 and Schedule 80 conduits and elbows are manufactured to NEMA TC-2, Federal specification WC1094A and UL 651 specifications. Fittings are manufactured to NEMA TC-3, Federal specification WC1094A and UL514B. Both conduit and fittings carry respective UL or ETL Listings and UL or ETL labels.

# Schedule 40 PVC Rigid Nonmetallic Conduit (RNC).
## (Heavy Wall EPC)

ETL Listed to UL 651 in compliance to the NEC

UL LISTED E35297

RUS Listed

Listed for underground applications encased in concrete or direct burial. Also for use in exposed or concealed applications aboveground.

• Sunlight resistant • Rated for use with 90°C conductors • Superior weathering characteristics

With Integral Bell*

### Schedule 40 Heavy Wall

| Part No. 10' | Part No. 20' | Nom. Size | Std. Crate Qty. 10' | Std. Crate Qty. 20' | Wt. Per 100' | Dimensions O.D. | Dimensions I.D. | Wall |
|---|---|---|---|---|---|---|---|---|
| 49005-010 | | 1/2" | 6000' | | 17 | .840 | .622 | .109 |
| 49007-010 | 49007-020 | 3/4" | 4400' | 8800' | 23 | 1.050 | .824 | .113 |
| 49008-010 | 49008-020 | 1" | 3600' | 7200' | 34 | 1.315 | 1.049 | .133 |
| 49009-010 | 49009-020 | 1 1/4" | 3300' | 6600' | 46 | 1.660 | 1.380 | .140 |
| 49010-010 | 49010-020 | 1 1/2" | 2250' | 4500' | 55 | 1.900 | 1.610 | .145 |
| 49011-010 | 49011-020 | 2" | 1400' | 2800' | 73 | 2.375 | 2.067 | .154 |
| 49012-010 | 49012-020 | 2 1/2" | 930' | 1860' | 124 | 2.875 | 2.469 | .203 |
| 49013-010 | 49013-020 | 3" | 880' | 1760' | 163 | 3.500 | 3.068 | .216 |
| 49014-010 | 49014-020 | 3 1/2" | 630' | 1260' | 196 | 4.000 | 3.548 | .226 |
| 49015-010 | 49015-020 | 4" | 570' | 1140' | 232 | 4.500 | 4.026 | .237 |
| 49016-010 | 49016-020 | 5" | 380' | 760' | 315 | 5.563 | 5.047 | .258 |
| 49017-010 | 49017-020 | 6" | 260' | 520' | 409 | 6.625 | 6.065 | .280 |

Rigid nonmetallic conduit is normally supplied in standard 10' lengths, with one belled end per length. For specific requirements, it may be produced in lengths shorter or longer than 10', with or without belled ends.

**Use RNC Fittings with Schedule 40 and Schedule 80 Conduit.**

**Notes:** 1. Special fittings and conduit sizes will be quoted on request.
2. DON'T FORGET TO ORDER CEMENT.
3. Carlon reserves the right to ship to the nearest unitized quantity.

# Schedule 80 PVC Rigid Nonmetallic Conduit (RNC)

## (Extra Heavy Wall EPC-80)

ETL Listed to UL 651 in compliance to the NEC

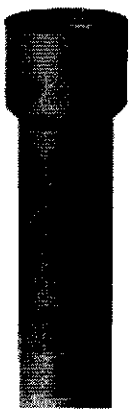
UL LISTED E35297

RUS Listed

Listed for use in aboveground and belowground applications that are subject to physical damage.

- Sunlight resistant
- Rated for use with 90°C conductors
- Superior weathering characteristics
- For use in areas subject to physical damage

With Integral Bell*



### Schedule 80 Extra Heavy Wall

| Part No. 10' | 20' | Nom. Size | Std. Crate Qty. 10' | 20' | Wt. Per 100' | Dimensions O.D. | I.D. | Wall |
|---|---|---|---|---|---|---|---|---|
| 49405-010 | 49405-020 | 1/2" | 6000' | 12000' | 21 | .840 | .546 | .147 |
| 49407-010 | 49407-020 | 3/4" | 4400' | 8000' | 30 | 1.050 | .742 | .154 |
| 49408-010 | 49408-020 | 1" | 3600' | 7200' | 44 | 1.315 | .957 | .179 |
| 49409-010 | 49409-020 | 1 1/4" | 3300' | 6600' | 60 | 1.660 | 1.278 | .191 |
| 49410-010 | 49410-020 | 1 1/2" | 2250' | 3600' | 72 | 1.900 | 1.500 | .200 |
| 49411-010 | 49411-020 | 2" | 1400' | 2800' | 101 | 2.375 | 1.939 | .218 |
| 49412-010 | 49412-020 | 2 1/2" | 930' | 1880 | 154 | 2.875 | 2.323 | .276 |
| 49413-010 | 49413-020 | 3" | 880' | 1760' | 210 | 3.500 | 2.900 | .300 |
| 49415-010 | 49415-020 | 4" | 570' | 1140' | 308 | 4.500 | 3.826 | .337 |
| 49416-010 | – | 5" | 380' | – | 428 | 5.563 | 4.813 | .375 |
| 49417-010 | 49417-020 | 6" | 260' | 520' | 588 | 6.625 | 5.761 | 4.32 |

Rigid nonmetallic conduit is normally supplied in standard 10' lengths, with one belled end per length. For specific requirements, it may be produced in lengths shorter or longer than 10', with or without belled ends.

**Use RNC Fittings with Schedule 40 and Schedule 80 Conduit.**

**Notes:** 1. Special fittings and conduit sizes will be quoted on request.
2. DON'T FORGET TO ORDER CEMENT.
3. Carlon reserves the right to ship to the nearest unitized quantity.

# Support of Carlon Rigid Nonmetallic Conduit in Aboveground Installations

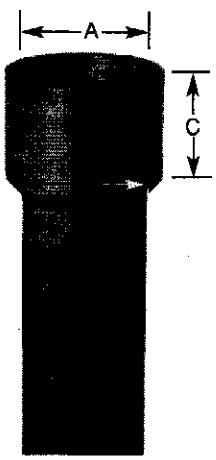
Table 352.30(B) NEC shows the support requirements for Schedule 40 and Schedule 80 rigid PVC nonmetallic conduit.

Plastic conduit should always be installed away from steam lines, etc. Support straps should allow for lineal movement caused by expansion and contraction.

Maximum ambient temperature is 122°F (50°C).

### Table 352.30(B), NEC

| Trade Size | Maximum Spacing Between Supports (feet) |
|---|---|
| 1/2 - 1 | 3 |
| 1 1/4 - 2 | 5 |
| 2 1/2 - 3 | 6 |
| 3 1/2 - 5 | 7 |
| 6 | 8 |




### Acceptable Dimensions in Inches of Integral Bell per UL 651

| Trade Size | A At Entrance (in.) Maximum | Minimum | B At Bottom (in.) Maximum | Minimum | C Nominal Bell Depth (in.) |
|---|---|---|---|---|---|
| 1/2 | 0.860 | 0.844 | 0.844 | 0.828 | 1.375 |
| 3/4 | 1.074 | 1.054 | 1.056 | 1.036 | 1.500 |
| 1 | 1.340 | 1.320 | 1.320 | 1.300 | 1.750 |
| 1 1/4 | 1.689 | 1.665 | 1.667 | 1.643 | 1.875 |
| 1 1/2 | 1.930 | 1.906 | 1.906 | 1.882 | 2.750 |
| 2 | 2.405 | 2.381 | 2.381 | 2.357 | 3.250 |
| 2 1/2 | 2.905 | 2.875 | 2.883 | 2.853 | 3.250 |
| 3 | 3.530 | 3.500 | 3.507 | 3.477 | 3.875 |
| 3 1/2 | 4.065 | 3.965 | 4.007 | 3.977 | 3.875 |
| 4 | 4.565 | 4.465 | 4.506 | 4.476 | 4.625 |
| 5 | 5.643 | 5.543 | 5.583 | 5.523 | 5.625 |
| 6 | 6.708 | 6.608 | 6.644 | 6.584 | 6.375 |

# Schedule 40 Elbows Standard Radius

Available in plain and integral belled end for use with nonmetallic solvent weld fittings.

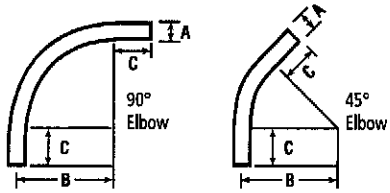
ETL Listed to UL 651 in compliance to the NEC

UL LISTED E35297

| Item | Plain End Part No. | Belled End Part No. | Size | Plain End Std. Ctn. Qty. | Belled End Std. Ctn. Qty. |
|---|---|---|---|---|---|
| **90° Elbow** | UA9AD | UA9ADB | 1/2" | 50 | 50 |
| | UA9ADR-CAR | UA9ADB | 1/2" | 25 | 50 |
| | UA9AE | UA9AEB | 3/4" | 25 | 25 |
| | UA9AFR-CTN | UA9AFB-CTN | 1" | 25 | 25 |
| | UA9AG | UA9AGB | 1 1/4" | 20 | 20 |
| | UA9AH | UA9AHB | 1 1/2" | 25 | 25 |
| | UA9AJ | UA9AJB | 2" | 20 | 20 |
| | UA9AJ-CAR | UA9AJB | 2" | 5 | 20 |
| | UA9AK-CAR | UA9AKB-CAR | 2 1/2" | 10 | 10 |
| | UA9AL | UA9ALB-CAR | 3" | 1 | 5 |
| | UA9AM | UA9AMB | 3 1/2" | 1 | 20 |
| | UA9AN | UA9ANB | 4" | 1 | 1 |
| | UA9AP | UA9APB | 5" | 1 | 1 |
| | UA9AR | UA9ARB | 6" | 1 | 1 |
| **45° Elbow** | UA7AD | UA7ADB | 1/2" | 50 | 50 |
| | UA7AE | UA7AEB | 3/4" | 25 | 25 |
| | UA7AER-CAR | UA7AEB | 3/4" | 15 | 25 |
| | UA7AF | UA7AFB | 1" | 20 | 20 |
| | UA7AF-CAR | UA7AFB | 1" | 15 | 20 |
| | UA7AG | UA7AGB | 1 1/4" | 20 | 20 |
| | UA7AH | UA7AHB | 1 1/2" | 20 | 20 |
| | UA7AJ | UA7AJB | 2" | 20 | 20 |
| | UA7AJ-CAR | UA7AJB-CAR | 2" | 4 | 4 |
| | UA7AK | UA7AKB | 2 1/2" | 20 | 20 |
| | UA7AK-CAR | UA7AKB-CAR | 2 1/2" | 5 | 5 |
| | UA7AL-CAR | UA7ALB | 3" | 5 | 25 |
| | UA7AL-CAR | UA7ALB-CAR | 3" | 5 | 10 |
| | UA7AM | UA7AMB | 3 1/2" | 1 | 20 |
| | UA7AN | UA7ANB | 4" | 1 | 20 |
| | UA7AP | UA7APB | 5" | 1 | 1 |
| | UA7AR | UA7ARB | 6" | 1 | 1 |
| **30° Elbow** | UA6AD | UA6ADB | 1/2" | 50 | 50 |
| | UA6AE | UA6AEB | 3/4" | 25 | 25 |
| | UA6AF | UA6AFB | 1" | 25 | 1 |
| | UA6AG | UA6AGB | 1 1/4" | 20 | 20 |
| | UA6AH | UA6AHB | 1 1/2" | 25 | 1 |
| | UA6AJ | UA6AJB | 2" | 20 | 20 |
| | UA6AK | UA6AKB | 2 1/2" | 10 | 20 |
| | UA6AL | UA6ALB | 3" | 1 | 1 |
| | UA6AM | UA6AMB | 3 1/2" | 1 | 1 |
| | UA6AN | UA6ANB | 4" | 1 | 1 |
| | UA6AP | UA6APB | 5" | 1 | 1 |
| | UA6AR | UA6ARB | 6" | 1 | 1 |

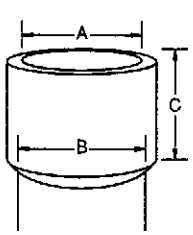
| Item | Plain End Part No. | Belled End Part No. | Size | Plain End Std. Ctn. Qty. | Belled End Std. Ctn. Qty. |
|---|---|---|---|---|---|
| **22 1/2° Elbow** | UA5AD | – | 1/2" | 1 | – |
| | UA5AE | – | 3/4" | 1 | – |
| | UA5AF | – | 1" | 1 | – |
| | UA5AG | – | 1 1/4" | 1 | – |
| | UA5AH | – | 1 1/2" | 1 | – |
| | UA5AJ | UA5AJB | 2" | 25 | 1 |
| | UA5AK | – | 2 1/2" | 20 | – |
| | UA5AL | UA5ALB | 3" | 5 | 1 |
| | UA5AM | – | 3 1/2" | 1 | – |
| | UA5AN | UA5ANB | 4" | 1 | 1 |
| | UA5AP | UA5APB | 5" | 1 | 1 |
| | UA5AR | UA5ARB | 6" | 1 | 1 |
| **11 1/4° Elbow** | UA3AD | – | 1/2" | 1 | – |
| | UA3AE | – | 3/4" | 1 | – |
| | UA3AF | – | 1" | 1 | – |
| | UA3AG | – | 1 1/4" | 1 | – |
| | UA3AH | – | 1 1/2" | 1 | – |
| | UA3AJ | – | 2" | 1 | – |
| | UA3AK | – | 2 1/2" | 1 | – |
| | UA3AL | – | 3" | 1 | – |
| | UA3AM | – | 3 1/2" | 1 | – |
| | UA3AN | UA3ANB | 4" | 1 | 1 |
| | UA3AP | – | 5" | 1 | – |
| | UA3AR | – | 6" | 1 | – |

## Standard Radius Elbow Dimensions




| Size | A | B Min. (Radius) | C Min. |
|---|---|---|---|
| 1/2" | .840 | 4" | 1 1/2" |
| 3/4" | 1.050 | 4 1/2" | 1 1/2" |
| 1" | 1.315 | 5 3/4" | 1 7/8" |
| 1 1/4" | 1.660 | 7 1/4" | 2" |
| 1 1/2" | 1.900 | 8 1/4" | 2" |
| 2" | 2.375 | 9 1/2" | 2" |
| 2 1/2" | 2.875 | 10 1/2" | 3" |
| 3" | 3.500 | 13" | 3 1/8" |
| 3 1/2" | 4.000 | 15" | 3 1/4" |
| 4" | 4.500 | 16" | 3 3/8" |
| 5" | 5.563 | 24" | 3 5/8" |
| 6" | 6.625 | 30" | 3 3/4" |

## Integral Belled End Dimensions



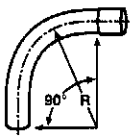

| Trade Size | A At Entrance Max. | A At Entrance Min. | B At Bottom Max. | B At Bottom Min. | C Socket Depth Max. | C Socket Depth Min. |
|---|---|---|---|---|---|---|
| 1/2" | .860 | 0.844 | 0.844 | 0.828 | 1.500 | 0.652 |
| 3/4" | 1.074 | 1.054 | 1.056 | 1.036 | 1.500 | 0.719 |
| 1" | 1.340 | 1.320 | 1.320 | 1.300 | 1.875 | 0.875 |
| 1 1/4" | 1.689 | 1.665 | 1.667 | 1.643 | 2.000 | 0.938 |
| 1 1/2" | 1.930 | 1.906 | 1.906 | 1.882 | 2.000 | 1.062 |
| 2" | 2.405 | 2.381 | 2.381 | 2.357 | 2.000 | 1.125 |
| 2 1/2" | 2.905 | 2.875 | 2.883 | 2.853 | 3.000 | 1.469 |
| 3" | 3.530 | 3.500 | 3.507 | 3.477 | 3.125 | 1.594 |
| 3 1/2" | 4.065 | 3.965 | 4.007 | 3.977 | 3.250 | 1.687 |
| 4" | 4.565 | 4.465 | 4.506 | 4.476 | 3.375 | 1.750 |
| 5" | 5.643 | 5.543 | 5.583 | 5.523 | 3.625 | 1.937 |
| 6" | 6.708 | 6.608 | 6.644 | 6.584 | 3.750 | 2.125 |

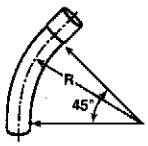
# Schedule 40 Elbows Special Radius

*Consult factory for additional sizes/configurations

ETL Listed to UL 651 in compliance to the NEC

UL LISTED E35297

| Segment | Plain End Part No. | Belled End Part No. | Nom. Diam. | Radius (in.) | Plain End Std. Ctn. Qty. | Belled End Std. Ctn. Qty. |
|---|---|---|---|---|---|---|
| 90° Elbow  | UA9CF | UA9CFB | 1" | 18" | 1 | 1 |
| | UA9DF | UA9DFB | 1" | 24" | 1 | 1 |
| | UA9EF | UA9EFB | 1" | 30" | 1 | 1 |
| | UA9FF | – | 1" | 36" | 1 | – |
| | UA9HF | – | 1" | 48" | 1 | – |
| | UA9CG | UA9CGB | 1¼" | 18" | 1 | 1 |
| | UA9DG | UA9DGB | 1¼" | 24" | 1 | 1 |
| | UA9EG | UA9EGB | 1¼" | 30" | 1 | 1 |
| | UA9FG | UA9FGB | 1¼" | 36" | 1 | 1 |
| | UA9HG | – | 1¼" | 48" | 1 | – |
| | UA9CH | UA9CHB | 1½" | 18" | 1 | 1 |
| | UA9DH | UA9DHB | 1½" | 24" | 1 | 1 |
| | UA9EH | UA9EHB | 1½" | 30" | 1 | 1 |
| | UA9FH | UA9FHB | 1½" | 36" | 1 | 1 |
| | UA9HH | – | 1½" | 48" | 1 | – |
| | UA9CJ | UA9CJB | 2" | 18" | 1 | 1 |
| | UA9DJ | UA9DJB-UPC | 2" | 24" | 1 | 1 |
| | UA9EJ | UA9EJB | 2" | 30" | 1 | 1 |
| | UA9FJ-UPC | UA9FJB | 2" | 36" | 1 | 1 |
| | UA9HJ | UA9HJB | 2" | 48" | 1 | 1 |
| | UA9JJ | – | 2" | 72" | 1 | – |
| | UA9CK | UA9CKB | 2½" | 18" | 1 | 1 |
| | UA9DK | UA9DKB-UPC | 2½" | 24" | 1 | 1 |
| | UA9EK | UA9EKB | 2½" | 30" | 1 | 1 |
| | UA9FK-UPC | UA9FKB | 2½" | 36" | 1 | 1 |
| | UA9HK | UA9HKB | 2½" | 48" | 1 | 1 |
| | UA9CL | UA9CLB | 3" | 18" | 1 | 1 |
| | UA9DL | UA9DLB-UPC | 3" | 24" | 1 | 1 |
| | UA9EL | UA9ELB | 3" | 30" | 1 | 1 |
| | UA9FL | UA9FLB | 3" | 36" | 1 | 1 |
| | UA9HL | UA9HLB | 3" | 48" | 1 | 1 |
| | UA9IL | – | 3" | 60" | 1 | – |
| | UA9DM | UA9DMB | 3½" | 24" | 1 | 1 |
| | UA9EM | UA9EMB | 3½" | 30" | 1 | 1 |
| | UA9FM | UA9FMB | 3½" | 36" | 1 | 1 |
| | UA9HM | UA9HMB | 3½" | 48" | 1 | 1 |
| | – | UA9CNB | 4" | 18" | – | 1 |
| | UA9DN | UA9DNB | 4" | 24" | 1 | 1 |
| | UA9EN | UA9ENB | 4" | 30" | 1 | 1 |
| | UA9FN | UA9FNB | 4" | 36" | 1 | 1 |
| | UA9HN | UA9HNB | 4" | 48" | 1 | 1 |
| | UA9IN | UA9INB | 4" | 60" | 1 | 1 |
| | UA9JN | – | 4" | 72" | 1 | 1 |
| | UA9EP | UA9EPB | 5" | 30" | 1 | 1 |
| | UA9FP | UA9FPB | 5" | 36" | 1 | 1 |
| | UA9HP | UA9HPB | 5" | 48" | 1 | 1 |
| | UA9IP | UA9IPB | 5" | 60" | 1 | 1 |
| | UA9FR | UA9FRB | 6" | 36" | 1 | 1 |
| | UA9HR | UA9HRB | 6" | 48" | 1 | 1 |
| | UA9IR | UA9IRB | 6" | 60" | 1 | 1 |
| | – | UA9TRB | 6" | 180" | – | 1 |
| | UA9HT | – | 8" | 48" | 1 | 1 |

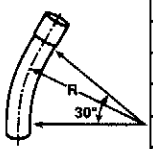
| Segment | Plain End Part No. | Belled End Part No. | Nom. Diam. | Radius (in.) | Plain End Std. Ctn. Qty. | Belled End Std. Ctn. Qty. |
|---|---|---|---|---|---|---|
| 45° Elbow  | UA7CF | – | 1" | 18" | 1 | – |
| | UA7DF | – | 1" | 24" | 1 | – |
| | UA7EF | – | 1" | 30" | 1 | – |
| | UA7FF | – | 1" | 36" | 1 | – |
| | UA7HF | – | 1" | 48" | 1 | – |
| | UA7CG | – | 1¼" | 18" | 1 | – |
| | UA7DG | – | 1¼" | 24" | 1 | – |
| | UA7EG | – | 1¼" | 30" | 1 | – |
| | UA7FG | – | 1¼" | 36" | 1 | – |
| | UA7HG | – | 1¼" | 48" | 1 | – |
| | UA7CH | – | 1½" | 18" | 1 | – |
| | UA7DH | – | 1½" | 24" | 1 | – |
| | UA7EH | – | 1½" | 30" | 1 | – |
| | UA7FH | UA7FHB | 1½" | 36" | 1 | 1 |
| | UA7HH | – | 1½" | 48" | 1 | – |
| | – | UA7BJB | 2" | 12" | – | 1 |
| | UA7CJ | UA7CJB | 2" | 18" | 1 | 1 |
| | UA7DJ | UA7DJB | 2" | 24" | 1 | 1 |
| | UA7EJ | UA7EJB | 2" | 30" | 1 | 1 |
| | UA7FJ | UA7FJB | 2" | 36" | 1 | 1 |
| | UA7HJ | UA7HJB | 2" | 48" | 1 | 1 |
| | UA7SJ | – | 2" | 150" | 1 | – |
| | UA7CK | – | 2½" | 18" | 1 | – |
| | UA7DK | UA7DKB | 2½" | 24" | 1 | 1 |
| | UA7EK | – | 2½" | 30" | 1 | – |
| | UA7FK | UA7FKB | 2½" | 36" | 1 | 1 |
| | UA7HK | – | 2½" | 48" | 1 | – |
| | UA7CL | UA7CLB | 3" | 18" | 1 | 1 |
| | UA7DL | UA7DLB | 3" | 24" | 1 | 1 |
| | UA7EL | UA7ELB | 3" | 30" | 1 | 1 |
| | UA7FL | UA7FLB | 3" | 36" | 1 | 1 |
| | – | UA7HLB | 3" | 48" | – | 1 |
| | UA7DM | – | 3½" | 24" | 1 | – |
| | UA7EM | – | 3½" | 30" | 1 | – |
| | UA7FM | – | 3½" | 36" | 1 | – |
| | UA7DN | UA7DNB | 4" | 24" | 1 | 1 |
| | UA7EN | UA7ENB | 4" | 30" | 1 | 1 |
| | UA7FN | UA7FNB | 4" | 36" | 1 | 1 |
| | UA7HN | UA7HNB | 4" | 48" | 1 | 1 |
| | – | UA7NNB | 4" | 120" | – | 1 |
| | UA7SN | UA7SNB | 4" | 150" | 1 | – |
| | UA7EP | UA7EPB | 5" | 30" | 1 | 1 |
| | UA7FP | UA7FPB | 5" | 36" | 1 | 1 |
| | UA7HP | UA7HPB | 5" | 48" | 1 | 1 |
| | – | UA7IPB | 5" | 60" | – | 1 |
| | – | UA7NPB | 5" | 120" | – | 1 |
| | – | UA7SPB | 5" | 150" | – | 1 |
| | UA7FR | UA7FRB | 6" | 36" | 1 | 1 |
| | UA7HR | UA7HRB | 6" | 48" | 1 | 1 |
| | UA7FT | – | 8" | 36" | 1 | – |
| | UA7HT | – | 8" | 48" | 1 | – |

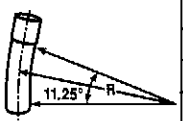
# Schedule 40 Elbows Special Radius

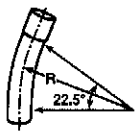
ETL Listed to UL 651 in compliance to the NEC

LISTED E35297

*Consult factory for additional sizes/configurations

| Segment | Plain End Part No. | Belled End Part No. | Nom. Diam. | Radius (in.) | Plain End Std. Ctn. Qty. | Belled End Std. Ctn. Qty. |
|---|---|---|---|---|---|---|
| **30° Elbow** | UA6CJ | – | 2" | 18" | 1 | – |
|  | UA6DJ | UA6DJB | 2" | 24" | 1 | 1 |
| | UA6FJ | UA6FJB | 2" | 36" | 1 | 1 |
| | UA6HJ | UA6HJB | 2" | 48" | 1 | 1 |
| | UA6CK | – | 2½" | 18" | 1 | – |
| | UA6DK | – | 2½" | 24" | 1 | – |
| | UA6CL | – | 3" | 18" | 1 | – |
| | UA6DL | UA6DLB | 3" | 24" | 1 | 1 |
| | UA6FL | UA6FLB | 3" | 36" | 1 | 1 |
| | UA6HL | UA6HLB | 3" | 48" | 1 | 1 |
| | UA6DM | – | 3½" | 24" | 1 | – |
| | UA6FM | – | 3½" | 36" | 1 | – |
| | UA6HM | – | 3½" | 48" | 1 | – |
| | UA6DN | – | 4" | 24" | 1 | – |
| | UA6FN | UA6FNB | 4" | 36" | 1 | 1 |
| | UA6HN | UA6HNB | 4" | 48" | 1 | 1 |
| | UA6FP | UA6FPB | 5" | 36" | 1 | 1 |
| | UA6HP | UA6HPB | 5" | 48" | 1 | 1 |
| | UA6FR | UA6FRB | 6" | 36" | 1 | 1 |
| | UA6HR | UA6HRB | 6" | 48" | 1 | 1 |

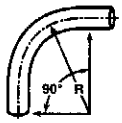
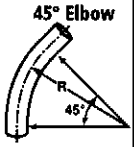
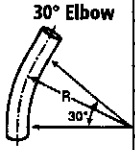
| Segment | Plain End Part No. | Belled End Part No. | Nom. Diam. | Radius (in.) | Plain End Std. Ctn. Qty. | Belled End Std. Ctn. Qty. |
|---|---|---|---|---|---|---|
| **11¼° Elbow** | UA3DJ | UA3DJB | 2" | 24" | 1 | 25 |
|  | UA3FJ | UA3FJB | 2" | 36" | 1 | 1 |
| | UA3HJ | – | 2" | 48" | 1 | – |
| | UA3HK | – | 2½" | 48" | 1 | – |
| | UA3DL | UA3DLB | 3" | 24" | 1 | 1 |
| | UA3FL | UA3FLB | 3" | 36" | 1 | 1 |
| | UA3HL | – | 3" | 48" | 1 | – |
| | UA3DM | – | 3½" | 24" | 1 | – |
| | UA3HM | – | 3½" | 48" | 1 | – |
| | UA3DN | UA3DNB | 4" | 24" | 1 | 1 |
| | UA3FN | UA3FNB | 4" | 36" | 1 | 1 |
| | – | UA3SNB | 4" | 150" | – | 1 |
| | UA3HN | UA3HNB | 4" | 48" | 1 | 1 |
| | UA3FP | UA3FPB | 5" | 36" | 1 | 1 |
| | UA3HP | – | 5" | 48" | 1 | – |
| | – | UA3UPB | 5" | 240" | – | 1 |
| | UA3FR | UA3FRB | 6" | 36" | 1 | 1 |
| | UA3HR | – | 6" | 48" | 1 | – |
| | UA3FT | – | 8" | 36" | 1 | – |

| Segment | Plain End Part No. | Belled End Part No. | Nom. Diam. | Radius (in.) | Plain End Std. Ctn. Qty. | Belled End Std. Ctn. Qty. |
|---|---|---|---|---|---|---|
| **22½° Elbow** | UA5FF | – | 1" | 36" | 1 | – |
|  | UA5FG | – | 1¼" | 36" | 1 | – |
| | UA5FH | UA5FHB | 1½" | 36" | 1 | 1 |
| | UA5CJ | UA5CJB | 2" | 18" | 1 | 1 |
| | UA5DJ | UA5DJB | 2" | 24" | 1 | 25 |
| | UA5EJ | UA5EJB | 2" | 30" | 1 | 1 |
| | UA5FJ | UA5FJB | 2" | 36" | 1 | 1 |
| | UA5HJ | – | 2" | 48" | 1 | – |
| | UA5VJ | – | 2" | 300" | 1 | – |
| | UA5CK | – | 2½" | 18" | 1 | – |
| | UA5DK | – | 2½" | 24" | 1 | – |
| | UA5EK | – | 2½" | 30" | 1 | – |
| | UA5FK | – | 2½" | 36" | 1 | – |
| | UA5HK | – | 2½" | 48" | 1 | – |
| | – | UA5CLB | 3" | 18" | 1 | 1 |
| | UA5DL | UA5DLB | 3" | 24" | 1 | 1 |
| | UA5EL | UA5ELB | 3" | 30" | 1 | 1 |
| | UA5FL | UA5FLB | 3" | 36" | 1 | 1 |
| | UA5HL | – | 3" | 48" | 1 | – |
| | UA5VL | – | 3" | 300" | 1 | – |
| | UA5DM | – | 3½" | 24" | 1 | – |
| | UA5EM | – | 3½" | 30" | 1 | – |
| | UA5FM | – | 3½" | 36" | 1 | – |
| | UA5HM | – | 3½" | 48" | 1 | – |
| | UA5DN | UA5DNB | 4" | 24" | 1 | 1 |
| | UA5EN | UA5ENB | 4" | 30" | 1 | 1 |
| | UA5FN | UA5FNB | 4" | 36" | 1 | 1 |
| | UA5HN | UA5HNB | 4" | 48" | 1 | |
| | UA5IN | – | 4" | 60" | 1 | – |
| | UA5JN | – | 4" | 72" | 1 | – |
| | UA5SN | UA5SNB | 4" | 150" | 1 | |
| | – | UA5UNB | 4" | 240" | – | 1 |
| | – | UA5VNB | 4" | 300" | – | 1 |
| | – | UA5DPB | 5" | 24" | 1 | 1 |
| | UA5EP | UA5EPB | 5" | 30" | 1 | 1 |
| | UA5FP | UA5FPB | 5" | 36" | 1 | 1 |
| | UA5HP | UA5HPB | 5" | 48" | 1 | 1 |
| | UA5IP | – | 5" | 60" | 1 | – |
| | UA5SP | – | 5" | 150" | 1 | – |
| | – | UA5UPB | 5" | 240" | – | 1 |
| | – | UA5VPB | 5" | 300" | – | 1 |
| | UA5FR | UA5FRB | 6" | 36" | 1 | 1 |
| | UA5HR | UA5HRB | 6" | 48" | 1 | 1 |
| | UA5IR | – | 6" | 60" | 1 | – |
| | UA5RR | – | 6" | 144" | 1 | – |
| | UA5SR | – | 6" | 150" | 1 | – |
| | UA5VR | – | 6" | 300" | 1 | – |
| | UA5FT | – | 8" | 36" | 1 | – |
| | UA5HT | – | 8" | 48" | 1 | – |

# Schedule 80 Elbows

## Standard Radius

Available in plain end only for use with nonmetallic solvent weld fittings.

| Item | Plain End Part No. | Belled End Part No. | Size | Plain End Std. Ctn. Qty. | Belled End Std. Ctn. Qty. |
|---|---|---|---|---|---|
| **90° Elbow**  | UB9AD | – | 1/2" | 50 | – |
| | UB9AD-CAR | – | 1/2" | 25 | – |
| | UB9AE | – | 3/4" | 25 | – |
| | UB9AE-CAR | – | 3/4" | 15 | – |
| | UB9AF | – | 1" | 25 | – |
| | UB9AF-CAR | – | 1" | 10 | – |
| | UB9AG | – | 1 1/4" | 20 | – |
| | UB9AG-CAR | – | 1 1/4" | 5 | – |
| | UB9AH | – | 1 1/2" | 25 | – |
| | UB9AH-CAR | – | 1 1/2" | 5 | – |
| | UB9AJ | – | 2" | 20 | – |
| | UB9AJ-CAR | – | 2" | 5 | – |
| | UB9AK-CAR | – | 2 1/2" | 10 | – |
| | UB9AL-CAR | – | 3" | 5 | – |
| | UB9AN | – | 4" | 1 | – |
| | UB9AP | UB9APB | 5" | 1 | 1 |
| | UB9AR | – | 6" | 1 | – |
| **45° Elbow**  | UB7AD | – | 1/2" | 50 | – |
| | UB7AE-UPC | – | 3/4" | 25 | – |
| | UB7AF-UPC | – | 1" | 20 | – |
| | UB7AG | – | 1 1/4" | 20 | – |
| | UB7AH | – | 1 1/2" | 20 | – |
| | UB7AH-CAR | – | 1 1/2" | 5 | – |
| | UB7AJ-UPC | – | 2" | 20 | – |
| | UB7AK | – | 2 1/2" | 20 | – |
| | UB7AL | – | 3" | 1 | – |
| | UB7AN | – | 4" | 1 | – |
| | UB7AP | UB7APB | 5" | 1 | 1 |
| | UB7AR | – | 6" | 1 | – |
| **30° Elbow**  | UB6AD | – | 1/2" | 50 | – |
| | UB6AE | – | 3/4" | 25 | – |
| | UB6AF | – | 1" | 25 | – |
| | UB6AG | – | 1 1/4" | 5 | – |
| | UB6AH | – | 1 1/2" | 25 | – |
| | UB6AJ | – | 2" | 20 | – |
| | UB6AK | – | 2 1/2" | 1 | – |
| | UB6AL | – | 3" | 1 | – |
| | UB6AN | – | 4" | 1 | – |
| | UB6AP | – | 5" | 1 | – |
| | UB6AR | – | 6" | 1 | – |
| **22 1/2° Elbow** | UB5AL | – | 3" | 5 | – |
| | UB5AN | – | 4" | 1 | – |
| | UB5AP | UB5APB | 5" | 1 | 1 |
| **11 1/4° Elbow** | UB3AL | – | 3" | 1 | – |
| | UB3AR | – | 6" | 1 | – |

# Flexible PVC Elbows

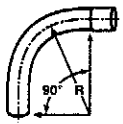
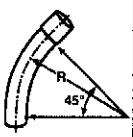
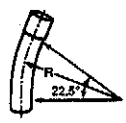
- UL listed for exposed and direct burial applications in accordance with Article 356 of 2002 NEC
- 0° - 90° bending and offset applications
- O-ring seal for moisture tight connections
- Maintains round shape throughout bend
- Sunlight resistant
- Non-corrosive – all PVC and Neoprene material
- Fully assembled and ready to use

| Part No. | Size | Std. Ctn. Qty. | Std. Ctn. Wt. (lbs.) | Length Fully Assembled |
|---|---|---|---|---|
| UAFAD | 1/2" | 8 | 1.6 | 8.5" |
| UAFAE | 3/4" | 6 | 1.9 | 9.6" |
| UAFAF | 1" | 6 | 2.4 | 11.9" |

# Special Radius

ETL Listed to UL 651 in compliance to the NEC

LISTED E35297

| Segment | Plain End Part No. | Belled End Part No. | Nom. Diam. | Radius (in.) | Plain End Std. Ctn. Qty. | Belled End Std. Ctn. Qty. |
|---|---|---|---|---|---|---|
| **90° Elbow**  | UB9CF | – | 1" | 18" | 1 | – |
| | UB9DF | – | 1" | 24" | 1 | – |
| | UB9FF | – | 1" | 36" | 1 | – |
| | UB9HF | – | 1" | 48" | 1 | – |
| | UB9CG | – | 1 1/4" | 18" | 1 | – |
| | UB9DG | – | 1 1/4" | 24" | 1 | – |
| | UB9FG | – | 1 1/4" | 36" | 1 | – |
| | UB9HG | – | 1 1/4" | 48" | 1 | – |
| | UB9CH | – | 1 1/2" | 18" | 1 | – |
| | UB9DH-UPC | UB9DHB | 1 1/2" | 24" | 1 | 1 |
| | UB9FH | – | 1 1/2" | 36" | 1 | – |
| | UB9HH | – | 1 1/2" | 48" | 1 | – |
| | UB9CJ | – | 2" | 18" | 1 | – |
| | UB9DJ-UPC | UB9DJB | 2" | 24" | 1 | 1 |
| | UB9FJ | UB9FJB | 2" | 36" | 1 | 1 |
| | UB9HJ | – | 2" | 48" | 1 | – |
| | UB9CK | – | 2 1/2" | 18" | 1 | – |
| | UB9DK-UPC | UB9DKB | 2 1/2" | 24" | 1 | 1 |
| | UB9FK | UB9FKB | 2 1/2" | 36" | 1 | 1 |
| | UB9HK | – | 2 1/2" | 48" | 1 | – |
| | UB9CL | – | 3" | 18" | 1 | – |
| | UB9DL | UB9DLB | 3" | 24" | 1 | 1 |
| | UB9FL | UB9FLB | 3" | 36" | 1 | 1 |
| | UB9HL | – | 3" | 48" | 1 | – |
| | UB9DN | UB9DNB | 4" | 24" | 1 | 1 |
| | UB9FN | UB9FNB | 4" | 36" | 1 | 1 |
| | UB9HN | UB9HNB | 4" | 48" | 1 | 1 |
| | UB9NN | – | 4" | 120" | 1 | – |
| | UB9FP | – | 5" | 36" | 1 | – |
| | UB9HP | – | 5" | 48" | 1 | – |
| | UB9IP | – | 5" | 60" | 1 | – |
| | UB9FR | – | 6" | 36" | 1 | – |
| | UB9HR | – | 6" | 48" | 1 | – |
| | UB9IR | – | 6" | 60" | 1 | – |
| **45° Elbow**  | UB7CF | – | 1" | 18" | 1 | – |
| | UB7DF | – | 1" | 24" | 1 | – |
| | UB7FF | – | 1" | 36" | 1 | – |
| | UB7HF | – | 1" | 48" | 1 | – |
| | UB7DG | – | 1 1/4" | 24" | 1 | – |
| | UB7FG | – | 1 1/4" | 36" | 1 | – |
| | UB7HG | – | 1 1/4" | 48" | 1 | – |
| | UB7CH | – | 1 1/2" | 18" | 1 | – |
| | UB7DH | UB7DHB | 1 1/2" | 24" | 1 | 1 |
| | UB7FH | – | 1 1/2" | 36" | 1 | – |
| | UB7HH | – | 1 1/2" | 48" | 1 | – |
| | UB7CJ | – | 2" | 18" | 1 | – |
| | UB7DJ | UB7DJB | 2" | 24" | 1 | 1 |
| | UB7FJ | UB7FJB | 2" | 36" | 1 | 1 |
| | UB7HJ | – | 2" | 48" | 1 | – |
| | UB7DK | UB7DKB | 2 1/2" | 24" | 1 | 1 |
| | UB7FK | – | 2 1/2" | 36" | 1 | – |
| | UB7HK | – | 2 1/2" | 48" | 1 | – |
| | UB7CL | – | 3" | 18" | 1 | – |
| | UB7DL | UB7DLB | 3" | 24" | 1 | 1 |
| | UB7FL | UB7FLB | 3" | 36" | 1 | 1 |
| | UB7HL | – | 3" | 48" | 1 | – |
| | UB7DN | UB7DNB | 4" | 24" | 1 | 1 |
| | UB7FN | UB7FNB | 4" | 36" | 1 | 1 |
| | UB7HN | – | 4" | 48" | 1 | – |
| | UB7FP | – | 5" | 36" | 1 | – |
| | UB7HP | – | 5" | 48" | 1 | – |
| | UB7FR | – | 6" | 36" | 1 | – |
| | UB7HR | – | 6" | 48" | 1 | – |
| | UB7IR | – | 6" | 60" | 1 | – |
| **30° Elbow** | UB6FN | – | 4" | 36" | 1 | – |
| | UB6FR | – | 6" | 36" | 1 | – |
| **22 1/2° Elbow**  | – | UB5DHB | 1 1/2" | 24" | – | 20 |
| | – | UB5DJB | 2" | 24" | – | 20 |
| | – | UB5FJB | 2" | 36" | – | 25 |
| | – | UB5DKB | 2 1/2" | 24" | – | 15 |
| | UB5DL | UB5DLB | 3" | 24" | 1 | 10 |
| | – | UB5FLB | 3" | 36" | – | 1 |
| | UB5DN | UB5DNB | 4" | 24" | 1 | 5 |
| | – | UB5FNB | 4" | 36" | – | 1 |
| | UB5FP | – | 5" | 36" | 1 | – |
| **11 1/4° Elbow** | UB3FP | – | 5" | 36" | 1 | – |

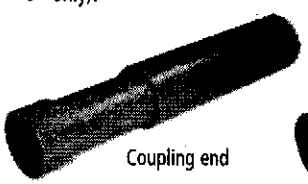
# Expansion Fittings

c UL us LISTED E33447

## (For Use with Schedule 40 & 80 Conduit)

E945 series expansion fittings are designed to compensate for length changes due to temperature variations in exposed conduit runs.

- EXCLUSIVE Molded in Mid-point indicator on the piston.
- EXCLUSIVE 2" Expansion Fitting with an 8" travel distance.
- Two-piece molded design with lubricated seals for easier movement for the life of the product.
- Ridges on the fitting for easier installation (Sizes 2" through 6" only).
- Male terminal Adapter End design (1/2" – 2" NPT Threads, and 2 1/2" – 6" NPSC Threads).
- Two O-Rings to prevent leakage.
- Can be installed vertically or horizontally.



Coupling end

Male terminal adapter end

| Coupling End Part No. | Male Terminal Adapter End Part No. | Size | Std. Ctn. Qty. | Travel Length (in.) |
|---|---|---|---|---|
| E945D | E945DX | 1/2 | 20 | 4" |
| E945E | E945EX | 3/4 | 15 | 4" |
| E945F | E945FX | 1 | 10 | 4" |
| E945G | E945GX | 1 1/4 | 5 | 4" |
| E945H | E945HX | 1 1/2 | 5 | 4" |
| E945J | E945JX | 2 | 15 | 8" |
| E945K | E945KX | 2 1/2 | 10 | 8" |
| E945L | E945LX | 3 | 10 | 8" |
| E945M | E945MX | 3 1/2 | 5 | 8" |
| E945N | E945NX | 4 | 5 | 8" |
| E945P | E945PX | 5 | 1 | 8" |
| E945R | E945RX | 6 | 1 | 8" |

# Short Expansion Couplings

c UL us LISTED E32447

(Expands to a maximum of 2")

| Part No. | Size | Std. Ctn. Qty. |
|---|---|---|
| E955D | 1/2 | 40 |
| E955E | 3/4 | 40 |
| E955F | 1 | 25 |
| E955G | 1 1/4 | 15 |
| E955H | 1 1/2 | 10 |
| E955J | 2 | 6 |

# Couplings

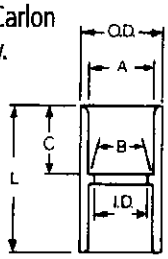
UL LISTED E32447

Except where noted by ▶

## Standard Couplings

All socket fittings should be attached Using Carlon solvent cement. Using Carlon fittings with Carlon nonmetallic conduit insures system integrity.

Socket type for joining nonmetallic conduit.




| Part No. | Size | Std. Ctn. Qty. | A Typical | B | I.D. | O.D. | C Typical | L |
|---|---|---|---|---|---|---|---|---|
| E940D | 1/2 | 150 | .852 | .836 | .728 | 17/64 | 11/16 | 1 1/2 |
| E940E | 3/4 | 100 | 1.064 | 1.046 | .840 | 15/16 | 3/4 | 1 5/8 |
| E940F | 1 | 50 | 1.330 | 1.310 | 1.210 | 1 5/8 | 15/16 | 2 |
| E940G | 1 1/4 | 30 | 1.677 | 1.655 | 1.535 | 1 63/64 | 1 | 2 1/8 |
| E940H | 1 1/2 | 25 | 1.918 | 1.894 | 1.755 | 2 15/64 | 1 1/8 | 2 3/8 |
| E940J | 2 | 30 | 2.393 | 2.369 | 2.190 | 2 47/64 | 1 3/16 | 2 1/2 |
| E940K | 2 1/2 | 20 | 2.890 | 2.868 | 2.688 | 3 5/16 | 1 33/64 | 3 3/16 |
| E940K-CAR | 2 1/2 | 4 | 2.890 | 2.868 | 2.688 | 3 5/16 | 1 33/64 | 3 3/16 |
| E940L | 3 | 25 | 3.515 | 3.492 | 3.375 | 3 31/32 | 1 3/4 | 3 13/32 |
| E940L-CAR | 3 | 5 | 3.515 | 3.492 | 3.375 | 3 31/32 | 1 3/4 | 3 13/32 |
| E940M | 3 1/2 | 20 | 4.015 | 3.992 | 3.780 | 4 9/16 | 1 3/4 | 3 5/8 |
| E940N | 4 | 15 | 4.515 | 4.491 | 4.265 | 5 3/32 | 1 25/32 | 3 3/4 |
| E940N-CAR | 4 | 5 | 4.515 | 4.491 | 4.265 | 5 3/32 | 1 25/32 | 3 3/4 |
| E940P | 5 | 8 | 5.593 | 5.553 | 5.097 | 6 1/4 | 1 5/16 | 4 1/16 |
| E940R | 6 | 5 | 6.658 | 6.614 | 6.115 | 7 1/2 | 2 3/16 | 4 5/8 |

# Special Long Line Couplings

Long Line Couplings

| Part No. | Size | Std. Ctn. Qty. | Std. Ctn. Wt. (lbs.) |
|---|---|---|---|
| E941H | 1 1/2 | 40 | 9 |
| E941J | 2 | 25 | 8 |
| E941K | 2 1/2 | 15 | 8 |
| E941L | 3 | 15 | 14 |
| E941N | 4 | 10 | 15 |
| E941PF | 5 | 4 | 12 |
| ▶ E941RF | 6 | 5 | 21 |

# Fabricated Expansion Couplings

UL LISTED E33447

| Part No. | Size | Std. Ctn. Qty. | Travel Length (in.) |
|---|---|---|---|
| E945KXL | 2 1/2 | 10 | 12 |

# Couplings

## Special Long Line Couplings – Sleeve Couplings

Sleeve Coupling *(For Repair Work)*
No Internal Stop

| Part No. | Size | Std. Ctn. Qty. | Std. Ctn. Wt. (lbs.) |
|---|---|---|---|
| ▶ E948H | 1 1/2 | 25 | 6 |
| ▶ E948J | 2 | 25 | 5 |
| ▶ E948K | 2 1/2 | 25 | 16 |
| ▶ E948L | 3 | 25 | 13 |
| ▶ E948N | 4 | 10 | 8 |
| ▶ E948P | 5 | 14 | 33 |
| ▶ E948R | 6 | 6 | 16 |
| ▶ E948JR | 2" (6" long) | 15 | 8 |
| ▶ E948JS | 2" (Sch. 40 Split Duct) | 25 | 6 |
| ▶ E948L12 | 3" (12" long) | 1 | 1 |
| ▶ E948L6 | 3" (6" long) | 15 | 15 |
| ▶ E948LS | 3" (Sch. 40 Split Duct) | 25 | 17 |
| ▶ E948N12 | 4" (12" long) | 10 | 28 |
| ▶ E948N7 | 4" (7" long) | 15 | 25 |
| ▶ E948NS | 4" (Sch. 40 Split Duct) | 10 | 15 |
| ▶ E948PS | 5" (Sch. 40 Split Duct) | 1 | 2 |
| ▶ E948R10 | 6" (10" long) | 6 | 25 |
| ▶ E948R12 | 6" (12" long) | 6 | 25 |
| ▶ E948RS | 6" (Sch. 40 Split Duct) | 1 | 2 |

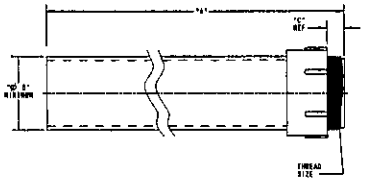
## Special Schedule 40 Swedge Couplings

*Consult factory for additional sizes

| Part No. | Size | Std. Ctn. Qty. | Std. Ctn. Wt. (lbs.) |
|---|---|---|---|
| ▶ E442K | 2 1/2 | 20 | 13 |
| ▶ E442R | 6 | 6 | 27 |
| ▶ E442T | 8 | 2 | 17 |

# Risers

## Schedule 40

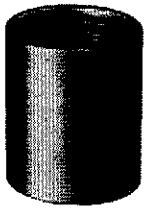


| Part No. | Size | A (Length) | B (Min.) | C | Thread Size | Std. Ctn. Qty. | Std. Ctn. Wt. (lbs.) |
|---|---|---|---|---|---|---|---|
| E954HX | 1 1/2 | 80.00 | 1.567 | .950 | 1 1/2" NPT | 1 | 3.8 |
| E954J | 2 | 60.00 | 2.024 | .825 | 2" NPT | 1 | 3.7 |
| E954JX | 2 | 80.00 | 2.024 | .825 | 2" NPT | 1 | 5.0 |
| E954K | 2 1/2 | 60.00 | 2.418 | .812 | 2 1/2" NPSC | 1 | 6.0 |
| E954KX | 2 1/2 | 80.00 | 2.418 | .812 | 2 1/2" NPSC | 1 | 8.4 |
| E954L | 3 | 60.00 | 3.012 | .798 | 3" NPSC | 1 | 8.7 |
| E954LX | 3 | 80.00 | 3.012 | .798 | 3" NPSC | 1 | 11.0 |

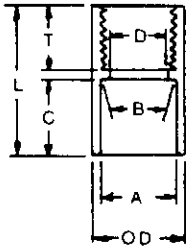
# Adapters

UL LISTED
E32447
Except where noted by ▶

## Female Adapters



For adapting nonmetallic conduits to threaded fittings, metallic systems. Female threads on one end, socket end on other.

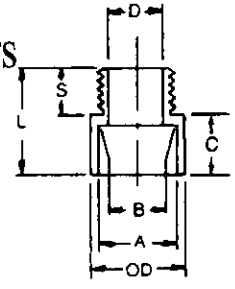



| Part No. | Size | Std. Ctn. Qty. | A Typical | B Typical | Min. D | Max. OD | C Typical | T Typical | L Typical |
|---|---|---|---|---|---|---|---|---|---|
| E942D | 1/2 | 150 | .852 | .836 | .620 | 17/64 | 11/16 | 3/4 | 19/16 |
| E942E | 3/4 | 100 | 1.064 | 1.046 | .822 | 15/16 | 13/16 | 3/4 | 15/8 |
| E942F | 1 | 50 | 1.330 | 1.310 | 1.046 | 15/8 | 15/16 | 7/8 | 1 15/16 |
| E942G | 1 1/4 | 30 | 1.677 | 1.655 | 1.377 | 1 63/64 | 1 | 7/8 | 2 |
| E942H | 1 1/2 | 25 | 1.918 | 1.894 | 1.607 | 2 5/32 | 1 1/8 | 7/8 | 2 7/32 |
| E942J | 2 | 30 | 2.393 | 2.369 | 2.064 | 2 47/64 | 1 3/16 | 1 | 2 5/16 |
| E942K | 2 1/2 | 20 | 2.890 | 2.868 | 2.450 | 3 11/32 | 1 5/8 | 1 1/8 | 2 15/16 |
| E942K-CAR | 2 1/2 | 4 | 2.890 | 2.868 | 2.450 | 3 11/32 | 1 5/8 | 1 1/8 | 2 15/16 |
| E942L | 3 | 25 | 3.515 | 3.492 | 3.000 | 3 31/32 | 1 3/4 | 1 1/8 | 3 1/16 |
| E942L-CAR | 3 | 3 | 3.515 | 3.492 | 3.000 | 3 31/32 | 1 3/4 | 1 1/8 | 3 1/16 |
| E942M | 3 1/2 | 20 | 4.015 | 3.992 | 3.500 | 4 1/2 | 1 7/8 | 1 1/8 | 3 1/4 |
| E942N | 4 | 15 | 4.515 | 4.491 | 4.000 | 5 1/64 | 2 | 1 1/8 | 3 13/64 |
| E942N-CAR | 4 | 7 | 4.515 | 4.491 | 4.000 | 5 1/64 | 2 | 1 1/8 | 3 13/64 |
| E942NX9* | 4 | 15 | (Call for information) | | | | | | |
| E942P | 5 | 8 | 5.593 | 5.553 | 5.047 | 6 1/4 | 1 15/16 | 1 1/16 | 3 3/16 |
| E942R | 6 | 6 | 6.658 | 6.614 | 6.055 | 7 1/4 | 2 1/8 | 1 1/16 | 3 3/8 |
| E942RX* | 6 | 6 | (Call for information) | | | | | | |

* Long Line Adapter

## Male Terminal Adapters

For adapting nonmetallic conduits to boxes, threaded fittings, metallic systems. Male threads on one end, socket end on other.

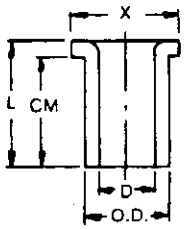



| Part No. | Size | Std. Ctn. Qty. | A Typical | B Typical | Min. D | Max. OD | C Typical | S Typical | L Typical |
|---|---|---|---|---|---|---|---|---|---|
| E943D | 1/2 | 150 | .852 | .836 | .597 | 1 1/8 | 5/8 | 9/16 | 15/16 |
| E943E | 3/4 | 125 | 1.064 | 1.046 | .800 | 1 11/32 | 3/4 | 9/16 | 1 3/8 |
| E943F | 1 | 50 | 1.330 | 1.310 | 1.018 | 1 5/8 | 1 | 11/16 | 1 25/32 |
| E943G | 1 1/4 | 50 | 1.677 | 1.655 | 1.332 | 2 1/32 | 1 | 3/4 | 1 15/16 |
| E943H | 1 1/2 | 25 | 1.918 | 1.894 | 1.566 | 2 5/32 | 1 3/16 | 3/4 | 2 1/16 |
| E943J | 2 | 50 | 2.393 | 2.369 | 2.000 | 2 21/32 | 1 3/16 | 3/4 | 2 1/8 |
| E943K | 2 1/2 | 25 | 2.890 | 2.868 | 2.376 | 3 5/16 | 1 3/4 | 7/8 | 2 7/8 |
| E943K-CAR | 2 1/2 | 5 | 2.890 | 2.868 | 2.376 | 3 5/16 | 1 3/4 | 7/8 | 2 7/8 |
| E943L | 3 | 45 | 3.515 | 3.492 | 2.954 | 4 | 1 15/16 | 7/8 | 3 1/16 |
| E943L-CAR | 3 | 5 | 3.515 | 3.492 | 2.954 | 4 | 1 15/16 | 7/8 | 3 1/16 |
| E943M | 3 1/2 | 30 | 4.015 | 3.992 | 3.440 | 4 1/2 | 2 7/16 | 1 7/8 | 3 7/16 |
| E943N | 4 | 20 | 4.515 | 4.491 | 3.940 | 5 3/32 | 2 3/8 | 7/8 | 3 1/2 |
| E943N-CAR | 4 | 20 | 4.515 | 4.491 | 3.940 | 5 3/32 | 2 3/8 | 7/8 | 3 1/2 |
| E943P | 5 | 5 | 5.593 | 5.553 | 4.815 | 6 1/4 | 2 1/3 | 1 | 3 15/16 |
| E943R | 6 | 10 | 6.658 | 6.614 | 5.860 | 7 1/2 | 2 3/8 | 1 | 3 3/8 |

# Adapters

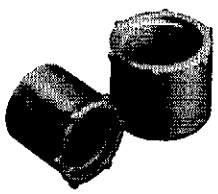
## Box Adapters for Enclosures

Adapts nonmetallic conduit to all electrical enclosures by inserting adapter through knockout and cementing into Carlon couplings.




| Part No. | Size | Std. Ctn. Qty. | Min D | OD Typical | Max X | CM Typical | L |
|---|---|---|---|---|---|---|---|
| E996D | 1/2 | 100 | .662 | .840 | 17/64 | 23/32 | 27/32 |
| E996E | 3/4 | 100 | .824 | 1.050 | 1 21/64 | 25/32 | 29/32 |
| E996F | 1 | 100 | 1.049 | 1.315 | 1 5/8 | 61/64 | 1 3/32 |
| E996G | 1 1/4 | 50 | 1.380 | 1.660 | 1 31/32 | 1 1/16 | 1 1/4 |
| E996H | 1 1/2 | 50 | 1.610 | 1.900 | 2 13/64 | 1 3/16 | 1 3/8 |
| E996J | 2 | 25 | 2.067 | 2.375 | 2 29/32 | 1 1/4 | 1 7/16 |
| E996K-CAR | 2 1/2 | 10 | 2.469 | 2.875 | 3 7/16 | 1 7/8 | 1 15/16 |
| E996L | 3 | 20 | 3.068 | 3.500 | 4 1/8 | 2 | 2 1/16 |
| E996L-CAR | 3 | 5 | 3.068 | 3.500 | 4 1/8 | 2 | 2 1/16 |
| E996N | 4 | 10 | 4.026 | 4.500 | 5 1/8 | 2 1/2 | 2 3/4 |

## Threaded Adapters



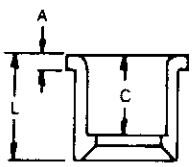
| Part No. | Size | Std. Ctn. Qty. |
|---|---|---|
| E9842D [1] | 1/2 | 25 |
| E9842E [2] | 3/4 | 25 |

[1] Fits 3/4" sockets [2] Fits 1" sockets

# Reducers

## Reducer Bushings

For connecting different sizes of conduit. Bell x Spigot.




| Part No. | Size | Std. Ctn. Qty. | L Typical | A Typical | C Typical |
|---|---|---|---|---|---|
| E950ED | 3/4" x 1/2" | 100 | 15/32 | 13/64 | 11/32 |
| E950FD-CAR | 1" x 1/2" | 25 | 1 11/32 | 3/16 | 57/64 |
| E950FE | 1" x 3/4" | 100 | 1 11/32 | 3/16 | 1 1/64 |
| E950GE-CAR | 1 1/4" x 3/4" | 10 | 1 15/32 | 3/16 | 1 1/64 |
| E950GF | 1 1/4" x 1" | 50 | 1 15/32 | 3/16 | 1 9/64 |
| E950HF-CAR | 1 1/2" x 1" | 10 | 1 19/32 | 3/16 | 1 9/64 |
| E950HG-CAR | 1 1/2" x 1 1/4" | 10 | 1 19/32 | 3/16 | 1 17/64 |
| E950JG-CAR | 2" x 1 1/4" | 10 | 1 3/4 | 7/32 | 1 17/64 |
| E950JH-CAR | 2" x 1 1/2" | 10 | 1 3/4 | 7/32 | 1 25/64 |
| E950KJ-CAR | 2 1/2" x 2" | 10 | 2 5/32 | 3/8 | 1 27/64 |
| E950LJ-CAR | 3" x 2" | 10 | 2 1/8 | 1/4 | 1 7/8 |
| ▶ E950LK | 3" x 2 1/2" | 25 | 1 15/16 | 1/4 | 1 11/16 |
| E950NL | 4" x 3" | 25 | 2 3/4 | 5/16 | 1 15/16 |

# Reducers

UL LISTED E32447

Except where noted by ▶

## Fabricated Reducers

Fabricated Reducers (Male x Male)

| Part No. | Size | Std. Ctn. Qty. | Std. Ctn. Wt. (lbs.) |
|---|---|---|---|
| ▶ E952KJ | 2 1/2" x 2" | 48 | 28 |
| ▶ E952LJ | 3" x 2" | 36 | 21 |
| ▶ E952LK | 3" x 2 1/2" | 36 | 31 |
| ▶ E952NL | 4" x 3" | 15 | 23 |
| ▶ E952NM | 4" x 3 1/2" | 15 | 25 |
| ▶ E952PN | 5" x 4" | 12 | 26 |
| ▶ E952RP | 6" x 5" | 10 | 31 |

# Plugs

## Reducer Plugs

| Part No. | Size | Std. Ctn. Qty. | Std. Ctn. Wt. (lbs.) |
|---|---|---|---|
| ▶ E971C | 3/4" x 1/2" | 100 | 2 |
| ▶ E971D | 1" x 3/4" | 100 | 3 |

## Plugs (Polyethylene)

| Part No. | Size | Std. Ctn. Qty. | Std. Ctn. Wt. (lbs.) |
|---|---|---|---|
| ▶ P258H | 1 1/2" | 50 | 2 |
| ▶ P258K | 2 1/2" | 25 | 1.5 |

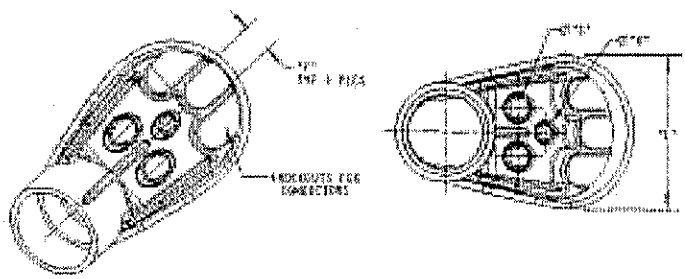
## Plugs with Pull Tabs (Polyethylene)

| Part No. | Size | Std. Ctn. Qty. | Std. Ctn. Wt. (lbs.) |
|---|---|---|---|
| ▶ P258JT | 2 | 60 | 3 |
| ▶ P258LT | 3 | 30 | 3 |
| ▶ P258NT | 4 | 48 | 8 |
| ▶ P258PT | 5 | 30 | 6 |
| ▶ P258RT | 6 | 30 | 9 |

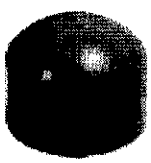
# Caps

## Service Entrance Caps

| Part No. | Size | Std. Ctn. Qty. | Dimensions (in.) F | G | H |
|---|---|---|---|---|---|
| E998D | 1/2 | 5 | .45 | .45 | – |
| E998E | 3/4 | 20 | .45 | .45 | – |
| E998E-CAR | 3/4 | 5 | .45 | .45 | – |
| E998F | 1 | 15 | .59 | .58 | – |
| E998F-CAR | 1 | 5 | .59 | .58 | – |
| E998G-CAR | 1 1/4 | 5 | .74 | .71 | .50 |
| E998H-CAR | 1 1/2 | 5 | .74 | .71 | .50 |
| E998J-CAR | 2 | 5 | .83 | .78 | .56 |
| E998K-UPC | 2 1/2 | 2 | 1.70 | 1.31 | 1.00 |
| E998L | 3 | 2 | 1.70 | 1.31 | 1.00 |
| E998N | 4 | 2 | 2.25 | 1.88 | 1.31 |



## End Caps



| Part No. | Size | Std. Ctn. Qty. | Std. Ctn. Wt. (lbs.) |
|---|---|---|---|
| ▶ E958D | 1/2 | 100 | 3 |
| ▶ E958E | 3/4 | 100 | 4 |
| ▶ E958F | 1 | 75 | 5 |
| ▶ E958G | 1 1/4 | 40 | 4 |
| ▶ E958H | 1 1/2 | 30 | 4 |
| ▶ E958J | 2 | 25 | 5 |
| ▶ E958K | 2 1/2 | 10 | 4 |
| ▶ E958L | 3 | 10 | 5 |
| ▶ E958N | 4 | 5 | 17 |
| ▶ E958P | 5 | 5 | 11 |
| ▶ E958R | 6 | 5 | 13 |

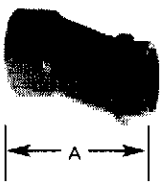
## PVC Riser Caps

| Part No. | Size | Std. Ctn. Qty. | Std. Ctn. Wt. (lbs.) |
|---|---|---|---|
| ▶ E935J | 2 | 25 | 9 |
| ▶ E935L | 3 | 25 | 18 |
| ▶ E935N | 4 | 25 | 18 |
| ▶ E935P | 5 | 25 | 35 |
| ▶ E935R | 6 | 10 | 13 |

# Offsets

UL LISTED E32447
Except where noted by ▶

## Meter Offset




| Part No. | Size | Std. Ctn. Qty. | Offset | A |
|---|---|---|---|---|
| ▶ E995G | 1 1/4 | 15 | 0.758 | 4.230 |
| E995G-CTN | 1 1/4 | 6 | 0.758 | 4.230 |
| ▶ E995J | 2 | 8 | 0.684 | 4.270 |

## Offset

| Part No. | Size | Std. Ctn. Qty. | Std. Ctn. Qty. Wt. (lbs.) |
|---|---|---|---|
| ▶ E994DR-CAR | 1/2 | 25 | 3 |
| ▶ E994ER-CAR | 3/4 | 15 | 2 |
| ▶ E994F | 1 | 50 | 12 |

# End Bells

## End Bells

| Part No. | Size | Std. Ctn. Qty. | Std. Ctn. Wt. (lbs.) |
|---|---|---|---|
| ▶ E997F | 1 | 50 | 1 |
| ▶ E997F-CAR | 1 | 15 | 1 |
| ▶ E997G | 1 1/4 | 35 | 1 |
| ▶ E997G-CAR | 1 1/4 | 15 | 1 |
| ▶ E997H | 1 1/2 | 30 | 1 |
| ▶ E997H-CAR | 1 1/2 | 10 | 1 |
| ▶ E997J | 2 | 40 | 1 |
| ▶ E997J-CAR | 2 | 10 | 1 |
| ▶ E997K | 2 1/2 | 30 | 2 |
| ▶ E997K-CAR | 2 1/2 | 10 | 2 |
| ▶ E997L | 3 | 50 | 2 |
| ▶ E997L-CAR | 3 | 10 | 2 |
| ▶ E997M | 3 1/2 | 40 | 10 |
| ▶ E997N | 4 | 30 | 11 |
| ▶ E997P | 5 | 15 | 10 |
| ▶ E997R | 6 | 10 | 7.4 |
| ▶ E997T | 8 | 3 | 14.55 |

## Fabricated End Bells Schedule 40

| Part No. | Size | Std. Ctn. Qty. | Std. Wt. (lbs.) |
|---|---|---|---|
| E949J5 | 2" x 5" | 50 | 10 |
| E949J6 | 2" x 6" | 25 | 12 |
| E949JN | 2" x 4" | 25 | 7 |
| E949JX | 2" x 8" | 12 | 7 |
| E949LR | 3" x 6" | 20 | 21 |
| E949N5 | 4" x 5" | 20 | 2 |
| E949NR | 4" x 6" | 15 | 21 |
| E949R5 | 6" x 5" | 12 | 27 |
| E949RX | 6" x 8" | 6 | 17 |

# Washers

## Flat Sealing Washer

Where a waterproof termination is required into any enclosure (metallic or nonmetallic), install the neoprene washer over the threads of a terminal adapter before inserting into the enclosure. Use a standard locknut or threaded bushing to secure the assembly.

| Part No. | Size | Std. Ctn. Qty. |
|---|---|---|
| ▶ E943DW | 1/2 | 125 |
| ▶ E943EW | 3/4 | 125 |
| ▶ E943FW | 1 | 100 |
| ▶ E943GW | 1 1/4 | 50 |
| ▶ E943HW | 1 1/2 | 50 |
| ▶ E943JW | 2 | 25 |

# Lock Nuts

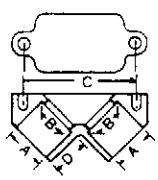
## PVC Lock Nut

| Part No. | Size | Std. Ctn. Qty. |
|---|---|---|
| ▶ LT9LD | 1/2 | 1200 |
| ▶ LT9LE | 3/4 | 700 |
| ▶ LT9LF | 1 | 600 |

# Pull Elbows

## Access Pull Elbows

Gasket included.




| Part No. | Size | Std. Ctn. Qty. | A Typical | B Typical | C Typical | D Typical |
|---|---|---|---|---|---|---|
| E990D | 1/2 | 75 | .852 | .836 | 2.187 | .718 |
| E990DR-CAR | 1/2 | 25 | .852 | .836 | 2.187 | .718 |
| E990E | 3/4 | 50 | 1.064 | 1.046 | 2.531 | .781 |
| E990ER-CAR | 3/4 | 20 | 1.064 | 1.046 | 2.531 | .781 |

# Sleeves

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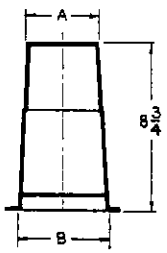
E32447
Except where noted by ▶

## HOLFORM™ Concrete Sleeves

HOLFORM nonmetallic concrete sleeve forms are the easy way to form holes in concrete. They install in seconds with nails, screws or staples and are easily removed. Concrete will not adhere to them. HOLFORMS are adjustable to any slab thickness.

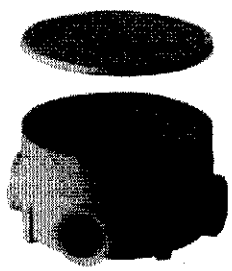


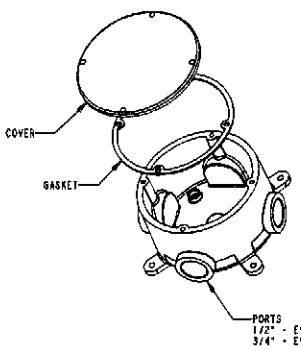

| Part No. | Min. O.D. A | B | Std. Ctn. Qty. | Std. Ctn. Wt. (lbs.) |
|---|---|---|---|---|
| ▶ E92CSH | 1 1/2 | 1 3/4 | 20 | 3 |
| ▶ E92CSJ | 2 | 2 13/32 | 25 | 6 |
| ▶ E92CSL | 3 | 3 13/32 | 25 | 8 |
| ▶ E92CSN | 4 | 4 13/32 | 18 | 8 |
| ▶ E92CSP | 5 | 5 13/32 | 15 | 8 |
| ▶ E92CSR | 6 | 6 13/32 | 12 | 8 |

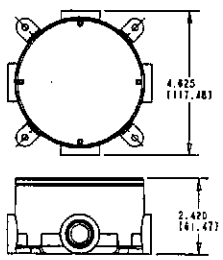
# Conduit Bodies

## Type X with Cover

Four knock-out type socket openings, 90° spacing. Available with 1/2" or 3/4" socket outlets. Includes cover and gasket.



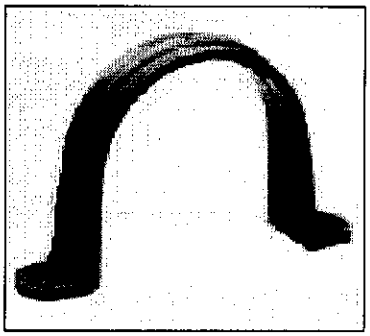



| Part No. | Size | Vol. Cu. In. | Std. Ctn. Qty. |
|---|---|---|---|
| E970CD | 1/2 | 15.16 | 15 |
| E970CE | 3/4 | 15.16 | 15 |

Supplied with 4 stainless steel cover screws. Diameter 4 1/8", Thickness 1/4".
*Not designed for use with wiring devices or light fixtures.

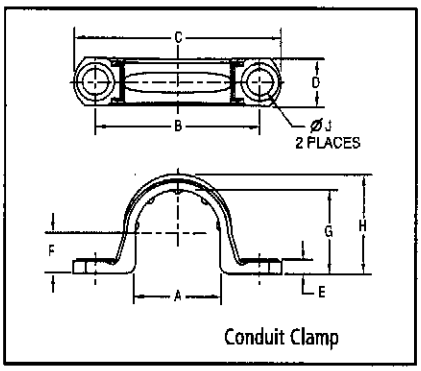
# Nonmetallic Clamps



Nonmetallic clamps offer the same chemical resistance as Carlon nonmetallic conduits for a complete, corrosion resistant system.

To be used in accordance with conduit spacing requirements per the NEC, Section 352.30.

- UV inhibited for use in direct sunlight




Conduit Clamp

## Conduit Clamps

| Part No. | Size: inches (mm) | Std. Ctn. Qty. | Std. Ctn. Wt. (lbs.) | A | B | C | D | E | F | G | H | J |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E977DC | 1/2" (16) | 100 | 1.2 | 0.892 (22.6) | 1.71 (43.4) | 2.16 (54.8) | 0.50 (12.7) | .14 (3.5) | .42 (10.6) | .866 (21.9) | 1.04 (26.4) | .260 (6.6) |
| E977EC | 3/4" (21) | 100 | 1.4 | 1.102 (27.9) | 1.97 (50.0) | 2.40 (60.9) | 0.50 (12.7) | .14 (3.5) | .525 (13.3) | 1.076 (27.3) | 1.255 (31.8) | .260 (6.6) |
| E977FC | 1" (27) | 100 | 2 | 1.39 (35.3) | 2.25 (57.1) | 2.81 (71.3) | 0.594 (15.0) | .14 (3.5) | .658 (16.7) | 1.342 (34.0) | 1.574 (39.9) | .260 (6.6) |
| E977GC | 1 1/4" (35) | 50 | 5 | 1.714 (43.5) | 2.68 (68.0) | 3.28 (83.3) | .64 (16.2) | .15 (3.8) | .83 (21.0) | 1.687 (42.8) | 1.89 (48.0) | .320 (8.1) |
| E977HC | 1 1/2" (41) | 50 | 6 | 1.92 (48.7) | 2.82 (71.6) | 3.44 (87.3) | .70 (17.7) | .15 (3.8) | .97 (24.6) | 1.93 (49.0) | 2.12 (53.8) | .312 (7.9) |
| E977JC | 2" (53) | 25 | 4.5 | 2.54 (64.5) | 3.54 (89.9) | 4.18 (106.1) | .76 (19.3) | .16 (4.0) | 1.05 (26.6) | 2.29 (58.1) | 2.49 (63.2) | .315 (8.0) |
| E977KC-CAR | 2 1/2" (63) | 25 | 1.4 | 2.86 (72.6) | 4.50 (114.3) | 5.46 (138.7) | 1.00 (25.4) | .20 (5.08) | 1.43 (36.3) | 2.86 (72.6) | 3.12 (79.2) | .36 (9.14) |
| E977LC-CAR | 3" (78) | 20 | 1.4 | 3.47 (88.2) | 5.00 (127.0) | 6.00 (152.4) | 1.00 (25.4) | .20 (5.08) | 1.74 (44.3) | 3.48 (88.4) | 3.70 (94.0) | .36 (9.14) |
| E977NC-CAR | 4" (103) | 15 | 12.2 | 4.366 (110.9) | 6.15 (156.2) | 7.20 (182.9) | 1.00 (25.4) | .20 (5.08) | 2.32 (58.8) | 4.50 (114.3 | 4.70 (119.4) | .36 (9.14) |

*Note: Some clamp applications require 2 screws, 2 nuts and 2 washers.

# Typical Properties of Conduit Raw Material Compound

## Thermal

| | ASTM Test | Typical Values |
|---|---|---|
| Co-efficient of Thermal Expansion-inch/inch/°F (properties @ 73.4°F) | D696 | 3.38 x $10^{-5}$ |
| Heat Distortion °F at 264 psi | D648 | 160°F |
| Thermal Conductivity BTU (hr.) (ft.) (°F/in.) | N/A | 1.3 |

## Mechanical

| | ASTM Test | Typical Values |
|---|---|---|
| Specific Gravity | D792 | 1.43 - 1.6 |
| Tensile Strength (psi) @ 73.4°F | D638 | 5,000-6,500 |
| Izod Impact ft lbs./in. of notch | D256 | 0.65 - 1.5 |
| Flexural Strength (psi) | D790 | 12,500 |
| Compressive Strength (psi) | D695 | 9,000 |
| Hardness (Durometer D) | D2240 | 85 |

## Electrical

| | ASTM Test | Typical Values |
|---|---|---|
| Dielectrical Strength volts/mil | D149 | 1100 |
| Dielectric Constant 60 CPS @ 30°C | D150 | 4.00 |
| Power Factor 60 CPS @ 30°C | D150 | 1.93 |

## Impedance (Volts lost per ampere per 100 feet)

| | 3∅90% P.F. | 80% P.F. | 1∅90% P.F. | 80% P.F. |
|---|---|---|---|---|
| Steel Conduit | .0118 | .0123 | .0136 | .0142 |
| Schedule 40® | .0105 | .0106 | .0121 | .0122 |

Using 250 KCmil Cu. conductor. comparable values for other conductor sizes.

# Wire Fill

## Maximum number of conductors in Schedule 40 PVC conduit

(Based on Table 1, Chapter 9 of the NEC)

| Type Letters | Conductor Size AWG, MCM | Trade Size ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 3½ | 4 | 4¼ | 5 | 6 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| THWN | 14 | 13 | 24 | 39 | 69 | 94 | 154 | | | | | | | | |
| | 12 | 10 | 18 | 29 | 51 | 79 | 114 | 164 | | | | | | | |
| | 10 | 6 | 11 | 18 | 32 | 44 | 73 | 194 | 160 | | | | | | |
| | 8 | 3 | 5 | 9 | 19 | 22 | 36 | 51 | 71 | 106 | 136 | | | | |
| THHN | 6 | 1 | 4 | 6 | 11 | 15 | 26 | 37 | 57 | 76 | 98 | 125 | 154 | | |
| | 4 | 1 | 2 | 4 | 7 | 9 | 16 | 22 | 35 | 47 | 60 | 75 | 94 | 137 | 236 |
| FEP (14 thru 2) | 3 | 1 | 1 | 3 | 6 | 8 | 13 | 19 | 29 | 39 | 51 | 64 | 90 | 116 | 201 |
| | 2 | 1 | 1 | 3 | 5 | 7 | 11 | 16 | 25 | 33 | 43 | 54 | 67 | 97 | 169 |
| FEPB (14 thru 8) | 1 | | 1 | 1 | 3 | 5 | 9 | 12 | 18 | 25 | 32 | 49 | 59 | 72 | 125 |
| | 1/0 | | 1 | 1 | 3 | 4 | 7 | 10 | 15 | 21 | 27 | 33 | 42 | 61 | 105 |
| PFA (14 thru 4/0) | 2/0 | | 1 | 1 | 2 | 3 | 6 | 8 | 13 | 17 | 22 | 28 | 35 | 51 | 88 |
| | 3/0 | | 1 | 1 | 1 | 3 | 5 | 7 | 11 | 14 | 18 | 23 | 29 | 42 | 73 |
| PFAH (14 thru 4/0) | 4/0 | | 1 | 1 | 1 | 2 | 4 | 6 | 9 | 12 | 15 | 19 | 24 | 35 | 61 |
| | 250 | | | 1 | 1 | 1 | 3 | 4 | 7 | 10 | 12 | 16 | 20 | 28 | 49 |
| Z (14 thru 4/0) | 300 | | | 1 | 1 | 1 | 3 | 4 | 6 | 8 | 11 | 13 | 17 | 24 | 42 |
| | 350 | | | 1 | 1 | 1 | 2 | 3 | 5 | 7 | 9 | 12 | 15 | 21 | 37 |
| | 400 | | | | 1 | 1 | 1 | 3 | 5 | 6 | 8 | 10 | 13 | 19 | 33 |
| XHHW (4 thru 500MCM) | 500 | | | | 1 | 1 | 1 | 2 | 4 | 5 | 7 | 9 | 11 | 16 | 27 |
| | 600 | | | | 1 | 1 | 1 | 1 | 3 | 4 | 5 | 7 | 9 | 13 | 22 |
| | 700 | | | | | 1 | 1 | 1 | 3 | 4 | 5 | 6 | 8 | 11 | 19 |
| | 750 | | | | | 1 | 1 | 1 | 2 | 3 | 4 | 6 | 7 | 11 | 19 |
| | 6 | 1 | 3 | 5 | 9 | 13 | 21 | 30 | 47 | 63 | 81 | 102 | 128 | 185 | 320 |
| | 600 | | | | 1 | 1 | 1 | 1 | 3 | 4 | 5 | 7 | 9 | 13 | 22 |
| XHHW | 700 | | | | | 1 | 1 | 1 | 3 | 4 | 5 | 6 | 7 | 11 | 19 |
| | 750 | | | | | 1 | 1 | 1 | 2 | 3 | 4 | 6 | 7 | 10 | 18 |

## Maximum number of conductors in Schedule 80 PVC conduit

(Based on Table 1, Chapter 9 of the NEC)

| Conductor Size AWG, MCM | | Trade Size ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| #14 | THW | 4 | 8 | 13 | 24 | 34 | 57 | 82 | 128 | | |
| | THHN | 10 | 19 | 33 | 58 | 81 | 135 | 194 | 0 | | |
| 12 | THW | 3 | 6 | 11 | 20 | 28 | 47 | 67 | 105 | 183 | |
| | THHN | 8 | 14 | 24 | 43 | 60 | 100 | 144 | 0 | | |
| 10 | THW | 3 | 5 | 9 | 16 | 22 | 37 | 54 | 85 | 148 | |
| | THHN | 5 | 9 | 15 | 27 | 38 | 64 | 92 | 143 | | |
| 8 | THW | 1 | 2 | 4 | 8 | 11 | 19 | 28 | 44 | 77 | 121 |
| | THHN | 1 | 4 | 7 | 13 | 18 | 31 | 45 | 70 | 123 | 195 |
| 6 | THW | 1 | 1 | 3 | 6 | 8 | 14 | 20 | 32 | 56 | 88 |
| | THHN | 1 | 3 | 5 | 9 | 13 | 22 | 32 | 50 | 88 | 140 |
| 4 | THW | 0 | 1 | 2 | 4 | 6 | 10 | 15 | 24 | 42 | 66 |
| | THHN | 1 | 1 | 3 | 6 | 8 | 13 | 20 | 31 | 54 | 86 |
| 3 | THW | 0 | 1 | 1 | 4 | 5 | 9 | 13 | 20 | 36 | 57 |
| | THHN | 1 | 1 | 2 | 5 | 7 | 11 | 17 | 26 | 46 | 73 |
| 2 | THW | 0 | 1 | 1 | 3 | 4 | 8 | 11 | 17 | 31 | 49 |
| | THHN | 1 | 1 | 1 | 4 | 5 | 9 | 14 | 22 | 38 | 61 |
| 1 | THW | 0 | 1 | 1 | 1 | 3 | 5 | 8 | 13 | 22 | 35 |
| | THHN | 0 | 1 | 1 | 3 | 4 | 7 | 10 | 16 | 28 | 45 |
| 0 | THW | 0 | 0 | 1 | 1 | 2 | 4 | 7 | 11 | 19 | 30 |
| | THHN | 0 | 1 | 1 | 2 | 3 | 6 | 8 | 13 | 24 | 38 |
| 00 | THW | 0 | 0 | 1 | 1 | 1 | 4 | 6 | 9 | 16 | 26 |
| | THHN | 0 | 1 | 1 | 1 | 3 | 5 | 7 | 11 | 20 | 32 |
| 000 | THW | 0 | 0 | 1 | 1 | 1 | 3 | 5 | 8 | 14 | 22 |
| | THHN | 0 | 0 | 1 | 1 | 2 | 4 | 6 | 9 | 16 | 26 |
| 0000 | THW | 0 | 0 | 1 | 1 | 1 | 3 | 4 | 6 | 11 | 18 |
| | THHN | 0 | 0 | 1 | 1 | 1 | 3 | 5 | 8 | 14 | 22 |
| 250 | THW | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 5 | 9 | 14 |
| | THHN | 0 | 0 | 0 | 1 | 1 | 2 | 4 | 6 | 11 | 18 |
| 300 | THW | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 4 | 8 | 13 |
| | THHN | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 5 | 9 | 15 |
| 350 | THW | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 4 | 7 | 11 |
| | THHN | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 4 | 8 | 13 |
| 400 | THW | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 6 | 10 |
| | THHN | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 4 | 7 | 12 |
| 500 | THW | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 5 | 8 |
| | THHN | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 6 | 10 |
| 600 | THW | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 4 | 7 |
| | THHN | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 5 | 8 |
| 700 | THW | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 6 |

# Weight Comparison

Carlon Schedule 40® rigid nonmetallic conduit compared to other rigid conduit in pounds per 100 feet (approx.)

| Nom. Size | Carlon Schedule 40® Rigid Nonmetallic Conduit | Carlon Schedule 80® Rigid Nonmetallic Conduit | Aluminum | Electrical Metallic Tubing (EMT) | Intermediate Metal Conduit (IMC) | Rigid Metal Conduit (RMC) |
|---|---|---|---|---|---|---|
| ½ | 18 | 22 | 27 | 30 | 57 | 79 |
| ¾ | 23 | 29 | 36 | 46 | 78 | 105 |
| 1 | 35 | 43 | 53 | 66 | 112 | 153 |
| 1¼ | 48 | 60 | 70 | 96 | 114 | 201 |
| 1½ | 57 | 72 | 86 | 112 | 176 | 246 |
| 2 | 76 | 100 | 116 | 142 | 230 | 334 |
| 2½ | 125 | 153 | 183 | 230 | 393 | 527 |
| 3 | 164 | 212 | 239 | 270 | 483 | 690 |
| 3½ | 198 | | 288 | 350 | 561 | 831 |
| 4 | 234 | 310 | 340 | 400 | 625 | 982 |
| 5 | 317 | 431 | 465 | Not Made | Not Made | 1344 |
| 6 | 412 | 592 | 612 | Not Made | Not Made | 1770 |

# Expansion and Contraction

## Temperature Considerations for Rigid Nonmetallic Conduit Compensation for Linear Expansion

Like all construction materials, PVC will expand or contract with variations in temperatures. The coefficient of linear expansion in PVC conduit is 3.38 x $10^{-5}$ in./in./°F as compared to 1.2 x $10^{-5}$ for aluminum and 0.6 x $10^{-5}$ for steel. An expansion coupling is needed whenever the change in length due to temperature variation will exceed 1/2 in.

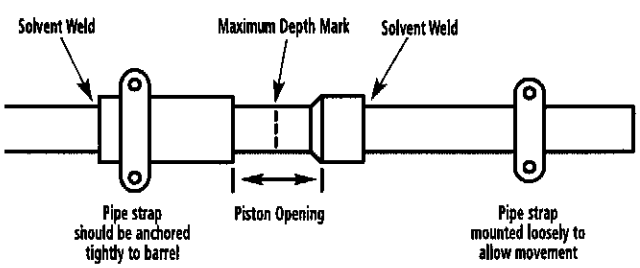
Add 30°F to the estimated temperature range when conduit is installed in direct sunlight to allow for radiant heating.

An expansion coupling consists of two sections of conduit, one telescoping inside another. When installing expansion couplings, alignment of piston and barrel is important. Be sure to mount expansion joint level for best performance.

For a vertical run, the expansion coupling must be installed close to the top of the run with the barrel jointing down, in order that rain water does not run into the opening. The lower end of the conduit run must be secured at the bottom so that any length change due to temperature variation will result in an upward movement.

### Expansion Characteristics of PVC Rigid Nonmetallic Conduit
### Coefficient of Thermal Expansion = 3.38 x $10^{-5}$ in./in./°F

| Temperature Change in Degrees F | Length Change in inches per 100 Ft. of PVC Conduit | Temperature Change in Degrees F | Length Change in inches per 100 Ft. of PVC Conduit | Temperature Change in Degrees F | Length Change in inches per 100 Ft. of PVC Conduit | Temperature Change in Degrees F | Length Change in inches per 100 Ft. of PVC Conduit |
|---|---|---|---|---|---|---|---|
| 5 | 0.2 | 55 | 2.2 | 105 | 4.2 | 155 | 6.3 |
| 10 | 0.4 | 60 | 2.4 | 110 | 4.5 | 160 | 6.5 |
| 15 | 0.6 | 65 | 2.6 | 115 | 4.7 | 165 | 6.7 |
| 20 | 0.8 | 70 | 2.8 | 120 | 4.9 | 170 | 6.9 |
| 25 | 1.0 | 75 | 3.0 | 125 | 5.1 | 175 | 7.1 |
| 30 | 1.2 | 80 | 3.2 | 130 | 5.3 | 180 | 7.3 |
| 35 | 1.4 | 85 | 3.4 | 135 | 5.5 | 185 | 7.5 |
| 40 | 1.6 | 90 | 3.6 | 140 | 5.7 | 190 | 7.7 |
| 45 | 1.8 | 95 | 3.8 | 145 | 5.9 | 195 | 7.9 |
| 50 | 2.0 | 100 | 4.1 | 150 | 6.1 | 200 | 8.1 |




## Determine the Piston Opening

The expansion joint must be installed to allow both expansion and contraction of the conduit run. The correct piston opening for any installation condition should use the following formula:

$$O = \left[\frac{T\,max - T\,installed}{\Delta T}\right] E$$

Where:

| | | |
|---|---|---|
| O | = | Piston opening (in.) |
| T max | = | Maximum anticipated temperature of conduit (°F) |
| T inst. | = | Temperature of conduit at time of installation (°F) |
| $\Delta$ T | = | Total change in temperature of conduit (°F) |
| E | = | Expansion allowance built into each expansion coupling (in.) |

## Example

380 ft. of conduit is to be installed on the outside of a building exposed to the sun in a single straight run. It is expected that the conduit will vary in temperature from 0°F in the winter to 140°F in the summer (this includes the 30°F for radiant heating from the sun.) The installation is to be made at a conduit temperature of 90°F. From the table, a 140°F temperature change will cause a 5.7 in. length change in 100 ft. of conduit. The total change for this example is 5.7" x 3.8 = 21.67" which should be rounded to 22". The number of expansion couplings will be 22" x coupling range (4" for Carlon trade sizes 1/2" through 1-1/2", and 8" for sizes 2" through 6".) If the E945D coupling is used, the number will be 22" x 4 = 5.50 which should be rounded to 6. The coupling should be placed at 62 ft. intervals (380 x 6). the proper piston setting at the time of installation is calculated as explained above.

$$O = \left[\frac{140 - 90}{140}\right] 4.0 = 1.4 \text{ in.}$$

Insert the piston into the barrel to the maximum depth. Place a mark on the piston at the end of the barrel. To properly set the piston, pull the piston out of the barrel to correspond to the 2.1 in. calculated above. See drawing at lower left.

## Summary

1. Anticipate expansion and contraction of PVC conduit in aboveground, exposed installation.
2. Use an expansion coupling when length change due to temperature variation will exceed 1/2".
3. PVC conduit expands 4.1" for each 100 feet of run and a 100°F temperature change.
4. Align expansion coupling with the conduit run to prevent binding.
5. Follow the instructions to set the piston opening.
6. Rigidly fix the outer barrel of the expansion coupling so it cannot move. Mount the conduit connected to the piston loosely enough to allow the conduit to move as the temperature changes.

# Corrosion Resistance of Carlon Schedule 40 and Schedule 80 PVC Conduit and Fittings

Carlon Schedule 40 and Schedule 80 are generally acceptable for use in environments containing the chemicals below. These environmental resistance ratings are based upon tests where the specimens were placed in complete submergence in the reagent listed. Schedule 40 and Schedule 80 can be used in many process areas where chemicals not on this list are manufactured or used because worker safety requirements dictate that any air presence or splashing be at a very low level.

**If there are any questions for specific suitability in a given environment, prototype samples should be tested under actual conditions.**

- Acetic Acid 0-20%
- Acetic Acid 20-30%
- Acetic Acid 30-60%
- Acetic Acid 80%
- Acetic Acid – Glacial
- Acetic Acid Vapors
- Acetylene
- Adipic Acid
- Alum
- Aluminum Chloride
- Aluminum Fluoride
- Aluminum Hydroxide
- Aluminum Oxychloride
- Aluminum Nitrate
- Aluminum Sulfate
- Ammonia-Dry Gas
- Ammonium Bifluoride
- Ammonium Carbonate
- Ammonium Chloride
- Ammonium Hydroxide 28%
- Ammonium Metaphosphate
- Ammonium Nitrate
- Ammonium Persulfate
- Ammonium Phosphate – Neutral
- Ammonium Sulfate
- Ammonium Sulfide
- Ammonium Thiocyanate
- Amyl Alcohol
- Anthraquinone
- Anthraquinonesulfonic Acid
- Antimony Trichloride
- Aqua Regia
- Arsenic Acid 80%
- Arylsulfonic Acid
- Barium Carbonate
- Barium Chloride
- Barium Hydroxide
- Barium Sulfate
- Barium Sulfide
- Beet – Sugar Liquor
- Benzine Sulfonic Acid 10%
- Benzoic Acid
- Bismuth Carbonate
- Black Liquor (Paper Industry)
- Bleach – 12.5% Active CL
- Borax
- Boric Acid
- Brine
- Breeder Pellets – Dane. Fish
- Bromic Acid
- Bromine – Water
- Butane
- Butadiene
- Butyl Alcohol
- Butyl Phenol
- Butylene
- Butyric Acid
- Calcium Bisulfite
- Calcium Carbonate
- Calcium Chlorate
- Calcium Chloride
- Calcium Hydroxide
- Calcium Hypochlorite
- Calcium Nitrate
- Calcium Sulfate
- Carbonic Acid
- Carbon Dioxide Gas – Wet
- Carbon Dioxide – Aqueous Solution
- Carbon Monoxide
- Caustic Potash
- Caustic Soda
- Chloracatic Acid
- Chloral Hydrate
- Chlorine Gas (Dry)
- Chlorine Gas (Moist)
- Chlorine Water
- Chlorosulfonic Acid
- Chrome Alum
- Chromic Acid 10%
- Chromic Acid 30%
- Chromic Acid 40%
- Chromic Acid 50%
- Citric Acid
- Copper Chloride
- Copper Cyanide
- Copper Fluoride
- Copper Nitrate
- Copper Sulfate
- Cottonseed Oil
- Cresylic Acid 50%
- Crude Oil – Sour
- Crude Oil – Sweet
- Demineralized Water
- Dextrin
- Dextrose
- Diglycolic Acid
- Disodium Phosphate
- Ethyl Alcohol
- Ethylene Glycol
- Fatty Acids
- Ferric Chloride
- Ferric Nitrate
- Ferric Sulfate
- Ferrous Chloride
- Ferrous Sulfate
- Fluorine Gas – Wet
- Fluorine Gas – Dry
- Fluoroboric Acid
- Fluorosilicic Acid
- Formaldehyde
- Formic Acid
- Fructose
- Gallic Acid
- Gas – Coke Oven
- Gas – Natural (Dry)
- Gas – Natural (Wet)
- Gasoline – Sour
- Gasoline – Refined
- Glucose
- Glycerine (Glycerol)
- Glycol
- Glycolic Acid
- Green Liquor (Paper Industry)
- Heptane
- Hexanol, Tertiary
- Hydrobromic Acid 20%
- Hydrochloric Acid 0% - 25%
- Hydrochloric Acid 25% - 40%
- Hydrocyanic Acid or Hydrogen Cyanide
- Hydrofluoric Acid 10%
- Hydrofluorosilicic Acid
- Hydrogen Phosphide
- Hydrogen Sulfide – Dry
- Hydrogen Sulfide – Aqueous Solution
- Hydroquinone
- Hydroxylamine Sulfate
- Iodine
- Kerosene
- Lactic Acid 28%
- Lauric Acid
- Lauryl Chloride
- Lauryl Sulfate
- Lead Acetate
- Lime Sulfur
- Linoleic Acid
- Linseed Oil
- Lubricating Oils
- Magnesium Carbonate
- Magnesium Chloride
- Magnesium Hydroxide
- Magnesium Nitrate
- Magnesium Sulfate
- Maleic Acid
- Malic Acid
- Mercuric Chloride
- Mercuric Cyanide
- Mercurous Nitrate
- Mercury
- Methyl Sulfate
- Methylene Chloride
- Mineral Oils
- Naphthalene
- Nickel Chloride
- Nickel Nitrate
- Nitric Acid, Anydrous
- Nitric Acid 20%
- Nitric Acid 40%
- Nitric Acid 60%
- Nitrobenzene
- Nitrous Oxide
- Oils and Fats
- Oils – Petroleum – (See Type)
- Oleic Acid
- Oxalic Acid
- Palmitic Acid 10%
- Perchloric Acid 10%
- Phenylhydrazine Hydrochloride
- Phosgene, Gas
- Phosphoric Acid – 0-25%
- Phosphoric Acid – 25-50%
- Phosphoric Acid – 50-85%
- Photographic Chemicals
- Plating Solutions
- Potassium Bicarbonate
- Potassium Bichromate
- Potassium Borate
- Potassium Bromide
- Potassium Carbonate
- Potassium Chloride
- Potassium Chromate
- Potassium Cyanide
- Potassium Dichromate
- Potassium Ferricyanide
- Potassium Ferrocyanide
- Potassium Fluoride
- Potassium Hydroxide
- Potassium Nitrate
- Potassium Perborate
- Potassium Perchlorate
- Potassium Permanganate 10%
- Potassium Persulfate
- Potassium Sulfate
- Propane
- Propyl Alcohol
- Silicic Acid
- Silver Cyanide
- Silver Nitrate
- Silver Plating Solutions
- Sodium Acetate
- Sodium Arsenite
- Sodium Benzoate
- Sodium Bicarbonate
- Sodium Bisulfate
- Sodium Bisulfite
- Sodium Bromide
- Sodium Chlorate
- Sodium Chloride
- Sodium Cyanide
- Sodium Dichromate
- Sodium Ferricyanide
- Sodium Ferrocyanide
- Sodium Fluoride
- Sodium Hydroxide
- Sodium Hypochlorite
- Sodium Nitrate
- Sodium Nitrite
- Sodium Sulfate
- Sodium Sulfide
- Sodium Sulfite
- Sodium Thiosulfate (Hypo)
- Stannic Chloride
- Stannous Chloride
- Stearic Acid
- Sulfur
- Sulfur Dioxide – Gas Dry
- Sulfur Trioxide
- Sulfuric Acid – 0-10%
- Sulfuric Acid – 10-75%
- Sulfuric Acid – 75-90%
- Sulfurous Acid
- Tannic Acid
- Tanning Liquors
- Tartaric Acid
- Titanium Tetrachloride
- Triethanolamine
- Trimethyl Propane
- Trisodium Phosphate
- Turpentine
- Urea
- Vinegar
- Whiskey
- White Liquor (Paper Industry)
- Wines
- Zinc Chloride
- Zinc Chromate
- Zinc Cyanide
- Zinc Nitrate
- Zinc Sulfate

# Suggested Format for Specifying Carlon Nonmetallic Conduit, Conduit Fittings and Junction Boxes

**A.** The Carlon rigid nonmetallic conduit system shall be installed as indicated on the drawings and as specified herein.

**B.** All wiring shall be installed in Carlon rigid nonmetallic conduit. All conduit shall be secured by means of proper fittings. All fittings shall be Carlon.

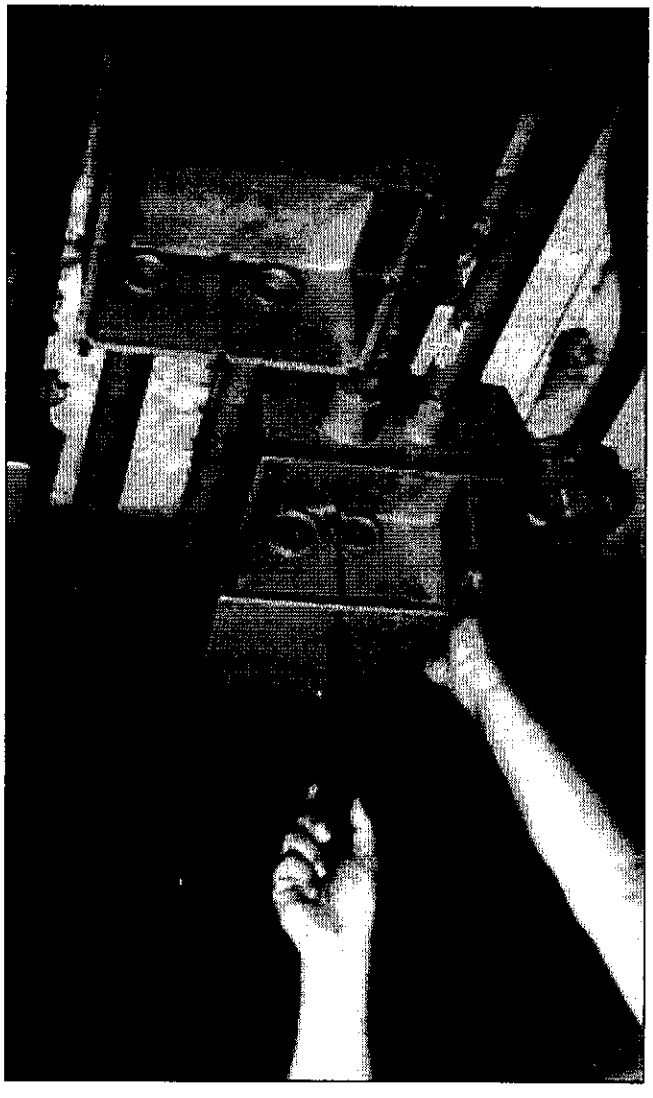
**C.** Carlon outlet boxes, fittings and junction boxes shall be used for all outlets, pull boxes and junction points. (Lighting fixtures shall not be supported or hung from PVC junction boxes but be supported in position by other means.)

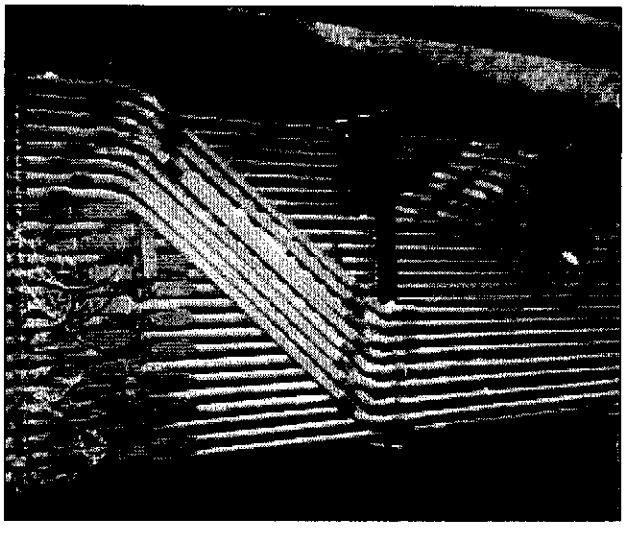
**D.** Exposed conduits shall be mounted securely by suitable hangers or straps with the maximum spacing of points of supports not greater than indicated by Section 352.30 of the NEC.

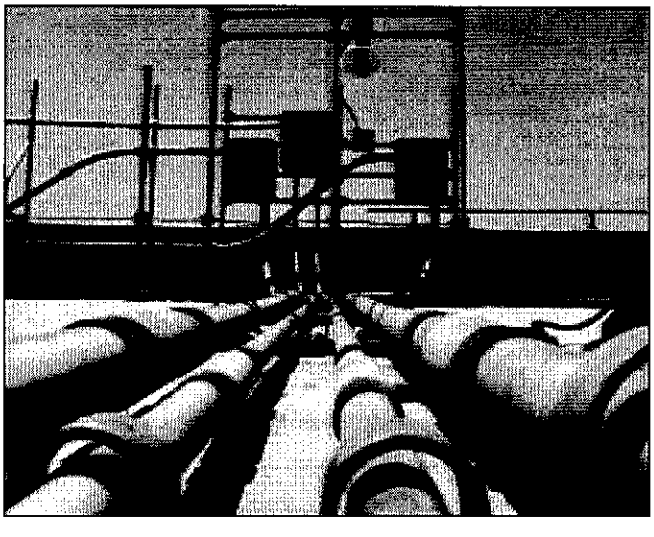
**E.** Except where embedded in concrete or direct buried, Carlon conduit shall be supported to permit adequate lineal movement to allow for expansion and contraction of conduit due to temperature change.

**F.** For aboveground installations where temperature change in excess of 14°C (25°F) is anticipated, expansion joints shall be installed. See Table 352.44(A) NEC for expansion characteristics.

**G.** Proper care shall be taken when field bending is employed to maintain the internal diameter and wall thickness of the conduit.







# Carlon®
# Cements, Primers and Sealers

*Spray Cement*

*Medium Clear*

*Medium Gray*

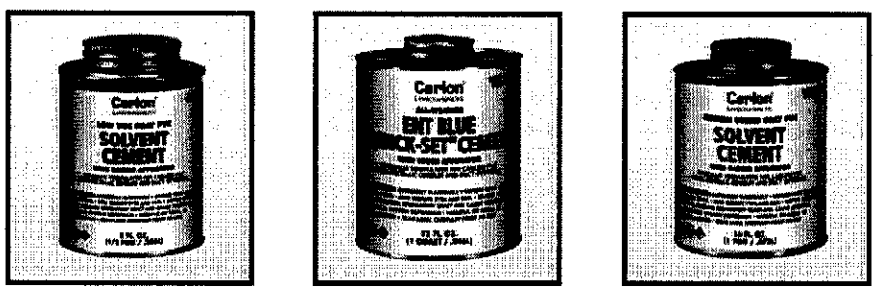
*Regular Clear*

*Regular Gray*

*Low VOC Gray*

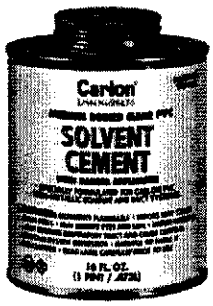
*Primers*

*Spray Sealers*




***Innovative Solutions For Wire and Cable Management***

# Medium – Clear




| Recommended pipe application and sizes | Set-up time (Evaporation Rate) | Recommended installation temp. | Lap Shear @ 73°F | Viscosity at 75° as manufactured |
|---|---|---|---|---|
| Recommended for all grades and types of Carlon PVC conduit, duct, wireway and fittings, except Flex-Plus® Blue™ ENT (Electrical Nonmetallic Tubing.) **Up through 6" diameter.** | 10°-30°F Not recommended<br>30°-50°F 5-6 minutes<br>50°-70°F 3-4 minutes<br>70°-90°F 1-2 minutes | 40° to 100°F | 2 hrs. 350 psi<br>16 hrs. 800 psi<br>72 hrs. 1,500 psi | 500-900 cps |

| Part No | Size | Applicator | Description | Ctn. Qty. | Ctn. Wt. (lbs.) |
|---|---|---|---|---|---|
| VC9963 | Pint | Dauber | PVC Medium Clear | 24 | 29.0 |
| VC9962 | Quart | Dauber | PVC Medium Clear | 12 | 27.5 |
| VC9961P | Gallon | – | PVC Medium Clear | 6 | 53.5 |

*Meets ASTM D-2564*

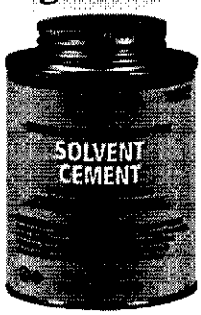
# Medium – Gray

| Recommended pipe application and sizes | Set-up time (Evaporation Rate) | Recommended installation temp. | Lap Shear @ 73°F | Viscosity at 75° as manufactured |
|---|---|---|---|---|
| Recommended for all grades and types of Carlon PVC conduit, duct, wireway and fittings, except Flex-Plus® Blue™ ENT (Electrical Nonmetallic Tubing.) **Up through 6" diameter.** | 10°-30°F Not recommended<br>30°-50°F 5-6 minutes<br>50°-70°F 3-4 minutes<br>70°-90°F 1-2 minutes | 40° to 100°F | 2 hrs. 350 psi<br>16 hrs. 800 psi<br>72 hrs. 1,500 psi | 500-900 cps |

| Part No | Size | Applicator | Description | Ctn. Qty. | Ctn. Wt. (lbs.) |
|---|---|---|---|---|---|
| VC9923 | Pint | Dauber | PVC Medium Gray | 24 | 29.0 |
| VC9922 | Quart | Dauber | PVC Medium Gray | 12 | 27.5 |
| VC9941P | Gallon | – | PVC Medium Gray | 6 | 53.5 |

*Meets ASTM D-2564*

# Regular – Clear

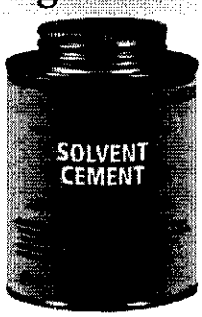



| Recommended pipe application and sizes | Set-up time (Evaporation Rate) | Recommended installation temp. | Lap Shear @ 73°F | Viscosity at 75° as manufactured |
|---|---|---|---|---|
| Recommended for all grades and types of Carlon PVC conduit, duct, wireway and fittings, except Flex-Plus® Blue™ ENT (Electrical Nonmetallic Tubing.) **Up through 6" diameter.** | 10°-30°F Not recommended<br>30°-50°F 5-6 minutes<br>50°-70°F 3-4 minutes<br>70°-90°F 1-2 minutes | 40° to 100°F | 2 hrs. 350 psi<br>16 hrs. 800 psi<br>72 hrs. 1,500 psi | 500-900 cps |

| Part No | Size | Applicator | Description | Ctn. Qty. | Ctn. Wt. (lbs.) |
|---|---|---|---|---|---|
| VC9964 | 1/2 Pint | Dauber | PVC Regular Clear | 10 | 29.06.5 |

*Meets ASTM D-2564*

# Regular – Gray




| Recommended pipe application and sizes | Set-up time (Evaporation Rate) | Recommended installation temp. | Lap Shear @ 73°F | Viscosity at 75° as manufactured |
|---|---|---|---|---|
| Recommended for all grades and types of Carlon PVC conduit, duct, wireway and fittings, except Flex-Plus® Blue™ ENT (Electrical Nonmetallic Tubing.) **Up through 6" diameter.** | 10°-30°F Not recommended<br>30°-50°F 5-6 minutes<br>50°-70°F 3-4 minutes<br>70°-90°F 1-2 minutes | 40° to 100°F | 2 hrs. 350 psi<br>16 hrs. 800 psi<br>72 hrs. 1,500 psi | 500-900 cps |

| Part No | Size | Applicator | Description | Ctn. Qty. | Ctn. Wt. (lbs.) |
|---|---|---|---|---|---|
| VC9924-24 | 1/2 Pint | Dauber | PVC Regular Gray | 24 | 15.0 |

*Meets ASTM D-2564*

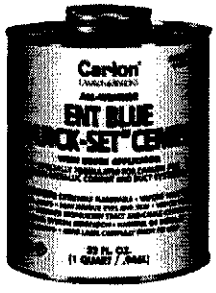
## All Weather – Clear

| Recommended pipe application and sizes | Set-up time (Evaporation Rate) | Recommended installation temperature | Lap Shear @ 73°F | Viscosity at 75° as manufactured |
|---|---|---|---|---|
| Recommended for all grades and types of Carlon PVC conduit, duct, wireway and fittings, except Flex-Plus® Blue™ ENT (Electrical Nonmetallic Tubing.) **Up through 6" diameter.** | -5°–10°F 6-8 minutes<br>10°–30°F 4-5 minutes<br>30°–50°F 3-4 minutes<br>50°–70°F 1-2 minutes<br>70°–90°F 1/2-1 1/2 minutes | -5° to 100°F | 2 hrs. 350 psi<br>16 hrs. 800 psi<br>72 hrs. 1,500 psi | 400-700 cps |

| Part No | Size | Applicator | Description | Ctn. Qty. | Ctn. Wt. (lbs.) |
|---|---|---|---|---|---|
| VC9984 | 1/2 Pint | Dauber | All Weather "Quick-Set" Cement | 10 | 7.0 |
| VC9983 | Pint | Dauber | All Weather "Quick-Set" Cement | 24 | 30.0 |
| VC9982 | Quart | Dauber | All Weather "Quick-Set" Cement | 12 | 29.0 |
| VC9981P | Gallon | – | All Weather "Quick-Set" Cement | 6 | 54.0 |

*Meets ASTM D-2564*

## All Weather – ENT Blue




| Recommended pipe application and sizes | Set-up time (Evaporation Rate) | Recommended installation temperature | Lap Shear @ 73°F | Viscosity at 75° as manufactured |
|---|---|---|---|---|
| Required for use with Flex-Plus® Blue™ ENT (Electrical Nonmetallic Tubing), Riser-Gard®, P&C Flex®, and Carlon PVC fittings. **Up through 6" diameter.** | -5°–10°F 6-8 minutes<br>10°–30°F 4-5 minutes<br>30°–50°F 3-4 minutes<br>50°–70°F 1-2 minutes<br>70°–90°F 1/2-1 1/2 minutes | -5° to 100°F | 2 hrs. 350 psi<br>16 hrs. 800 psi<br>72 hrs. 1,500 psi | 400-700 cps |

| Part No | Size | Applicator | Description | Ctn. Qty. | Ctn. Wt. (lbs.) |
|---|---|---|---|---|---|
| VC9992 | Quart | Dauber | All Weather "Quick-Set" Blue | 12 | 29.0 |

*Meets ASTM D-2564*

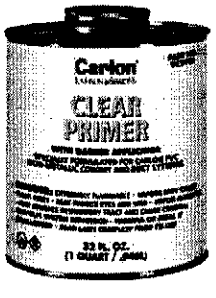
## Resi-Gard® – Clear

| Recommended pipe application and sizes | Set-up time (Evaporation Rate) | Recommended installation temperature | Lap Shear @ 73°F | Viscosity at 75° as manufactured |
|---|---|---|---|---|
| For use with Resi-Gard®, Riser-Gard®, P&C Flex®, and Carlon PVC fittings. **Up through 6" diameter.** | 10°–30°F Use extra caution<br>30°–50°F 5-6 minutes<br>50°–70°F 3-4 minutes<br>70°–90°F 1-2 minutes | 40° to 100°F | 2 hrs. 350 psi<br>16 hrs. 800 psi<br>72 hrs. 1,500 psi | 500-900 cps |

| Part No | Size | Applicator | Description | Ctn. Qty. | Ctn. Wt. (lbs.) |
|---|---|---|---|---|---|
| VC9963SC | Pint | Brush | Resi-Gard® Solvent Cement Clear | 24 | 28.0 |

*Meets ASTM D-2564*

## Clear Primer

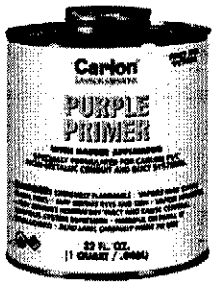



| Recommended pipe application and sizes | Recommended installation temperature |
|---|---|
| Recommended for use with Carlon cement | 5° to 100°F |

| Part No | Size | Applicator | Ctn. Qty. | Ctn. Wt. (lbs.) |
|---|---|---|---|---|
| VC9903 | Pint | Dauber | 24 | 27.0 |
| VC9902 | Quart | Dauber | 12 | 25.0 |

*Meets ASTM F-686*

## Purple Primer

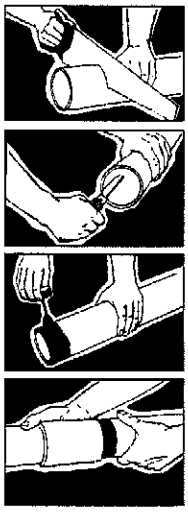



| Recommended pipe application and sizes | Recommended installation temperature |
|---|---|
| Recommended for use with Carlon cement | 5° to 100°F |

| Part No | Size | Applicator | Ctn. Qty. | Ctn. Wt. (lbs.) |
|---|---|---|---|---|
| VC9932 | Quart | Dauber | 12 | 25.0 |

*Meets ASTM F-686*

# Cement Joints



Carlon nonmetallic products are joined by means of solvent cement joints. Sizes 1/2" through 1 1/2" should be cut square (using a fine tooth handsaw) and deburred. For sizes 2" through 6" a miter box or similar saw guide should be utilized to keep the material steady. After cutting and deburring, wipe ends clean of dust, dirt and shavings.

Joining process as follows: Be sure that conduit end is clean and dry. Apply coat of Carlon Solvent Cement (use dauber) to end of conduit, the length of the socket to be attached. Push conduit firmly into fitting while rotating conduit slightly about one-quarter turn to spread cement evenly. Allow joint to set approximately 10 minutes.

Carlon recommends the use of Carlon cement for proper solvent cement joints. Since this cement is prepared particularly for our product compounds and tolerances, we cannot guarantee joints assembled with cement materials supplied by other manufacturers. Regular grade grey solvent cement will accommodate most application situations being of a general purpose nature. In situations requiring an extremely fast-setting joint, (low temperature or difficult installation conditions) Carlon All Weather Quick-Set Cement is recommended. Standard grade clear cement is recommended for noncritical utility applications where gap filling and leak testing are not required.

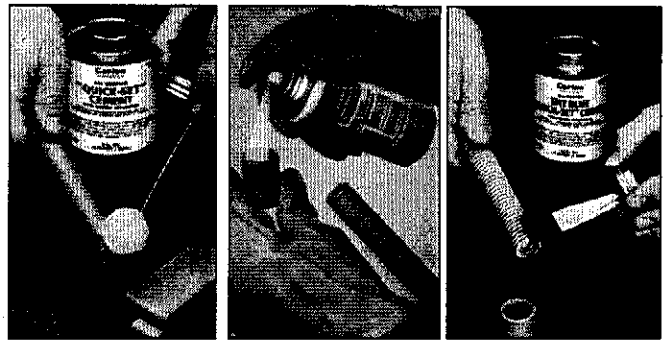
## Average number of joints per can

| Pipe size | 1/2 Pint 8 oz. | Pint 16 oz. | Quart 32 oz. | Gallon 128 oz. | Spray 4 oz. | Spray 16 oz. |
|---|---|---|---|---|---|---|
| 1/2 | 140 | 275 | 550 | 2,200 | 70 | 275 |
| 3/4 | 90 | 180 | 360 | 1,440 | 45 | 180 |
| 1 | 70 | 140 | 280 | 1,120 | 35 | 140 |
| 1 1/4 | 50 | 100 | 200 | 800 | 25 | 100 |
| 1 1/2 | 37 | 75 | 150 | 600 | 18.5 | 75 |
| 2 | 20 | 40 | 80 | 320 | 10 | 40 |
| 2 1/2 | 17 | 35 | 70 | 280 | 8.5 | 35 |
| 3 | 15 | 30 | 60 | 240 | 7.5 | 30 |
| 3 1/2 | 13 | 27 | 54 | 216 | 6.5 | 27 |
| 4 | 12 | 25 | 50 | 200 | 6 | 25 |
| 5 | 9 | 19 | 38 | 150 | N/A | N/A |
| 6 | 6 | 12 | 24 | 95 | N/A | N/A |

CAN: Average shelf-life of all Carlon cement is 24 months (unopened cans stored below 80°F.)

SPRAY: Average shelf-life of all Carlon Spray PVC Cement is 3 years.

All Carlon cements are specially formulated to be used with Carlon PVC products, and do not require primers when parts are clean of dirt and moisture.



## Cementing PVC Conduit:

1. Make square saw cut with fine tooth saw.
2. Deburr and round inside edge of the cut end.
3. Clean socket ID and spigot OD of dirt and moisture.
4. Apply a uniform coat of cement to spigot end and push onto socket bottom, rotating 1/4 turn.
5. Allow time to set before disturbing. This will depend upon temperature.

## Cementing PVC Conduit for Submerged Areas Requiring Air or Water Tightness:

1. Follow the procedure to the left for cementing conduit.
2. Test workmanship by conducting a low pressure air (3.0 - 5.0 psi) test after system is installed and cemented joints are set.
3. Plug and block ends to prevent movement prior to pressurization.
4. Check for leaks with soap solution.
5. Even low pressure air can cause high thrust loads and caution must be observed.

## Cementing ENT for Concrete-Tight Applications:

1. Use Carlon Socket tight fittings or couplings.
2. ***Do not*** use chemical primer or cleaner.
3. Apply a light uniform coat of cement, labeled for use with ENT.
4. ***A brush*** shall be used to apply the cement.
5. Brush excess cement out of ENT grooves
6. Promptly insert ENT into fitting while cement is wet, until the fitting stop is reached, and give 1/4 turn.
7. Do not disturb until the joint is set.

MSDS available at **www.carlon.com**

**Carlon®**
LAMSON & SESSIONS

In USA, contact:
25701 Science Park Drive • Cleveland, Ohio 44122
1-800-3-CARLON (1-800-322-7566)
In Ohio, (216) 464-3400 • Fax: (216) 766-6444
TDD/Hearing Impaired Access (216) 831-5918 • www.carlon.com

In Canada, contact:
Lamson & Sessions Ltd. • 121 Watline Avenue
Mississauga, ON • Canada L4Z 1P2
(905) 755-1262 • (888) 269-9902
Fax: (905) 755-1265 • (888) 269-8622

2F18 SP 7.5M 7/07
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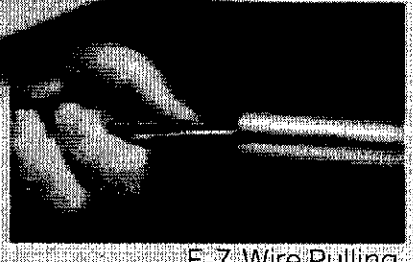
# Allied E-Z PULL® **EMT**

## Quality Electrical Metallic Tubing

### E-Z to Install

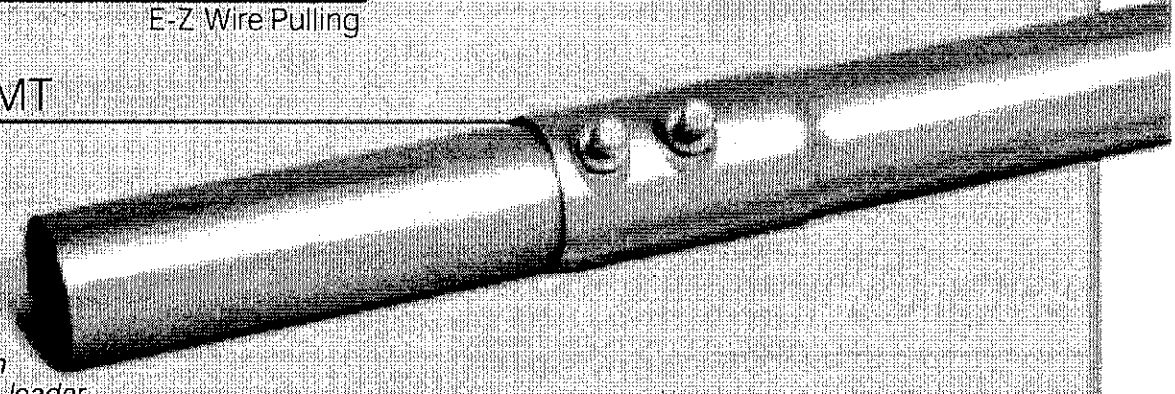


E-Z Wire Pulling

Allied EMT combines strength with ductility, resulting in faster and easier installations. EMT provides easy bending, cutting and joining while resisting flattening, kinking and splitting, creating smooth, continuous raceways for fast wire pulling.

Allied E-Z Pull EMT has a special low friction ID coating that greatly improves the slip properties between conduit and wire. With E-Z Pull, wire pulls through the conduit smoothly and easily.

### KWIK-FIT® EMT



*A new innovation from the conduit leader.*

Allied's Kwik-Fit EMT has an integral steel set-screw coupling formed on one end of each length of EMT. Specifying U.L. listed Kwik-Fit EMT ensures an all steel system — both conduit and coupling for excellent strength and ground return, as well as economy. Contact Allied for detailed specifications on Kwik-Fit EMT. Available in trade sizes 2-4.

allied®
TUBE & CONDUIT

# Allied E-Z PULL® **EMT** Specifications

## MANUFACTURED FOR LONG LIFE

Allied EMT is precision manufactured from high grade mild strip steel for exceptional durability and long-lasting life.

Allied EMT is hot galvanized using Allied's patented in-line Flo-Coat® process. This process combines zinc, a conversion coating, and a clear organic polymer top-coat to form a triple layer of protection against corrosion and abrasion.

## EMI SHIELDING

Allied EMT greatly reduces electromagnetic fields, effectively shielding computers and sensitive electronic equipment from the electromagnetic interference caused by power distribution systems. For further information, visit our website for a free download of the GEMI (Grounding and Electromagnetic Interference) analysis software and related research papers.

## FULL CODES AND STANDARDS COMPLIANCE

Allied EMT is listed to Underwriters Laboratories Safety Standard UL 797 and meets ANSI C80.3. The Federal specifications are UL 797 and ANSI C80.3 in lieu of WWC 563. EMT is recognized as an equipment grounding conductor by NEC Section 250-118. Documentation for compliance with NEC Article 250 is available from Allied.

Installation of EMT shall be in accordance with the National Electrical Code and the UL listing information. Allied EMT is listed in category FJMX.

Master bundles conform to NEMA Standard RN2.

## SPECIFICATION DATA

To specify Allied EMT, include the following: Electrical Metallic Tubing shall be equal to that manufactured by Allied Tube & Conduit Corporation. EMT shall be hot galvanized steel O.D. with an organic corrosion resistant I.D. coating and shall be produced in accordance with U.L. Safety Standard #797 and ANSI C80.3 and shall be listed by a nationally recognized testing laboratory with follow-up service. Where **Kwik-Fit EMT** is used it shall also meet U.L. Safety Standard #514-B. It is noted that these U.L. and ANSI standards have been adopted by the federal government and separate military specifications no longer exist.

### Weights and Dimensions for Electrical Metallic Tubing

| *Trade Size Designator* | | *Approx. Wt. Per 100 Ft. (30.5M)* | | *Nominal Outside Diameter*[1] | | *Nominal Wall Thickness* | | *Quantity In Master Bundle* | |
|---|---|---|---|---|---|---|---|---|---|
| U.S. | Metric | lb. | kg. | in. | mm | in. | mm | ft. | m |
| 1/2 | 16 | 30 | 13.6 | 0.706 | 17.9 | 0.042 | 1.07 | 7000 | 2135.0 |
| 3/4 | 21 | 46 | 20.9 | 0.922 | 23.4 | 0.049 | 1.25 | 5000 | 1525.0 |
| 1 | 27 | 67 | 30.4 | 1.163 | 29.5 | 0.057 | 1.45 | 3000 | 915.0 |
| 1-1/4 | 35 | 101 | 45.8 | 1.510 | 38.4 | 0.065 | 1.65 | 2000 | 610.0 |
| 1-1/2 | 41 | 116 | 52.6 | 1.740 | 44.2 | 0.065 | 1.65 | 1500 | 457.5 |
| 2 | 53 | 148 | 67.1 | 2.197 | 55.8 | 0.065 | 1.65 | 1200 | 366.0 |
| 2-1/2 | 63 | 216 | 98.0 | 2.875 | 73.0 | 0.072 | 1.83 | 610 | 186.1 |
| 3 | 78 | 263 | 119.3 | 3.500 | 88.9 | 0.072 | 1.83 | 510 | 155.6 |
| 3-1/2 | 91 | 249 | 158.3 | 4.000 | 101.6 | 0.083 | 2.11 | 370 | 112.9 |
| 4 | 103 | 393 | 178.2 | 4.500 | 114.3 | 0.083 | 2.11 | 300 | 91.5 |

[1]Outside diameter tolerances: +/- .005 in. (.13mm) for trade sizes 1/2" (16mm) through 2" (53mm); +/- .010 in. (.25mm) for trade sizes 2-1/2" (63mm) +/- .015 in. (.38mm) for trade size 3" (78mm) +/- .020 in. (.51mm) for trade sizes 3-1/2" (91mm) and 4" (103mm).
NOTE: Length = 10 ft. (3.05m) with a tolerance of ± .25" (6.35 mm)

### Weights and Dimensions for Kwik-Fit EMT

| *Trade Size Designator* | | *Approx. Wt. Per 100 Ft. (30.5M)* | | *Nominal Outside Diameter*[1] | | *Nominal Wall Thickness* | | *Quantity In Master Bundle* | |
|---|---|---|---|---|---|---|---|---|---|
| U.S. | Metric | lb. | kg. | in. | mm | in. | mm | ft. | m |
| 2 | 53 | 148 | 67.1 | 2.197 | 55.8 | 0.065 | 1.65 | 500 | 152.4 |
| 2-1/2 | 63 | 216 | 98.0 | 2.875 | 73.0 | 0.072 | 1.83 | 350 | 106.8 |
| 3 | 78 | 263 | 119.3 | 3.500 | 88.9 | 0.072 | 1.83 | 300 | 91.5 |
| 3-1/2 | 91 | 349 | 158.3 | 4.000 | 101.6 | 0.083 | 2.11 | 250 | 76.3 |
| 4 | 103 | 393 | 178.2 | 4.500 | 114.3 | 0.083 | 2.11 | 250 | 76.3 |

[1]Outside diameter tolerances: +/- .005 in. (.13mm) for trade size 2"(53mm); +/- .010 in. (.25mm) for trade size 2-1/2" (63mm); +/- .015 in. (.38mm) for trade size 3" (78mm) +/- .020 in. (.51mm) for trade sizes 3-1/2" (91mm) and 4" (103mm).

NOTE: Length = 10 ft. (3.05m) with a tolerance of ± .25" (6.35 mm)

For more information, contact Allied at **(800) 882-5543**
or visit our website at **www.atcelectrical.com**

tyco
*Electrical & Metal Products*

AFC Cable Systems® • **Allied Tube & Conduit** • Cope® Cable Tray • Power-Strut® Metal & Fiberglass Framing

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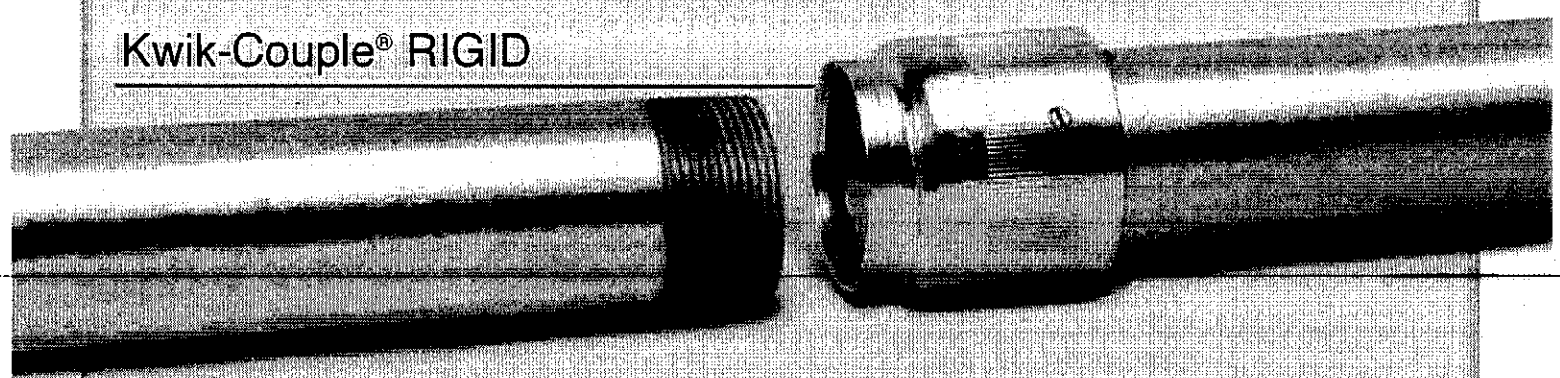
# Allied **RIGID**

## Quality, Long Lasting Steel Conduit

### Heavy Duty

Allied Rigid is precision manufactured for dependable, long-lasting value and protection for the electrical raceway system. Allied Rigid also provides radiation protection, magnetic shielding and resists impact.

### Kwik-Couple® RIGID



Allied's patented* Kwik-Couple Rigid cuts threaded conduit installation time and cost significantly. Kwik-Couple comes installed right on the conduit or elbows, right where you need it. Just line up the ends, spin the coupling forward onto the next piece and wrench tighten. It's that easy!

*U.S. Patent Numbers 4258936,4547004.

allied
TUBE & CONDUIT

# Allied **RIGID** Specifications

### *PROVIDES FULL ELECTRICAL SYSTEM PROTECTION*

Allied RIGID is precision manufactured for dependable, long-lasting value and protection for the electrical raceway system.

Manufactured from high-strength steel, Allied RIGID combines damage-resistant strength with ductility to assure easy bending, cutting and joining. It also provides smooth, continuous raceways for fast wire-pulling. No need to worry about damage to the conduit system even when pulling through multiple 90° bends.

Allied RIGID is hot-dipped galvanized inside and out. It is top-coated with a compatible organic layer to inhibit white rust and increase corrosion resistance.

Allied RIGID is impact and crush resistant for maximum conductor protection.

The 3/4" taper NPT threads (ANSI B1.20.1) are full cut and hot galvanized after cutting. Color-coded end-cap thread protectors keep the threads clean and sharp and also provide instant trade size recognition. Even trade sizes are color-coded blue, 1/2 trade sizes are black, and 1/4 trade sizes are red.

### *EMI SHIELDING*

Allied RIGID greatly reduces electromagnetic fields, effectively shielding computers and sensitive electronic equipment from the electromagnetic interference caused by power distribution systems. For further information, visit our website for a free download of the **GEMI** (**G**rounding and **E**lectro**M**agnetic **I**nterference) analysis software and related research papers.

### *FULL CODES AND STANDARDS COMPLIANCE*

Allied RIGID is covered by article 344 of the National Electrical Code. It is listed to Underwriters Laboratories Safety Standard U.L. 6. and is manufactured to ANSI C80.1, both of which have been adopted as Federal Specifications in lieu of WWC 581.
Allied RIGID is recognized as an equipment grounding conductor by NEC Article 250. Documentation for compliance with NEC Article 250 is also available in the **GEMI** (**G**rounding and **E**lectro**M**agnetic **I**nterference) analysis software and related research studies found at the www.alliedeg.com website.

Installation of Rigid Metal Conduit shall be in accordance with the National Electrical Code and U.L. General Information card #DYIX. Master bundles conform to NEMA standard RN2.

### *SPECIFICATION DATA*

RIGID Metal Conduit shall be hot-dip galvanized steel equal to that manufactured by Allied Tube & Conduit Corporation. Threads shall be hot galvanized after cutting. RIGID shall be produced in accordance with U.L. Safety Standard #6 and ANSI C80.1 and shall be listed by a nationally recognized testing laboratory with follow-up service. Where **Kwik-Couple RIGID** is used it shall also meet U.L. Safety Standard #514-B. It is noted that these U.L. standards have been adopted by the federal government and separate military specifications no longer exist.

For more information, contact Allied at (800) 882-5543, or visit our website at **www.alliedeg.com**

**Weights and Dimensions for Galvanized Rigid Tubing**

| *Trade Size Designator* | | *Approx. Wt.* Per 100 Ft. (30.5M)* | | *Nominal Outside Diameter*[1] | | *Nominal Wall Thickness* | | *Quantity In Master Bundle* | |
|---|---|---|---|---|---|---|---|---|---|
| **U.S.** | **Metric** | **lb.** | **kg** | **in.** | **mm** | **in.** | **mm** | **ft.** | **m** |
| 1/2 | 16 | 82 | 37.2 | 0.840 | 21.3 | 0.104 | 2.60 | 2500 | 762.5 |
| 3/4 | 21 | 109 | 49.4 | 1.050 | 26.7 | 0.107 | 2.70 | 2000 | 610.0 |
| 1 | 27 | 161 | 73.0 | 1.315 | 33.4 | 0.126 | 3.20 | 1250 | 381.3 |
| 1-1/4 | 35 | 218 | 98.9 | 1.660 | 42.2 | 0.133 | 3.40 | 900 | 274.5 |
| 1-1/2 | 41 | 263 | 119.3 | 1.900 | 48.3 | 0.138 | 3.50 | 800 | 244.0 |
| 2 | 53 | 350 | 158.7 | 2.375 | 60.3 | 0.146 | 3.70 | 600 | 183.0 |
| 2-1/2 | 63 | 559 | 253.5 | 2.875 | 73.0 | 0.193 | 4.90 | 370 | 112.9 |
| 3 | 78 | 727 | 329.7 | 3.500 | 88.9 | 0.205 | 5.20 | 300 | 91.5 |
| 3-1/2 | 91 | 880 | 399.1 | 4.000 | 101.6 | 0.215 | 5.50 | 250 | 76.3 |
| 4 | 103 | 1030 | 467.1 | 4.500 | 114.3 | 0.225 | 5.70 | 200 | 61.0 |
| 5 | 129 | 1400 | 634.9 | 5.563 | 141.3 | 0.245 | 6.20 | 150 | 45.8 |
| 6 | 155 | 1840 | 834.5 | 6.625 | 168.3 | 0.266 | 6.80 | 100 | 30.5 |

[1] For more information only; not a spec requirement.

NOTE: Length = 10 ft. (3.05m) with a tolerance of +/- .25 in. (6.35mm).
* NEMA Standard

**Weights and Dimensions for Kwik-Couple Rigid**

| *Trade Size Designator* | | *Approx. Wt. Per 100 Ft. (30.5M)* | | *Nominal Outside Diameter*[1] | | *Nominal Wall Thickness*[2] | | *Quantity In Master Bundle* | |
|---|---|---|---|---|---|---|---|---|---|
| **U.S.** | **Metric** | **lb.** | **kg** | **in.** | **mm** | **in.** | **mm** | **ft.** | **m** |
| 2-1/2 | 63 | 559 | 253.5 | 2.875 | 73.0 | 0.193 | 4.90 | 400 | 122.0 |
| 3 | 78 | 727 | 329.7 | 3.500 | 88.9 | 0.205 | 5.20 | 300 | 91.5 |
| 3-1/2 | 91 | 880 | 399.1 | 4.000 | 101.6 | 0.215 | 5.50 | 250 | 76.3 |
| 4 | 103 | 1030 | 467.1 | 4.500 | 114.3 | 0.225 | 5.70 | 200 | 61.0 |

[1]Outside diameter tolerances: +/- .025 in. (.64mm) [2]For information only; not a spec requirement.

Allied Tube & Conduit
Registered to ISO 9001:2000
File Numbers A2106, A1854, A12768



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BEST FOR

# PROTECTION IN DRY ENVIRONMENTS

## GREENFIELD and RAYFLEX

Eastern offers a *complete line* of aluminum and steel flexible conduits for use in dry locations.

Eastern's **RAYFLEX** is a heavy wall aluminum conduit which is suitable for all applications where UL and CSA certifications are required.

Our Greenfield **GFAU** is a reduced wall UL aluminum conduit which can be installed anywhere a UL flexible aluminum conduit is required.

**GFSU**, a reduced wall UL flexible steel conduit, that is suitable anywhere steel is preferred.

**GFSN** is an extra flexible steel conduit used in those areas where tight bends are required.

# RAYFLEX

| Trade Size | Inside Diameter (Minimum) | Inside Diameter (Maximum) | Outside Diameter (Minimum) | Outside Diameter (Maximum) | Weight per Meter (Kg) | Bend Diameter (Inches) | Standard Cartons (Meters) | Standard Reels (Meters) |
|---|---|---|---|---|---|---|---|---|
| **3/8** | .375 | .394 | .560 | .610 | .096 | 4 | 75 | 150/300 |
| **1/2** | .625 | .645 | .860 | .920 | .25 | 6 | 30 | 150/300 |
| **3/4** | .812 | .835 | 1.045 | 1.105 | .30 | 8 | 30 | 150/300 |
| **1** | 1.000 | 1.040 | 1.300 | 1.380 | .47 | 10 | 30 | 120 |
| **1 1/4** | 1.250 | 1.300 | 1.550 | 1.630 | .58 | 13 | 15 | |
| **1 1/2** | 1.500 | 1.575 | 1.850 | 1.950 | .76 | 15 | 15 | |
| **2** | 2.000 | 2.080 | 2.350 | 2.245 | .98 | 20 | 15 | |
| **2 1/2** | 2.500 | | 2.860 | 3.060 | 1.46 | 25 | 15 | |
| **3** | 3.000 | | 3.360 | 3.560 | 1.67 | 30 | 15 | |
| **3 1/2** | 3.500 | | 3.860 | 4.060 | 1.89 | 35 | 15 | |
| **4** | 4.000 | | 4.360 | 4.560 | 2.1 | 40 | 15 | |

**Approvals:** * CSA C22.2 No. 56-1961
* ULI, CSA-NRTL

# GREENFIELD - GFAU, GFSU, GFSN

| Trade Size | Inside Diameter (Minimum) | Inside Diameter (Maximum) | Outside Diameter (Minimum) | Outside Diameter (Maximum) | Bend Diameter (Inches) | Standard Cartons (Feet) | Standard Reels (Feet) |
|---|---|---|---|---|---|---|---|
| **3/8** | .375 | .393 | .560 | .610 | 2 | 100/250 | 1000 |
| **1/2** | .625 | .645 | .860 | .920 | 3 | 100 | 1000 |
| **3/4** | .812 | .835 | 1.045 | 1.105 | 4 | 100 | 500 |
| **1** | 1.000 | 1.040 | 1.300 | 1.380 | 5 | 50 | 400 |
| **1 1/4** | 1.250 | 1.300 | 1.550 | 1.630 | 6.25 | 50 | 250 |
| **1 1/2** | 1.500 | 1.575 | 1.850 | 1.950 | 7.5 | 25 | 150 |
| **2** | 2.000 | 2.080 | 2.350 | 2.450 | 10 | 25 | 100 |
| **2 1/2** | 2.500 | | 2.860 | 3.060 | 12.5 | 25 | |
| **3** | 3.000 | | 3.360 | 3.560 | 15 | 25 | |
| **3 1/2** | 3.500 | | 3.860 | 4.060 | 17.5 | 25 | |
| **4** | 4.000 | | 4.360 | 4.560 | 20 | 25 | |

**Approvals:** * UL1, CSA-NRTL (Reduced Wall Aluminum Greenfield-GFAU)
* ULI Listed (Reduced Wall Steel Greenfield-GFSU)

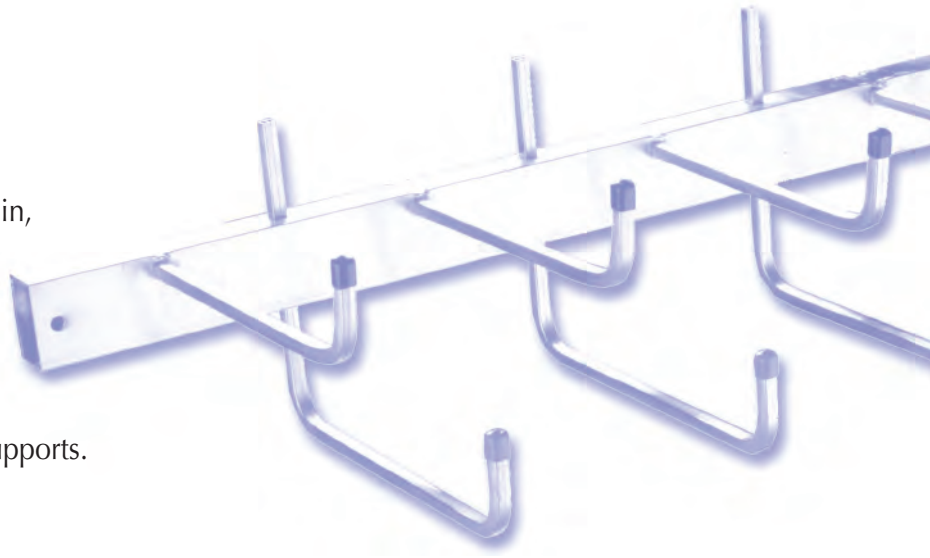
tyco Electrical & Metal Products

EASTERN

1-800-483-3473
www.easternwire.com

# Mono-Tray® Aluminum and Steel

Mono-Tray® is a unique center-hung cable tray system, which provides organization and support for virtually any cable or wiring installation. Available in both steel and aluminum, Mono-Tray® redefines labor-saving with its versatile "lay-in feature".



Full side accessibility allows cable to be laid-in, as opposed to the time consuming, and potentially damaging, effects of cable pulling required with conventional trapeze supports.

A full line of quick fittings and accessories are available to complete any installation.

UL Listed, CSA Certified. Available in Steel or Aluminum.

## Ordering Summary Guide Quick Selector

**Example Catalog Number**

**Bottom Rung Mono-Tray Aluminum, 3" Rung Spacing, 3" High, 12"-0" Length, 6" Wide**

| B | 1 | 1 | 5 | 3 | - | 0 | 3 2 | 1 | - | _ |
|---|---|---|---|---|---|---|---|---|---|---|

### TRAY STYLE

| | |
|---|---|
| B | Bottom Rung Tray |
| L | L-Series Top Rung |
| LB | L-Series Bottom Rung |
| CB | 4" High Spine |

### TRAY TYPE

| | |
|---|---|
| 1 | Mono-Tray (Ladder) |
| 2 | Dual-Rail |
| 6 | Wall-Rack |
| 9 | Wall-Rack Double-Tier |

### MATERIAL

| | |
|---|---|
| 1 | Aluminum |
| 2 | Pre-Galvanized Steel |
| 3 | Hot Dipped Galvanized Steel after Fabrication |
| 4 | Epoxy Paint (Aluminum) |
| 5 | Epoxy Paint (Steel) |
| 6 | Anodized Aluminum |

### RUNG SPACING

| | in | mm |
|---|---|---|
| 1 | 6" | 150 |
| 2 | 9" | 225 |
| 3 | 12" | 300 |
| 4 | 18" | 450 |
| 5 | 3" | 75 |
| 6 | 4" | 100 |

3" Rung spacing not available with "L" Series Tray.

### RUNG HEIGHT

| | in | mm |
|---|---|---|
| 3 | 3" | 75 |
| 4 | 4" | 100 |
| 6 | 6" | 150 |

### TRAY LENGTH

| | ft | m |
|---|---|---|
| 32 | 12' | 3.6 |
| 35 | 10' | 3.0 |

### TRAY WIDTH

| | in | mm |
|---|---|---|
| 1 | 6" | 150 |
| 2 | 9" | 225 |
| 3 | 12" | 300 |
| 4 | 18" | 450 |
| 5 | 24" | 600 |
| 6 | 36" | 900 |
| 7 | 3" | 75 |
| 8 | 4" | 100 |
| 9 | 30" | 750 |

### RUNG STYLE

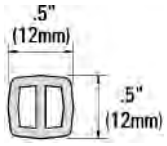
| | |
|---|---|
| R | Removable 1/2" (12mm) Type "C" Rung |
| D | 3/4" (19mm) Type "D" Rung |
| RD | Removable 3/4" (19mm) Type "D" Rung |
| A | "A" Rung ("L" Series) Only |
| B | "B" Rung |

## CSA Load Ratings

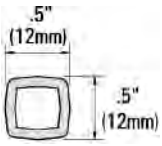
**CSA LOAD RATING**

| CSA Load Class | Product Line | Maximum Tray Width in | Maximum Tray Width mm | Maximum Rung Spacing in | Maximum Rung Spacing mm | Rung Style |
|---|---|---|---|---|---|---|
| A 37Kg/m/3m | "L"-Series Mono-Tray® Aluminum | 12 | 300 | 12 | 300 | A, B |
| | "L"-Series Wall-Rack Aluminum | 6 | 150 | 12 | 300 | A, B |
| C1 97Kg/m/3m | Mono-Tray® Aluminum | 24 | 600 | 6 | 150 | B, C |
| | Mono-Tray® Aluminum | 12 | 300 | 12 | 300 | B |
| | Mono-Tray® Aluminum | 9 | 230 | 18 | 450 | B |
| | Wall-Rack Aluminum | 12 | 300 | 6 | 150 | C, D |
| | Wall-Rack Steel | 12 | 300 | 6 | 150 | E |
| D1 179Kg/m/3m | Mono-Tray® Aluminum | 12 | 300 | 12 | 300 | B |
| | Mono-Tray® Aluminum | 18 | 450 | 9 | 230 | C |
| | Mono-Tray® Aluminum | 24 | 600 | 6 | 150 | C |
| | Mono-Tray® Aluminum | 24 | 600 | 12 | 300 | D |
| | Mono-Tray® Steel | 24 | 600 | 12 | 300 | E |
| E 299Kg/m/3m | Dual-Rail® Aluminum | 36 | 900 | 12 | 300 | C |
| | Dual-Rail® Steel | 36 | 900 | 12 | 300 | E |

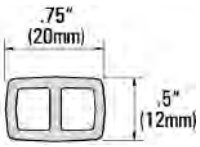
## Material Data - Aluminum




"C" Rung
(Standard)

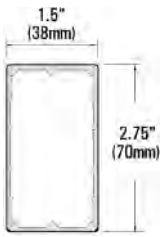



"B" Rung
(Light Duty)

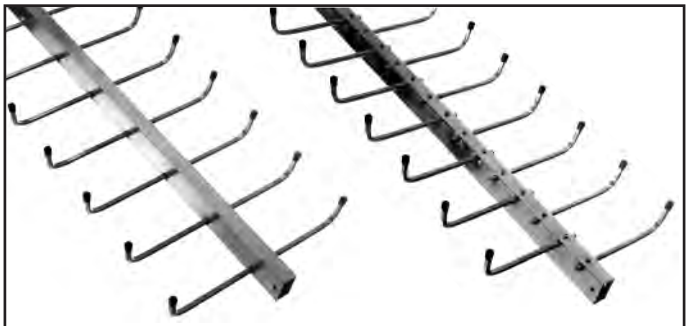



"D" Rung
(Optional)

Spine
(Standard Tray)




Spine
(Light Duty Tray)



Mono-Tray
Aluminum

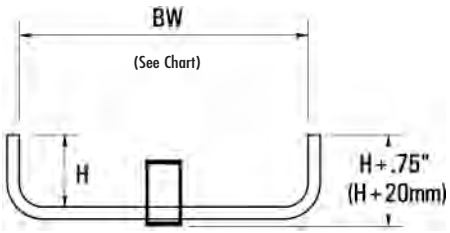
Mono-Tray
Aluminum
Removable Rung

| SPINE DEFLECTION @ 100#/ft (149kg/m) | | | | | |
|---|---|---|---|---|---|
| Spine Type | Support Span | | Deflection | | NEMA Rating |
| | ft | m | in | mm | (1.5 Safety Factor) |
| Standard | 12 | 3.6 | 2.8 | 71 | 12C |
| Light | 12 | 3.6 | 3.4 | 86 | 12B |

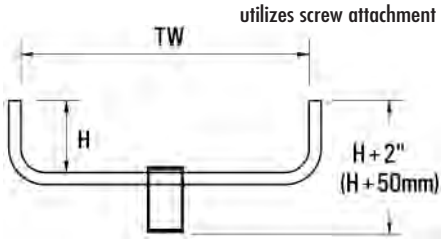
## Design Data

One splice connector (p/n: 0100-0420) is provided with each tray length.

| BOTTOM RUNG WIDTH CHART (ALUMINUM TRAY) | | |
|---|---|---|
| W | BW | |
| | in | mm |
| 6 | 7.5 | 191 |
| 9 | 10.5 | 267 |
| 12 | 13.5 | 343 |
| 18 | 18 | 450 |
| 24 | 24 | 600 |




Note: Removable Rung
utilizes screw attachment




## Ordering Data

Example Tray Catalog Number
Bottom Rung Mono-Tray Aluminum, 6" Rung Spacing, 3" High, 12'-0" Length, 6" Wide

| B | 1 | 1 | 1 | 3 | - | 0 | 3 | 2 | 1 | - | _ |
|---|---|---|---|---|---|---|---|---|---|---|---|

LB1133-0324-B

**TRAY STYLE**

| | |
|---|---|
| B | Bottom Rung Tray |
| L | Light Duty Tray |
| LB | L-Series Bottom Rung |

For Top Rung Standard Spine Tray No Letter Prefix is required.

**MATERIAL**

| | |
|---|---|
| 1 | Aluminum |
| 4 | Epoxy Paint (Aluminum) |
| 6 | Anodized Aluminum |

**RUNG SPACING**

| | in | mm |
|---|---|---|
| 1 | 6" | 150 |
| 2 | 9" | 225 |
| 3 | 12" | 300 |
| 4 | 18" | 450 |
| 5 | 3" | 75 |
| 6 | 4" | 100 |

3" R.S. for Standard Tray Only. Not available in "L" Series

18" R.S. only for 6" & 9" widths.

12" R.S. only for 6", 9" & 12" widths.

**RUNG HEIGHT**

| | in | mm |
|---|---|---|
| 3 | 3" | 75 |
| 4 | 4" | 100 |
| 6 | 6" | 150 |

**TRAY LENGTH**

| | ft | m |
|---|---|---|
| 32 | 12' | 3.6 |
| 35 | 10' | 3.0 |

**TRAY WIDTH**

| | in | mm |
|---|---|---|
| 1 | 6" | 150 |
| 2 | 9" | 225 |
| 3 | 12" | 300 |
| 4 | 18" | 450 |
| 5 | 24" | 600 |
| 7 | 3" | 75 |
| 8 | 4" | 100 |

**RUNG STYLE**

| | |
|---|---|
| R | Removable 1/2" (12mm) Type "C" Rung |
| D | 3/4" (19mm) Type "D" Rung |
| RD | Removable 3/4" (19mm) Type "D" Rung |
| B | "B" Hollow Rung |

For Standard Type "C" Aluminum Fixed Rung. No Letter Suffix is required.

Removable Rung is not available for Double Tier.

CLASSIFIED UL
CSA Certified

## PART 1 - GENERAL

**1.10 REFERENCE STANDARDS:**

A. Underwriter1s Laboratories, Inc. certified No. E80034; National Electrical Code 318; NEMA class 12C (100#/ft./12 ft.) for Mono-Tray. L-Series NEMA 12A - 50#/ft./12ft..
B. Canadian Standards Association No. LR 082927, Mono-Tray 3 meter sections are CSA classified 3C12 and 3D12 (179kg/m/3m). L-Series Mono-TrayCSA classified 3A2 (37kg/m/3m).
C. The cable tray system components shall be certified by one of the following UL, C-UL, CSA and/or a recognized testing laboratory.

**1.20 DESCRIPTION:**

A. Complete center hung and/or wall mounted steel or aluminum (select one) cable tray system and necessary accessories shall be provided as shown on plans. Install entire cable tray system in accordance with all local governing codes.

**1.30 SUBMITTALS:**

A. Submittal drawings, in the form of 8 1/2 x 11 catalog cut sheets, shall be provided for the following items: cable trays, fittings, accessories and load data.

## PART 2 - PRODUCTS

**2.10 MATERIALS - Steel or Aluminum (SELECT 3A or B2)**

A. Steel cable trays shall be ventilated ladder type construction with widths and depths as indicated on the drawings. The ladder tray shall be supported from one (1) steel splice connector, installed in a telescoping manner, around the outer portion of the main spine members.
B. Aluminum cable trays shall be ventilated ladder type construction with widths and depths as indicated on the drawings. The ladder tray shall be supported from one (1) aluminum splice connector, installed inside the inner portion of the main spine members.

**2.20 CENTER HUNG Mono-Tray - Steel or Aluminum (SELECT 3A or B2)**

A. Steel Mono-Tray shall be constructed of one (1) 12x32 rectangular seam welded steel tube to which .6252 square seam welded tube steel rungs are attached on _____ inch (mm) centers. The cross rungs shall be bent up at their ends to a height of _____ inches (mm) to form a center supported, open sided, ladder type assembly. The tray shall be _____inches (mm) wide and must not have continuous side rails. As noted on drawings, rungs shall emanate at right angles from the top of the spine or bottom of the spine (select one).
B. Aluminum Mono-Tray Ladder Tray shall be constructed of one (1) 1.52x2.752 rectangular extruded aluminum tube to which 1/2" square box beam (type C standard) or 3/4" x 1/2" box beam (type D) (select one) rungs are attached on _____ inch (mm) centers. The cross rungs shall be bent up at their ends to a height of _____ inches (mm) to form a dual supported, open sided, ladder type assembly. The tray must not have continuous side rails. As noted on drawings, rungs shall emanate at right angles from the top of the spine or bottom of the spine (select one). L-Series Mono-Tray shall have 1/2" solid aluminum triangular (type B) rungs.

**2.30 WALL RACK LADDER TRAY - Steel or Aluminum (SELECT 3A or B2)**

A. Steel Wall Rack tray shall be constructed of one (1) 12x32 rectangular seam welded steel tubes to which .6252 square seam welded tube steel rungs are attached on _____ inch (mm) centers. The cross rungs shall emanate from one side of the spine and shall be bent up at their ends to a height of _____ inches (mm) to form an open sided, ladder type assembly. The tray shall be _____inches (mm) wide and must not have continuous side rails. As noted on drawings, rungs shall emanate at right angles from the top of the spine or bottom of the spine (select one).
B. Aluminum Wall Rack tray shall be constructed of one (1) 1.52x2.752 rectangular extruded aluminum tube to which ?2 square box beam (type C standard) or 3/4" x 1/2" box beam (type D) rungs are attached on _____ inch (mm) centers. The cross rungs shall be emanate from one side of the spine and shall be bent up at their ends to a height of _____ inches (mm) to an open sided, ladder type assembly. The tray must not have continuous side rails. As noted on drawings, rungs shall emanate at right angles from the top of the spine or bottom of the spine (select one). L-Series Wall Rack shall have 1/2" solid aluminum triangular (type B) rungs.

**2.40 DOUBLE TIER WALL RACK LADDER TRAY - Aluminum Only**

A. Aluminum Wall Rack Double Tier tray shall be constructed of one (1) 1.52x2.752 rectangular extruded aluminum tube to which 1/2" square box beam (type C standard) rungs are attached on _____ inch (mm) centers. These cross rungs shall emanate from one side (top of the spine only) and also vertically from the bottom of the spine to form two tiers of cable tray, one above the other and shall be bent up at their ends to a height of _____ inches (mm) to an open sided, ladder type assembly. The tray must not have continuous side rails. Tray shall be mounted by fastening the spine directly to the wall in accordance with manufacturer's specifications.

**2.50 FITTINGS**

A. Splice Connectors - Steel or Aluminum (select one). Sections of Mono-Tray, Wall Rack and/or Double Tier Wall Rack and all other fittings shall be joined by using one (1), two bolt, 4 inch (102mm) long, rectangular splice connector which telescope about the spine of the tray. Splice connectors shall allow for thermal expansion/contraction of the tray system. The splice connectors shall be provided with a vertical hole to accept a 1/2 inch (12mm) threaded rod (furnished by others) which is used to support the tray in an overhead application. In addition, steel splice connectors shall be installed with the seam up and shall have holes to accommodate mounting configurations associated with horizontal and vertical pivot connectors.
B. Quick Tee and Quick Cross Connectors. Horizontal and Vertical quick connect items shall be used for all 90 degree elbows. Quick Tees and Crosses shall have factory installed splice connector(s) welded to the component assembly.
C. Horizontal and Vertical Pivot Connectors - Angle tray connections to be field installed with Horizontal and Vertical pivot connectors. Fittings and shall telescope about the spine in a similar manner as the above splice connectors with top or side mounted pivot plates.
D. Tray Inserts / Tray Covers - Steel or Aluminum (select one), as well as other accessories shall be constructed of compatible material and design. Inserts and covers shall be field installed and rigidly secured by means of self tapping screws.

**2.60 CONSTRUCTION**

A. The Mono-Tray, Wall Rack and/or Double Tier Wall Rack rungs must pass through sections of spine and be staked in place, not screwed or welded. Each tray length shall consist of one tubular rectangular shaped spine member. All fittings and accessories to be constructed of steel or aluminum (select one) and to be manufactured for use with cable tray system.

**2.70 SUPPORTS**

A. Each Mono-Tray, Wall Rack and/or Double Tier Wall Rack ladder tray section shall be supported on maximum 12 foot centers (3.6 meters) in Canada 10 foot centers (3 meters) by one .50 inch (12mm) piece of threaded rod which pass through the vertical hole in each of the splice connectors and fasten directly to each piece of spine by one .50 inch (12mm) nut and washer on both the top and bottom sides of each piece spine. When shorter spans are required, then a 5/8 inch (16 mm) diameter hole should be drilled through the top and bottom walls of each piece of spine at support points only, and a single .50 inch (12mm) threaded rod should be inserted, through each spine member, also using a .50 inch (12mm) nut and washer on both the top and bottom sides of the spine.
B. Wall Mounted Mono-Tray Steel or Aluminum (select one) Ladder Tray - shall utilize wall bracket of adequate widths to accommodate Mono-Tray configuration. Brackets to be Mono-Systems, Inc. Series 0100-047_. All mounting material shall be furnished and installed by others.

**2.80 OPTIONAL PAINTED FINISHES**

A. Optional powder coated painted finish to be applied to the outer surfaces of the cable tray and associated components. Prior to the application of the powder coat all surfaces shall be cleaned and have an iron phosphate film applied. The color shall be _____.

## PART 3 - MANUFACTURER

**3.10 MANUFACTURER**

A. Company specializing in manufacturing products specified in this section must have a minimum of ten years documented experience. Unless written approval is obtained from the engineer 14 days prior to bid, the cable tray and fittings shall be manufactured by: Mono-Systems, Inc., 4 International Drive, Rye Brook New York 10573. (TEL) 914-934-2075 (FAX) 914-934-2190.

## PART 1 - GENERAL

**1.10 REFERENCE STANDARDS:**

A. Underwriter's Laboratories, Inc. certified No. E80034; National Electrical Code 318; NEMA class 12C (100#/ft./12 ft.).
B. Canadian Standards Association No. LR 082927, Dual-Rail 3 meter sections are CSA classified "E" (299kg/m/3m).
C. The cable tray system components shall be certified by one of the following UL, C-UL, CSA and/or a recognized testing laboratory.

**1.20 DESCRIPTION:**

A. Complete assembly of steel or aluminum (select one) cable tray system and necessary accessories shall be provided as shown on plans. Install entire cable tray system in accordance with all local governing codes.

**1.30 SUBMITTALS:**

A. Submittal drawings, in the form of 8 " x 11" catalog cut sheets, shall be provided for the following items: cable trays, fittings, accessories and load data.

## PART 2 - PRODUCTS

**2.10 MATERIALS (SELECT "A or B")**

A. Steel Dual-Rail shall be ventilated ladder type construction with widths and depths as indicated on the drawings. The ladder tray shall be supported from two (2) steel splice connectors, installed in a telescoping manner, around the outer portion of the main spine members.
B. Aluminum Dual-Rail shall be ventilated ladder type construction with widths and depths as indicated on the drawings. The ladder tray shall be supported from two (2) aluminum splice connectors, installed inside the inner portion of the main spine members.

**2.20 Dual-Rail® LADDER TRAY - Steel or Aluminum (SELECT "A or B")**

A. Steel Dual-Rail Ladder Tray shall be constructed of two (2) 1"x3" rectangular seam welded steel tubes to which .625" square seam welded tube steel rungs are attached on _____ inch (mm) centers. The cross rungs shall be bent up at their ends to a height of _____ inches (mm) to form a dual supported, open sided, ladder type assembly. The tray must not have continuous side rails. As noted on drawings, rungs shall emanate at right angles from the top of the spine or bottom of the spine (select one).
B. Aluminum Dual-Rail Ladder Tray shall be constructed of two (2) 1.5""x2.75" rectangular extruded aluminum tubes to which " square box beam (type C standard) or " x " box beam (type D) (select one) rungs are attached on _____ inch (mm) centers. The cross rungs shall be bent up at their ends to a height of _____ inches (mm) to form a dual supported, open sided, ladder type assembly. The tray must not have continuous side rails. As noted on drawings, rungs shall emanate at right angles from the top of the spine or bottom of the spine (select one).

**2.30 FITTINGS**

A. Splice Connectors - Steel or Aluminum (select one). Sections of Dual-Rail tray and all other fittings shall be joined by using two (2), two bolt, 4 inch (102mm) long, rectangular splice connectors which telescope about the spine of the tray. Splice connectors shall allow for thermal expansion/contraction of the tray system. The splice connectors shall be provided with a vertical hole to accept a 1/2 inch (12mm) threaded rod (furnished by others) which is used to support the tray in an overhead application. In addition, steel splice connectors shall be installed with the welded seam up and shall have holes to accommodate mounting configurations associated with horizontal and vertical pivot connectors.
B. Quick Tee - Steel or Aluminum (select one), Horizontal and Vertical quick connect items shall be used for all 90 degree elbows, tees and crosses by clamping to the spine(s).
C. Horizontal and Vertical Pivot Connectors - Steel or Aluminum (select one), shall be used for angles of 90 degrees to 30 degrees and fasten into the spine in a similar manner as the above splice connectors with top or side mounted pivot plates.
D. Tray Inserts / Tray Covers - Steel or Aluminum (select one), as well as other accessories shall be constructed of compatible material and design. Inserts and covers shall be field installed and rigidly secured by means of self tapping screws.

**2.40 CONSTRUCTION**

A. The Dual-Rail rungs must pass through both sections of spine and be staked in place, not screwed or welded. Each tray length shall consist of two parallel spine members, each being a tubular rectangular shape. All fittings and accessories to be constructed of steel or aluminum (select one) and to be manufactured for use with cable tray system.

**2.50 SUPPORTS**

A. Each Dual-Rail Steel or Aluminum (select one). Ladder Tray section shall be supported on maximum 12 foot centers (3.6 meters) in Canada 10 foot centers (3 meters) by two .50 inch (12mm) pieces of threaded rod which pass through the vertical hole in each of the splice connectors and fasten directly to each piece of spine by one .50 inch (12mm) nut and washer on both the top and bottom sides of each piece spine. When shorter spans are needed, then a 5/8 inch (16 mm) diameter hole should be drilled through the top and bottom walls of each piece of spine at support points only, and a single .50 inch (12mm) threaded rod should be inserted, through each spine member, also using a .50 inch (12mm) nut and washer on both the top and bottom sides of each piece of spine. All mounting material shall be furnished and installed by others.

**2.60 OPTIONAL PAINTED FINISHES**

A. Optional powder coated painted finish to be applied to the outer surfaces of the cable tray and associated components. Prior to the application of the powder coat all surfaces shall be cleaned and have an iron phosphate film applied. The color shall be _____.

## PART 3 - MANUFACTURER

**3.10 MANUFACTURER**

A. Company specializing in manufacturing products specified in this section must have a minimum of ten years documented experience. The cable tray and fittings shall be manufactured by: Mono-Systems, Inc., 4 International Drive, Rye Brook New York 10573. (TEL) 914-934-2075 (FAX) 914-934-2190.

Consumer Indoor Timers
Consumer Outdoor Timers
Electronic Time Switches
In-Wall Timers
- 24-Hour Mechanical Time Switches
- Commercial Spring Wound Timers
- Compact Programmable Timers
- Decorator Spring Wound Timers
- Digital 7-Day Time Switches
- Digital Auto-Off Timers
- Electronic 7-Day Astro Time Switches
- Electronic Auto-Off Timers

Mechanical Time Switches

# Commercial Spring Wound Timers

These energy saving commercial timers use no electricity to operate. These timers are designed to replace any standard wall switch, single or multi-gang, and automatically limit the “ON” time of fans, lights, motors, heaters and other energy consuming loads. Time limits of 5, 15, 30 and 60 minutes and 2, 4, 6 and 12 hours are available. The “hold feature” allows the user to override the automatic shut-off function for extended use of the load as required. Rugged time-dial plate takes the abuse encountered in commercial environments. Time saving “up front” terminal connection with teeter type terminals and an easy “press-on” knob design ensure quick and easy installation.

## Specifications

- **Switch Rating** –
  - **Inductive**: 20 Amp 125 VAC 50/60 Hz; 10 Amp 250 VAC 50/60 Hz; 10 Amp 277 VAC 50/60 Hz,
  - **Tungsten**: 7 Amp 125 VAC,
  - **Motor**: 1 HP 125 VAC 50/60 Hz; 2 HP 250 VAC 50/60Hz

  Caution: Do not use for sunlamps, sauna, etc...
- **Colors** – Commercial “brush metal” look
- **Style** – New simulated metal finish meets NEC requirements

Products

| Model | Time Cycle | Pole | Finish | Hold |
|---|---|---|---|---|
| FF12HC | 12 hour | SPST | Simulated brushed metal | no |
| FF12HHC | 12 hour | SPST | Simulated brushed metal | yes |
| FF15MC | 15 minute | SPST | Simulated brushed metal | no |
| FF15MH | 15 minute | SPST | Simulated brushed metal | yes |
| FF2H | 2 hour | SPST | Simulated brushed metal | no |
| FF30MC | 30 minute | SPST | Simulated brushed metal | no |

| | | | | |
|---|---|---|---|---|
| FF30MH | 30 minute | SPST | Simulated brushed metal | yes |
| FF312H | 12 hour | SPDT | Simulated brushed metal | no |
| FF312HH | 12 hour | SPDT | Simulated brushed metal | yes |
| FF32H | 2 hour | SPDT | Simulated brushed metal | no |
| FF32HH | 2 hour | SPDT | Simulated brushed metal | yes |
| FF34H | 4 hour | SPDT | Simulated brushed metal | no |
| FF34HH | 4 hour | SPDT | Simulated brushed metal | yes |
| FF36H | 6 hour | SPDT | Simulated brushed metal | no |
| FF412H | 12 hour | DPST | Simulated brushed metal | no |
| FF415M | 15 minute | DPST | Simulated brushed metal | no |
| FF430M | 30 minute | DPST | Simulated brushed metal | no |
| FF460M | 60 minute | DPST | Simulated brushed metal | no |
| FF46H | 6 hour | DPST | Simulated brushed metal | no |
| FF4H | 4 hour | SPST | Simulated brushed metal | no |
| FF5M | 5 minute | SPST | Simulated brushed metal | no |
| FF5MH | 5 minute | SPST | Simulated brushed metal | yes |
| FF60MC | 60 minute | SPST | Simulated brushed metal | no |
| FF60MHC | 60 minute | SPST | Simulated brushed metal | yes |
| FF6H | 6 hour | SPST | Simulated brushed metal | no |
| FF6HH | 6 hour | SPST | Simulated brushed metal | yes |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Thomas&Betts

# Steel City®

## 665 Cast Iron Floor Box

NEW!

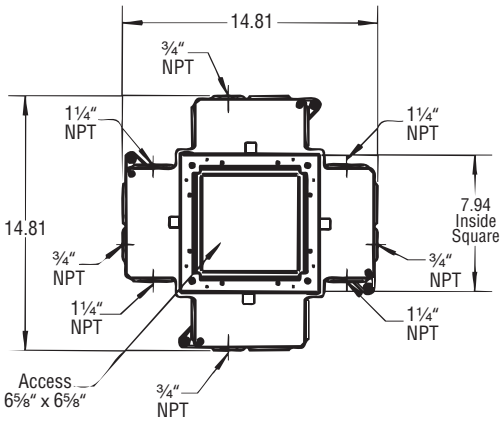
*Cover opened with single-gang GFCI plate and Keystone Jack plate installed.*

*Cover shown closed.*

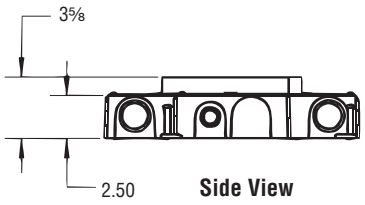
The new Steel City® 665 Cast Iron Floor Box provides a high capacity power and data solution for ground floor installations. This 4-gang recessed service floor box is ideal for slab-on-grade applications. Removable voltage dividers allow users to customize wiring configurations by feeding two or more adjacent compartments with a single conduit. Aesthetic covers feature a recess to accept floor covering to match the surrounding floor.

- Cast iron construction for slab-on-grade applications
- 4-Gang, recessed service for a high capacity, aesthetic floor box solution
- Removable voltage dividers between compartments allow a single conduit to feed two or more adjacent compartments
- Heavy duty nonmetallic covers with steel reinforcement plates are available in a wide variety of colors to match any décor (black, gray, brown and beige)
- Separate cord door in the cover latches firmly in the open position to prevent damage to cables
- MopTite™ covers meet UL scrubwater exclusion requirements for carpet, tile and wood
- Largest cubic inch capacity of any cast iron recessed 4-gang floor box
- Inline 1¼" hubs allow high capacity straight runs for communication wiring
- Custom device panels and hub sizes are available – contact technical service about these offerings

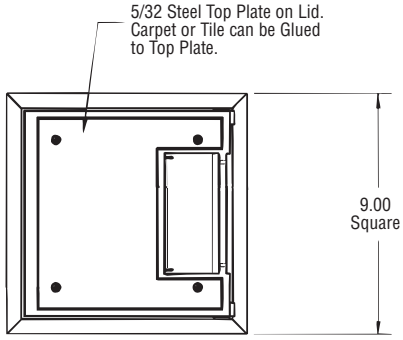
| | |
|---|---|
| Material: | Box – Cast Iron<br>Cover – Polycarbonate with Steel Reinforcement Plate |
| Listing: | UL, CSA Listed |

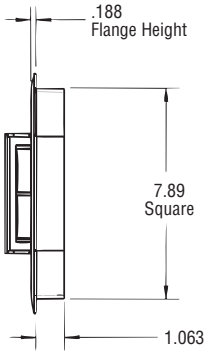


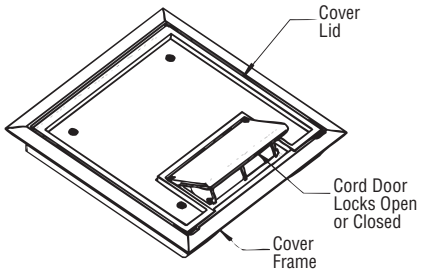

**Top View**




**Side View**

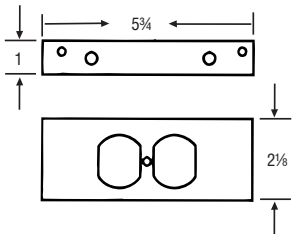


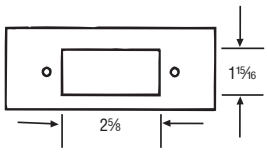




## Steel City® 665 Cast Iron Floor Box

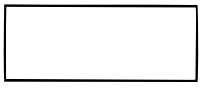
| Cat. Number | Description | Std. Pkg. Qty. | UPC Number |
|---|---|---|---|
| **665-CI** | 665 Cast Iron Floor Box | 1 | 78599103865 |
| **665-CST-SW-BGE** | 665 Cover, Scrubwater Tight, Beige | 4 | 78599103268 |
| **665-CST-SW-BLK** | 665 Cover, Scrubwater Tight, Black | 4 | 78599103269 |
| **665-CST-SW-BRN** | 665 Cover, Scrubwater Tight, Brown | 4 | 78599103270 |
| **665-CST-SW-GRY** | 665 Cover, Scrubwater Tight, Gray | 4 | 78599103271 |
| **665-RP** | 665 Single Gang Duplex Plate | 4 | 78599161862 |
| **665-GP** | 665 Single Gang GFCI Plate | 4 | 78599161864 |
| **665-BP** | 665 Blank Plate | 4 | 78599161863 |
| **665-6RJ** | 665 Data Plate - 6 Keystone Jacks | 4 | 78599101372 |



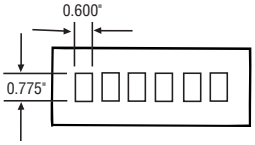

665-RP




665-GP



665-BP




665-6RJ

Please ask your Thomas & Betts sales representative for a complete catalog of quality Thomas & Betts electrical products or visit us at **www.tnb.com**. For customer service, **1-800-816-7809**. For technical questions, call **1-888-862-3289**.

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Electrical Division
8155 T&B Boulevard
Memphis, TN 38125
901-252-5000

**Thomas & Betts Ltd.**
700 Thomas Avenue
Iberville, Québec J2X 2M9
450-347-5318

# Better by Design™

### Adjustable Bumper Stop
Allows any desired length of cord to be maintained outside the reel.

### Corrosion-Resistant
Steel components are individually powder coated to virtually eliminate corrosion.

### Reelcraft offers eight styles of outlets and lamps
- Single receptacle
- Duplex outlet box w/ GFCI (F) - 2 styles available
- R.V. plug
- Fluorescent - 2 styles available
- Incandescent - 2 styles available

### Easy to Mount
Attaches to most structurally sound surfaces. Edges are curved for safety.
**NOTE:** Swing brackets should be used if cords are pulled at more than 45°, see page 49.

600993

L 4035 163 3

### Adjustable Guide Arm
Multiple guide arm positions for versatile uses and easier field adjustment.

### Enclosed Drive Spring
Drive mechanism is enclosed for protection against the environment.

### Long Life Drive Spring
Declutching arbor virtually eliminates possibility of spring damage due to reverse winding of reel spool.

### Structural Strength
Robotically welded heavy gauge steel frame .

## MODEL NUMBER SIGNIFICANCE
This chart is for reference purposes only. Reels cannot be ordered by selecting from this chart. Please see Selection Charts on pages 40-41 or consult manufacturer for any questions about option combinations.

**BUMPER ASSEMBLIES FOR CORD REELS**

| PART NUMBER | OUTSIDE DIA. OF CORD | CORD SPECIFICATIONS | | |
|---|---|---|---|---|
| | | AWG / mm² | # Cond. | Type |
| 600193 | .320" - .530" | 16 1.33 | 3 | SJO |
| 1-HR1004-A | .438" - .624" | 12 3.32 | 3 | SJO |
| 600267 | .645" | 10 5.37 | 3 | SO |
| 1-HR1004 | .625" - .749" | 12 3.32 | 3 | SO |
| 3-HR1004-3 | 1.06" - 1.30" | 6 8.00 | 3 | SO |

**SERIES 4000 and 5000 CORD REELS** — FOR REFERENCE ONLY

**L 4050 16 3 3**

**LATCH TYPE**
L = LATCHING
C = CONSTANT TENSION

**REEL SERIES**
40 = 4000 SERIES REEL
45 = 4500 SERIES REEL
55 = 5500 SERIES REEL
57 = 5700 SERIES REEL

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**WIRE SIZE**
10 = 10 GAUGE
12 = 12 GAUGE
16 = 16 GAUGE

**LENGTH OF CORD**
00 = W/O CORD
35 = 35 FEET
45 = 45 FEET
50 = 50 FEET

**NO. OF CONDUCTORS**
2 = TWO CONDUCTOR
3 = THREE CONDUCTOR

**STYLE NUMBERS**
NONE. OPEN END
1 = INCANDESCENT LAMP
2 = FLUORESCENT LAMP
3 = SINGLE RECEPTACLE
4 = R.V. PLUG (M)
5 = INCANDESCENT NON-SPARKING
6x = FLUORESCENT EXPLOSION PROOF
7 = DUPLEX OUTLET BOX (F) W/GFCI
8 = FLUORESCENT W/OUTLET

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# POWER CORD & LIGHT REELS Series 4000 and 5000

## POWER SOURCE STYLE OPTIONS

**Style #7**
Metal outlet box with dual 20 AMP receptacles and GFCI protection with flip-top lid.

The GFCI Receptacle is designed to protect people from the line-to-ground shock hazards which could occur from defective power tools or appliances operating from this device or from down line outlets protected by it.

**Style #4**
Male rubber plug used with recreational vehicles (RV's).

**Style #3A**
Single 20 AMP receptacle.

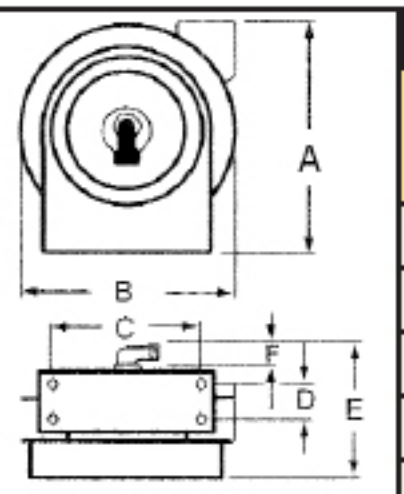
**Style #3B**
Single 20 AMP receptacle with twist lock connector.

**Style #3**
**Two Options**
**#600209**
Single 15 AMP receptacle with clamp type strain relief.
(Cord size - 16 AWG)

**#600251**
Single 15 AMP receptacle with clamp type strain relief.
(Cord size - 12 AWG)

The Ground Fault Circuit Interrupter does not protect against short circuits or overloads. This is the function of the fuse or circuit breaker.

- ✓ Spring retractable with latch
- ✓ Compact for critical space requirements
- ✓ Durable abrasion and corrosion resistant baked-on powder coat finish
- ✓ Wall, ceiling or bench mount
- ✓ Engineered for industrial use
- ✓ All models supplied with cord are complete with approx-mately 4-5 foot pigtail and three-prong plug
- ✓ Adjustable cord stop




Series 4000 and 5000 models have four 5/16" diameter mounting holes. Series L5700 "E" dimension is 12½".

## DIMENSIONS

| | L4000 L4500 | | L5000 L5400 | | L5500 L5700 | |
|---|---|---|---|---|---|---|
| | in | mm | in | mm | in | mm |
| A | 13 1/4 | 337 | 14 1/2 | 369 | 17 1/2 | 445 |
| B | 12 5/8 | 321 | 13 3/4 | 350 | 16 1/2 | 419 |
| C | 8 | 203 | 9 3/4 | 248 | 9 3/4 | 248 |
| D | 2 1/2 | 64 | 2 1/2 | 64 | 2 1/2 | 64 |
| E | 9 3/8 | 239 | 12 1/2 | 318 | 12 1/2* | 318 |
| F | 1 3/4 | 45 | 2 1/8 | 54 | 2 1/8 | 54 |

*Series L5700 "E" dimension is 12.5"

L 4050 163 3

L 4545 123 7

L 5700

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## POWER CORD & CABLE REEL SELECTION CHART For indoor non-weather light applications only

| MODEL | ACCESSORY | CORD SPECIFICATIONS AWG / mm² | No. Cond. | Length ft / m | Type | VOLTS * | AMPS | WEIGHT lbs / kg |
|---|---|---|---|---|---|---|---|---|
| L 4035 163 3 | Single Receptacle | 16 1.33 | 3 | 35 11 | SJTOW | 115 | 13 | 22 10 |
| L 4050 163 3 | Single Receptacle | 16 1.33 | 3 | 50 15 | SJTOW | 115 | 13 | 26 12 |
| L 4545 123 3 | Single Receptacle | 12 3.32 | 3 | 45 14 | SJEOW | 115 | 15 | 28 13 |
| L 5550 123 3 | Single Receptacle | 12 3.32 | 3 | 50 15 | STOW | 115 | 15 | 47 21 |
| L 4545 123 3A | Single Connector | 12 3.32 | 3 | 45 14 | SJEOW | 125 | 20 | 29 14 |
| L 4545 123 3B | Twist Lock Connector | 12 3.32 | 3 | 45 14 | SJEOW | 125 | 20 | 29 14 |
| L 5750 103 4 | R.V. Plug | 10 5.37 | 3 | 50 15 | SO | 115 | 35 | 50 23 |
| L 4545 123 7A | Duplex Outlet Box w/GFCI (F) | 12 3.32 | 3 | 45 14 | SJEOW | 125 | 20 | 28 13 |
| L 4545 123 7 | Duplex Outlet Box w/GFCI (F) | 12 3.32 | 3 | 45 14 | SJEOW | 115 | **20 | 29 14 |
| L 5550 123 7 | Duplex Outlet Box w/GFCI (F) | 12 3.32 | 3 | 50 15 | STOW | 115 | **20 | 47 21 |

*All models UL listed at 115 Volt 60 HZ single phase. Base power cord reels without cord ends are suitable for 220V.
**Inlet plug is NEMA5-15P configuration. Plug ends not set up for 20 amp. **NOTE:** Swing brackets should be used if cords are pulled at more than 45°, see page 49.

## POWER CORD & CABLE REEL SELECTION CHART For indoor non-weather light applications only

| MODEL | ACCESSORY | REEL CAPABILITIES sold w/o cable AWG / mm² | No. Cond. | Length ft / m | Type | VOLTS * | AMPS | WEIGHT lbs / kg |
|---|---|---|---|---|---|---|---|---|
| L 4000 | Reel w/o electric cord | 16 1.33 | 3 | 50 15 | SJO | 115 | 13 | 22 10 |
| L 4100 | Reel w/o electric cord | 16 1.33 | 4 | 40 12 | SJO | 115 | 13 | 22 10 |
| L 4500 | Reel w/o electric cord | 12 3.32 | 3 | 45 14 | SJO | 115 | 25 | 21 9 |
| L 5000 | Reel w/o electric cord | 10 5.27 | 3 | 35 11 | SO | 115 | 35 | 29 13 |
| L 5400 | Reel w/o electric cord | 12 3.32 | 3 | 35 11 | SO | 115 | 25 | 25 12 |
| L 5500 | Reel w/o electric cord | 12 3.32 | 3 | 50 15 | STOW | 115 | 25 | 34 15 |
| L 5700 | Reel w/o electric cord | 10 5.27 | 3 | 50 15 | SO | 115 | 35 | 37 17 |
| L 7000 | Reel w/o electric cord | 6 13.3 | 4 | 35 11 | SO | 220 | 50 | 41 19 |

*All models UL listed at 115 Volt 60 HZ single phase; suitable for 220 V. For indoor use only.



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Reelcraft Industries is **ISO 9001:2000** Certified Since 1996

Models listed with an icon can be shipped same day upon request when the order is received by 11:30 AM local time for quantities of 5 or fewer.

- Indiana Warehouse
- Indiana & California Warehouses
- California Warehouse
- Canadian Warehouse

# POWER CORD & LIGHT REELS Series 4000 and 5000

## LIGHT STYLE OPTIONS

**Fluorescent Light**
**Style #2**
- Durable shock absorbing lamp holder
- Shatter-resistant tube with switch

**▼ Style #6**
- Explosion Proof 13 watt fluorescent hand lamp
- Automatic on/off switch at reel guide arm
- Suitable for Class 1, group C and D locations

Note: Reel is not explosion-proof.

**Incandescent Hand Lamps**

**◄ Style #5**
- Rubber handle with vinyl-coated cage
- W/O switch or receptacle
- Automatic on/off switch at reel guide arm
- Complies with NEC #511-3,f., portable lighting equipment.
- Meets OSHA requirements.

**Style #8 ▲**
- One foot #16/3 conductor SJTOW-A yellow cord with molded NEMA 5-15P plug
- 120v-15amp receptacle is located in line on cord
- SAF-T-TIE keeps the light plugged into receptacle
- Scratch guard protects lamp cover
- For cord assembly only, order model 1 163 3 8

**Style #1 ▲**
- Single receptacle tool tap
- Push-through switch
- Metal grounded guard.

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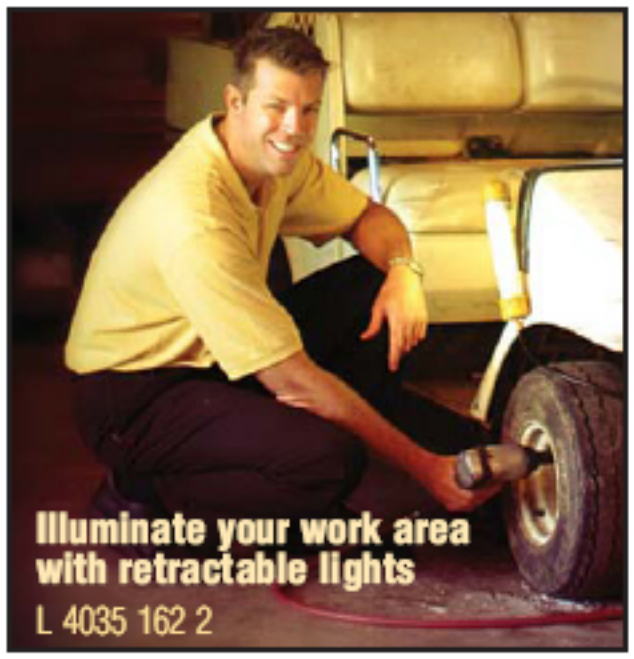
L 4050 163 1

Note: Reel is not explosion proof

## Five retractable light cord options

Illuminate your work area with incandescent, fluorescent or explosion-proof hand lamps




## Auto-Switch Light Cord Reels

Models equipped with an automatic on/off switch incorporate a guide arm mounted switch that activates power with a pull of the cord.

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L 5245 A 163 6X

## LIGHT CORD REEL SELECTION CHART For indoor non-weather light applications only

| MODEL | ACCESSORY | CORD SPECIFICATIONS | | | | | VOLTS * | AMPS | WEIGHT | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | AWG / mm² | | No. Cond. | Length ft / m | Type | | | lbs | / kg |
| L 4035 163 1 | *Incandescent | 16 | 1.33 | 3 | 35 11 | SJTOW | 115 | 13 | 22 | 10 |
| L 4050 163 1 | *Incandescent | 16 | 1.33 | 3 | 50 15 | SJTOW | 115 | 13 | 23 | 11 |
| L 4035 A163 5** | *Incandescent | 16 | 1.33 | 3 | 35 11 | SJOW | 115 | 15 | 25 | 12 |
| L 5245 A163 6X** | Fluorescent | 16 | 1.33 | 3 | 45 14 | SEOW | 115 | 0.3 | 32 | 15 |
| L 4035 162 2 | Fluorescent | 16 | 1.33 | 2 | 35 11 | SJTOW | 115 | 0.3 | 23 | 11 |
| L 4050 162 2 | Fluorescent | 16 | 1.33 | 2 | 50 15 | SJTOW | 115 | 0.3 | 24 | 11 |
| L 4035 163 8 | Fluorescent Light and Outlet | 16 | 1.33 | 3 | 35 11 | SJTO | 115 | 10 | 26 | 11 |
| L 4050 163 8 | Fluorescent Light and Outlet | 16 | 1.33 | 3 | 50 15 | SJTO | 115 | 10 | 27 | 12 |

* Incandescent bulb 75 watt maximum. All models UL listed at 115 Volt 60 HZ single phase. Base power cord reels without cord ends are suitable for 220 V. For indoor use only. See accessories page for optional mounting brackets and bases.
**Models are equipped with automatic on/off switch that activates power.
**NOTE:** Swing brackets should be used if cords are pulled at more than 45°, see page 49.

L 4035 162 2

SECTION 26 32 13.00 20

SINGLE OPERATION GENERATOR SETS
**04/07**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C2 | (2007; Errata 2007; INT 2008) National Electrical Safety Code |
| IEEE C50.12 | (2005) Requirements for Salient Pole Synchronous Generators |
| IEEE Std 115 | (1995; R 2002) Test Procedures for Synchronous Machines: Part I: Acceptance and Performance Testing; Part II: Test Procedures and Parameter Determination for Dynamic Analysis |

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

| | |
|---|---|
| ICBO UBC | (2000) Uniform Building Code (3 Vol.) |

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

| | |
|---|---|
| NETA ATS | (2003) Acceptance Testing Specifications |

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

| | |
|---|---|
| ISO 3046 | (1986; Am. 1) Reciprocating Internal Combustion Engines - Performance |
| ISO 8528 | (1993) Reciprocating Internal Combustion Engine Driven Alternating Current Generator Sets |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA C50.10 | (1990) Rotating Electrical Machinery - Synchronous Machines |
| NEMA ICS 6 | (1993; R 2006) Standard for Industrial Controls and Systems Enclosures |
| NEMA MG 1 | (2007) Standard for Motors and Generators |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 30 | (2007; Errata 2008) Flammable and Combustible Liquids Code |

| | |
|---|---|
| NFPA 37 | (2006) Installation and Use of Stationary Combustion Engines and Gas Turbines |
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| FS A-A-52557 | (Rev A)) Fuel Oil, Diesel; for Posts, Camps and Stations |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1236 | (2006) Standard for Safety Battery Chargers for Charging Engine-Starter Batteries |
| UL 142 | (2006; Rev thru Dec 2007) Steel Aboveground Tanks for Flammable and Combustible Liquids |
| UL 467 | (2007) Standard for Grounding and Bonding Equipment |
| UL 489 | (2002; Rev thru Jun 2006) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures |

## 1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, and Section 26 08 00 APPARATUS INSPECTION AND TESTING apply to this section except as modified herein.

## 1.3 SYSTEM DESCRIPTION

### 1.3.1 Engine-Generator Set Data

Submit data pertaining to the diesel engine-generator set and to the auxiliary equipment including but not limited to the following:

a. Make of engine.

b. Type or model of engine.

c. Gross bhp rating of engine shall be the total rated power output before deducting power requirements of electric motor-driven equipment or engine driven radiator fan.

d. Net brake power rating of engine shall include deductions for the total power requirements of electric motor-driven or engine-driven accessories as defined in ISO 3046. Net ratings shall include a deduction in power output for cooling media system power requirements including radiator fans and any other power consuming devices required to provide cooling as specified.

e. Strokes per cycle.

f. Number of cylinders.

g. Bore and stroke, inches.

h. Engine speed, rpm.

i. Piston speed, fpm.

j. kW power rating of engine-generator set as defined in the paragraph entitled "Engine-Generator Set Ratings and Performance."

k. Induction method (naturally aspirated, turbocharged).

l. Intercooler type (air-to-air or jacket water).

m. Governor type, make, and model.

n. Make and model of turbochargers.

1.3.2 Engine-Generator Set Efficiencies

Submit data pertaining to the diesel engine-generator set including but not limited to the following: Loads shall be calculated on basis of rated engine-generator set power.

a. Fuel consumption at 0.80 power factor, gallons per hr.

1. 1/2 load

2. 3/4 load

3. Full load

b. Generator efficiency at 0.80 power factor (percent).

1. 1/2 load

2. 3/4 load

3. Full load

c. Radiator capacity at design conditions.

1. Coolant shall be antifreeze mixture as specified under paragraph entitled "Cooling System."

2. gpm of coolant

3. cfm of air through radiator

4. Btu per hr of heat exchange based on optimum coolant temperature to and from engine.

1.3.3 Diesel Engine Data

Submit data certified by the engine manufacturer including but not limited to the following: Loads shall be calculated on basis of rated engine-generator set power.

a. Approximate exhaust temperature degrees F at full load

b. Weight of exhaust gas at full load lb per hr

c. Weight of intake air at full load lb per hr

d. Total heat rejected at full load Btu per hr

1. To jacket coolant system

2. To fuel oil cooling system

e. Emissions (Lbs/hr)(kg/hr) at full load

1. Total Suspended Particulate

2. Particulate matter with an average aerodynamic diameter of 10 microns (PM-10)

3. Sulfur dioxides

4. Nitrogen Oxides (as N02)

5. Carbon Monoxide

6. Volatile Organic Compounds

f. Visible Emissions (percent opacity) at full load

1.3.4 Generator and Exciter Data

Submit data certified by the generator manufacturer including but not limited to the following:

a. Make and model number of generator

b. kW rating of generator

c. Generator reactances

1. Synchronous reactance, Xd

2. Transient reactance, X'd

3. Subtransient reactance, X"d

4. Negative sequence reactance, X2

5. Zero sequence reactance, Xo

1.3.5 Capacity Calculations for Engine-Generator Set

Calculations shall verify that the engine-generator set power rating is adequate for the load described in the paragraph entitled "Load Profile."

1.3.6 Calculations for Brake Mean Effective Pressure (BMEP)

Calculation shall verify that the diesel engine meets the specified maximum BMEP as follows:

a. kW: Minimum power rating of engine-generator set as defined in the paragraph entitled "Engine-Generator Set Ratings and Performance."

b. rpm: Engine revolutions per minute.

c. cu. in.: Total engine piston displacement in cubic inches.

d. GEN.EFF.: Generator efficiency.

e. x: Multiplication sign.

f. bhp': Brake horsepower required from diesel engine by generator loaded to full power rating.

g. bhp': kW/(GEN.EFF. x 0.746).

h. bhp": Brake horsepower required by diesel engine driven fan for cooling radiator or motor driven fan for cooling radiator.

i. bhp: bhp' + bhp".

j. BMEP psi: (792,000 x bhp) /(rpm x cu. in.).

### 1.3.7 Capacity Calculations for Batteries

Calculation shall verify that the engine starting battery capacity exceeds dc power requirements.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Engine-Generator set and auxiliary equipment; G

SD-03 Product Data

Engine-generator set data; G

Engine-generator set efficiencies; G

Diesel engine data; G

Generator and exciter data; G

Diesel engine-generator set; G

Auxiliary systems and equipment; G

Remote alarm annunciator; G

SD-05 Design Data

Capacity calculations for engine-generator set; G

Calculations for brake mean effective pressure; G

Capacity Calculations for Batteries; G

SD-06 Test Reports

Acceptance checks and tests; G

Functional acceptance tests; G

Functional acceptance test procedure; G

SD-07 Certificates

Start-up engineer qualification resume; G

Instructor's qualification resume; G

SD-09 Manufacturer's Field Reports

Engine tests; G

Generator tests; G

Assembled engine-generator set tests; G

SD-10 Operation and Maintenance Data

Diesel engine-generator set, Data Package 4; G

Auxiliary systems and equipment, Data Package 4; G

Preliminary assembled operation and maintenance manuals; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and the paragraph entitled "Assembled Operation and Maintenance Manuals."

SD-11 Closeout Submittals

Posted operating instructions; G

Training plan; G

## 1.5 QUALITY ASSURANCE

### 1.5.1 Drawing Requirements

#### 1.5.1.1 Engine-Generator Set and Auxiliary Equipment

Submit drawings pertaining to the engine-generator set and auxiliary equipment, including but not limited to the following:

a. Certified outline, general arrangement (setting plan), and anchor bolt details. Show total weight and center of gravity of assembled equipment on the steel subbase.

b. Detailed elementary, schematic wiring, and interconnection diagrams of the engine starting system, jacket coolant heating system, engine protective devices, engine alarm devices, engine speed governor system, generator and excitation system, and other integral devices.

c. Detailed elementary, schematic wiring; and interconnection diagrams of the diesel fuel system, starting battery system, engine-generator control panel, generator circuit breaker, and remote alarm annunciator.

d. Dimensional drawings or catalog cuts of exhaust silencers, radiator, diesel fuel day tanks, fuel oil cooler, valves and pumps, intake filters, vibration isolators, and other auxiliary equipment not integral with the engine-generator set.

## 1.6 DELIVERY, STORAGE, AND HANDLING

Deliver equipment on pallets or blocking wrapped in heavy-duty plastic, sealed to protect parts and assemblies from moisture and dirt. Plug piping, conduit, exhaust, and air intake openings. Protect and prepare batteries for shipment as recommended by the battery manufacturer. Store auxiliary equipment at the site in covered enclosures, protected from atmospheric moisture, dirt, and ground water.

## 1.7 SITE CONDITIONS

Protect the components of the engine-generator set, including cooling system components, pumps, fans, and similar auxiliaries when not operating and provide components capable of the specified outputs in the following environment:

a. Site Location: Subtropical

b. Site Elevation: 0 feet above mean sea level

c. Ambient Temperatures:

1. Maximum 100 degrees F dry bulb, 95 degrees F wet bulb.

2. Minimum 0 degrees F dry bulb.

f. Seismic Zone: Zone B as defined by ICBO UBC.

## 1.8 MAINTENANCE

### 1.8.1 Extra Materials

#### 1.8.1.1 Paint

Furnish one gallon of identical paint used on engine-generator set in manufacturer's sealed container with each engine-generator set.

#### 1.8.1.2 Filters

Furnish four spare replacement elements in their original containers for each filter with each unit.

### 1.8.2 Posted Operating Instructions

Provide proposed operating instructions for the engine-generator set and

auxiliary equipment laminated between matte-surface thermoplastic sheets and suitable for placement adjacent to corresponding equipment. After approval, install operating instructions where directed.

PART 2 PRODUCTS

2.1 DIESEL ENGINE-GENERATOR SET

Provide diesel engine-generator sets consisting of a water cooled diesel engine direct connected to an ac generator with a brushless excitation system and accessories. Equipment and materials shall be the manufacturer's standard products offered in catalogs for commercial or industrial use.

2.1.1 Engine-Generator Set Ratings and Performance

ISO 8528. Each engine-generator set shall have a power rating of not less than 250 kW at 0.8 power factor and supply 480Y/277-volt, three-phase, 60-Hz ac output. Coordinate the engine-generator set to ensure an installed rating in the environment described in paragraph entitled "Site Conditions." The power of the engine-generator set is defined as the power output available at the generator terminals excluding the electrical power absorbed by the essential independent auxiliaries. Essential independent auxiliaries are items of equipment which are essential for the continued or repeated operation of the engine which uses power supplied from a source other than the engine.

2.1.1.1 Diesel Engine Capacity

The diesel engine shall meet the specified maximum BMEP requirements at rated speed as calculated in accordance with the paragraph entitled "Calculations for BMEP." The engine capacity shall be based on the following:

a. Engine burning diesel fuel conforming to FS A-A-52557, Grade DF-2, at an ambient temperature of 85 degrees F.

b. Engine cooled by a radiator fan mechanically driven by the diesel engine or remote with a motor driven fan.

c. Engine cooled by coolant mixture of water and ethylene glycol, 50 percent by volume of each.

Maximum BMEP, psi

| | Naturally Aspirated | Turbocharged | Turbocharged and Intercooled |
|---|---|---|---|
| Four-cycle engines | N/A | N/A | 302 |

Engine speed, rpm: 1800

2.1.1.2 Performance Class

The voltage and frequency behavior of the generator set shall be in accordance with ISO 8528 operating limit values for performance Class G2.

2.1.2 Diesel Engines and Accessories

ISO 3046. Diesel engines shall be four-cycle naturally aspirated, or turbocharged, or turbocharged and intercooled; vertical in-line or vertical Vee type; designed for stationary service. Engines shall be capable of immediate acceleration from rest to normal speed without intermediate idle/warm up period or prelubrication to provide essential electrical power. Two-cycle engines are not acceptable.

2.1.2.1 Subbase Mounting

Mount each engine-generator set on a structural steel subbase sized to support the engine, generator, and necessary accessories, auxiliaries and control equipment to produce a complete self-contained unit as standard with the manufacturer. Design the structural subbase to properly support the equipment and maintain proper alignment of the engine-generator set in the specified seismic zone. In addition, provide subbase with both lifting rings and jacking pads properly located to facilitate shipping and installation of the unit. Factory align engine and generator on the subbase and securely bolt into place in accordance with the manufacturer's standard practice. Crankshaft shall have rigid coupling for connection to the generator.

2.1.2.2 Assembly

Completely shop assemble each engine-generator set on its structural steel subbase. Paint entire unit with manufacturer's standard paints and colors. After factory tests and before shipping, thoroughly clean and retouch painting as necessary to provide complete protection.

2.1.2.3 Turbocharger

If required by the manufacturer to meet the engine-generator set rating, provide turbine type driven by exhaust gas from engine cylinders, and direct connected to the blower supplying air to the engine intake manifold.

2.1.2.4 Intercooler

Provide manufacturer's standard intercooler for engine size specified.

2.1.2.5 Crankcase Protection

Provide manufacturer's standard method of preventing crankcase explosions and standard method of crankcase ventilation.

2.1.2.6 Engine Lubricating Oil System

Provide each engine with the manufacturer's standard full pressure lubricating oil system arranged to cool the pistons and to distribute oil to moving parts of the engine. Provide oil type and oil filters as recommended by the engine manufacturer.

2.1.2.7 Engine Cooling System

Provide each engine with the manufacturer's standard jacket water pump. Provide a thermostatic control valve in the jacket coolant system for each engine-generator set to maintain a constant jacket coolant temperature to the engine.

2.1.2.8 Engine Fuel System

Provide each engine with the manufacturer's standard fuel system integral with the engine, complete with necessary piping, fittings, and valves for connecting items of equipment which are a part of the system. Provide engine manufacturer's standard hand priming pump. Provide manufacturer's standard simplex filter for each engine, of the throwaway filter element type, consisting of shell filter elements, drains, and necessary connections and fittings.

2.1.2.9 Engine Intake Filter

Provide intake filter assemblies for each engine of the oil bath or dry type, as standard with the manufacturer. Filters shall be capable of removing a minimum of 92 percent of dirt and abrasive 3 microns and larger from intake air. Size filters to suit engine requirements at 100 percent of rated full load. Design unit for field access for maintenance purposes.

2.1.2.10 Engine Starting System

Starting shall be accomplished using an adequately sized dc starter system with a positive shift solenoid to engage the starter motor and to crank the engine continuously for 60 seconds without overheating.

2.1.2.11 Jacket Coolant Heating System

Provide a factory-installed, 120 volts ac, jacket coolant heating system to ensure rapid starting. Thermostatically control heater at the temperature recommended by engine manufacturer. Include necessary equipment, piping, controls, wiring, and accessories.

2.1.2.12 Engine Protective (Shutdown) Devices

Equip each engine with devices to shut down the engine by shutting off the fuel supply to the engine via a fuel shutoff solenoid. Auxiliary contacts shall be suitable for activating a remote alarm system. Shutdown shall open the associated generator circuit breaker. Provide the following shutdown devices:

a. Overspeed device which operates when engine speed exceeds normal synchronous speed by 18 percent or as recommended by manufacturer. Device shall require manual reset.

b. Pressure switch which operates when lubricating oil pressure to engine drops below a preset value.

c. Temperature switch which operates when jacket coolant temperature exceeds a preset value.

d. Device which operates when the coolant level in the radiator drops below a preset level.

e. Other shutdown devices as recommended by the engine manufacturer.

2.1.2.13 Engine Alarm Devices

Equip each engine with alarm devices. Auxiliary contacts shall be suitable for activating a remote alarm system. Alarm devices shall have factory-fixed set points. Provide the following alarm contact devices:

a. Pressure switch which operates when lubricating oil pressure drops below a preset value.

b. Temperature switch which operates when jacket coolant temperature exceeds a preset value.

c. Temperature switch which operates when jacket coolant temperature is too low.

d. Other alarm devices as recommended by the engine manufacturer.

2.1.2.14 Miscellaneous Engine Accessories

Provide the following engine accessories where the manufacturer's standard design permits:

a. Piping on engine to inlet and outlet connections, including nonstandard companion flanges.

b. Structural steel subbase and vibration isolators.

e. Removable guard, around fan. Support guard, on engine subbase, to suit manufacturer's standard.

2.1.2.15 Engine Speed Governor System

Provide a forward acting type engine speed governor system. Steady-state frequency band and frequency regulation (droop) shall be in accordance with the operating limit values of the performance class specified in the paragraph entitled "Performance Class."

2.1.3 Generator and Excitation System

2.1.3.1 Generator

Provide salient-pole type, ac, brushless-excited, revolving field, air-cooled, self-ventilated, coupled type, synchronous generator conforming to NEMA MG 1, Part 22, NEMA C50.10, and IEEE C50.12. Generator shall be rated for standby duty at 100 percent of the power rating of the engine-generator set as specified in paragraph entitled "Engine-Generator Set Ratings and Performance." Temperature rise of each of the various parts of the generator shall not exceed 105 degrees C as measured by resistance, based on a maximum ambient temperature of 40 degrees C. Winding insulation shall be Class H.

a. Stator: Stator windings shall be 2/3 pitch design, 12 lead reconnectable.

b. Rotor: The rotor shall have connected amortisser windings.

c. Generator Space Heater: Provide 120 volt ac heaters. Heater capacity shall be as recommended by the generator manufacturer to aid in keeping the generator insulation dry.

d. Grounding: Provide non-corrosive steel grounding pads located at two opposite mounting legs.

2.1.3.2 Excitation System

Provide a brushless excitation system consisting of an exciter and rotating rectifier assembly, and permanent magnet generator integral with the generator and a voltage regulator. Insulation class for parts integral with the generator shall be as specified in paragraph entitled "Generator." System shall provide a minimum short circuit of 300 percent rated engine-generator set current for at least 10 seconds. Steady state voltage regulation shall be in accordance with the operating limit values of the performance class specified in the paragraph entitled "Performance Class."

a. Exciter and Rotating Rectifier Assembly: Rectifiers shall be provided with surge voltage protection.

b. Voltage Regulator: Voltage regulator shall be solid state or digital, automatic, three-phase sensing, volts per hertz type regulator. Regulator shall receive its input power from a PMG. Voltage variation for any 40 degree C change over the operating temperature range shall be less than plus or minus 1.0 percent. Operating temperature shall be minus 40 degree C to plus 70 degree C. Voltage adjust range shall be plus to minus 5.0 percent of nominal. Inherent regulator features shall include overexcitation shutdown.

2.2 ENGINE-GENERATOR SET AUXILIARY SYSTEMS AND EQUIPMENT

Provide auxiliary systems and equipment designed for continuous duty at 100 percent of the power rating of the engine-generator set as specified in the paragraph entitled "Engine-Generator Set Ratings and Performance."

2.2.1 Vibration Isolation System

Install the subbase on vibration isolators that are secured to a suitable concrete foundation. Provide isolators as recommended by the engine-generator set and isolator manufacturers and provide integral or external lateral support to limit lateral movement and overturning moments.

2.2.2 Exhaust System

Provide exhaust systems for each engine.

2.2.2.1 Exhaust Silencers

A critical class silencer shall be provided for each engine which will reduce the exhaust sound spectrum by the following listed values at a 75 foot radius from the outlet, with generator set loaded to rated capacity and clear weather. Inlet and outlet connections shall be flanged.

| | Octave Band Center Frequency (Hertz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Minimum Silencer Attenuation Decibels | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
| Critical Class | 15 | 32 | 37 | 36 | 30 | 36 | 37 | 37 |

2.2.3 Cooling System

Provide the specified cooling water system. Properly size equipment to handle the flow rate and pressure losses of the coolant mixture specified in the paragraph entitled "Diesel Engine Capacity," and at the site elevation specified in the paragraph entitled "Site Conditions."

2.2.3.1 Radiators

Provide for each engine-generator set, as standard with the manufacturer.

a. Design Conditions: Each radiator unit shall have ample capacity to remove not less than the total Btu per hour of heat rejected by its respective engine at 100 percent full-rated load to the jacket water, fuel oil, and lubricating oil system, and intercooler. Radiator capacity shall be rated at optimum temperature of coolant leaving the engine and intercooler as recommended by the engine manufacturer with an ambient dry bulb air temperature outside the enclosure of 122 degrees F maximum, and 0 degrees F minimum at the site elevation specified in the paragraph entitled "Site Conditions," and with the coolant mixture specified in the paragraph entitled "Diesel Engine Capacity." Pressure drop through the radiator shall not exceed 6 psi when circulating the maximum required coolant flow. Radiator air velocity shall be a maximum of 1500 feet per minute.

b. Engine Mounted Radiator Construction: Radiator fan shall direct airflow from the engine outward through the radiator. Fan shall be V-belt driven directly from the engine crankshaft. Radiator fan shall have sufficient capacity to meet design conditions against a static restriction of 0.5 inch of water. Fan static capacity shall be adjusted to suit the ductwork furnished. Cooling section shall have a tube and fin-type core consisting of copper or copper base alloy tubes with nonferrous fins. Select engine-driven fans for quiet vibration-free operation. Make provision for coolant expansion either by self-contained expansion tanks or separately mounted expansion tanks, as standard with the manufacturer. Provide suitable guards for each fan and drive.

c. Coolant solution shall be a mixture of clean water and ethylene glycol, 50 percent by volume each. Provide an anti-freeze solution tester suitable for the mixture.

2.2.4 Diesel Fuel System

NFPA 30 and NFPA 37 and the requirements herein.

2.2.4.1 Diesel Fuel Piping System

Factory installed piping shall conform to the engine manufacturer's standard.

2.2.4.2 Diesel Fuel Day Tank System

Provide diesel fuel sub base tank system. Include necessary equipment, piping, controls, wiring, and accessories.

a. Day Tanks: UL 142. Provide integral in skid double wall (110 percent containment) diesel fuel day tanks with a capacity as indicated. Epoxy coat day tanks inside and prime and paint outside. Construct tanks of

not less than 3/16 inch steel plate with welded joints and necessary stiffeners on exterior of tank. Provide a braced structural steel framework support. Provide proper venting of both inner and outer containment.

b. Float Switches: Provide tank-top mounted or external float cage, single-pole, single-throw type designed for use on fuel oil tanks. Arrange high level float switches to close on rise of liquid level, and low level float switches to close on fall of liquid level. Contacts shall be suitable for the station battery voltage.

1. Low-low level float switch which shall activate alarm at 30 percent of normal liquid level.

2. Critical high level float switch which shall activate alarm at 95 percent of normal liquid level.

c. Leak Detector Switch: Actuates when fuel is detected in containment basin, stops fuel transfer pump, and closes the fuel oil solenoid valve.

2.2.4.3 Fuel Oil Cooler

Provide an air cooled fuel oil cooler if the temperature of the fuel returned to the tank from the engine will cause overheating of the tank fuel above the maximum fuel temperature allowed by the engine manufacturer when operating at maximum rated generator power output and low fuel level in the tank. The fuel oil cooler shall be furnished by the engine manufacturer for the application and the installation shall be complete including piping and power requirements.

2.2.5 Starting Battery System

Provide a 24-volt dc starting battery installation for starting of each engine-generator set utilizing an electric cranking system.

2.2.5.1 Engine Starting Battery

Provide maintenance free, sealed, lead-acid, SAE Type D diesel engine starting batteries. Battery configuration shall be two series sets of two 12-volt batteries. Batteries shall have sufficient capacity to provide 60 seconds of continuous cranking of the engine in an ambient temperature of 95 degrees F.

2.2.5.2 Starting Battery Charger

UL 1236. Provide 480 volt ac, enclosed, automatic equalizing, dual-rate, solid-state, constant voltage type battery charger with automatic ac line compensation. Dc output shall be voltage regulated and current limited. Charger shall have two ranges, float and equalize, and shall provide continuous taper charging. The charger shall have a continuous output rating of not less than 10 amperes and shall be sized to recharge the engine starting batteries in a minimum of 8 hours while providing the control power needs of the engine-generator set. Unit shall be integral to the transfer switch. The following accessories shall be included:

a. Dc ammeter

b. Dc voltmeter

c. Equalize light

d. Ac on light

e. Low voltage light

f. High voltage light

g. Equalize test button/switch

h. Ac circuit breaker

i. Low dc voltage alarm relay

j. High dc voltage alarm relay

k. Current failure relay

l. Ac power failure relay

2.2.6 Engine-Generator Control Panel

Provide NEMA ICS 6, Type 1, enclosed control panel mounted on the engine-generator set with vibration isolators. Provide the following control panel mounted devices and control features.

2.2.6.1 Control Panel Mounted Devices

a. Engine Control Switch (ECS): Provide a three position control switch with "MANUAL START" - "OFF/RESET" - "AUTO START" positions.

b. Emergency Stop Push Button (ESPB): Provide a red, mushroom head, twist-to-reset, maintained contact type push button.

c. Generator Metering: Provide ac metering package that displays ac voltage, current, and frequency of one phase of the generator output simultaneously. Metering package shall include a voltmeter/ammeter phase selector switch to allow viewing of each phase.

d. Engine Instrumentation: Provide instrumentation package that displays the following engine information:

1. Engine oil pressure

2. Engine coolant temperature

3. Engine speed (rpm)

4. Engine running hours

e. Indicating Lamps: Provide LED type indicating lamps and a lamp test switch. Lamps shall indicate the following alarm and shutdown conditions:

1. Low engine lubricating oil pressure alarm

2. Low engine lubricating oil pressure shutdown

3. High engine coolant temperature alarm

4. High engine coolant temperature shutdown

5. Engine overcrank shutdown

6. Engine overspeed shutdown

7. Emergency stop shutdown

8. Starting battery system trouble alarm

9. Day tank low fuel shutdown

10. Low engine coolant temperature alarm

11. Low coolant level shutdown

f. Alarm Horn: Provide an alarm horn and a horn silence switch.

g. Panel Lamp: Provide a panel lamp and lamp "ON-OFF" switch.

2.2.6.2 Crank Cycle/Terminate Relay

Provide crank cycle/terminate relay with adjustable crank/rest periods of 1 to 60 seconds (initially set for 15 seconds) and adjustable total crank time of 30 seconds to 10 minutes (initially set for 75 seconds).

2.2.6.3 Engine Cooldown Relay

Provide cooldown relay with adjustable cool down time of 0 to 30 minutes (initially set at engine manufacturer's recommended time).

2.2.7 Remote Alarm Annunciator

Provide NEMA ICS 6, Type 1, enclosed remote alarm annunciator powered by the engine starting battery system. The annunciator shall have a lamp test switch and LED type indicating lamps. The annunciator shall give visual and audible warnings for the following operating and alarm conditions:

a. Provide lamps for the following operating conditions:

1. Operating power source, normal or emergency

2. Starting battery system trouble

b. Provide lamps and an audible signal for the following alarm conditions:

1. Low engine lubricating oil pressure

2. Low engine coolant temperature

3. High engine coolant temperature

4. Low fuel

5. Engine overcrank shutdown

6. Engine overspeed shutdown

2.2.7.1 Storage Battery

Provide storage batteries of suitable rating and capacity to supply and maintain power for the remote alarm annunciator for a period of 90 minutes minimum without the voltage applied falling below 87.5 percent of normal.

2.2.8 Generator Circuit Breaker

UL 489, molded case, adjustable thermal magnetic trip type circuit breaker. The circuit breaker continuous current rating shall be adequate for the power rating of the engine-generator set and the circuit breaker shall be rated to withstand the short circuit current provided by the generator set. Provide circuit breaker in a NEMA ICS 6, Type 1 enclosure mounted on the engine-generator set.

2.2.9 Electrical Support Equipment

Furnish with respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide electrical connections under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide controllers and contactors with maximum of 120-volt control circuits, and auxiliary contacts for use with controls furnished. When motors and equipment furnished are larger than size indicated, the cost of providing additional electrical service and related work shall be included under this section.

2.2.10 Weatherproof Enclosure

Provide for each engine-generator set and fabricate from zinc coated or phosphatized and shop primed 16 gage minimum sheet steel in accordance with the manufacturer's standard design. Provide a complete, weatherproof enclosure for the engine, generator, and auxiliary systems and equipment. Support exhaust piping and silencer so that the turbocharger is not subjected to exhaust system weight or lateral forces generated in connecting piping that exceed the engine manufacturer's maximum allowed forces and moments. The housing shall have sufficient louvered openings to allow entrance of outside air for engine and generator cooling at full load. Design louvered openings to exclude driving rain and snow. Provide properly arranged and sized, hinged panels in the enclosure to allow convenient access to the engine, generator, and control equipment for maintenance and operational procedures. Provide hinged panels with spring type latches which shall hold the panels closed securely and will not allow them to vibrate. Brace the housing internally to prevent excessive vibration when the set is in operation.

2.3 SPECIAL WRENCHES AND TOOLS

Wrenches and tools specifically designed and required to work on the new equipment, which are not commercially available as standard mechanic's tools, shall be furnished to the Contracting Officer.

2.4 ASSEMBLED OPERATION AND MAINTENANCE MANUALS

The contents of the assembled operation and maintenance manuals shall include the manufacturer's O&M information required by the paragraph entitled "SD-10, Operation and Maintenance Data" and the manufacturer's O&M information specified in Section 26 36 23.00 20 AUTOMATIC TRANSFER SWITCHES.

a. Manuals shall be in separate books or volumes, assembled and bound

securely in durable, hard covered, water resistant binder, and indexed by major assembly and components in sequential order.

b. A table of contents (index) shall be made part of the assembled O&M. The manual shall be assembled in the order noted in table of contents.

c. The cover sheet or binder on each volume of the manuals shall be identified and marked with the words, "Operation and Maintenance Manual."

## 2.5 SOURCE QUALITY CONTROL

Perform and report on factory tests and inspections prior to shipment. Provide certified copies of manufacturer's test data and results. Test procedures shall conform to ASME, IEEE, and ANSI standards, and to ISO requirements on testing, as appropriate and applicable. The manufacturer performing the tests shall provide equipment, labor, and consumables necessary for tests and measuring and indicating devices shall be certified to be within calibration. Tests shall indicate satisfactory operation and attainment of specified performance. If satisfactory, equipment tested will be given a tentative approval. Equipment shall not be shipped before approval of the factory test reports for the following tests.

### 2.5.1 Engine Tests

Perform customary commercial factory tests in accordance with ISO 3046 on each engine and associated engine protective device, including, but not limited to the following:

a. Perform dynamometer test at rated power. Record horsepower at rated speed and nominal characteristics such as lubricating oil pressure, jacket water temperature, and ambient temperature.

b. Test and record the values that the low oil pressure alarm and protective shutdown devices actuate prior to assembly on the engine.

c. Test and record values that the high jacket water temperature alarm and protective shutdown devices actuate prior to assembly on the engine.

### 2.5.2 Generator Tests

Tests shall be performed on the complete factory assembled generator prior to shipment. Conduct tests in accordance with IEEE Std 115, NEMA C50.10, and NEMA MG 1.

#### 2.5.2.1 Routine Tests

Perform the following routine tests on the generators and their exciters:

a. Resistance of armature and field windings

b. Mechanical balance

c. Phases sequence

d. Open circuit saturation curve and phase (voltage) balance test

e. Insulation resistance of armature and field windings

f. High potential test

2.5.2.2 Design Tests

Submit the following design tests made on prototype machines that are physically and electrically identical to the generators specified.

a. Temperature rise test

b. Short circuit saturation curve and current balance test

2.5.3 Assembled Engine-Generator Set Tests

Submit the following tests made on prototype machines that are physically and electrically identical to the engine-generator set specified.

2.5.3.1 Initial Stabilization Readings

Operate the engine-generator set and allow the set to stabilize at rated kW at rated power factor, rated voltage, and rated frequency. During this period record instrument readings for output power (kW), terminal voltage, line current, power factor, frequency (rpm) generator (exciter) field voltage and current, lubricating oil pressure, jacket water temperature, and ambient temperature at minimum intervals of 15 minutes. Adjust the load, voltage, and frequency to maintain rated load at rated voltage and frequency. Adjustments to load, voltage, or frequency controls shall be recorded on the data sheet at the time of adjustment. Stabilization shall be considered to have occurred when four consecutive voltage and current recorded readings of the generator (or exciter) field either remain unchanged or have only minor variations about an equilibrium condition with no evident continued increase or decrease in value after the last adjustment to the load, voltage, or frequency has been made.

2.5.3.2 Regulator Range Test

Remove load and record instrument readings (after transients have subsided). Adjust voltage to the maximum attainable value or to a value just prior to actuation of the overvoltage protection device. Apply rated load and adjust voltage to the minimum attainable value or a value just prior to activation of the undervoltage protection device. The data sheets shall indicate the voltage regulation as a percent of rated voltage and the maximum and minimum voltages attainable. Voltage regulation shall be defined as follows:

$$\text{Percent Regulation} = \frac{((\text{No-Load Voltage}) - (\text{Rated-Load Voltage})) \times 100}{(\text{Rated-Load Voltage})}$$

2.5.3.3 Frequency Range Test

Adjust the engine-generator set frequency for the maximum attainable frequency at rated load. Record instrument readings. Adjust the engine-generator set frequency for the specified minimum attainable frequency at rated load. Record instrument readings. Reduce the load to zero and adjust the engine-generator set frequency for the maximum attainable frequency. Record instrument readings. Adjust the engine-generator set frequency for the minimum attainable frequency. Record instrument readings. The data sheet shall show the maximum and minimum frequencies attained at rated load, and at no load.

#### 2.5.3.4 Transient Response Test

Drop the load to no load and re-apply rated load three times to ensure that the no load and rated load voltage and frequency values are repeatable and that the frequency and voltage regulation is within the limits specified. Record generator terminal voltage and frequency using a high speed strip chart recorder. The data sheet shall show the following results:

a. Frequency

1. Stability bandwidth or deviation in percent of rated frequency.

2. Recovery time.

3. Overshoot and undershoot.

b. Voltage

1. Stability bandwidth or deviation in percent of rated voltage.

2. Recovery time.

3. Overshoot and undershoot.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Installation shall conform to the applicable requirements of IEEE C2 NFPA 30, NFPA 37, and NFPA 70.

### 3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

#### 3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02.00 20 UNDERGROUND UNDERGROUND TRANSMISSION AND DISTRIBUTION. Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

#### 3.2.2 Engine-Generator Set Grounding

Provide separate copper grounding conductors and connect them to the ground system as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

#### 3.2.3 Connections

Make joints in grounding conductors by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in Section 33 71 02.00 20 UNDERGROUND UNDERGROUND TRANSMISSION AND DISTRIBUTION paragraph entitled "Grounding."

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 START-UP ENGINEER

Provide the services of a qualified factory trained start-up engineer, regularly employed by the engine-generator set manufacturer. The start-up services shall include conducting preliminary operations and functional acceptance tests. The start-up engineer shall be present at the engine generator set installation site, full-time, while preliminary operations and functional acceptance tests are being conducted.

3.4 PREREQUISITES FOR FUNCTIONAL ACCEPTANCE TESTING

Completion of the following requirements is mandatory prior to scheduling functional acceptance tests for the engine-generator set and auxiliary equipment.

3.4.1 Performance of Acceptance Checks and Tests

The acceptance checks and tests shall be accomplished by the testing organization as described in Section 26 08 00 APPARATUS INSPECTION AND TESTING.

3.4.1.1 Generator Sets

Complete as specified in the paragraph entitled "Acceptance Checks and Tests."

3.4.1.2 Automatic Transfer Switches

Complete acceptance checks and tests as specified in Section 26 36 23.00 20 AUTOMATIC TRANSFER SWITCHES.

3.4.2 Preliminary Operations

The start-up engineer shall conduct manufacturer recommended start-up procedures and tests to verify that the engine-generator set and auxiliary equipment are ready for functional acceptance tests. Give the Contracting Officer 15 days' advance notice that preliminary operations will be conducted. After preliminary operation has been successfully conducted, the start-up engineer will notify the Contracting Officer in writing stating the engine-generator set and auxiliary equipment are ready for functional acceptance tests.

3.4.3 Preliminary Assembled Operation and Maintenance Manuals

Preliminary assembled operation and maintenance manuals shall have been submitted to and approved by the Contracting Officer. Manuals shall be prepared as specified in the paragraph entitled "Assembled Operation and Maintenance Manuals."

3.4.4 Functional Acceptance Test Procedure

Test procedure shall be prepared by the start-up engineer specifically for the engine-generator set and auxiliary equipment. The test agenda shall cover the requirements specified in the paragraph entitled "Functional Acceptance Tests." The test procedure shall indicate in detail how tests

are to be conducted. A statement of the tests that are to be performed without indicating how the tests are to be performed is not acceptable. Indicate what work is planned on each workday and identify the calendar dates of the planned workdays. Specify what additional technical support personnel is needed such as factory representatives for major equipment. Specify on which testing workday each technical support personnel is needed. Data recording forms to be used to document test results are to be submitted with the proposed test procedure. A list of test equipment and instruments shall also be included in the test procedure.

3.4.5 Test Equipment

Test equipment and instruments shall be on hand prior to scheduling field tests or, subject to Contracting Officer approval, evidence shall be provided to show that arrangements have been made to have the necessary equipment and instruments on site prior to field testing.

3.5 FIELD QUALITY CONTROL

Give Contracting Officer 30 days notice of dates and times scheduled for tests which require the presence of the Contracting Officer. The Contracting Officer will coordinate with the using activity and schedule a time that will eliminate or minimize interruptions and interference with the activity operations. The Contractor shall be responsible for costs associated with conducting tests outside of normal working hours and with incorporating special arrangements and procedures, including temporary power conditions. The Contractor shall provide labor, equipment, diesel fuel, test load, and consumables required for the specified tests. The test load shall be a cataloged product. Calibration of measuring devices and indicating devices shall be certified. Refer to Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, for requirements for a cataloged product. Perform the following field tests.

3.5.1 Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.5.1.1 Circuit Breakers - Low Voltage Insulated Case/Molded Case

a. Visual and mechanical inspection

1. Compare nameplate data with specifications and approved shop drawings.

2. Inspect circuit breaker for correct mounting.

3. Operate circuit breaker to ensure smooth operation.

4. Inspect case for cracks or other defects.

5. Verify tightness of accessible bolted connections and cable connections by calibrated torque-wrench method. Thermographic survey is not required.

6. Inspect mechanism contacts and arc chutes in unsealed units.

b. Electrical Tests

1. Perform contact-resistance tests.

2. Perform insulation-resistance tests.

3. Adjust Breaker(s) for final settings in accordance with engine-generator set manufacturer's requirements.

3.5.1.2 Current Transformers

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify correct connection.

4. Verify that adequate clearances exist between primary and secondary circuit.

5. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermographic survey is not required.

6. Verify that all required grounding and shorting connections provide good contact.

b. Electrical Tests

1. Perform insulation-resistance tests.

2. Perform polarity tests.

3. Perform ratio-verification tests.

3.5.1.3 Metering and Instrumentation

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify tightness of electrical connections.

b. Electrical Tests

1. Determine accuracy of meters at 25, 50, 75, and 100 percent of full scale.

2. Calibrate watthour meters according to manufacturer's published data.

3. Verify all instrument multipliers.

4. Electrically confirm that current transformer secondary circuits

are intact.

3.5.1.4 Battery Systems

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermographic survey is not required.

4. Measure electrolyte specific gravity and temperature and visually check fill level.

5. Verify adequacy of battery support racks, mounting, anchorage, and clearances.

b. Electrical tests

1. Set charger float and equalizing voltage levels.

2. Verify all charger functions and alarms.

3. Measure each cell voltage and total battery voltage with charger energized and in float mode of operation.

4. Perform a capacity load test.

3.5.1.5 Engine-Generator Set

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Inspect for correct anchorage and grounding.

b. Electrical and mechanical tests

1. Perform an insulation-resistance test on generator winding with respect to ground. Calculate polarization index.

2. Perform phase rotation test to determine compatibility with load requirements.

3.5.1.6 Grounding System

a. Visual and mechanical inspection

1. Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

1. Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

### 3.5.2 Functional Acceptance Tests

The tests shall be performed by the start-up engineer. Upon successful test completion, the start-up engineer shall provide the Contracting Officer with a written test report within 15 calendar days showing the tests performed and the results of each test. The report shall include the completed approved test data forms and certification from the start-up engineer that the test results fall within the manufacturer's recommended limits and meet the specified requirements performance. The report shall be dated and signed by the start-up engineer, and submitted for approval by the Contracting Officer. The Contracting Officer will witness final acceptance tests. Testing shall include but not be limited to:

a. Verify proper functioning of each engine protective shutdown device and pre-shutdown alarm device. Testing of the devices shall be accomplished by simulating device actuation and observing proper alarm and engine shutdown operation.

b. Verify proper functioning of the engine overspeed trip device. Testing of the overspeed trip device shall be accomplished by raising the speed of the engine-generator set until an overspeed trip is experienced.

c. Verify proper functioning of the crank cycle/terminate relay. Testing of the relay shall be accomplished by engaging the starter motor with the engine being prevented from running. Observe the complete crank/rest cycle as described in the paragraph entitled "Crank Cycle/Terminate Relay."

d. Verify proper functioning of the following automatic and manual operations. Testing shall include but not be limited to:

    1. Loss of Utility: Initiate a normal power failure with connected test load of rated kW at 1.0 power factor. Record time delay on start, cranking time until engine starts and runs, time to come up to operating speed, voltage and frequency overshoot, and time to achieve steady state conditions with all switches transferred to emergency position.

    2. Return of Utility: Return normal power and record time delay on retransfer for each automatic transfer switch, and time delay on engine cooldown and shutdown.

    3. Manual starting

    4. Emergency stop

e. Operate the engine-generator set at rated current (amperes) until the jacket water temperature stabilizes. Stabilization will be considered to have occurred when three consecutive temperature readings remain unchanged. Continue to operate the generator set for an additional 2 hours. Record instrument readings for terminal voltage, line current, frequency (Hz), engine speed rpm, lubricating oil pressure, jacket water temperature, and ambient temperature at 5 minute intervals for first 15 minutes and at 15 minute intervals thereafter.

## 3.6 DEMONSTRATION

Upon completion of the work and at a time approved by the Contracting Officer, the Contractor shall provide instructions by a qualified instructor to the Government personnel in the proper operation and maintenance of the equipment. Appropriate Government personnel shall receive training comparable to the equipment manufacturer's factory operational training. The duration of instruction shall be for not less than one 8 hour working day for instruction of operating personnel and maintenance personnel.

### 3.6.1 Instructor's Qualification Resume

Instructors shall be regular employees of the engine-generator set manufacturer. The instruction personnel provided to satisfy the requirements above shall be factory certified by the related equipment manufacturer to provide instruction services. Submit the name and qualification resume of instructor to the Contracting Officer for approval.

### 3.6.2 Training Plan

Submit training plan 30 calendar days prior to training sessions. Training plan shall include scheduling, content, outline, and training material (handouts). Content shall include but not limited to the following:

#### 3.6.2.1 Operating Personnel Training

This instruction includes operating the engine-generator set, auxiliary equipment including automatic transfer switches in all modes, and the use of all functions and features specified.

-- End of Section --

# Diesel Generator Set

# Model DQDAA 60 Hz
## EPA Emissions

**250 kW, 313 kVA Standby**
**225 kW, 281 kVA Prime**

## Description

Cummins Power Generation commercial generator sets are fully integrated power generation systems providing optimum performance, reliability, and versatility for stationary standby or prime power applications.

A primary feature is strong motor-starting capability and fast recovery from transient load changes. The torque-matched system includes a heavy-duty Cummins 4-cycle diesel engine, an AC alternator with high motor-starting kVA capacity, and an electronic voltage regulator with three phase sensing for precise regulation under steady-state or transient loads. The GenSet accepts 100% of the nameplate standby rating in one step, in compliance with NFPA 110 Level 1 requirements.

The standard PowerCommand® digital electronic control is an integrated system that combines engine and alternator controls for high reliability and optimum GenSet performance.

Optional weather-protective enclosures and coolant heaters allow generators to perform in outdoor weather operating conditions. Environmental concerns are addressed by low exhaust emission engines, sound-attenuated enclosures, exhaust silencers, and dual-wall fuel tanks. A wide range of options, accessories, and services are available, allowing configuration to your specific power generation needs.

Every production unit is factory tested at rated load and power factor. This testing includes demonstration of rated power and single-step rated load pickup. Cummins Power Generation manufacturing facilities are registered to ISO9001 quality standards, emphasizing our commitment to high quality in the design, manufacture, and support of our products. The generator set is CSA certified (pending) and is available as UL 2200 Listed (pending). The PowerCommand control is UL 508 Listed.

All Cummins Power Generation systems are backed by a comprehensive warranty program and supported by a worldwide network of 170 distributors and service branches to assist with warranty, service, parts, and planned maintenance support.

## Features

**UL Listed Generator Set** - The complete generator set assembly is available as UL 2200 Listed.

**Low Exhaust Emissions** - Engine certified to U.S. EPA Nonroad Source Emissions Standards, 40 CFR 89, Tier 3.

**Cummins Heavy-Duty Engine** - Rugged 4-cycle industrial diesel engine delivers reliable power, low emissions, and fast response to load changes.

**Alternator** - Several alternator sizes offer selectable motor starting capability with low reactance 2/3 pitch windings; low waveform distortion with non-linear loads, fault clearing short-circuit capability, and class H insulation. The alternator electrical insulation system is UL1446 Recognized.

**Permanent Magnet Generator (PMG)** - Offers enhanced motor starting and fault clearing short circuit capability.

**Control System** - The PowerCommand electronic control is standard equipment and provides total genset system integration, including automatic remote starting/stopping, precise frequency and voltage regulation, alarm and status message display, AmpSentry™ protection, output metering, auto-shutdown at fault detection, and NFPA 110 Level 1 compliance. PowerCommand control is Listed to UL508.

**Cooling System** - Provides reliable running at the rated power level, at up to 54°C ambient temperature.

**Integral Vibration Isolation** - Robust skid base supports the engine, alternator, and radiator on isolators, minimizing transmitted vibration.

**E-Coat Finish** - Dual electro-deposition paint system provides high resistance to scratches, corrosion, or fading.

**Enclosures** - Optional weather-protective and sound-attenuated enclosures are available.

**Fuel Tanks** - Dual wall sub-base fuel tanks are also offered.

**Certifications** - Generator sets are designed, manufactured, tested, and certified to relevant UL, NFPA, ISO, IEC, and CSA standards.

**Warranty and Service** - Backed by a comprehensive warranty and worldwide distributor network.

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# Generator Set

The general specifications provide representative configuration details. Consult the outline drawing for installation design.

## Specifications – General

See outline drawing 500-4288 for installation design specifications.

| | |
|---|---|
| **Unit Width, in (mm)** | 50.0 (1270) |
| **Unit Height, in (mm)** | 66.0 (1676) |
| **Unit Length, in (mm)** | 119.0 (3023) |
| **Unit Dry Weight, lb (kg)** | 4814 (2184) |
| **Unit Wet Weight, lb (kg)** | 4926 (2234) |
| **Rated Speed, rpm** | 1800 |
| **Voltage Regulation, No Load to Full Load** | ±0.5% |
| **Random Voltage Variation** | ±0.5% |
| **Frequency Regulation** | Isochronous |
| **Random Frequency Variation** | ±0.5% |
| **Radio Frequency Interference** | IEC 801.2, Level 4 Electrostatic Discharge<br>IEC 801.3, Level 3 Radiated Susceptibility<br>IEC 801.4, Level 4 Electrical Fast Transients<br>IEC 801.5, Level 5 Voltage Surge Immunity<br>MIL STD 461C, Part 9 Radiated Emissions (EMI) |

| **Cooling** | **Standby** | **Prime** |
|---|---|---|
| Fan Load, HP (kW) | 17.0 (12.7) | 17.0 (12.7) |
| Coolant Capacity with radiator, US Gal (L) | 8.0 (30.3) | 8.0 (30.3) |
| Coolant Flow Rate, Gal/min (L/min) | 64.0 (242.2) | 64.0 (242.2) |
| Heat Rejection To Coolant, Btu/min (MJ/min) | 6554 (6.91) | 6281 (6.63) |
| Heat Radiated To Room, Btu/min (MJ/min) | 1913 (2.02) | 1823 (1.92) |
| Maximum Coolant Friction Head, psi (kPa) | 5.0 (34.5) | 5.0 (34.5) |
| Maximum Coolant Static Head, ft (m) | 60.0 (18.3) | 60.0 (18.3) |

| **Air** | | |
|---|---|---|
| Combustion Air, scfm ($m^3$/min) | 775 (21.9) | 770 (21.8) |
| Alternator Cooling Air, scfm ($m^3$/min) | 2100.0 (59.4) | 2100.0 (59.4) |
| Radiator Cooling Air, scfm ($m^3$/min) | 20075.0 (568.1) | 20075.0 (568.1) |
| Max. Static Restriction, in $H_2O$ (Pa) | 0.50 (124.50) | 0.50 (124.50) |

# Rating Definitions

**Standby Rating based on:** Applicable for supplying emergency power for the duration of normal power interruption. No sustained overload capability is available for this rating. (Equivalent to Fuel Stop Power in accordance with ISO3046, AS2789, DIN6271 and BS5514). Nominally rated.

**Prime (Unlimited Running Time) Rating based on:** Applicable for supplying power in lieu of commercially purchased power. Prime power is the maximum power available at a variable load for an unlimited number of hours. A 10% overload capability is available for limited time. (Equivalent to Prime Power in accordance with ISO8528 and Overload Power in accordance with ISO3046, AS2789, DIN6271, and BS5514). This rating is not applicable to all generator set models.

# Site Derating Factors

Standby engine power available at 40°C (104°F) ambient temperature and 1480 meters (4850 ft) altitude capability. Consult your Cummins Power Generation distributor for temperature and ambient requirements outside these parameters.

# Engine

Cummins heavy duty diesel engines use advanced combustion technology for reliable and stable power, low emissions, and fast response to sudden load changes.

Electronic governing provides precise speed regulation, especially useful for applications requiring constant (isochronous) frequency regulation such as Uninterruptible Power Supply (UPS) systems, non-linear loads, or sensitive electronic loads. Optional coolant heaters are recommended for all emergency standby installations or for any application requiring fast load acceptance after start-up.

## Specifications – Engine

| | |
|---|---|
| **Base Engine** | Cummins, Inc Model QSL9-G3 NR3, Turbocharged and CAC, diesel-fueled |
| **Displacement in$^3$ (L)** | 543.0 (8.9) |
| **Overspeed Limit, rpm** | 2070 ±50 |
| **Regenerative Power, kW** | 35.00 |
| **Cylinder Block Configuration** | Cast iron, In-line 6 cylinder |
| **Battery Capacity** | 750 amps at ambient temperature of 10°F (-12C) and above |
| **Battery Charging Alternator** | 70 amps |
| **Starting Voltage** | 24-volt, negative ground |
| **Lube Oil Filter Types** | Single spin-on, combination full flow and bypass filters |
| **Standard Cooling System** | 129$^o$F (54$^o$C) ambient radiator |

| **Power Output** | **Standby** | **Prime** |
|---|---|---|
| Gross Engine Power Output, bhp (kWm) | 399 (298) | 352 (262) |
| BMEP at Rated Load, psi (kPa) | 302 (2080) | 273 (1880) |
| Bore, in. (mm) | 4.49 (114.0) | 4.49 (114.0) |
| Stroke, in. (mm) | 4.69 (119.1) | 4.69 (119.1) |
| Piston Speed, ft/min (m/s) | 1707.0 (8.7) | 1707.0 (8.7) |
| Compression Ratio | 16.8:1 | 16.8:1 |
| Lube Oil Capacity, qt. (L) | 24.0 (22.7) | 24.0 (22.7) |
| **Fuel Flow** | | |
| Fuel Flow at Rated Load, US Gal/hr (L/hr) | 43.0 (162.8) | 43.0 (162.8) |
| Maximum Inlet Restriction, in. Hg (mm Hg) | 6.0 (152.4) | 6.0 (152.4) |
| Maximum Return Restriction, in. Hg (mm Hg) | 10.0 (254.0) | 10.0 (254.0) |
| **Air Cleaner** | | |
| Maximum Air Cleaner Restriction, in. $H_2O$ (kPa) | 25.0 (6.2) | 25.0 (6.2) |
| **Exhaust** | | |
| Exhaust Flow at Rated Load, cfm (m$^3$/min) | 2085 (59.0) | 2001 (56.7) |
| Exhaust Temperature, $^o$F ($^o$C) | 1061 (572) | 1013 (545) |
| Max Back Pressure, in. $H_2O$ (kPa) | 41.0 (10.2) | 41.0 (10.2) |

| **Fuel System** | Direct injection, number 2 diesel fuel; fuel filters (one with water separator); automatic electric fuel shutoff |
|---|---|

| **Fuel Consumption** | | **Standby** | | | | **Prime** | | | |
|---|---|---|---|---|---|---|---|---|---|
| **60 Hz Ratings, kW (kVA)** | | **250 (313)** | | | | **225 (281)** | | | |
| | Load | 1/4 | 1/2 | 3/4 | Full | 1/4 | 1/2 | 3/4 | Full |
| | US Gal/hr | 5.9 | 11.5 | 15.9 | 19.2 | 5.4 | 10.5 | 14.8 | 18.0 |
| | L/hr | 22.3 | 43.5 | 60.2 | 72.7 | 20.4 | 39.7 | 56.0 | 68.1 |
| | | | | | | | | | |

# Alternator

Several alternators are available for application flexibility based on the required motor-starting kVA and other requirements. Larger alternator sizes have lower temperature rise for longer life of the alternator insulation system. In addition, larger alternator sizes can provide a cost-effective use of engine power in across-the-line motor-starting applications and can be used to minimize voltage waveform distortion caused by non-linear loads.

Single-bearing alternators couple directly to the engine flywheel with flexible discs for drivetrain reliability and durability. No gear reducers or speed changers are used. Two-thirds pitch windings eliminate third-order harmonic content of the AC voltage waveform and provide the standardization desired for paralleling of generator sets. The standard excitation system is a PMG excited system.

## Alternator Application Notes

**Separately Excited Permanent Magnet Generator (PMG) System** - This standard system uses an integral PMG to supply power to the voltage regulator. A PMG system generally has better motor-starting performance, lower voltage dip upon load application, and better immunity from problems with harmonics in the main alternator output induced by non-linear loads. This system provides improved performance over self-excited regulators in applications that have large transient loads, sensitive electronic loads (especially UPS applications), harmonic content, or that require sustained short-circuit current (sustained 3-phase short circuit current at approximately 3 times rated for 10 seconds).

**Alternator Sizes** - On any given model, various alternator sizes are available to meet individual application needs. Alternator sizes are differentiated by maximum winding temperature rise, at the generator set standby or prime rating, when operated in a 40$^{o}$C ambient environment. Available temperature rises range from 80$^{o}$C to 150$^{o}$C. Not all temperature rise selections are available on all models. Lower temperature rise is accomplished using larger alternators at lower current density. Lower temperature rise alternators have higher motor-starting kVA, lower voltage dip upon load application, and they are generally recommended to limit voltage distortion and heating due to harmonics induced by non-linear loads.

**Alternator Space Heater** - is recommended to inhibit condensation.

## Available Output Voltages

Three Phase Reconnectable

[ ] 110/190
[ ] 120/208
[ ] 127/220
[ ] 139/240
[ ] 120/240
[ ] 220/380
[ ] 240/416
[ ] 254/440
[ ] 277/480

Three Phase Non-Reconnectable

[ ] 277/480
[ ] 347/600

# Specifications – Alternator

| | |
|---|---|
| **Design** | Brushless, 4 pole, drip proof revolving field |
| **Stator** | 2/3 pitch |
| **Rotor** | Direct coupled by flexible disc |
| **Insulation System** | Class H per NEMA MG1-1.65 |
| **Standard Temperature Rise** | 125°C Standby, 105°C @ Prime |
| **Exciter Type** | Permanent Magnet Generator (PMG) |
| **Phase Rotation** | A (U), B (V), C (W) |
| **Alternator Cooling** | Direct drive centrifugal blower |
| **AC Waveform Total Harmonic Distortion** | <5% total no load to full linear load<br><3% for any single harmonic |
| **Telephone Influence Factor (TIF)** | <50 per NEMA MG1-22.43 |
| **Telephone Harmonic Factor (THF)** | <3 |

| **Three Phase Table**[1] | | **80° C** | **80° C** | **80° C** | **80° C** | **105° C** | **105° C** | **105° C** | **125° C** | **125° C** | **125° C** | **125° C** | **125° C** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feature Code | | B260 | B257 | B251 | B302 | B259 | B256 | B301 | B258 | B252 | B246 | B247 | B300 |
| Alternator Data Sheet Number | | 342 | 341 | 341 | 341 | 341 | 341 | 340 | 341 | 340 | 339 | 340 | 339 |
| Voltage Ranges | | 110/190 Thru 139/240 220/380 Thru 277/480 | 120/208 Thru 139/240 240/416 Thru 277/480 | 277/480 | 347/600 | 110/190 Thru 139/240 220/380 Thru 277/480 | 120/208 Thru 139/240 240/416 Thru 277/480 | 347/600 | 110/190 Thru 139/240 220/380 Thru 277/480 | 120/208 Thru 139/240 240/416 Thru 277/480 | 277/480 | 277/480 | 347/600 |
| Surge kW | | 322 | 322 | 322 | 322 | 322 | 322 | 322 | 322 | 322 | 322 | 322 | 322 |
| Motor Starting kVA (at 90% sustained voltage) | PMG | 1372 | 1210 | 1210 | 1210 | 1210 | 1210 | 1028 | 1210 | 1028 | 904 | 1028 | 904 |

| Full Load Current - Amps at Standby Rating | 120/208 | 127/220 | 139/240 | 220/380 | 240/416 | 254/440 | 277/480 | 347/600 |
|---|---|---|---|---|---|---|---|---|
| | 867 | 820 | 752 | 475 | 434 | 410 | 376 | 301 |

**Notes:**
Single phase power can be taken from a three phase generator set at up to 40% of the generator set nameplate kW rating at unity power factor.

# Control System

**PowerCommand Control with AmpSentry™ Protection (PCC2100 CAN)**

- The PowerCommand Control is an integrated generator set control system providing governing, voltage regulation, engine protection, and operator interface functions.
- PowerCommand Controls include integral UL Listed AmpSentry protection. AmpSentry provides a full range of alternator protection functions that are matched to the alternator provided.
- Controls provided include Battery monitoring and testing features.
- Integral PCCNet interface, to allow high speed network interconnections to remote input/output (I/O) and annunciator modules.
- InPower PC-based service tool available for detailed diagnostics.
- NEMA 3R enclosure.
- Suitable for operation in ambient temperatures from -40C to +70C, and altitudes to 13,000 feet (5000 meters).
- Prototype tested; UL, CSA, and CE compliant.

| AmpSentry AC Protection | Engine Protection | Operator Interface |
|---|---|---|
| • Overcurrent and short circuit shutdown<br>• Overcurrent warning<br>• Single & 3-phase fault regulation<br>• Over and under voltage shutdown<br>• Over and under frequency shutdown<br>• Overload warning with alarm contact<br>• Reverse power and reverse Var shutdown<br>• Excitation fault | • Overspeed shutdown<br>• Low oil pressure warning and shutdown<br>• High coolant temperature warning and shutdown<br>• High oil temperature warning (optional)<br>• Low coolant level warning or shutdown<br>• Low coolant temperature warning<br>• High and low battery voltage warning<br>• Weak battery warning<br>• Dead battery shutdown<br>• Fail to start (overcrank) shutdown<br>• Fail to crank shutdown<br>• Redundant start disconnect<br>• Cranking lockout<br>• Sensor failure indication | • OFF/MANUAL/AUTO mode switch<br>• MANUAL RUN/STOP switch<br>• Panel lamp test switch<br>• Emergency Stop switch<br>• Alpha-numeric display with pushbutton access, for viewing engine and alternator data and providing setup, controls, and adjustments<br>• LED lamps indicating genset running, not in auto, common warning, common shutdown<br>• (5) configurable LED lamps<br>• LED Bargraph AC data display (optional) |
| **Alternator Data** | **Engine Data** | **Other Data** |
| • Line-to-line and line-to-neutral AC volts<br>• 3-phase AC current<br>• Frequency<br>• Total and individual phase kW and kVA | • DC voltage<br>• Lube oil pressure<br>• Coolant temperature<br>• Lube oil temperature (optional) | • Genset model data<br>• Start attempts, starts, running hours<br>• KW hours (total and since reset)<br>• Fault history<br>• Load profile (hours less than 30% and hours more than 90% load)<br>• System data display (optional with network and other PowerCommand gensets or transfer switches |
| **Governing** | **Voltage Regulation** | **Control Functions** |
| • Digital electronic isochronous governor<br>• CAN data-link interface to full authority electronic engine control | • Integrated digital electronic voltage regulator<br>• 3-phase line to neutral sensing<br>• PMG (Optional)<br>• Single and three phase fault regulation<br>• Configurable torque matching | • Data logging on faults<br>• Fault simulation (requires InPower)<br>• Time delay start and cooldown<br>• Cycle cranking<br>• (4) Configurable customer inputs<br>• (4) Configurable customer outputs<br>• PCCNet Interface, network interconnections to I/O modules, annunciators, and other equipment |
| **Options** | | |
| [ ] Analog AC Meter Display<br>[ ] Thermostatically-Controlled Space Heater | [ ] Key-type mode switch<br>[ ] Engine oil temperature sensing and alarm<br>[ ] Auxiliary Relays (3) | [ ] Echelon LonWorks interface<br>[ ] LonWorks network input and output module(s) (loose) (8) Configurable inputs and (16) outputs<br>[ ] Remote network annunciator (loose) - LonWorks |

## Generator Set Options

**Engine**

[ ] 120/240 V, 1500 W coolant heater
[ ] 120/240 V, 150 W lube oil heater
[ ] Heavy Duty Air Cleaner

**Cooling System**

[ ] 125°F (50°C) ambient cooling

**Fuel System**

[ ] 12 hour dual wall sub-base tank
[ ] 24 hour dual wall sub-base tank
[ ] Single wall sub-base fuel tank, 125 gal

**Alternator**

[ ] 80°C Rise Alternator
[ ] 105°C rise alternator
[ ] 125°C rise alternator
[ ] 120/240 V, 100 W anti-condensation heater
[ ] PMG excitation
[ ] Single phase

**Control Panel**

[ ] 120/240 V, 100 W control anti-condensation heater
[ ] Exhaust pyrometer
[ ] Ground fault indication
[ ] Remote fault signal package
[ ] Run relay package

**Exhaust System**

[ ] GenSet mounted muffler
[ ] Heavy duty exhaust elbow
[ ] Slip on exhaust connection
[ ] NPT Exhaust connection

**Generator Set**

[ ] AC entrance box
[ ] Batteries
[ ] Battery charger
[ ] Export box packaging
[ ] UL 2200 Listed
[ ] Main line circuit breaker
[ ] PowerCommand Network Communication Module (NCM)
[ ] QuietSite Stage 1 housing w/silencer
[ ] QuietSite Stage 2 housing w/silencer
[ ] Remote annunciator panel
[ ] Spring isolators
[ ] Weather protective enclosure with silencer
[ ] 2 year prime power warranty
[ ] 2 year standby warranty
[ ] 5 year basic power warranty
[ ] 10 year major components warranty

## Available Products and Services

A wide range of products and services is available to match your power generation system requirements. Cummins Onan products and services include:

Diesel and Spark-Ignited Generator Sets

Transfer Switches

Bypass Switches

Parallel Load Transfer Equipment

Digital Paralleling Switchgear

PowerCommand Network and Software

Distributor Application Support

Planned Maintenance Agreements

## Warranty

All components and subsystems are covered by an express limited one-year warranty. Other optional and extended factory warranties and local distributor maintenance agreements are available. Contact your distributor/dealer for more information.

## Certifications

**ISO9001** - This generator set was designed and manufactured in facilities certified to ISO9001.

**CSA** - This generator set is CSA certified to product class 4215-01.

**PTS** - The Prototype Test Support (PTS) program verifies the performance integrity of the generator set design. Products bearing the PTS symbol have been subjected to demanding tests in accordance to NFPA 110 Level 1 to verify the design integrity and performance under both normal and abnormal operating conditions including short circuit, endurance, temperature rise, torsional vibration, and transient response, including full load pickup.

**UL** - The generator set is available Listed to UL 2200, Stationary Engine Generator Assemblies. The PowerCommand control is Listed to UL 508 - Category NITW7 for U.S. and Canadian usage.

## See your distributor for more information

**Cummins Power Generation**
**1400 73rd Avenue N.E.**
**Minneapolis, MN 55432**
**763.574.5000**
**Fax: 763.574.5298**
**www.cumminspower.com**

Cummins and PowerCommand are registered trademarks of Cummins Inc.
Detector and AmpSentry are trademarks of Cummins Inc.

**Important: Backfeed to a utility system can cause electrocution and/or property damage. Do not connect generator sets to any building electrical system except through an approved device or after building main switch is open.**

SECTION 26 36 23.00 20

AUTOMATIC TRANSFER SWITCHES
**04/06**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

| | |
|---|---|
| NETA ATS | (2003) Acceptance Testing Specifications |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1008 | (1996; Rev thru Dec 2007) Standard for Transfer Switch Equipment |
| UL 508 | (1999; Rev thru Sep 2008) Standard for Industrial Control Equipment |

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, and Section 26 08 00 APPARATUS INSPECTION AND TESTING, apply to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Automatic Transfer Switch Drawings; G

SD-03 Product Data

Automatic Transfer Switches; G

SD-06 Test Reports

Acceptance Checks and Tests; G

Functional Acceptance Tests; G

SD-07 Certificates

Proof of Listing; G

SD-10 Operation and Maintenance Data

Automatic Transfer Switches, Data Package 5; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 QUALITY ASSURANCE

1.4.1 Proof of Listing

Submit proof of listing by UL 1008.

1.4.2 Automatic Transfer Switch Drawings

Drawings shall include outline, arrangement, and detail drawings. Detail drawings shall include manufacturer's name and catalog number, electrical ratings, total system transfer statement, reduced normal supply voltage at which transfer to the alternate supply is initiated, transfer delay times, short-circuit current rating, wiring diagram, description of interconnections, testing instructions, acceptable conductor type for terminals, tightening torque for each wire connector, and other required UL 1008 markings.

PART 2 PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCHES

Provide four-pole, automatic transfer switches for use in emergency systems in accordance with UL 1008. Each automatic transfer switch shall be rated for total system transfer and have the current and voltage ratings as indicated. The rating of the switch shall be adequate for withstanding the effects of the indicated RMS symmetrical fault current when protected by the indicated overcurrent device without contact welding. The switch operating mechanism shall be electrically operated from the source to which it is transferring, shall have quick-make, quick-break, load break contacts, and shall be mechanically held in both positions. Non-fire pump service transfer switches shall have manual operating means provided for maintenance and servicing accessible only by opening the enclosure. The manual operating means shall affect the opening and closing of the switch contacts at the same rate of speed as that caused by the automatic operation of the switch. Automatic transfer switches provided with by-pass/isolation switches shall be mounted on a drawout mechanism so that the automatic transfer switch can be removed from the enclosure. The switch enclosure shall comply with UL 508, NEMA Type 1, and shall be equipped with an equipment ground lug.

2.1.1 By-Pass/Isolation Switches

Include by-pass/isolation switches for the indicated automatic transfer switches. Provide by-pass/isolation switches in accordance with UL 1008 that can be used to manually select an available power source to feed load circuits and to permit total isolation of the automatic transfer switch. The by-pass/isolation switch shall be rated for total system transfer and have the same current rating, voltage rating, number of poles, and withstand and closing rating as the associated automatic transfer switch.

2.1.2 Automatic Transfer Switch Controls

2.1.2.1 Controls for Utility-Generator Automatic Transfer Switch

Provide all necessary controls to start the generator set upon loss of the normal (utility) source, transfer the load to the generator set upon reaching rated voltage and frequency, re-transfer the load when the normal (utility) source returns, and stop the generator set.

The switch shall include the following control features.

a. Three-phase normal source voltage sensing circuit with adjustable dropout, 75-93 percent of nominal, and pickup, 85-100 percent of nominal.

b. Engine starting control contacts with adjustable commit-to-start delay circuit, 0.5-6.0 seconds.

c. Voltage/frequency sensing circuit, set for 80 percent of nominal, for enabling load transfer to emergency source.

d. Transfer to emergency source time delay for transfer switches as indicated, adjustable 0-5 minutes.

e. Re-transfer to normal source time delay, adjustable 1-30 minutes.

f. Programmable exerciser to allow automatic starting of the generator set and subsequent load transfer. Exercise periods shall be selectable for 1 to 24 hours per day for 0 to 7 days a week.

2.1.3 Front Panel Devices

Provide devices mounted on cabinet front consisting of:

a. Mode selector switch with the following positions and associated functions;

    1. TEST - Simulates loss of normal/preferred source system operation.

    2. NORMAL - Transfers system to normal/preferred source bypassing re-transfer time delay.

b. Lamps for indicating connected source and normal/preferred source is available.

c. Auxiliary contacts for indicating connected source and normal/preferred source available.

e. Lamps for indicating that the by-pass/isolation switch is in the "normal by-pass", "alternate by-pass", or "isolated" position.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall conform to the requirements of NFPA 70 and manufacturer's recommendation.

## 3.2 PREREQUISITES FOR FUNCTIONAL ACCEPTANCE TESTING

Completion of the following requirements is mandatory prior to scheduling functional acceptance tests for the automatic transfer switch.

### 3.2.1 Performance of Acceptance Checks and tests

Complete as specified in paragraph entitled "Acceptance Checks and Tests". The Acceptance Checks and Tests shall be accomplished by the Testing organization as described in Section 26 08 00 APPARATUS INSPECTION AND TESTING.

### 3.2.2 Manufacturers O&M Information

The manufacturers O&M information required by the paragraph entitled "SD-10 Operation and Maintenance Data", shall have been submitted to and approved by the Contracting Officer.

### 3.2.3 Test Equipment

All test equipment and instruments shall be on hand prior to scheduling field tests, or subject to Contracting Officer's approval, evidence shall be provided to show that arrangements have been made to have the necessary equipment and instruments on site prior to field testing.

## 3.3 FIELD QUALITY CONTROL

Give Contracting Officer 15 days notice of dates and times scheduled for tests which require the presence of the Contracting Officer. The Contracting Officer will coordinate with the using activity and schedule a time that will eliminate or minimize interruptions and interference with the activity operations. The contractor shall be responsible for costs associated with conducting tests outside of normal working hours and with incorporating special arrangements and procedures, including temporary power conditions. The contractor shall provide labor, equipment, apparatus, including test load, and consumables required for the specified tests. Calibration of all measuring devices and indicating devices shall be certified. The test load shall be a cataloged product in accordance with Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS. Perform the following field tests in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

### 3.3.1 Automatic Transfer Switch Acceptance Checks and Tests

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Confirm correct application of manufacturer's recommended lubricants.

4. Verify that manual transfer warnings are attached and visible.

5. Verify tightness of all control connections.

6. Verify tightness of accessible bolted connections by calibrated torque-wrench method. Thermographic survey is not required.

7. Perform manual transfer operation.

8. Verify positive mechanical interlocking between normal and alternate sources.

b. Electrical Tests

1. Measure contact-resistance.

2. Perform insulation-resistance on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole for one minute. Perform tests in both source positions.

3. Verify settings and operations of control devices.

4. Calibrate and set all relays and timers.

### 3.3.2 Functional Acceptance Tests

Functional Acceptance Tests shall be coordinated with Section 26 32 13.00 20 SINGLE OPERATION GENERATOR SETS and shall include simulating power failure and demonstrating the following operations for each automatic transfer switch. Contractor shall show by demonstration in service that the automatic transfer switches are in good operating condition, and function not less than five times.

a. Perform automatic transfer tests:

1. Simulate loss of normal/preferred power.

2. Return to normal/preferred power.

3. Simulate loss of emergency power.

4. Simulate all forms of single-phase conditions.

b. Verify correct operation and timing of the following functions:

1. Normal source voltage-sensing relays.

2. Engine start sequence.

3. Time delay upon transfer.

4. Alternate source voltage-sensing relays.

5. Automatic transfer operation.

6. Interlocks and limit switch function.

7. Time delay and retransfer upon normal power restoration.

-- End of Section --

# BTPC
# bypass isolation transfer switch
# open or closed transition

**> Specification sheet**

**150 - 4000 Amp**

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## Description

The Cummins Power Generation BTPC series bypass isolation transfer switch combines an automatic transfer switch with a drawout isolation mechanism and a manual bypass switch. It provides redundant power transfer and retransfer capability for critical-need applications that require a reliable power supply to the load.

For the most sophisticated applications, the BTPC with closed transition offers the best solution. By briefly connecting the two sources (for 100 msec or less), the transfer from the alternate source back to the normal source occurs seamlessly, without any interruption in the power supply.

| | |
|---|---|
| UL | All switches are UL 1008 Listed with UL Type Rated cabinets and UL Listed CU-AL terminals. |
| CSA | All switches are certified to CSA 282 Emergency Electrical Power Supply for Buildings, up to 600 VAC. |
| NEC | Suitable for use in emergency, legally required and standby applications per NEC 700, 701 and 702. |
| NFPA | All switches comply with NFPA 70, 99 and 110 (Level 1 systems). |
| NEMA | All switches comply with NEMA ICS 10. |
| IEEE | All switches comply with IEEE 446 Recommended Practice for Emergency and Standby Power Systems. |
| ISO 9001 | This transfer switch is designed and manufactured in facilities certified to ISO9001. |

## Features

**Bypass to normal or emergency power source** - The BTPC is a two-source system which can bypass the automatic transfer switch to engage normal or emergency power sources.

**Programmed transition** – Open transition timing can be adjusted to completely disconnect the load from both sources for a programmed time period, as recommended by NEMA MG-1.

**Mechanical and electrical interlocks** - For open transition, reliable mechanical interlocks prevent source-to-source connections. An electrical interlock prohibits closing to a dead source.

**PowerCommand® control** - A standard, fully featured microprocessor-based control. Software-enabled features, settings, and adjustments are available for ease of setup and accuracy. Optically isolated logic inputs and isolation transformers for AC power inputs provide high-voltage surge protection.

**Communications capability** - The BTPC transfer switch is capable of communicating with other transfer switches, accessories, with a SCADA network or with Cummins Power Generation generators utilizing LonWorks® protocol.

**Main contacts** - Heavy-duty silver alloy contacts are rated for total system transfer including overload interruption.

**Easy service/access** - Plug connections, door-mounted controls, ample access space, and compatible terminal markings.

**Product lines and services** - Cummins Power Generation offers a wide range of products and services to precisely suit your requirements.

**Warranty and service** - Backed by a comprehensive warranty and worldwide distributor network.

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## Transfer switch mechanism

- Manual bypass switch mechanism allows the operator to select either the normal or emergency source by closing the bypass contacts. Visual indicators show bypass source selected, bypass "closed" or "open" to either source, and automatic transfer switch isolation or "disable."
- Isolation contacts allow the automatic transfer switch and the bypass switch to be separated electrically and mechanically. The automatic transfer switch is isolated by a drawout mechanism similar to that used on power circuit breakers.
- The drawout mechanism can be latched in one of three positions: connected, test, and isolated. In the connected position the mechanism is locked. In the test position, the transfer switch is isolated but the controls receive power. In the isolated position, the switch is completely isolated.
- The automatic transfer switch can be rolled out on extension rails and can be removed with overhead lifting equipment. Wheel-mounted carriages are standard on 1600 A to 4000 A models.
- Protective safety shutters, provided on switches up to and including 1200 amps, cover the stationary power terminals on the bypass switch when the automatic transfer switch is isolated and removed.

## Specifications

| | |
|---|---|
| **Voltage rating** | 600 VAC |
| **Arc interruption** | Leaf arc chutes cool and quench the arcs. See-through arc chute covers prevent interphase flashover and allow visual inspection. |
| **Neutral bar** | A full current-rated neutral bar with lugs is standard on enclosed 3-pole transfer switches. |
| **Auxiliary contacts** | Easily accessible auxiliary contacts are rated at 10 A continuous and 250 VAC maximum. UL recognized, and CSA-certified. |
| **Operating temperature** | -40 °F (-40 °C) to 140 °F (60 °C) |
| **Storage temperature** | -40 °F (-40 °C) to 140 °F (60 °C) |
| **Humidity** | Up to 95% relative, non-condensing |
| **Altitude** | Up to 10,000 ft (3,000 m) |
| **Surge withstand ratings** | Voltage surge performance and testing in compliance with the requirements of IEEE C62.41 (Category B3) and IEEE C62.45. |

**Open transition** – BTPC transfer switches are available with programmed transition and in-phase monitor operation. The switch contacts operate in a break-before-make sequence.

**Programmed transition –** Open transition timing can be adjusted to completely disconnect the load from both sources for a programmed time period, as recommended by NEMA MG-1. Programmed transition allows regenerative voltage to decay to a safe level before the new source is connected. This pause prevents nuisance-tripping breakers and load damage.

**Closed transition -** Closed transition transfer is required in applications with loads sensitive to momentary power interruptions. The switch contacts operate in a make-before-break sequence. This allows the seamless transfer of critical loads from one source to another by paralleling the two sources momentarily (for less than 100 msec).

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## PowerCommand microprocessor control

PowerCommand controls are microprocessor based and developed specifically for automatic transfer switch operation. The control provides features and options useful for most applications. Flash memory is used to store control settings. The contents of the memory are not lost even if power to the controller is lost. There is also an on-board battery to maintain the real-time clock setting and the engine start time delay. Control features include:

### Level 2 control

**Open transition** (in-phase transition)
**Programmed transition** (timed)
**Closed transition** (momentary overlap) – Includes fail-to-disconnect timer to prevent extended paralleling with the utility during closed transition transfer.
**Utility-to-genset applications**
**Utility-to-utility applications**
**Software adjustable time delays:**
- Engine start: 0 to 120 sec
- Transfer normal to emergency: 0 to 120 sec
- Retransfer emergency to normal: 0 to 30 min
- Engine stop: 0 to 30 min
- Programmed transition: 0 to 60 sec

**Undervoltage sensing:** 3-phase normal, 3-phase emergency
- Pickup: 85% to 98% of nominal voltage
- Dropout: 75% to 98% of pickup setting
- Dropout time delay: 0.1 to 1.0 sec

**Overvoltage sensing:** 3-phase normal, 3-phase emergency
- Dropout: 105% to 135% of nominal voltage
- Pickup: 95% to 99% of dropout setting
- Dropout time delay: 0.5 to 120 sec

**Over/under frequency sensing**
- Pickup: ±5% to ±20% of nominal frequency
- Dropout: ±1% beyond pickup
- Dropout time delay: 0.1 to 15.0 sec

**Voltage imbalance sensing**
- Dropout: 2% to 10%
- Pickup: 90% of dropout
- Time delay: 2.0 to 20.0 sec

**Phase rotation sensing**
- Time delay: 100 msec

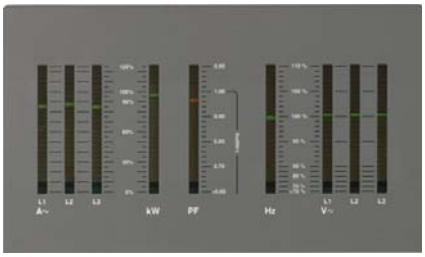
**Loss of single phase detection**
- Time delay: 0.1 to 1.0 seconds

**Programmable genset exerciser** - Eight events/schedules with or w/o load

**Basic indicator panel**
- Source available/connected LED indicators
- Test/exercise/bypass buttons
- Digital display - standard
- Analog bargraph metering - optional

**Date/time-stamped event record** - 50 events

**Load sequencing** (optional with network communications module)



**Optional analog bargraph**

**Basic indicator panel**

**Digital display**

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## Time-delay functions

**Engine start:** Prevents nuisance genset starts in the event of momentary power system variation or loss. Not included in utility-to-utility systems.

**Transfer normal to emergency:** Allows genset to stabilize before application of load. Prevents power interruption if normal source variation or loss is momentary. Allows staggered transfer of loads in multiple transfer switch systems.

**Retransfer emergency to normal:** Allows the utility to stabilize before retransfer of load. Prevents needless power interruption if return of normal source is momentary. Allows staggered transfer of loads in multiple transfer switch systems.

**Engine stop:** Maintains availability of the genset for immediate reconnection in the event that the normal source fails shortly after retransfer. Allows gradual genset cool down by running unloaded. Not included in utility-to-utility systems.

**Programmed transition:** Controls the speed of operation of the transfer switch to allow load-generated voltages to decay before connecting to an oncoming source.

## User interfaces

### Basic interface panel

LED indicators provide at-a-glance source and transfer switch status for quick summary of system conditions. Test and Override buttons allow delays to be bypassed for rapid system checkout.

### Digital display (M018)

The digital display provides a convenient method for monitoring load power conditions, adjusting transfer switch parameters, monitoring PowerCommand network status, or reviewing transfer switch events. Password protection limits access to adjustments to authorized personnel. The digital display comes standard with the Level 2 PowerCommand microprocessor control.

## User interface options

### Front panel security key (M017)

Front panel access can be locked out using this option. Prevents unauthorized transfers or testing. Prevents unauthorized adjustments via the digital display.

### Analog bar graph meter (D009)

An LED bar graph display provides an easy-to-read indicator of the level of power being supplied to the load. Information displayed includes: 3-phase voltage and current, power factor, and kilowatts. Green, amber, and red LED's provide at-a-glance indication of system acceptability. Available as an option with the Level 2 PowerCommand microprocessor control.

## Control options

### Relay signal module (M023)

Provides an adjustable transfer pre-signal time delay of 0 to 60 seconds to prevent interruption of power during elevator operation. Relay outputs include: Source 1 Connected and Available, Source 2 Connected and Available, Not in Auto, Test/Exercise Active, Failed to Disconnect, Failed to Synchronize, Failed to Transfer/Retransfer, and Transfer Pre-Signal (elevator signal).

### Loadshed (M007)

Removes the load from the emergency power source by driving the transfer switch to the neutral position when signaled remotely. Transfers load back to the emergency source when the signal contacts open. Immediate retransfer to the preferred source when it is re-established.

### PowerCommand network interface (M031)

Provides connection to the PowerCommand network. LonWorks compatible for integration into customer monitoring strategy.

### Load power and load current monitoring (M022)

Measures load phase and neutral, current, power factor, real power (kW) and apparent power (kVA). Warns of excessive neutral current resulting from unbalanced or nonlinear loads.

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## UL withstand and closing ratings

The transfer switches listed below must be protected by circuit breakers or fuses. Referenced drawings include detailed listings of specific breakers or fuse types that must be used with the respective transfer switches. Consult with your distributor/dealer to obtain the necessary drawings. Withstand and Closing Ratings (WCR) are stated in symmetrical RMS amperes.

| | MCCB protection | | | Current limited breaker protection | | |
|---|---|---|---|---|---|---|
| **Transfer switch ampere** | **WCR @ volts max with specific manufacturers MCCBs** | **Max MCCB rating** | **Drawing reference** | **With specific current limiting breakers (CLB)** | **Max CLB rating** | **Drawing reference** |
| 150, 225, 260 | 30,000 @ 480<br>25,000 @ 600 | 400 A | 0098-6889 | 200,000 @ 480<br>100,000 @ 600 | 400 A | 0098-6919 |
| 300, 400, 600 | 65,000 @ 480<br>65,000 @ 600 | 1200 A | 0098-6887 | 200,000 @ 480<br>100,000 @ 600 | 1200 A | 0098-6923 |
| 800, 1000 | 65,000 @ 480<br>65,000 @ 600 | 1400 A | 0098-6891 | 200,000 @ 480<br>100,000 @ 600 | 1400 A | 0098-6924 |
| 1000, 1200 (closed transition) | 85,000 @ 480<br>65,000 @ 600 | 1600 A | 0098-7312 | 85,000 @ 480<br>65,000 @ 600 | 1600 A | Use MCCB ratings |
| 1600, 2000 | 100,000 @ 480<br>85,000 @ 600 | 2500 A | 0098-7311 | 100,000 @ 480<br>85,000 @ 600 | 2500 A | Use MCCB ratings |
| 3000 | 100,000 @ 480<br>85,000 @ 600 | 4000 A | 0098-7313 | 100,000 @ 480<br>85,000 @ 600 | 4000 A | Use MCCB ratings |
| 4000 | 100,000 @ 480<br>85,000 @ 600 | 5000 A | 0098-8576 | 100,000 @ 480<br>85,000 @ 600 | 5000 A | Use MCCB ratings |

## Fuse protection

| **Transfer switch ampere** | **WCR @ volts max. with current limiting fuses** | **Max fuse, size and type** | **Drawing reference** |
|---|---|---|---|
| 150, 225, 260 | 200,000 @ 600 | 600 A Class J, RK1, RK5 or<br>1200 A Class L, T | 0098-6889 |
| 300, 400, 600 | 200,000 @ 600 | 600 A Class J, RK1, RK5 or<br>1200 A Class L, T | 0098-6887 |
| 800, 1000 | 200,000 @ 600 | 600 A Class J, RK1, RK5,<br>1200 A Class T, or 2000 A Class L | 0098-6891 |
| 1200 | 200,000 @ 480<br>150,000 @ 600 | 2000 A Class L | 0098-7312 |
| 1600, 2000 | 200,000 @ 480<br>150,000 @ 600 | 2500 A Class L | 0098-7311 |
| 3000 | 200,000 @ 480<br>150,000 @ 600 | 4000 A Class L | 0098-7313 |
| 4000 | 200,000 @ 480<br>150,000 @ 600 | 6000 A Class L | 0098-8576 |

## 3-cycle ratings

| **Transfer switch ampere** | **WCR @ volts max 3-cycle rating** | **Max MCCB rating** | **Drawing reference** |
|---|---|---|---|
| 1200 | 50,000 @ 480<br>42,000 @ 600 | 1600 A | 0098-7312 |
| 1600, 2000 | 100,000 @ 480<br>85,000 @ 600 | 4000 A | 0098-7311 |
| 3000 | 100,000 @ 480<br>85,000 @ 600 | 4000 A | 0098-7313 |
| 4000 | 100,000 @ 480<br>85,000 @ 600 | 5000 A | 0098-8576 |

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## Enclosures

The transfer switch and control are mounted in a key-locking enclosure. Wire bend space complies with 2008 NEC.

**Dimensions - transfer switch in UL Type 1 enclosure**

| | Height | | Width | | Depth | | | | Weight 3-pole type | | Outline[1] drawing |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Door closed | | Door open | | | | |
| Amp rating | in | mm | in | mm | in | mm | in | mm | lb | kg | |
| 150, 225, 260 | 71.75 | 1822 | 36.00 | 915 | 22.75 | 578 | 55.2 | 1402 | 564 | 256 | 310-0538 |
| 300, 400, 600 | 83.25 | 2115 | 36.00 | 914 | 22.75 | 578 | 55.2 | 1403 | 639 | 291 | 500-4726 |
| 800, 1000 | 90.00 | 2290 | 48.00 | 1219 | 27.75 | 705 | 62.5 | 1588 | 1097 | 499 | 310-0570 |
| 1200 3-pole | 90.00 | 2290 | 40.00 | 1016 | 27.00 | 686 | 67.0 | 1702 | 1980 | 898 | 310-0566 |
| 1200 4-pole | 90.00 | 2290 | 46.00 | 1168 | 27.00 | 686 | 73.0 | 1854 | 2185 | 991 | 310-0566 |
| 1600, 2000 3-pole | 90.00 | 2290 | 40.00 | 1016 | 62.00 | 1575 | 102.0 | 2591 | 3085 | 1399 | 310-0567 |
| 1600, 2000 4-pole | 90.00 | 2290 | 50.00 | 1270 | 62.00 | 1575 | 112.0 | 2845 | 3650 | 1656 | 310-0567 |
| 3000 3-pole | 90.00 | 2290 | 40.00 | 1016 | 74.00 | 1880 | 114.0 | 2897 | 4100 | 1860 | 310-0568 |
| 3000 4-pole | 90.00 | 2290 | 50.00 | 1270 | 74.00 | 1880 | 124.0 | 3150 | 5010 | 2273 | 310-0568 |
| 4000 3-pole | 90.00 | 2290 | 47.50 | 1210 | 81.00 | 2060 | 128.5 | 3270 | 4730 | 2145 | 500-4488 |
| 4000 4-pole | 90.00 | 2290 | 54.00 | 1370 | 81.00 | 2060 | 135.0 | 3430 | 5930 | 2689 | 500-4488 |

**Dimensions - transfer switch in UL Type 3R, 4, 4x, or 12 enclosure**

| | Height | | Width | | Depth | | | | Weight | | Cabinet type | Outline[1] drawing |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Door closed | | Door open | | | | | |
| Amp rating | in | mm | in | mm | in | mm | in | mm | lb | kg | | |
| 150, 225, 260 | 71.75 | 1822 | 36.00 | 915 | 22.75 | 578 | 55.20 | 1402 | 564 | 256 | 3R, 12 | 310-0651 |
| | 71.75 | 1822 | 36.00 | 915 | 22.75 | 578 | 55.20 | 1402 | 564 | 256 | 4, 4x | 310-0652 |
| 300, 400, 600 | 83.25 | 2115 | 36.00 | 915 | 22.75 | 578 | 55.20 | 1402 | 639 | 290 | 3R, 12 | 500-4726 |
| | 83.25 | 2115 | 36.00 | 915 | 22.75 | 578 | 55.20 | 1402 | 639 | 290 | 4, 4x | 500-4727 |
| 800,1000 | 90.00 | 2290 | 48.00 | 1214 | 27.75 | 705 | 62.50 | 1534 | 1097 | 498 | 3R | 310-0711 |
| | 90.00 | 2290 | 48.00 | 1214 | 27.75 | 705 | 62.50 | 1534 | 1097 | 498 | 4, 4x, 12 | 310-0712 |
| 1200 3-pole[2] | 90.00 | 2290 | 40.00 | 1016 | 28.25 | 718 | 65.50 | 1654 | 1980 | 748 | 3R, 12, 4, 4x | 310-0734 |
| 1200 4-pole[2] | 90.00 | 2290 | 46.00 | 1168 | 28.25 | 718 | 71.69 | 1821 | 2185 | 991 | 3R, 12, 4, 4x | 310-0734 |
| 1600, 2000 3-pole[3] | 90.00 | 2290 | 43.52 | 1105 | 62.77 | 1594 | 99.77 | 2534 | 3085 | 1399 | 3R, 12, 4, 4x | 310-0725 |
| 1600, 2000 4-pole[3] | 90.00 | 2290 | 53.52 | 1359 | 62.77 | 1594 | 109.77 | 2788 | 3650 | 1656 | 3R, 12, 4, 4x | 310-0725 |
| 3000 3-pole[3] | 90.00 | 2290 | 43.52 | 1105 | 74.77 | 1899 | 111.77 | 2839 | 3970 | 1801 | 3R | 310-0726 |
| 3000 4-pole[3] | 90.00 | 2290 | 53.52 | 1359 | 74.77 | 1899 | 121.77 | 3093 | 5070 | 2300 | 3R | 310-0726 |
| 4000 3-pole[3] | 90.00 | 2290 | 48.50 | 1232 | 81.75 | 2076 | 131.00 | 3308 | 4730 | 2145 | 3R | 500-4489 |
| 4000 4-pole[3] | 90.00 | 2290 | 55.00 | 1397 | 81.75 | 2076 | 137.00 | 3473 | 5930 | 2689 | 3R | 500-4489 |

Note 1: On the outline drawing the BT door is shown. All physical dimensions are the same for BT and BTPC.
Note 2: Dimensions shown are for top entry only. If bottom or side entry is required, an adapter bay is required and the depth increases by 14 in (356 mm). See outline drawing. Adapter needs to be part of the original order.
Note 3: 1600 through 4000 A are rear connected. Allow 36-inch wide (914 mm) space at rear for access to cable compartment.

## Transfer switch lug capacities

All lugs accept copper or aluminum wire unless indicated otherwise.

| Amp rating | Cables per phase | Size |
|---|---|---|
| 150, 225 | 1 | #6 AWG to 300 MCM |
| 260 | 1 | #6 AWG to 400 MCM |
| 150, 225, 260[4] | 1 | #4 AWG to 500 MCM |
| 300, 400 | 1 | #3/0 AWG to 600 MCM |
| 300, 400 | 2 | #3/0 AWG to 250 MCM |
| 300, 400[4] | 1 | 350 MCM to 1000 MCM |
| 300, 400[4] | 2 | #2 AWG to 600 MCM |
| 600 | 2 | 250 MCM to 500 MCM |
| 600[4] | 2 | #2 AWG to 600 MCM |
| 800, 1000 | 4[5] | 250 MCM to 500 MCM |
| 800, 1000[4] | 3 | 300 MCM to 750 MCM |
| 1200 | 4 | #2 AWG to 600 MCM |
| 1600, 2000 | 8 | #2 AWG to 600 MCM (lugs optional) |
| 3000 | 8 | #2 AWG to 600 MCM (lugs optional) |
| 4000 | 12 | #2 AWG to 600 MCM (lugs optional) |

Note 4: Optional lug capacities on accessories spec sheet AC-166.
Note 5: Four-wire for neutral bar is 3-pole only.

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# Submittal detail – options (accessories specification sheet AC-166)

**Amperage ratings**
- ☐ 150
- ☐ 225
- ☐ 260
- ☐ 300
- ☐ 400
- ☐ 600
- ☐ 800
- ☐ 1000
- ☐ 1200
- ☐ 1600
- ☐ 2000
- ☐ 3000
- ☐ 4000

**Voltage ratings**
- ☐ R038 190
- ☐ R021 208
- ☐ R022 220
- ☐ R023 240
- ☐ R024 380
- ☐ R025 416
- ☐ R035 440
- ☐ R026 480
- ☐ R027 600

**Pole configuration**
- ☐ A028 Poles - 3 (solid neutral)
- ☐ A029 Poles - 4 (switched neutral)

**Frequency**
- ☐ A044 60 Hertz
- ☐ A045 50 Hertz

**Transfer mode**
- ☐ A077 Open transition (in-phase transition)
- ☐ A078 Delayed transition (programmed transition)
- ☐ A079 Closed transition

**Application**
- ☐ A035 Utility to genset
- ☐ A036 Utility to utility
- ☐ A037 Genset to genset

**System options**
- ☐ A041 Single phase, 2-wire or 3-wire
- ☐ A042 Three phase, 3-wire or 4-wire

**Enclosure**
- ☐ B001 Type 1: general purpose indoor (similar to IEC type IP30)
- ☐ B002 Type 3R: intended for outdoor use (dustproof and rainproof) (similar to IEC type IP34)
- ☐ B003 Type 4: indoor or outdoor use (watertight) (similar to IEC type IP65)
- ☐ B004 Open construction: no enclosure - includes automatic transfer switch and controls (not available for 1200-4000 A)
- ☐ B010 Type 12: indoor use, dust-tight and drip-tight (similar to IEC type IP61)
- ☐ B025 Type 4X: stainless steel, indoor or outdoor use (watertight) (similar to IEC type IP65)

**Standards**
- ☐ A046 UL 1008/CSA certification
- ☐ A064 NFPA 20 compliant (not available 1200-4000 A)
- ☐ A080 Seismic certification

**Control options**
- ☐ M017 Security key - front panel
- ☐ M022 Monitoring - load
- ☐ M023 Module - relay signal
- ☐ M031 Communications - LonWorks Network Communications Module FTT-10

**Meters**
- ☐ D009 Digital bar graph meters

**Battery chargers**
- ☐ K001 2 A, 12/24 V
- ☐ KB59 15 A, 12 V
- ☐ KB60 12 A, 24 V

**Protective relays**
- ☐ M036 62PL relay
- ☐ M038 86 lock-out relay

**Auxiliary** relays - Relays are UL Listed and factory installed. All relays provide (2) normally open and (2) normally closed isolated contacts rated 10 A @ 600 VAC.
- ☐ L101 24 VDC coil - installed, not wired (for customer use).
- ☐ L102 24 VDC coil - emergency position - relay energized when switch in source 2 (emergency) position.
- ☐ L103 24 VDC coil - normal position - relay energized when switch in source 1 (normal) position
- ☐ L201 12 VDC coil - installed, not wired (for customer use)
- ☐ L202 12 VDC coil - emergency position - relay energized when switch in source 2 (emergency) position
- ☐ L203 12 VDC coil - normal position - relay energized when switch in source 1 (normal) position

**Miscellaneous options**
- ☐ M003 Terminal block - 30 points (not wired)
- ☐ M007 Load shed - from emergency - drives switch to neutral position when remote signal contact closes
- ☐ N008 Terminal lugs - cable (1600-3000 amp only)
- ☐ N009 Power connect - bus stabs (150-1000 amp open construction only)

**Optional lug kits**
- ☐ N008 Terminal lugs - cable (1600-3000 amps only)

**Warranty**
- ☐ G002 One year basic
- ☐ G004 Two year comprehensive
- ☐ G006 Five year basic
- ☐ G007 Five year comprehensive
- ☐ G008 Ten year major components

**Shipping**
- ☐ A051 Packing - export box


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S-1271r (1/09)


Power Generation

SECTION 26 41 00.00 20

LIGHTNING PROTECTION SYSTEM
**04/06**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE Std 81 | (1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)Normal Measurements |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |
| NFPA 780 | (2007) Standard for the Installation of Lightning Protection Systems |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 467 | (2007) Standard for Grounding and Bonding Equipment |
| UL 96 | (2005) Standard for Lightning Protection Components |
| UL 96A | (2007) Standard for Installation Requirements for Lightning Protection Systems |
| UL Electrical Constructn | (2008) Electrical Construction Equipment Directory |

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

1.2.1 Verification of Dimensions

Contractor shall become familiar with all details of work, verify all dimensions in field, and shall advise Contracting Officer of any discrepancy before performing work. No departures shall be made without prior approval of Contracting Officer.

1.2.2 System Requirements

Materials shall consist of standard products of a manufacturer regularly

engaged in production of lightning protection systems and shall be manufacturer's latest UL approved design. Lightning protection system shall conform to NFPA 70, NFPA 780, UL 96 and UL 96A.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Overall lightning protection system; G

Each major component; G

SD-06 Test Reports

Grounding system test; G

Lightning protection system inspection; G

SD-07 Certificates

UL listing or label; G

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Contracting Officer.

1.4.1 Installation Drawings

a. Submit installation shop drawing for the overall lightning protection system. Drawings shall include physical layout of the equipment, mounting details, relationship to other parts of the work, and wiring diagram.

b. Submit detail drawings for each major component to include manufacturer's descriptive and technical literature, catalog cuts, and installation instructions.

1.4.2 UL Listing or Label

Submit proof of compliance. Label of or listing in UL Electrical Constructn is acceptable evidence. In lieu of label or listing, submit written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that items have been tested and conform to requirements and testing methods of Underwriters Laboratories.

1.5 SITE CONDITIONS

Contractor will become familiar with details of the work, verify dimensions in the field, and advise Contracting Officer of discrepancies before performing work. Deviations from contract drawings will not be made

without prior approval of Contracting Officer.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Do not use a combination of materials that forms an electrolytic couple of such nature that corrosion is accelerated in presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, provide conductors with protective coatings or oversize conductors. Where mechanical hazard is involved, increase conductor size to compensate for hazard or protect conductors by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is provided, electrically bond conductor to conduit or tubing at the upper and lower ends by clamp type connectors or welds (including exothermic).

#### 2.1.1 Main and Bonding Conductors

NFPA 780 and UL 96 Class I, Class II, or Class II modified materials as applicable.

#### 2.1.2 Copper

Provide copper conductors on nonmetallic stacks that do not weigh less than 319 pounds per thousand feet, and provide cable such that the size of any strand in the cable is not less than No. 15 AWG. Provide thickness of web or ribbon on stacks that is not less than No. 12 AWG. Provide loop conductors that are comprised of copper conductors not smaller than No. 1/0 AWG.

#### 2.1.3 Aluminum

Do not allow aluminum to contact the earth and do not use in any other manner that will contribute to rapid deterioration of the metal. Observe appropriate precautions at connections with dissimilar metals in accordance with NFPA 70 Article 110-14. Provide aluminum cable conductors for bonding and interconnecting metallic bodies to main cable that are at least equivalent to strength cross-sectional area of a No. 4 AWG aluminum wire. When perforated strips are provided, use strips that are much wider than solid strips. Use a strip width that is at least twice that of the diameter of the perforations. Use an aluminum strip which has a thickness of not less than the diameter of No. 12 AWG and at least 1 1/2 inches wide for connecting exposed water pipes.

### 2.2 COMPONENTS

#### 2.2.1 Air Terminals

Provide terminals in accordance with UL 96, except provide Class II for Class I and Class II applications. Support air terminals more than 24 inches in length by suitable brace, with guides, not less than one-half the height of the terminal.

#### 2.2.2 Ground Rods

Provide ground rods made of copper-clad steel conforming to conform to UL 467. Provide ground rods that are not less than 5/8 inch in diameter and 20 feet in length. Do not mix ground rods of copper-clad steel, stainless

steel, galvanized ferrous, or solid copper on the job.

2.2.3 Connections and Terminations

Provide connectors for splicing conductors that conform to UL 96, class as applicable. Conductor connections can be made by clamps or welds (including exothermic). Provide style and size connectors required for the installation.

2.2.4 Connector Fittings

Provide connector fittings for "end-to-end", "Tee", or "Y" splices that conform to NFPA 780.

2.2.5 Lightning Protection Components

Provide bonding plates, air terminal supports, chimney bands, clips, and fasteners that conform to UL 96 classes as applicable.

PART 3 EXECUTION

3.1 INTEGRAL SYSTEM

Lightning protection system consists of air terminals, roof conductors, down conductors, ground connections, grounding electrodes and ground loop conductor. Electrically interconnect lightning protection system to form the shortest distance to ground. Do not use nonconducting parts of the structure as part of the building's lightning protection system. Expose conductors on the structures except where conductors are required to be in protective sleeves. Interconnect secondary conductors with grounded metallic parts within the building. Make interconnections within side-flash distances at or above the level of the grounded metallic parts.

3.1.1 Air Terminals

Air terminal design and support conforming to NFPA 780. Rigidly connect terminals to, and make electrically continuous with, roof conductors by means of pressure connectors or crimped joints of T-shaped malleable metal. Provide pressure connector or crimped joint with a dowel or threaded fitting to connect ground rod conductor with air terminal. Set air terminals at ends of structures not more than 2 feetfrom ends of ridges and corners of roofs. Do not exceed 25 feet in spacing of 2 foot high air terminals on ridges, parapets, and around perimeter of building with flat roofs. When necessary to exceed this spacing, increase specified height of air terminals not less than 2 inches for each one foot of increase over 25 feet. On large flat, or gently sloping roofs, as defined in NFPA 780, place air terminals at points of the intersection of imaginary lines dividing the surface into rectangles having sides not exceeding 50 feet in length. Secure air terminals against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces which are permanently and rigidly attached to the building or structure. Metal projections and metal parts of buildings such as smokestacks and other metal objects that are at least 3/16 inch thick and that do not contain hazardous materials, need not be provided with air terminals. However, bond these metal objects to a lightning conductor through a metal conductor of the same unit weight per length as the main conductor. Where nonmetallic spires, steeples, or ventilators are present, mount air terminals to the side. In addition, where spires or steeples project more than 10 feet above the building, continue conductor from air

terminal to nearest down conductor securely connect thereto.

3.1.2 Roof Conductors

Connect roof conductors directly to the roof or ridge roll. Avoid sharp bends or turns in conductors. Do not make turns of less than 8 inches. Preserve horizontal or downward course on conductors. Rigidly fasten conductors every 3 feet along the roof and down the building to the ground. Rigidly connect metal ventilators to the roof conductor at three places. Make connections electrically continuous. Course roof conductors along contours of flat roofs, ridges, parapets, and edges; and where necessary, over flat surfaces, in such a way as to join each air terminal to all the rest. Connect roof conductors surrounding tank tops, decks, flat surfaces, and flat roofs to form a closed loop.

3.1.3 Down Conductors

Make down conductors electrically continuous from air terminals and roof conductors to grounding electrodes. Course down conductors over outer extreme portions of the building, such as corners, with consideration given to location of ground connections and air terminals. Provide each building or structure not less than two down conductors located as widely separated as practicable, such as at diagonally opposite corners. Rectangular structures having gable, hip, or gambrel roofs more than 110 feet long, provide at least one additional down conductor for each additional 50 feet of length or fraction thereof. L- or T-shaped structure, provide at least one additional down conductor. Install additional down conductors when necessary to avoid "dead ends" or branch conductors exceeding 16 feet in length, ending at air terminals. Equally and symmetrically spaced down conductors about the perimeter of the structure. Protect conductors where necessary, to prevent physical damage or displacement to the conductor.

3.1.4 Interconnection of Metallic Parts

Connect metal doors, windows, and gutters directly to ground or down conductors using not smaller than No. 6 copper conductor, or equivalent. Where there is probability of unusual wear, mechanical injury, or corrosion, provide conductors with greater electrical capacity than normal or protect the conductor. Provide mechanical ties or pressure connectors between grounds and metal doors and windows.

3.1.5 Ground Connections

Securely connect conductor forming continuations of down conductors from structure to grounding electrode in a manner to ensure electrical continuity between the two. Provide clamp type connections or welds (including exothermic) for continuation. Provide a ground connection for each down conductor. Attach down conductors to ground rods by welding (including exothermic), brazing, or clamping. Provide clamps suitable for direct burial. Protect ground connection from mechanical injury. Bond metal water pipes and other large underground metallic objects together with all grounding mediums. In making ground connections, take advantage of all permanently moist places where practicable, although avoid such places when area is wet with waste water that contains chemical substances, especially those corrosive to metal.

3.1.6 Grounding Electrodes

Provide grounding electrode for each down conductor. Extend driven ground

rods into the existing undisturbed earth for a distance of not less 10 feet. Set ground rods not less than 2 feet nor more than 10 feet, from the structure. After the completed installation, measure the total resistance to ground using the fall-of-potential method described in IEEE Std 81. Maximum resistance of a driven ground rod shall be 10 ohms, under normally dry conditions when a ground loop is not used. Use a ground loop when two of any three ground rods, driven not less than 10 feet into the ground, a minimum of 10 feet apart, and equally spaced around the perimeter, give a combined value exceeding 50 ohms immediately after having driven. For ground loop, provide continuous No. 1/0 bare stranded copper cable or equivalent material having suitable resistance to corrosion. Lay ground loop around the perimeter of the structure in a trench not less than 30 inches below grade, at a distance not less than 2 feet nor more than 10 feet from the nearest point of the structure. Install a ground loop in earth undisturbed by excavation, not earth fill, and do not locate beneath roof overhang, or wholly under paved areas or roadways where rainfall cannot penetrate to keep soil moist in the vicinity of the cable. Make connections between ground conductors and grounds or ground loop, and between ground loop and grounds electrically continuous.

## 3.2 APPLICATIONS

### 3.2.1 Metal Roofs with Metal Walls

Bond metal roof and metal walls so that they are electrically continuous and considered as one unit. Connect air terminals to and make them electrically continuous with the metal roof as well as the roof down conductors. Bond all roof conductors and down conductors to metal roof or metal walls at upper and lower edges at intervals not to exceed 100 feet. Make all connections electrically continuous and have surface contact of at least 3 square inches.

### 3.2.2 Steel Frame Building

Make the steel framework of the building electrically continuous. Electrical continuity may be provided by bolting, riveting, or welding unless another specific method is indicated. Connect air terminals to the structural steel framework at the ridge. Provide short runs of conductors to join air terminals to the metal framework so that proper placing of air terminals is maintained. Separate down conductors from air terminals to ground connections are not required. Where water system enters the building, securely connect structural steel framework and water system at point of entrance by a ground connector. Make connections to pipes by means of ground clamps with lugs. Make connections to structural framework by means of nut and bolt or welding. Make connections between columns and ground connections at bottom of steel columns. Make ground connections to grounds or ground loop runs from not less than one-half of the columns distributed equally around perimeter of structure. When no water system enter the structure, run ground connections from steel columns distributed equally around the perimeter of the structure. Bond metal doors, windows, gutters, and similar metal installation to steel work of the building. Provide a grounding electrode for each ground connection.

### 3.2.3 Ramps and Covered Passageways

Ramps and covered passageways which are in the zone of protection of a lightning protection system, as defined by NFPA 780, need no additional lightning protection. However, ramps and covered passageways which are outside the zone of protection of a lightning protection system shall be

provided with a lightning protection conforming to the requirements for lightning protection systems for buildings of similar construction. Place a down conductor and a driven ground at one of the corners where the ramp connects to each building or structure. Connect down conductor and driven ground to the ground loop or nearest ground connection of the building or structure. Where buildings or structures and connecting ramps are clad with metal, connect metal of the buildings or structures and metal of the ramp in a manner to ensure electrical continuity, in order to avoid the possibility of a flash-over or spark due to a difference in potential. Make connections electrically continuous and have a surface contact area of at least 3 square inches.

## 3.3 INTERFACE WITH OTHER STRUCTURES

### 3.3.1 Interconnection of Metal Bodies

Protect metal bodies when not within the zone of protection of air terminal. Bond metal bodies having an area of 400 square inches or greater or a volume of 1000 cubic inches or greater to lightning protection system using main size conductors and a bonding plate having a surface contact area of not less than 3 square inches. Make provisions to guard against the corrosive effect of bonding dissimilar metals. Bond metal bodies at their closest point to the lightning protection system using bonding conductors and fittings. Independently ground any metal body that exceeds 5 feet in any dimension, that is situated wholly within a building, and that does not at any point come within 6 feet of a lightning conductor or metal connected to a lightning protection system.

## 3.4 FIELD QUALITY CONTROL

### 3.4.1 Grounding System Test

Test the grounding system to ensure continuity and that resistance to ground is not in excess of 10 ohms. Test the ground rod for resistance to ground before making connections to the rod. Tie the grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Include in the written report: locations of ground rods, resistance, and soil conditions at the time that measurements were made. Submit results of each test to the Contracting Officer.

### 3.4.2 Lightning Protection System Inspection

Make visual inspections to verify that there are no loose connections which may result in high resistance joints, and that conductors and system components are securely fastened to their mounting surfaces and are protected against accidental mechanical displacement.

-- End of Section --

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# Stennis Space Center SOF Riverine & Combatant Craft Operations Facility Lightning Protection

**Bay St. Louis, MS**
87839-08-

Bonded Lightning Protection is UL Listed for Lightning Protection Installation (UL# E83936). All components are manufactured by UL Listed manufacturers including Advanced Lightning Technology (UL# E153482), East Coast Lightning Equipment (UL# E93753) and Thompson Lightning Protection (UL# E14909).

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## Class I Conductors (LP-COND-C1-01)

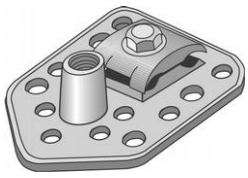
| Item # | Description | Unit | Weight |
|---|---|---|---|
| **129** | **29 Strand 17 Ga Braided Copper Lightning Conductor - UL Labeled (Spooled to Special Lengths)** | **FT** | **0.19** |
| 129-500 | 29 Strand 17 Ga Braided Copper Lightning Conductor - UL Labeled on 500' Spools (SOLD in 500' ROLL SPOOL CAN NOT BE BROKEN) | FT | 0.20 |
| 132 | 32 Strand 17 Ga Copper Lightning Conductor - UL Labeled (Spooled to Special Lengths) | FT | 0.22 |
| 132-500 | 32 Strand 17 Ga Copper Lightning Conductor - UL Labeled on 500' Spools (Spool Size Can Not Be Broken) | FT | 0.22 |
| 174 | 24 Strand 14 Ga Copper Braided Lightning Conductor - UL Labeled on 500' Spools | FT | 3.20 |
| 129T | 29 Strand 17 Ga Tinned Copper Braided Lightning Conductor - UL Labeled on 500' Spools | FT | 0.19 |
| 132T | 32 Strand 17 Ga Tinned Copper Lightning Conductor - UL Labeled on 500' Spools | FT | 2.17 |
| **A124** | **24 Strand 14 Ga Aluminum Braided Lightning Conductor UL Labeled (Spooled to Special Lengths)** | **FT** | **0.10** |
| A124-500 | 24 Strand 14 Ga Braided Aluminum Lightning Conductor - UL Labeled on 500' Spools (SOLD in 500' ROLL SPOOL CAN NOT BE BROKEN) | FT | 0.00 |
| A128 | 28 Strand 14 Ga Aluminum Rope Lay Lightning Conductor - UL Labeled on 500' Spools | FT | 1.15 |
| 168 | 28 Strand 16 Ga Copper Rope Lay Lightning Conductor - UL Labeled on 500' Spools | FT | 2.30 |

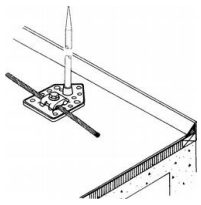
## Air Terminals - Aluminum Blunt Tip (LP-AT-02-02)

| Item # | Description | Unit | Weight |
|---|---|---|---|
| **A410B** | **1/2" x 10" Blunt Tip Solid Aluminum Air Terminal - UL Label** | **EA** | **0.20** |
| **A412B** | **1/2" x 12" Blunt Tip Solid Aluminum Air Terminal - UL Label** | **EA** | **0.22** |
| A415B | 1/2" x 15" Blunt Tip Solid Aluminum Air Terminal - UL Label | EA | 0.31 |
| A418B | 1/2" x 18" Blunt Tip Solid Aluminum Air Terminal - UL Label | EA | 0.34 |
| A424B | 1/2" x 24" Blunt Tip Solid Aluminum Air Terminal - UL Label | EA | 0.46 |
| A436B | 1/2" x 36" Blunt Tip Solid Aluminum Air Terminal - UL Label | EA | 0.69 |
| A448B | 1/2" x 48" Blunt Tip Solid Aluminum Air Terminal - UL Label | EA | 0.92 |
| A460B | 1/2" x 60" Blunt Tip Solid Aluminum Air Terminal - UL Label | EA | 1.15 |
| A472B | 1/2" x 72" Blunt Tip Solid Aluminum Air Terminal - UL Label | EA | 1.38 |
| A510B | 5/8" x 10" Blunt Tip Solid Aluminum Air Terminal - UL Label | EA | 0.31 |
| A512B | 5/8" x 12" Blunt Tip Solid Aluminum Air Terminal - UL Label | EA | 0.46 |
| A518B | 5/8" x 18" Blunt Tip Solid Aluminum Air Terminal - UL Label | EA | 0.55 |
| A524B | 5/8" x 24" Blunt Tip Solid Aluminum Air Terminal - UL Label | EA | 0.74 |
| A536B | 5/8" x 36" Blunt Tip Solid Aluminum Air Terminal - UL Label | EA | 1.10 |
| A548B | 5/8" x 48" Blunt Tip Solid Aluminum Air Terminal - UL Label | EA | 1.47 |
| A560B | 5/8" x 60" Blunt Tip Solid Aluminum Air Terminal - UL Label | EA | 1.94 |
| A584B | 5/8" x 84" Blunt Tip Solid Aluminum Air Terminal - UL Label | EA | 6.57 |

## Base - Adhesive Mount (LP-C2BASE-10)

A cast base designed for mounting air terminals with adhesive on flat roofs and other surfaces that cannot be penetrated with fasteners. The base includes bolt type conductor connector.





Typical application

| Item # | Description | Unit | Weight |
|---|---|---|---|
| 839-38 | Bronze Fm Adhesive Base 3/8" Fits Conductor Sizes .292 to .528 | EA | 1.00 |
| 839-12 | Bronze Fm Adhesive Base 1/2" Fits Conductor Sizes .292 to .528 | EA | 1.00 |
| 839-12T | Tinned Bronze Fm Adhesive Base 1/2" Fits Conductor Sizes .292 to .528 | EA | 0.97 |
| 839-58 | Bronze Fm Adhesive Base 5/8" Fits Conductor Sizes .292 to .528 | EA | 1.00 |
| **A839-12** | **Aluminum Fm Adhesive Base 1/2" Fits Conductor Sizes .292 to .562** | **EA** | **0.38** |
| A839-58 | Aluminum Fm Adhesive Base 5/8" Fits Conductor Sizes .292 to .562 | EA | 0.38 |

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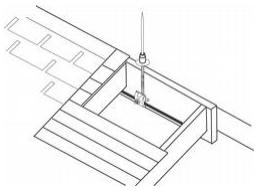
## Thru Roof Point Base with Horizontal Connector (LP-TWTR-05)

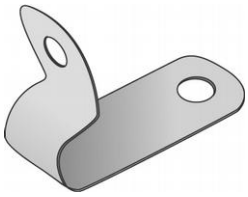
The conductor connector is designed to mount on the roof framing for additional support. The assembly includes an under roof nut and sealing washer.

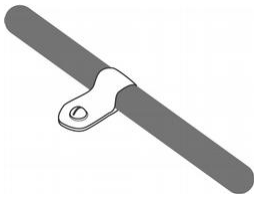


Typical application

| Item # | Description | Unit | Weight |
|---|---|---|---|
| 2380-38 | Bronze 12" Thru Roof Point Base for 3/8" Air Terminal with 1/2" Brass Threaded Rod - Fits Conductor Sizes .375 to .500 | EA | 1.34 |
| 2380-12 | Bronze 12" Thru Roof Point Base for 1/2" Air Terminal with 1/2" Brass Threaded Rod - Fits Conductor Sizes .375 to .500 | EA | 1.34 |
| **2380BM-12** | **Bimetal 12" Thru Roof Point Base for 1/2" Aluminum Air Terminal with 1/2" Stainless Threaded Rod to Copper Conductors - Fits Conductor Sizes .375 to .500** | **EA** | **0.00** |
| 2380BM-58 | Bimetal 12" Thru Roof Point Base for 5/8" Aluminum Air Terminal with 1/2" Stainless Threaded Rod to Copper Conductors - Fits Conductor Sizes .375 to .500 | EA | 0.00 |
| A2380-12 | Aluminum 12" Thru Roof Point Base for 1/2" Air Terminal with 1/2" Stainless Steel Threaded Rod - Fits Conductor Sizes .375 to .500 | EA | 0.92 |
| A2380-58 | Aluminum 12" Thru Roof Point Base for 5/8" Air Terminal with 1/2" Stainless Steel Threaded Rod - Fits Conductor Sizes .375 to .500 | EA | 0.92 |

## Loop - 1/4" Holes (LP-LOOP-03)



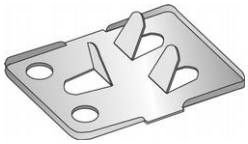


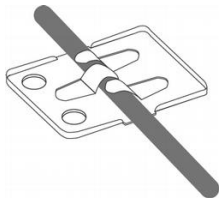
Typical application

| Item # | Description | Unit | Weight |
|---|---|---|---|
| **2425** | **Copper Conductor Loop - Loop Width 5/8" - Hole Size 1/4" - Maximum Conductor Size .437"** | **EA** | **0.01** |
| 2425T | Tinned Copper Conductor Loop - Loop Width 5/8" - Hole Size 1/4" - Maximum Conductor Size .437" | EA | 0.01 |
| 2430 | Copper Conductor Loop 1/4" Hole | EA | 0.02 |
| 2430T | Tinned Copper Conductor Loop 1/4" Hole | EA | 0.04 |

## Conductor Support - Adhesive (LP-SPT-04)

A stamped conductor support for mounting with adhesive on flat roofs and other surfaces that connot be penetrated with fasteners.





Typical application

| Item # | Description | Unit | Weight |
|---|---|---|---|
| 2510 | Copper Adhesive Conductor Support - Overall Size 2-1/4" x 3-1/2" - Maximum Conductor Size .528 | EA | 0.09 |
| **A2510** | **Aluminum Adhesive Conductor Support - Overall Size 2-1/4" x 3-1/2" - Maximum Conductor Size .562** | **EA** | **0.04** |

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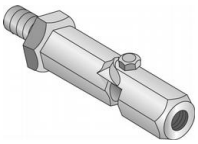
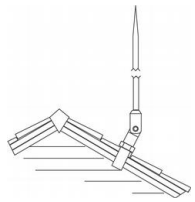
## Swivel Air Terminal Adapter Male (LP-AT-ACC-10)

A swivel adapter designed to allow plumb air terminal mounting on sloped surfaces. Available in aluminum or brass for 3/8", 1/2" and 5/8" air terminals mounting to 3/8", 1/2" or 5/8" bases.



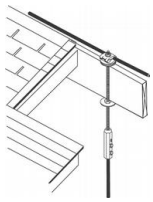


Typical application

| Item # | Description | Unit | Weight |
|---|---|---|---|
| 1950-12-38 | Premier Brass Male Swivel Point Adapter 1/2" Base - 3/8" Air Terminal | EA | 0.40 |
| 1950-12-12 | Premier Brass Male Swivel Point Adapter 1/2" Base - 1/2" Air Terminal | EA | 0.40 |
| 1950-12-58 | Premier Brass Male Swivel Point Adapter 1/2" Base - 5/8" Air Terminal | EA | 0.40 |
| 1950-38-38 | Premier Brass Male Swivel Point Adapter 3/8" Base - 3/8" Air Terminal | EA | 0.40 |
| 1950-38-12 | Premier Brass Male Swivel Point Adapter 3/8" Base - 1/2" Air Terminal | EA | 0.40 |
| 1950-38-58 | Premier Brass Male Swivel Point Adapter 3/8" Base - 5/8" Air Terminal | EA | 0.40 |
| 1950-58-38 | Premier Brass Male Swivel Point Adapter 5/8" Base - 3/8" Air Terminal | EA | 0.40 |
| 1950-58-12 | Premier Brass Male Swivel Point Adapter 5/8" Base - 1/2" Air Terminal | EA | 0.40 |
| 1950-58-58 | Premier Brass Male Swivel Point Adapter 5/8" Base - 5/8" Air Terminal | EA | 0.40 |
| **A1950-12-12** | **Premier Aluminum Male Swivel Point Adapter 1/2" Base - 1/2" Air Terminal** | **EA** | **0.24** |
| A1950-12-58 | Premier Aluminum Male Swivel Point Adapter 1/2" Base - 5/8" Air Terminal | EA | 0.24 |
| A1950-58-12 | Premier Alum Male Swivel Point Adapter 5/8" Base - 1/2" Air Terminal | EA | 0.24 |
| A1950-58-58 | Premier Aluminum Male Swivel Point Adapter 5/8" Base- 5/8" Air Terminal | EA | 0.24 |

## Thru Roof Assembly (LP-TWTR-04)

An assembly designed to make a sealed roof penetration while maintaining low resistance grounding. Stainless steel hardware and sealing washers are included.

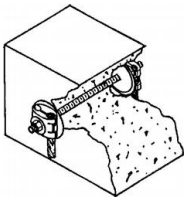


Typical application

| Item # | Description | Unit | Weight |
|---|---|---|---|
| 2350 | Bronze Copper to Copper 18" Thru Roof Assembly with no PVC and 1/2" Brass Threaded Rod - Fits Conductor Sizes .257 to .500 | EA | 1.50 |
| A2350 | Aluminum to Aluminum 18" Thru Roof Assembly with no PVC and 1/2" Stainless Steel Threaded Rod - Fits Conductor Sizes .257 to .562 | EA | 1.20 |
| **2351** | **Bronze / Aluminum 18" Thru Roof Assembly with no PVC and 1/2" Stainless Steel Threaded Rod - Fits Conductor Sizes .257 to .500** | **EA** | **1.30** |

## Thru Wall Assembly (LP-TWTR-01)

An assembly designed for a thru wall penetration that can be easily sealed while maintaining low resistance grounding. Stainless steel hardware and sealing washers are included.



Typical application

| Item # | Description | Unit | Weight |
|---|---|---|---|
| 2300 | Bronze Copper to Copper 18" Thru Wall Assembly with 1/2" Brass Threaded Rod - Fits Conductor Sizes .292 to .528 | EA | 1.92 |
| A2300 | Aluminum to Aluminum 18" Thru Wall Assembly with 1/2" Stainless Steel Threaded Rod - Fits Conductor Sizes .292 to .562 | EA | 1.42 |
| **2301** | **Bronze / Aluminum Bimetal 18" Thru Wall Assembly with 1/2" Stainless Steel Threaded Rod - Fits Conductor Sizes .292 to .562** | **EA** | **1.72** |

## Ground Rod Clamp - Brass Standard Duty (GC-GRCLMP-09)

A standard duty ground rod clamp. Provides enough contact between rod and conductor to be used for lightning protection. Two stainless steel bolts included.

| Item # | Description | Unit | Weight |
|---|---|---|---|
| **3014U** | **Brass Standard Duty Ground Rod Clamp - Fits Rod Sizes: 1/2", 5/8" and 3/4" to Maximum Conductor Size .528** | **EA** | **0.32** |

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## Ground Rods - Copper Clad Sectional (GC-GROD-01a)

1-1/2" thread at both ends of rod.



| Item # | Description | Unit | Weight |
|---|---|---|---|
| **2921** | **5/8" x 10' Copper Clad Sectional Ground Rod** | **EA** | **8.70** |
| 2953 | 3/4" x 8' Copper Clad Sectional Ground Rod | EA | 9.98 |
| 2961 | 3/4" x 10' Copper Clad Sectional Ground Rod | EA | 12.80 |
| 2981 | 1" x 10' Copper Clad Sectional Ground Rod | EA | 23.00 |

## Ground Rod Couplers (GC-GROD-06)

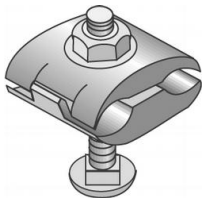
Ground rod couplers are used to connect threaded or sectional ground rods.

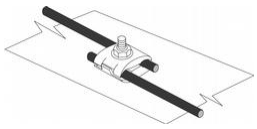
| Item # | Description | Unit | Weight |
|---|---|---|---|
| 3040-12 | Brass Coupler 1/2" Ground Rod for Full Size Rods | EA | 0.20 |
| **3040-58** | **Brass Coupler 5/8" Ground Rod** | **EA** | **0.30** |
| 3040-34 | Brass Coupler 3/4" Ground Rod | EA | 0.40 |
| 3040-1 | Brass Coupler 1" Ground Rod | EA | 1.00 |
| 3050-12 | 304 Stainless Steel Coupler 1/2" Ground Rod | EA | 0.20 |
| 3050-58 | 304 Stainless Steel Coupler 5/8" Ground Rod | EA | 0.30 |
| 3050-34 | 304 Stainless Steel Coupler 3/4" Ground Rod | EA | 0.40 |
| 3050-1 | Stainless Steel Coupler 1" Ground Rod | EA | 0.80 |

## Connector - One Bolt Parallel with Countersunk Bolt

(LP-C2CON-02)

A cast parallel connector for attaching conductor to conductor, or conductor to rod. The clamp provides for 1-1/2" of contact. The bolt head is recessed into the connector to provide a smooth bottom surface.



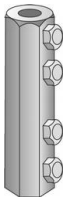


Typical application

| Item # | Description | Unit | Weight |
|---|---|---|---|
| 902 | Bronze One Bolt Parallel Clamp with Countersunk Bolt - Fits Conductor Sizes .162 to .528 | EA | 0.41 |
| 902T | Tinned Bronze One Bolt Parallel Clamp with Countersunk Bolt - Fits Conductor Sizes .162 to .528 | EA | 0.47 |
| **A902** | **Aluminum One Bolt Parallel Clamp with Countersunk Bolt - Fits Conductor Sizes .167 to .562** | **EA** | **0.15** |

## Splicer - Hex Standard Straight (LP-C2CON-06)

A straight splicer suitable for Class I and Class II lightning and grounding conductor.



Typical application

| Item # | Description | Unit | Weight |
|---|---|---|---|
| 917 | Brass Standard Straight Connector - Accepts 129/#2 Solid Thru 268/#4/0 Cable | EA | 0.35 |
| 917-1 | H D Brass Straight Connector - Accepts 129/#2 Solid Thru 288/#250MCM Cable | EA | 0.53 |
| **A917** | **Aluminum Std Straight Connector - Accepts A124 Thru A237 Cable** | **EA** | **0.18** |

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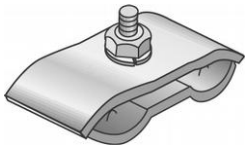
## Connector - Stainless Steel Parallel Secondary Bimetal

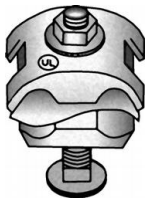
(LP-C2CON-14)

A stainless steel bimetal connector for joining copper and aluminum secondary bonding cables, which provides 2" of contact on each conductor.

| Item # | Description | Unit | Weight |
|---|---|---|---|
| **929-1** | **Secondary Stainless Steel Bimetal Parallel Connector - Fits Conductor Sizes .292 to .562** | **EA** | **0.18** |
| **929-5** | **Bimetal Parallel Splicer - Aluminum Top with Bronze Bottom** | **EA** | **0.30** |
| 929-5LH-12 | Bimetal Parallel Splicer Less Hardware - Aluminum Top, Stainless Shim and Bronze Bottom All Drilled Out 17/32" | EA | 0.27 |



Illustrates the 929-1

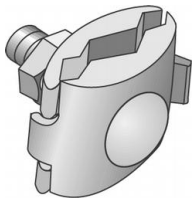


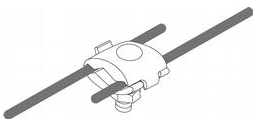
Illustrates the 929-5

## Connector - Secondary (LP-C2CON-23)

A cast connector suitable for connecting two conductors, two rods or a conductor to a rod.

| Item # | Description | Unit | Weight |
|---|---|---|---|
| 940 | Bronze Secondary Connector - Fits Conductor Sizes .162 to .528 ( Cut 905 In Half To Get 940, Cut On Line) | EA | 0.22 |
| 940T | Tinned Bronze Seconday Connector - Fits Conductor Sizes .162 to .528 | EA | 0.22 |
| **A940** | **Aluminum Secondary Connector - Fits Conductor Sizes .162 to .562** | **EA** | **0.11** |



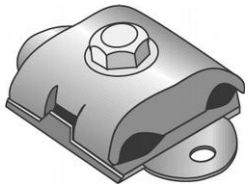


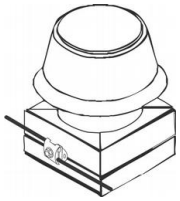
Typical application

## Bonding Plate (LP-C2BP-03)

A cast bonding connector with three square inches of surface contact.

| Item # | Description | Unit | Weight |
|---|---|---|---|
| 1005 | Three Square Inch Bronze Bonding Plate - Fits Conductor Sizes .292 to .528 | EA | 0.44 |
| **A1005** | **Three Square Inch Aluminum Bonding Plate - Fits Conductor Sizes .292 to .562** | **EA** | **0.16** |
| 1005BM | Three Square Inch Bi-Metal Bonding Plate for Bonding Aluminum Surface to Copper Conductor - Fits Conductor Sizes .292 to .528 | EA | 0.31 |



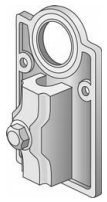


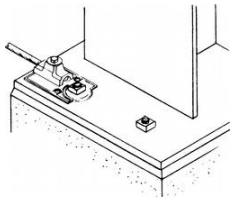
Typical application

## Bolt Hole Bonding Plate (LP-C2BP-11)

A cast bonding connector with a hole for bolts up to 1" diameter. The bonding conductor has eight square inches of contact surface.

| Item # | Description | Unit | Weight |
|---|---|---|---|
| 1040 | Bronze Bolt Hole Bonding Plate - Fits Conductor Sizes .375 to .500 | EA | 0.63 |
| **A1040** | **Aluminum Bolt Hole Bonding Plate - Fits Conductor Sizes .375 to .500** | **EA** | **0.22** |





Typical application

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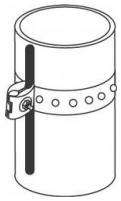
## Strap - Ground (LP-C2BS-01)

A ground strap used to bond pipes and round objects. The strap is 1" wide by 1/16" thick and is available in multiple lengths. The conductor is secured with a heavy duty cast bolt type conductor connector.

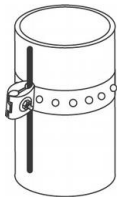


Vertical application

| Item # | Description | Unit | Weight |
|---|---|---|---|
| 1201 | Copper Bonding Strap Fits 2" Thru 6-1/2" OD - Overall Length 22-1/4" - Connector Fits Grounding Conductor Sizes #2 Stranded - 4/0 Stranded | EA | 0.36 |
| 1202 | Copper Bonding Strap Fits 3/4" Thru 2-1/2" OD - Overall Length 10-13/16" - Connector Fits Grounding Conductor Sizes #2 Stranded - 4/0 Stranded | EA | 0.29 |
| 1209 | Copper Bonding Strap Fits 6" Thru 10-1/2" OD - Overall Length 35-7/16" - Connector Fits Grounding Conductor Sizes #2 Stranded - 4/0 Stranded | EA | 0.42 |
| 1201T | Tinned Copper Bonding Strap Fits 2" Thru 6-1/2" OD - Overall Length 22-1/4" - Connector Fits Grounding Conductor Sizes #2 Stranded - 4/0 Stranded | EA | 0.36 |
| 1202T | Tinnedcopper Bonding Strap Fits 3/4" Thru 2-1/2" OD - Overall Length 10-13/16" - Connector Fits Grounding Conductor Sizes #2 Stranded - 4/0 Stranded | EA | 0.29 |
| 1209T | Tinned Copper Bonding Strap Fits 6" Thru 10-1/2" OD - Overall Length 35-7/16" - Connector Fits Grounding Conductor Sizes #2 Stranded - 4/0 Stranded | EA | 0.42 |
| **A1201** | **Aluminum Bonding Strap Fits 2" Thru 6-1/2" OD - Overall Length 22-1/4" - Connector Fits Lightning Conductor Sizes A124 thru A237** | **EA** | **0.27** |
| A1202 | Aluminum Bonding Strap Fits 3/4" Thru 2-1/2" OD - Overall Length 10-13/16" - Connector Fits Lightning Conductor Sizes A124 thru A237 | EA | 0.20 |
| A1209 | Aluminum Bonding Strap Fits 6" Thru 10-1/2" OD - Overall Length 35-7/16" - Connector Fits Lightning Conductor Sizes A124 thru A237 | EA | 0.33 |

## Strap - Heavy Duty Pipe (LP-C2BS-02)

The 2" wide, heavy duty strap qualifies as a water pipe bond as outlined in UL96 and UL96A.



Vertical application

| Item # | Description | Unit | Weight |
|---|---|---|---|
| 1240 | Copper Heavy Duty Pipe Strap Fits 2" Thru 4-1/2" OD - Overall Length 20-11/16" - Connector Fits Grounding Conductor Sizes #2 Stranded - 4/0 Stranded | EA | 1.40 |
| 1246 | Copper Heavy Duty Pipe Strap Fits 4" Thru 6-1/2" OD - Overall Length 27-1/4" - Connector Fits Grounding Conductor Sizes #2 Stranded - 4/0 Stranded | EA | 1.65 |
| 1248 | Copper Heavy Duty Pipe Strap Fits 6" Thru 8-1/2" OD - Overall Length 33-7/8" - Connector Fits Grounding Conductor Sizes #2 Stranded - 4/0 Stranded | EA | 1.92 |
| 1250 | Copper Heavy Duty Pipe Strap Fits 8" Thru 10-1/2" OD - Overall Length 40-7/16" - Connector Fits Grounding Conductor Sizes #2 Stranded - 4/0 Stranded | EA | 2.18 |
| 1260 | Copper Heavy Duty Pipe Strap Fits 10" Thru 12-1/2" OD - Overall Length 47" - Connector Fits Grounding Conductor Sizes #2 Stranded - 4/0 Stranded | EA | 2.45 |
| A1240 | Aluminum Heavy Duty Pipe Strap Fits 2" Thru 4-1/2" OD - Overall Length 20-11/16" - Connector Fits Lightning Conductor Sizes A124 thru A237 | EA | 0.61 |
| **A1246** | **Aluminum Heavy Duty Pipe Strap Fits 4" Thru 6-1/2" OD - Overall Length 27-1/4" - Connector Fits Lightning Conductor Sizes A124 thru A237** | **EA** | **0.72** |
| A1248 | Aluminum Heavy Duty Pipe Strap Fits 6" Thru 8-1/2" OD - Overall Length 33-7/8" - Connector Fits Lightning Conductor Sizes A124 thru A237 | EA | 0.85 |
| A1250 | Aluminum Heavy Duty Pipe Strap Fits 8" Thru 10-1/2" OD - Overall Length 40-7/16" - Connector Fits Lightning Conductor Sizes A124 thru A237 | EA | 0.97 |
| A1260 | Aluminum Heavy Duty Pipe Strap Fits 10" Thru 12-1/2" OD - Overall Length 47" - Connector Fits Lightning Conductor Sizes A124 thru A237 | EA | 1.08 |

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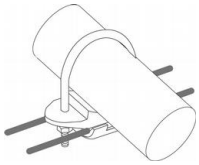
## U-Bolt Ground Clamp (GC-UBOLT-02)

A U-bolt cast ground clamp with stainless steel U-bolt and hardware. The conductor connector can accept one or two conductors.



Typical application

| Item # | Description | Unit | Weight |
|---|---|---|---|
| 1372 | Bronze U-Bolt Twin Connector Fits 1-1/4" to 2" Maximum Diameter with 2 Wires .292 to .528 Maximum Diameter | EA | 0.80 |
| 1372T | Tinned Bronze U-Bolt Twin Connector Fits 1 1/4" to 2" Maximum Diameter with 2 Wires .292 to .528 Maximum Diameter | EA | 0.50 |
| 1373 | Bronze U-Bolt Twin Connector Fits 2" to 3" Maximum Diameter with 2 Wires .292 to .528 Maximum Diameter | EA | 0.80 |
| 1373T | Tinned Bronze U-Bolt Twin Connector Fits 2" to 3" Maximum Diameter with 2 Wires .292 to .528 Maximum Diameter | EA | 1.04 |
| 1374 | Bronze U-Bolt Twin Connector Fits 3" to 4-1/2" Maximum Diameter with 2 Wires .292 to .528 Maximum Diameter | EA | 1.70 |
| 1374T | Tinned Bronze U-Bolt Twin Connector Fits 3" to 4-1/2" Maximum Diameter with 2 Wires .292 to .528 Maximum Diameter | EA | 1.54 |
| 1376 | Bronze U-Bolt Twin Connector Fits 4" to 6-3/4" Maximum Diameter with 2 Wires .292 to .528 Maximum Diameter | EA | 2.30 |
| 1376T | Tinned Bronze U-Bolt Twin Connector Fits 4" to 6-3/4" Maximum Diameter with 2 Wires .292 to .528 Maximum Diameter | EA | 2.30 |
| **A1372** | **Aluminum U-Bolt Twin Connector Fits 1-1/4" to 2" Maximum Diameter Round Objects with 1 or 2 Wires .292 to .562 Maximum Diameter** | **EA** | **0.30** |
| A1373 | Aluminum U-Bolt Twin Connector Fits 2" to 3" Maximum Diameter Round Objects with 1 or 2 Wires .292 to .562 Maximum Diameter | EA | 0.40 |
| A1374 | Aluminum U-Bolt Twin Connector Fits 3" to 4-1/2" Maximum Diameter Round Objects with 1 or 2 Wires .292 to .562 Maximum Diameter | EA | 0.70 |

SECTION 26 51 00

INTERIOR LIGHTING
**07/07**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 641/A 641M | (2003) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire |

CALIFORNIA ENERGY COMMISSION (CEC)

| | |
|---|---|
| CEC Title 24 | (1978; R 2005) California's Energy Efficiency Standards for Residential and Nonresidential Buildings |

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

| | |
|---|---|
| IESNA HB-9 | (2000; Errata 2004; Errata 2005) IES Lighting Handbook |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C2 | (2007; Errata 2007; INT 2008) National Electrical Safety Code |
| IEEE C62.41.1 | (2002) IEEE Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits |
| IEEE C62.41.2 | (2002) IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits |
| IEEE Std 100 | (2000) The Authoritative Dictionary of IEEE Standards Terms |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA 250 | (2003) Enclosures for Electrical Equipment (1000 Volts Maximum) |
| NEMA ANSLG C78.42 | (2007) Standard for High-Pressure Sodium Lamps |
| NEMA C78.81 | (2005) Electric Lamps - Double-capped Fluorescent Lamps Dimensional and Electrical Characteristics |
| NEMA C78.901 | (2005) Electric Lamps - Single Base |

| | |
|---|---|
| | Fluorescent Lamps Dimensional and Electrical Characteristics |
| NEMA C82.11 | (2002) High-Frequency Fluorescent Lamp Ballasts |
| NEMA C82.4 | (2002) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type) |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 101 | (2008) Life Safety Code, 2006 Edition |
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

| | |
|---|---|
| Energy Star | (1992; R 2006) Energy Star Energy Efficiency Labeling System |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1029 | (1994; Rev thru Dec 2007) Standard for Safety High-Intensity-Discharge Lamp Ballasts |
| UL 1598 | (2008) Luminaires |
| UL 773 | (1995; Rev thru Mar 2002) Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting |
| UL 773A | (2006) Nonindustrial Photoelectric Switches for Lighting Control |
| UL 924 | (2006) Standard for Emergency Lighting and Power Equipment |
| UL 935 | (2001; Rev thru Dec 2007) Standard for Fluorescent-Lamp Ballasts |

## 1.2 RELATED REQUIREMENTS

Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in this section.

## 1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

b. Average life is the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

c. Total harmonic distortion (THD) is the root mean square (RMS) of all the harmonic components divided by the total fundamental current.

## 1.4 SYSTEM DESCRIPTION

### 1.4.1 Lighting Control System

Provide lighting control system as indicated. Lighting control equipment shall include, if indicated: control modules, power packs, dimming ballasts, occupancy sensors, and light level sensors.

## 1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IESNA HB-9, as applicable, for the lighting system specified.

SD-03 Product Data

Fluorescent lighting fixtures; G

Fluorescent electronic ballasts; G

Fluorescent lamps; G

High-intensity-discharge (HID) lighting fixtures; G

HID ballasts; G

High-pressure sodium (HPS) lamps; G

Photocell switch; G

Exit signs; G

Electronic dimming ballast; G

Dimming ballast controls; G

Energy Efficiency

SD-06 Test Reports

Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

SD-10 Operation and Maintenance Data

Lighting Control System, Data Package 5; G

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein, showing all light fixtures, control modules, control zones, occupancy sensors, light level sensors, power packs, dimming ballasts, schematic diagrams and all interconnecting control wire, conduit, and associated hardware.

Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

## 1.6 QUALITY ASSURANCE

### 1.6.1 Fluorescent Electronic Ballasts

Submit ballast catalog data as required in the paragraph entitled "Fluorescent Lamp Electronic Ballasts" contained herein. As an option, submit the fluorescent fixture manufacturer's electronic ballast specification information in lieu of the actual ballast manufacturer's catalog data. This information shall include published specifications and sketches, which covers the information required by the paragraph entitled "Fluorescent Lamp Electronic Ballasts" herein. This information may be supplemented by catalog data if required, and shall contain a list of vendors with vendor part numbers.

### 1.6.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

### 1.6.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

#### 1.6.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6.3.3 Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products. Submit data indicating lumens per watt efficiency and color rendition index of light source.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.7.1 Electronic Ballast Warranty

Furnish the electronic ballast manufacturer's warranty. The warranty period shall not be less than 5 years from the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage shall not exceed 12 months, thereby permitting 4 years of the ballast 5 year warranty to be in service and energized. The warranty shall state that the malfunctioning ballast shall be exchanged by the manufacturer and promptly shipped to the using Government facility. The replacement ballast shall be identical to, or an improvement upon, the original design of the malfunctioning ballast.

PART 2 PRODUCTS

2.1 FLUORESCENT LIGHTING FIXTURES

UL 1598. Fluorescent fixtures shall have electronic ballasts unless specifically indicated otherwise.

2.1.1 Fluorescent Lamp Electronic Ballasts

The electronic ballast shall as a minimum meet the following characteristics:

a. Ballast shall comply with UL 935, NEMA C82.11, NFPA 70, and CEC Title 24 unless specified otherwise. Ballast shall be 100% electronic high frequency type with no magnetic core and coil components. Ballast shall provide transient immunity as recommended by IEEE C62.41.1 and IEEE C62.41.2. Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.

b. Power factor shall be 0.95 (minimum).

c. Ballast shall operate at a frequency of 20,000 Hertz (minimum). Ballast shall be compatible with and not cause interference with the operation of occupancy sensors or other infrared control systems. Provide ballasts operating at or above 40,000 Hertz where available.

d. Ballast shall have light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation.

Ballast shall have 10 percent flicker (maximum) using any compatible lamp.

e. Ballast factor shall be between 0.85 (minimum) and 1.00 (maximum). Current crest factor shall be 1.7 (maximum).

f. Ballast shall be UL listed Class P with a sound rating of "A."

g. Ballast shall have circuit diagrams and lamp connections displayed on the ballast.

h. Ballasts shall be instant start unless otherwise indicated. Ballasts shall be programmed start where indicated. Instant start ballasts shall operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed. Programmed start ballasts may operate lamps in a series circuit configuration. Provide series/parallel wiring for programmed start ballasts where available.

i. Ballasts for compact fluorescent fixtures shall be programmed start.

j. Ballasts for T-5 and smaller lamps shall have end-of-life protection circuits as required by NEMA C78.81 and NEMA C78.901 as applicable.

k. Ballast shall be capable of starting and maintaining operation at a minimum of 32 degrees F unless otherwise indicated.

l. Electronic ballast shall have a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

2.1.1.1 T-8 Lamp Ballast

a. Total harmonic distortion (THD): Shall be 10 percent (maximum).

b. Input wattage.

2. 62 watts (maximum) when operating two F32T8 lamps

3. 92 watts (maximum) when operating three F32T8 lamps

c. Ballast efficacy factor.

2. 1.44 (minimum) when operating two F32T8 lamps

3. 0.93 (minimum) when operating three F32T8 lamps

d. Provide three lamp fixtures with two ballasts per fixture where multilevel switching is indicated.

2.1.1.2 F17T8 Lamp Ballast

a. Total harmonic distortion (THD): Shall be 25 percent (maximum).

b. Input wattage:

1. 34 watts (maximum) when operating two F17T8 lamps.

2.1.2 Fluorescent Lamp Electronic Dimming Ballast

The electronic ballast shall as a minimum meet the following characteristics:

a. Ballast shall comply with NEMA C82.11, UL 935, and NFPA 70, unless specified otherwise. Ballast shall provide transient immunity as recommended by IEEE C62.41.1 and IEEE C62.41.2. Ballast dimming capability range shall be from 100 to 5 percent (minimum range) of light output, flicker free. Ballast shall start lamp at any preset light output setting without first having to go to full light output. Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.

b. Power factor shall be 0.95 (minimum) at full light output, and 0.90 (minimum) over the entire dimming range.

c. Ballast shall operate at a frequency of 20,000 Hertz (minimum). Ballast shall be compatible with and not cause interference with the operation of occupancy sensors or other infrared control systems. Provide ballasts operating at or above 40,000 Hertz where available.

d. Ballast factor at full light output shall be between 0.85 (minimum) and 1.00 (maximum). Current crest factor shall be 1.7 (maximum).

e. Ballast shall be UL listed Class P with a sound rating of "A".

f. Ballast shall have circuit diagrams and lamp connections displayed on the ballast.

g. Ballast shall be programmed start. Ballast may operate lamps in a series circuit configuration. Provide series/parallel wiring for programmed start ballasts where available.

h. Ballasts for compact fluorescent fixtures shall be programmed start.

i. Ballast shall be capable of starting and maintaining operation at a minimum of 32 degrees F unless otherwise indicated.

j. Total harmonic distortion (THD): Shall be 20 percent (maximum) over the entire dimming range.

k. Ballasts for T-5 and smaller lamps shall have end-of-life protection circuits as required by NEMA C78.81 and NEMA C78.901 as applicable.

2.1.2.1 T-8 Lamp Ballast

Input wattage, for indicated lamp quantity shall be:

a. 35 watts (maximum) when operating one F32T8 lamp.

b. 70 watts (maximum) when operating two F32T8 lamps.

c. 104 watts (maximum) when operating three F32T8 lamps.

2.1.3 Dimming Ballast Controls

The dimming ballast controls shall be a slide dimmer with on/off control.

The slide dimmer shall be compatible with the ballast and control the ballast light output over the full dimming range. Dimming ballast controls shall be approved by the ballast manufacturer.

2.1.4 Fluorescent Lamps

a. T-8 rapid start lamps shall be rated 32 watts (maximum), 2800 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours.

g. Compact fluorescent lamps shall be: CRI 80, minimum, 3000 K, 10,000 hours average rated life, and as follows:

1. T-4, double twin tube, rated 13 watts, 900 initial lumens (minimum), 18 watts, 1200 initial lumens (minimum), and 26 watts, 1800 initial lumens (minimum), as indicated.

Average rated life is based on 3 hours operating per start.

2.1.5 Open-Tube Fluorescent Fixtures

Provide with self-locking sockets, or lamp retainers (two per lamp). Provide lamps with shatter resistant coating, non-yellowing, nominal thickness of 15 mils, and with 97 percent (minimum) light transmission. Provide a clear polycarbonate protective sleeve with end caps, over lamp, with 95 percent (minimum) light transmission. The sleeve shall be rated to withstand the thermal profile of the lamp and ballast.

2.1.6 Electromagnetic Interference Filters

Provide in each fluorescent fixture mounted in shielded enclosures. Filters shall be integral to the fixture assembly with one filter per ballast and shall suppress electromagnetic interference in the AM radio band from 500 to 1700 kHz.

2.2 HIGH-INTENSITY-DISCHARGE (HID) LIGHTING FIXTURES

2.2.1 HID Ballasts

UL 1029 and NEMA C82.4 and shall be constant wattage autotransformer (CWA) or regulator, high power factor type (minimum 90%). Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

a. Designed to operate on the voltage system to which they are connected.

b. Designed for installation in a normal ambient temperature of 40 degrees C.

c. Constructed so that open circuit operation will not reduce the average life.

High-pressure sodium (HPS) ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 3500 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C in any mode.

2.2.2 High-Pressure Sodium (HPS) Lamps

NEMA ANSLG C78.42 wattage as indicated. 150 watt lamps, if required, shall be 55 volt type.

2.2.2.1 Luminaire Efficiency Rating (LER)

a. Upward efficiency of 0%

1. 150-399 watts: minimum 58 LER for closed fixture; minimum 68 for open fixture

2. 400-999 watts: minimum 63 LER for closed fixture; minimum 84 for open fixture

b. Upward efficiency of 1%-10%

1. 150-399 watts: minimum 64 LER for closed fixture; minimum 63 for open fixture

2. 400-999 watts: minimum 82 LER for closed fixture; minimum 89 for open fixture

3. 1000+ watts: minimum 109 LER for open fixture

c. Upward efficiency of 11% to 20%

1. 150-399 watts: minimum 78 LER for open fixture

2. 400-999 watts: minimum 94 for open fixture

d. Upward efficiency greater than 20%

1. 150-399 watts: minimum 75 LER for closed fixture; minimum 77 for open fixture

2.3 RECESS- AND FLUSH-MOUNTED FIXTURES

Provide type that can be relamped from the bottom. Access to ballast shall be from the bottom. Trim for the exposed surface of flush-mounted fixtures shall be as indicated.

2.4 SUSPENDED FIXTURES

Provide hangers capable of supporting twice the combined weight of fixtures supported by hangers. Provide with swivel hangers to ensure a plumb installation. Hangers shall be cadmium-plated steel with a swivel-ball tapped for the conduit size indicated. Hangers shall allow fixtures to swing within an angle of 45 degrees. Brace pendants 4 feet or longer provided in shops or hangers to limit swinging. Single-unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple-unit or continuous row fluorescent fixtures shall have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end. Rods shall be a minimum 0.18 inch diameter.

## 2.5 SWITCHES

### 2.5.1 Toggle Switches

Provide toggle switches as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

### 2.5.2 PHOTOCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated 277 volts ac, 60 Hz with single-throw contacts. Switch shall turn on at or below 3 footcandles and off at 2 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Provide switch:

a. In a U.V. stabilized polycarbonate housing with swivel arm and adjustable window slide, rated 1800 VA, minimum.

## 2.6 EXIT SIGNS

UL 924, NFPA 70, and NFPA 101. Exit signs shall be AC only type. Exit signs shall use no more than 5 watts.

## 2.7 SUPPORT HANGERS FOR LIGHTING FIXTURES IN SUSPENDED CEILINGS

### 2.7.1 Wires

ASTM A 641/A 641M, galvanized regular coating, soft temper, 0.1055 inches in diameter (12 gage).

## 2.8 EQUIPMENT IDENTIFICATION

### 2.8.1 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

### 2.8.2 Labels

Provide labeled luminaires in accordance with UL 1598 requirements. All luminaires shall be clearly marked for operation of specific lamps and ballasts according to proper lamp type. The following lamp characteristics shall be noted in the format "Use Only _____":

a. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.

b. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.

c. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.

d. ANSI ballast type (M98, M57, etc.) for HID luminaires.

e. Correlated color temperature (CCT) and color rendering index (CRI) for

all luminaires.

All markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Ballasts shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

## 2.9 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

### 3.1.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to the Government if more than 15 percent of their rated life has been used. Lamps shall be tested for proper operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer. Provide 10 percent spare lamps of each type from the original manufacturer.

### 3.1.2 Lighting Fixtures

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings. Installation shall meet requirements of NFPA 70. Mounting heights specified or indicated shall be to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Recessed and semi-recessed fixtures shall be independently supported from the building structure by a minimum of four wires per fixture and located near each corner of each fixture. Ceiling grid clips are not allowed as an alternative to independently supported light fixtures. Round fixtures or fixtures smaller in size than the ceiling grid shall be independently supported from the building structure by a minimum of four wires per fixture spaced approximately equidistant around the fixture. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently and provide at least two 3/4 inch metal channels spanning, and secured to, the ceiling tees for centering and aligning the fixture. Provide wires for lighting fixture support in this section. Lighting fixtures installed in suspended ceilings shall also comply with the requirements of Section 09 51 00 ACOUSTICAL CEILINGS.

### 3.1.3 Suspended Fixtures

Suspended fixtures shall be provided with 45 degree swivel hangers so that they hang plumb and shall be located with no obstructions within the 45 degree range in all directions. The stem, canopy and fixture shall be capable of 45 degree swing. Pendants, rods, or chains 4 feet or longer excluding fixture shall be braced to prevent swaying using three cables at 120 degree separation. Suspended fixtures in continuous rows shall have internal wireway systems for end to end wiring and shall be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Aligning splines shall be used on extruded aluminum fixtures to assure hairline joints. Steel fixtures shall be supported to prevent "oil-canning" effects. Fixture finishes shall be free of scratches, nicks, dents, and warps, and shall match the color and gloss specified. Pendants shall be finished to match fixtures. Aircraft cable shall be stainless steel. Canopies shall be finished to match the ceiling and shall be low profile unless otherwise shown. Maximum distance between suspension points shall be 10 feet or as recommended by the manufacturer, whichever is less.

### 3.1.4 Ballasts

#### 3.1.4.1 Electronic Dimming Ballasts

All electronic dimming ballasts controlled by the same controller shall be of the same manufacturer. All fluorescent lamps on electronic dimming ballast control shall be seasoned or burned in at full light output for 100 hours before dimming.

### 3.1.5 Exit Signs and Emergency Lighting Units

Wire exit signs and emergency lighting units ahead of the switch to the normal lighting circuit located in the same room or area.

### 3.1.6 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations. Set adjustable window slide for 3 minimum footcandles photocell turn-on.

## 3.2 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

## 3.3 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test to show that equipment operates in accordance with requirements of this section.

### 3.3.1 Electronic Dimming Ballast

Test for full range of dimming capability. Observe for visually detectable flicker over full dimming range.

-- End of Section --

# LIGHTING FIXTURE SCHEDULE

| FIXTURE SYMBOL | DESCRIPTION | LAMP | VOLTAGE | MOUNTING | MODEL NUMBER |
|---|---|---|---|---|---|
| A | LENSED TROFFER, #12 PATTERN ACRYLIC, 3–LAMP, EMI/RFI FILTER, ELECTRONIC BALLAST 10%THD | 3–F32/T8 3500K | 277V | RECESSED | COOPER 2GR8–332A–UNV–GL–TEB81–RIF1–U |
| B | LENSED TROFFER, #12 PATTERN ACRYLIC, 2–LAMP, EMI/RFI FILTER, ELECTRONIC BALLAST 10%THD | 2–F32/T8 3500K | 277V | RECESSED | COOPER 2GR8–232A–UNV–GL–TEB81–RIF1–U |
| C | VAPORTITE STRIP, WET LOCATION, FLUORESCENT, 2–LAMP, EMI/RFI FILTER, ELECTRONIC BALLAST 10%THD | 2–F32/T8 3500K | 277V | SURFACE | COOPER VT2–232DR–UNV–TEB81–WL |
| D | LENSED TROFFER, #12 PATTERN ACRYLIC, 2–LAMP, EMI/RFI FILTER, ELECTRONIC BALLAST 10%THD FLANGE FOR GYP CEILING | 2–F32/T8 3500K | 277V | RECESSED | COOPER 2FR8–232A–UNV–GL–TEB81–RIF1–U |
| E | FLUORESCENT STRIP WITH WIRE GUARD, EMI/RFI FILTER, ELECTRONIC BALLAST 10%THD | 2–F32/T8 3500K | 277V | PENDANT | COOPER SS–232–UNV–GL–TEB81–RIF1–U–WG/SS–4FT–B |
| F | LENSED TROFFER, #12 PATTERN ACRYLIC, 3–LAMP, EMI/RFI FILTER, 2 ELECTRONIC BALLASTS 10%THD BI–LEVEL SWITCHING | 3–F32/T8 3500K | 277V | RECESSED | COOPER 2GR8–332A–UNV–GL–TEB82–RIF1–U |
| G | SHOWER LIGHT, COMPACT FLUORESCENT, GLASS ALBALITE LENS, WHITE TRIM RING MAINTAIN 3" CLEARANCE TO ANY INSULATION | 1–26W 4–PIN CFL 3000K | 277V | RECESSED | COOPER H285E–70PS–26TTT |
| H | DOWNLIGHT, COMPACT FLUORESCENT, DIMMING BALLAST, CLEAR REFLECTOR, 6" CAN | 1–42W 4–PIN CFL 3000K | 277V | RECESSED | COOPER PD6–H142–2DMARX–6HC |
| I | WALL BRACKET, FLUORESCENT, 2–LAMP, EMI/RFI FILTER, ELECTRONIC BALLAST 10%THD | 2–F32/T8 3500K | 277V | WALL HEIGHT VARIES | COOPER BC–232A–UNV–GL–TEB81–RIF1–U |
| J | EXTERIOR WALL–MOUNT, CUTOFF, HIGH PRESSURE SODIUM, MULTI–TAP HPF BALLAST, BLACK FINISH | 1–250W HPS | 277V | WALL HEIGHT VARIES | COOPER HPIP–TM–250–MT–4–F1–BK |
| K | POLE LIGHT, HIGH PRESSURE SODIUM, CWA BALLAST, TYPE 3 OPTICS, SINGLE ARM–MOUNT TO 40–FOOT ROUND TAPERED ALUMINUM POLE, BLACK FINISH | 1–400W HPS | 277V | 8" ARM MOUNT | COOPER HPTR–3S–400–MT–BRZ RTA–845394–DX–BRZ |
| L | POLE LIGHT, HIGH PRESSURE SODIUM, CWA BALLAST, TYPE 5 OPTICS, SINGLE ARM–MOUNT TO 40–FOOT ROUND TAPERED ALUMINUM POLE, BLACK FINISH | 1–400W HPS | 277V | 8" ARM MOUNT | COOPER HPTR–5F–400–MT–BRZ RTA–845394–DX–BRZ |
| M | DOWNLIGHT, COMPACT FLUORESCENT, ELECTRONIC BALLAST 10%THD, 6" CLEAR REFLECTOR | 1–42W 4–PIN CFL 3000K | 277V | RECESSED | COOPER PD6–H142E–6HC |
| N | HIGH–BAY FLUORESCENT, 8–FOOT TANDEM, HIGH REFLECTANCE OPTICS, EMI/RFI FILTER, 2 ELECTRONIC BALLASTS 10%THD | 8–F32/T8 3500K | 277V | PENDANT | COOPER 8TI8–832G–UNV–L8835–EB82–RIF1 |
| O | DOWNLIGHT, COMPACT FLUORESCENT, ELECTRONIC BALLAST 10%THD, CLEAR REFLECTOR, 6" CAN | 1–26W 4–PIN CFL 3000K | 277V | RECESSED | COOPER PD6–H126E–6HC |
| P | VIDEO CONFERENCE INDIRECT, 2X2 FLUORESCENT, ELECTRONIC DIMMING BALLAST | 2–40W BIAX 3000K | 277V | RECESSED | ELP 240BXVT–TB |
| ⊗ | EXIT SIGN, LED, RED LETTERS, WHITE POLYCARBONATE HOUSING, AC ONLY | RED LED | 277V | UNIVERSAL | COOPER LPX60RWH |

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** 2GR8-332A-UNV-GL-TEB81-RIF1-U<br>Notes: | **Type:** **A**<br>WK08-1600 |

# METALUX®

## DESCRIPTION

The GR8 is a T8-dedicated lensed troffer designed to offer premium performance in a low profile housing. T8 dedication and optimized lamp to lens spacing provides the best in energy efficiency and optical control. The GR8's shallow, low profile housing is compatible with even highly restrictive plenums. Luminaires are compatible with today's popular ceiling systems.

## APPLICATION

The GR8 offers great performance and great quality. The series is an excellent choice for commercial offices, schools, hospitals, retail merchandising and many other applications.

| Catalog # | Type |
|---|---|
| Project | |
| Comments | |
| Prepared by | Date |

## SPECIFICATION FEATURES

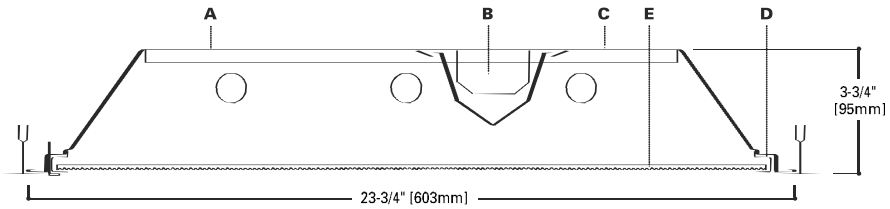
**A···Construction**
Unitized low profile recessed housing is die formed of code gauge prime cold rolled steel with full length stiffeners and mechanical endplate attachment for added strength. Off center, ballast cover is easily removed without tools. Die formed captive lampholder bracket fully encloses lampholder wiring for easy lampholder replacement. Ample KOs are provided for continuous row wiring. Built-in grid-lock feature for safety and convenience. Standard unit is NYC Approved. (No modifications necessary).

**B···Electrical****
Ballasts are CBM/ETL Class "P" and are positively secured by mounting bolts. Pressure lock lampholders. UL/CUL listed. Suitable for damp locations.

**C···Finish**
Multistage, iron phosphate pretreatment ensures maximum bonding and rust inhibition. Lighting grade baked white enamel finish with premium reflectance for high efficiency.

**D···Hinging/Latching**
Positive spring loaded cam action steel latches and safety lock T-hinges provide secure, high quality door fit and allow hinging and latching from either side.

**E···Frame/Shielding**
Heavy gauge flat steel door is die formed with reinforced mitered corners. Housing and door frame assemblies incorporate full length and width mechanical light traps. Light stabilized, acrylic prismatic lens.

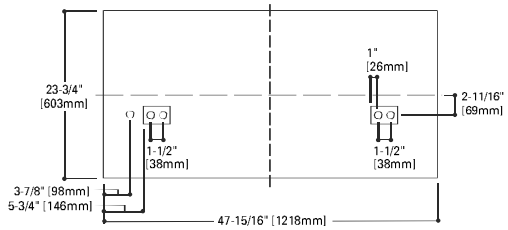


**2GR8**332

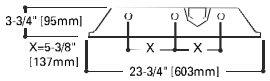
**2' X 4' TROFFER**
**3 LAMP**

General Purpose
T8 Commercial Troffer

## MOUNTING DATA

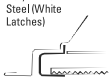



## LAMP CONFIGURATIONS



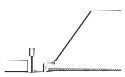

## DOOR FRAMES

2GR8
Flat, White
Steel (White
Latches)

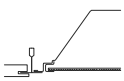


## CEILING COMPATIBILITY

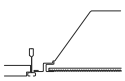
**G**
Grid/Lay-in
Standard



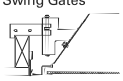
**G**
Concealed T



**G**
Slot Grid



**F**
Flange Trim
With Supporting
Swing Gates



| Ceiling Type | Trim Type |
|---|---|
| Exposed Grid | G |
| Concealed T | G |
| Slot Grid | G |
| Flange | G*** |

## ENERGY DATA

Input Watts:
**EB Ballast & STD Lamps**
332 (91)

**ES Ballast & STD Lamps**
332 (108)

Luminaire Efficacy Rating
**LER = FL-68**
**Catalog Number:** 2GR8-332A

**Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH** = $3.53

*Standard G (Grid) Type Fixtures can be field converted by adding trim kits. See Compatibility Section or Consult Factory.

**Reference the lamp/ballast data in the Technical Section for specific lamp/ballast requirements.

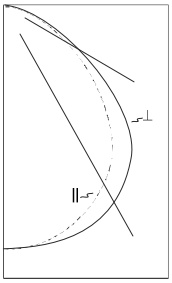
***Order FCS-24W-U Flange Kit for installation in drywall ceiling. See options and accessories compatibility section.

ADF012708

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** 2GR8-332A-UNV-GL-TEB81-RIF1-U Notes: | **Type:** A WK08-1600 |



## PHOTOMETRICS



**2GR8-332A**
Electronic Ballast

F32T8/35K lamps
2800 lumens

Spacing criterion: (II) 1.2 x mounting height, (⊥) 1.4 x mounting height

Efficiency 76.0%

Test Report: 2GR8332A.IES

LER = FL-68

Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH = $3.53

### Coefficients of Utilization

| Effective floor cavity reflectance | | | | | 20% | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| rc | 80% | | | | 70% | | | | 50% | | | 30% | | | 10% | | | 0% |
| rw | 70 | 50 | 30 | 10 | 70 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 0 |
| RCR | | | | | | | | | | | | | | | | | | |
| 0 | 91 | 91 | 91 | 91 | 88 | 88 | 88 | 88 | 84 | 84 | 84 | 81 | 81 | 81 | 78 | 78 | 78 | 76 |
| 1 | 84 | 81 | 78 | 75 | 82 | 79 | 76 | 74 | 76 | 74 | 72 | 73 | 71 | 69 | 70 | 69 | 67 | 66 |
| 2 | 77 | 72 | 67 | 63 | 75 | 70 | 66 | 63 | 68 | 64 | 61 | 65 | 62 | 60 | 63 | 61 | 59 | 57 |
| 3 | 71 | 64 | 59 | 54 | 70 | 63 | 58 | 54 | 61 | 57 | 53 | 59 | 55 | 52 | 57 | 54 | 51 | 50 |
| 4 | 66 | 58 | 52 | 47 | 64 | 57 | 51 | 47 | 55 | 50 | 46 | 53 | 49 | 45 | 51 | 48 | 45 | 43 |
| 5 | 60 | 51 | 45 | 40 | 59 | 51 | 45 | 40 | 49 | 44 | 40 | 48 | 43 | 39 | 46 | 42 | 39 | 37 |
| 6 | 56 | 46 | 40 | 35 | 54 | 46 | 40 | 35 | 44 | 39 | 35 | 43 | 38 | 35 | 42 | 38 | 34 | 33 |
| 7 | 51 | 42 | 35 | 31 | 50 | 41 | 35 | 31 | 40 | 34 | 31 | 39 | 34 | 30 | 38 | 33 | 30 | 29 |
| 8 | 47 | 37 | 31 | 27 | 46 | 37 | 31 | 27 | 36 | 30 | 27 | 35 | 30 | 26 | 34 | 30 | 26 | 25 |
| 9 | 44 | 34 | 27 | 23 | 43 | 33 | 27 | 23 | 32 | 27 | 23 | 31 | 26 | 23 | 31 | 26 | 23 | 21 |
| 10 | 41 | 30 | 24 | 20 | 40 | 30 | 24 | 20 | 29 | 24 | 20 | 29 | 24 | 20 | 28 | 23 | 20 | 19 |

### Zonal Lumen Summary

| Zone | Lumens | %Lamp | %Fixture |
|---|---|---|---|
| 0-30 | 1965 | 23.4 | 30.8 |
| 0-40 | 3239 | 38.6 | 50.7 |
| 0-60 | 5421 | 64.5 | 84.9 |
| 0-90 | 6386 | 76.0 | 100.0 |
| 0-180 | 6386 | 76.0 | 100.0 |

### Typical VCP Percentages

| | Height Along | | Height Across | |
|---|---|---|---|---|
| Room Size (Ft.) | 8.5′ | 10.0′ | 8.5′ | 10.0′ |
| 20 x 20 | 67 | 71 | 64 | 68 |
| 30 x 30 | 60 | 64 | 57 | 61 |
| 30 x 60 | 52 | 55 | 47 | 50 |
| 60 x 30 | 62 | 66 | 60 | 64 |
| 60 x 60 | 52 | 55 | 48 | 51 |

### Candela

| Angle | Along II | 45° | Across ⊥ |
|---|---|---|---|
| 0 | 2460 | 2460 | 2460 |
| 5 | 2445 | 2456 | 2468 |
| 10 | 2416 | 2440 | 2464 |
| 15 | 2367 | 2409 | 2449 |
| 20 | 2295 | 2358 | 2413 |
| 25 | 2194 | 2281 | 2352 |
| 30 | 2063 | 2176 | 2266 |
| 35 | 1900 | 2045 | 2163 |
| 40 | 1705 | 1879 | 2015 |
| 45 | 1474 | 1650 | 1794 |
| 50 | 1200 | 1362 | 1474 |
| 55 | 932 | 1045 | 1122 |
| 60 | 710 | 745 | 811 |
| 65 | 533 | 497 | 566 |
| 70 | 389 | 326 | 416 |
| 75 | 275 | 243 | 327 |
| 80 | 201 | 204 | 251 |
| 85 | 110 | 122 | 143 |
| 90 | 0 | 0 | 0 |

## ORDERING INFORMATION

**SAMPLE NUMBER: 2GR8-332A-120V-EB81-U**

**2=2"** Width

**Series**
**GR8**=General Purpose T8 Commercial Troffer[1]

**Number of Lamps**[2]
**3**=3 Lamps
(Not included)

**Wattage (Length)**
**32**=32W T8 (48")

**A**=#12 Pattern Acrylic
**A125**=#12 Pattern Acrylic (.125" Thick)
**A19/156**=#19 Pattern Acrylic (.156" Thick)
**IMA 48**=Injection Moldeed Acrylic (.150" Thick)
**PB1S**=Silver Parabolic Louver (1/2" x 1/2" x 1/2")
(Additional shielding media available, see accessory section)

**Voltage**[3]
**120V**=120 Volt
**277V**=277 Volt
**347V**=347 Volt
**UNV**=Universal Voltage 120-277[4]

**Options**
**GL**=Single Element Fuse
**GM**=Double Element Fuse
**Lamps**=Lamps Installed
**Flex**=Flex Installed
**Emergency**=EM Installed

**Ballast Type**[3]
**Blank**=Standard Magnetic Ballast (Biax & 20W)
**LEOC8**=T8 Magnetic Energy Saving
**ER8_**=T8 Electronic Program Rapid Start. Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
**EB8_**=T8 Electronic Instant Start. Total Harmonic Distortion < 20%
No. of Ballast 1, 2 or 3
**EB8_/PLUS**= T8 Electronic Instant Start. High Ballast Factor >1.13. Total Harmonic Distortion < 20%
No. of Ballast 1, 2 or 3
**TEB8_**=T8 Electronic Instant Start. Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
**DLS**=Digital Lighting System Dimming

**Options**
**FCS-24W-U**=Field Installed Flange Kit
**FR**=Suitable for Fire Rated Applications
**EQ**=T-BAR Safety Earthquake Clips[1]
(See options & accessories )

**Packaging**
**U**=Unit Pack

NOTES: [1]An EQ Grid Clip is recommended for all 9/16" ceiling systems. [2]Standard off-center ballast compartment on 3-lamp fixtures. [3]Products also available in non-US voltages and frequencies for international markets. [4]Not available when specifying emergencies, voltage must be specific.

For complete product data, reference the Fluorescent Specification binder. Specifications & dimensions subject to change without notice. Consult your Cooper Lighting Representative for availability and ordering information.

## SHIPPING INFORMATION

| Catalog No. | Wt. |
|---|---|
| 2GR8-332A | 31 lbs. |

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** 2GR8-232A-UNV-GL-TEB81-RIF1-U<br>Notes: | **Type:** **B**<br>WK08-1600 |

# METALUX®

## DESCRIPTION

The GR8 is a T8-dedicated lensed troffer designed to offer premium performance in a low profile housing. T8 dedication and optimized lamp to lens spacing provides the best in energy efficiency and optical control. The GR8's shallow, low profile housing is compatible with even highly restrictive plenums. Luminaires are compatible with today's popular ceiling systems.

| Catalog # | Type |
|---|---|
| Project | |
| Comments | |
| Prepared by | Date |

## APPLICATION

The GR8 offers great performance and great quality. The series is an excellent choice for commercial offices, schools, hospitals, retail merchandising and many other applications.

## SPECIFICATION FEATURES

**A···Construction**

Unitized low profile recessed housing is die formed of code gauge prime cold rolled steel with full length stiffeners and mechanical endplate attachment for added strength. Ballast cover is easily removed without tools. Die formed captive lampholder bracket fully encloses lampholder wiring for easy lampholder replacement. Ample KOs are provided for continuous row wiring. Built-in grid-lock feature for safety and convenience. Standard unit is NYC Approved. (No modifications necessary).

**B···Electrical****

Ballasts are CBM/ETL Class "P" and are positively secured by mounting bolts. Pressure lock lampholders. UL/CUL listed. Suitable for damp locations.

**C···Finish**

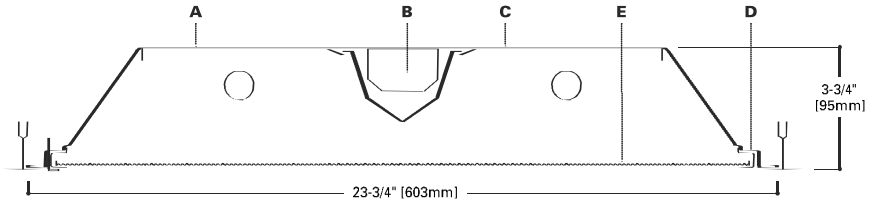
Multistage, iron phosphate pretreatment ensures maximum bonding and rust inhibition. Lighting grade baked white enamel finish with premium reflectance for high efficiency.

**D···Hinging/Latching**

Positive spring loaded cam action steel latches and safety lock T-hinges provide secure, high quality door fit and allow hinging and latching from either side.

**E···Frame/Shielding**

Heavy gauge flat steel door is die formed with reinforced mitered corners. Housing and door frame assemblies incorporate full length and width mechanical light traps. Light stabilized, acrylic prismatic lens.

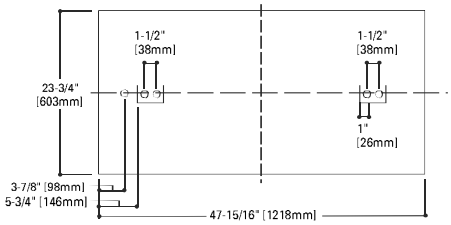


**2GR8**232
432

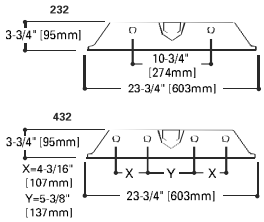
**2' X 4' TROFFER**
**2 OR 4 LAMP**

General Purpose
T8 Commercial Troffer

## MOUNTING DATA

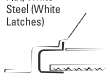



## LAMP CONFIGURATIONS



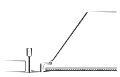

## DOOR FRAMES

2GR8
Flat, White Steel (White Latches)

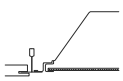


## CEILING COMPATIBILITY

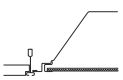
**G**
Grid/Lay-in Standard



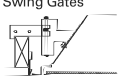
**G**
Concealed T



**G**
Slot Grid



**F**
Flange Trim With Supporting Swing Gates



| Ceiling Type | Trim Type |
|---|---|
| Exposed Grid | G |
| Concealed T | G |
| Slot Grid | G |
| Flange | G*** |

## ENERGY DATA

Input Watts:
**EB Ballast & STD Lamps**
232 (61)
432 (122)

**ES Ballast & STD Lamps**
232 (71)
432 (142)

Luminaire Efficacy Rating
**LER = FL-67**
**Catalog Number**: 2GR8-232A

**Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH** = $3.58

Luminaire Efficacy Rating
**LER = FL-68**
**Catalog Number**: 2GR8-432A

**Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH** = $3.53

*Standard G (Grid) Type Fixtures can be field converted by adding trim kits. See Compatibility Section or Consult Factory.

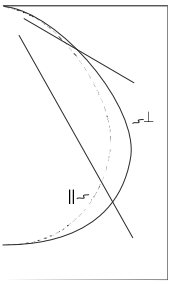
**Reference the lamp/ballast data in the Technical Section for specific lamp/ballast requirements.

***Order FCS-24W-U Flange Kit for installation in drywall ceiling. See options and accessories compatibility section.

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** 2GR8-232A-UNV-GL-TEB81-RIF1-U<br>Notes: | **Type:** **B**<br>WK08-1600 |



## PHOTOMETRICS



**2GR8-232A**
Electronic Ballast
F32T8/35K lamps
2800 lumens
Spacing criterion: (II) 1.2 x mounting height, (⊥) 1.4 x mounting height
Efficiency 79.8%
Test Report: 2GR8232A.IES
LER = FL-67
Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH = $3.58

**Candela**

| Angle | Along II | 45° | Across ⊥ |
|---|---|---|---|
| 0 | 1697 | 1697 | 1697 |
| 5 | 1689 | 1696 | 1705 |
| 10 | 1669 | 1685 | 1703 |
| 15 | 1636 | 1665 | 1694 |
| 20 | 1586 | 1632 | 1673 |
| 25 | 1518 | 1582 | 1634 |
| 30 | 1430 | 1512 | 1582 |
| 35 | 1320 | 1427 | 1517 |
| 40 | 1188 | 1318 | 1422 |
| 45 | 1031 | 1162 | 1271 |
| 50 | 843 | 964 | 1046 |
| 55 | 657 | 740 | 796 |
| 60 | 501 | 528 | 581 |
| 65 | 378 | 353 | 405 |
| 70 | 277 | 232 | 294 |
| 75 | 196 | 172 | 231 |
| 80 | 143 | 144 | 176 |
| 85 | 77 | 85 | 97 |
| 90 | 0 | 0 | 0 |

**Coefficients of Utilization**

Effective floor cavity reflectance 20%

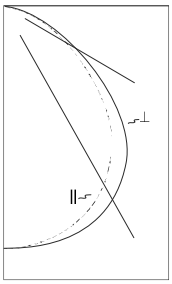
| rc | 80% | | | | 70% | | | | 50% | | | 30% | | | 10% | | | 0% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| rw | 70 | 50 | 30 | 10 | 70 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 0 |
| RCR | | | | | | | | | | | | | | | | | | |
| 0 | 95 | 95 | 95 | 95 | 93 | 93 | 93 | 93 | 89 | 89 | 89 | 85 | 85 | 85 | 81 | 81 | 81 | 80 |
| 1 | 88 | 85 | 82 | 79 | 86 | 83 | 80 | 78 | 79 | 77 | 75 | 76 | 74 | 73 | 73 | 72 | 71 | 69 |
| 2 | 81 | 75 | 70 | 66 | 79 | 74 | 69 | 66 | 71 | 67 | 64 | 68 | 65 | 63 | 66 | 64 | 61 | 60 |
| 3 | 75 | 67 | 62 | 57 | 73 | 66 | 61 | 56 | 64 | 59 | 55 | 62 | 58 | 55 | 60 | 56 | 54 | 52 |
| 4 | 69 | 60 | 54 | 49 | 67 | 59 | 53 | 49 | 57 | 52 | 48 | 56 | 51 | 47 | 54 | 50 | 47 | 45 |
| 5 | 63 | 54 | 47 | 42 | 62 | 53 | 47 | 42 | 51 | 46 | 42 | 50 | 45 | 41 | 48 | 44 | 41 | 39 |
| 6 | 58 | 48 | 42 | 37 | 57 | 48 | 41 | 37 | 46 | 41 | 36 | 45 | 40 | 36 | 44 | 39 | 36 | 34 |
| 7 | 54 | 44 | 37 | 32 | 53 | 43 | 37 | 32 | 42 | 36 | 32 | 41 | 35 | 32 | 40 | 35 | 31 | 30 |
| 8 | 50 | 39 | 32 | 28 | 48 | 39 | 32 | 28 | 38 | 32 | 28 | 37 | 31 | 28 | 36 | 31 | 27 | 26 |
| 9 | 46 | 35 | 29 | 24 | 45 | 35 | 28 | 24 | 34 | 28 | 24 | 33 | 28 | 24 | 32 | 27 | 24 | 22 |
| 10 | 42 | 32 | 26 | 21 | 41 | 31 | 25 | 21 | 31 | 25 | 21 | 30 | 25 | 21 | 29 | 24 | 21 | 20 |

**Zonal Lumen Summary**

| Zone | Lumens | %Lamp | %Fixture |
|---|---|---|---|
| 0-30 | 1360 | 24.3 | 30.4 |
| 0-40 | 2249 | 40.2 | 50.3 |
| 0-60 | 3788 | 67.6 | 84.7 |
| 0-90 | 4471 | 79.8 | 100.0 |
| 0-180 | 4471 | 79.8 | 100.0 |

**Typical VCP Percentages**

| Room Size (Ft.) | Height Along 8.5′ | Height Along 10.0′ | Height Across 8.5′ | Height Across 10.0′ |
|---|---|---|---|---|
| 20 x 20 | 73 | 77 | 71 | 75 |
| 30 x 30 | 68 | 72 | 65 | 69 |
| 30 x 60 | 60 | 63 | 56 | 59 |
| 60 x 30 | 69 | 73 | 68 | 71 |
| 60 x 60 | 60 | 63 | 57 | 60 |



**2GR8-432A**
Electronic Ballast
F32T8/35K lamps
2800 lumens
Spacing criterion: (II) 1.2 x mounting height, (⊥) 1.4 x mounting height
Efficiency 75.5%
Test Report: 2GR8432A.IES
LER = FL-68
Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH = $3.53

**Candela**

| Angle | Along II | 45° | Across ⊥ |
|---|---|---|---|
| 0 | 3299 | 3299 | 3299 |
| 5 | 3281 | 3295 | 3310 |
| 10 | 3241 | 3274 | 3306 |
| 15 | 3176 | 3233 | 3284 |
| 20 | 3079 | 3164 | 3236 |
| 25 | 2946 | 3059 | 3145 |
| 30 | 2772 | 2911 | 3012 |
| 35 | 2555 | 2721 | 2841 |
| 40 | 2296 | 2480 | 2612 |
| 45 | 1989 | 2162 | 2293 |
| 50 | 1621 | 1770 | 1890 |
| 55 | 1262 | 1357 | 1442 |
| 60 | 957 | 970 | 1043 |
| 65 | 716 | 649 | 736 |
| 70 | 520 | 430 | 542 |
| 75 | 368 | 321 | 427 |
| 80 | 269 | 269 | 327 |
| 85 | 147 | 160 | 185 |
| 90 | 0 | 0 | 0 |

**Coefficients of Utilization**

Effective floor cavity reflectance 20%

| rc | 80% | | | | 70% | | | | 50% | | | 30% | | | 10% | | | 0% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| rw | 70 | 50 | 30 | 10 | 70 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 0 |
| RCR | | | | | | | | | | | | | | | | | | |
| 0 | 90 | 90 | 90 | 90 | 88 | 88 | 88 | 88 | 84 | 84 | 84 | 80 | 80 | 80 | 77 | 77 | 77 | 75 |
| 1 | 83 | 80 | 77 | 75 | 81 | 78 | 76 | 73 | 75 | 73 | 71 | 72 | 71 | 69 | 70 | 68 | 67 | 65 |
| 2 | 77 | 71 | 67 | 63 | 75 | 70 | 66 | 62 | 67 | 64 | 61 | 65 | 62 | 59 | 63 | 60 | 58 | 57 |
| 3 | 71 | 64 | 58 | 54 | 69 | 63 | 58 | 54 | 61 | 56 | 53 | 59 | 55 | 52 | 57 | 54 | 51 | 49 |
| 4 | 65 | 57 | 51 | 47 | 64 | 56 | 51 | 46 | 54 | 50 | 46 | 53 | 49 | 45 | 51 | 48 | 45 | 43 |
| 5 | 60 | 51 | 45 | 40 | 59 | 50 | 44 | 40 | 49 | 44 | 40 | 47 | 43 | 39 | 46 | 42 | 39 | 37 |
| 6 | 56 | 46 | 40 | 35 | 54 | 45 | 39 | 35 | 44 | 39 | 35 | 43 | 38 | 34 | 42 | 37 | 34 | 33 |
| 7 | 51 | 42 | 35 | 31 | 50 | 41 | 35 | 31 | 40 | 34 | 30 | 39 | 34 | 30 | 38 | 33 | 30 | 29 |
| 8 | 47 | 37 | 31 | 27 | 46 | 37 | 31 | 27 | 36 | 30 | 27 | 35 | 30 | 26 | 34 | 30 | 26 | 25 |
| 9 | 43 | 33 | 27 | 23 | 42 | 33 | 27 | 23 | 32 | 27 | 23 | 31 | 26 | 23 | 31 | 26 | 23 | 21 |
| 10 | 40 | 30 | 24 | 21 | 39 | 30 | 24 | 20 | 29 | 24 | 20 | 29 | 24 | 20 | 28 | 23 | 20 | 19 |

**Zonal Lumen Summary**

| Zone | Lumens | %Lamp | %Fixture |
|---|---|---|---|
| 0-30 | 2634 | 23.5 | 31.2 |
| 0-40 | 4327 | 38.6 | 51.2 |
| 0-60 | 7184 | 64.1 | 85.0 |
| 0-90 | 8452 | 75.5 | 100.0 |
| 0-180 | 8452 | 75.5 | 100.0 |

**Typical VCP Percentages**

| Room Size (Ft.) | Height Along 8.5′ | Height Along 10.0′ | Height Across 8.5′ | Height Across 10.0′ |
|---|---|---|---|---|
| 20 x 20 | 60 | 65 | 58 | 62 |
| 30 x 30 | 54 | 58 | 51 | 55 |
| 30 x 60 | 45 | 48 | 40 | 44 |
| 60 x 30 | 55 | 59 | 53 | 58 |
| 60 x 60 | 45 | 48 | 42 | 45 |

## ORDERING INFORMATION

**SAMPLE NUMBER: 2GR8-232A-120V-EB81-U**

**2** **GR8** **2** **32** **A** **UNV** **GL** **EB81** **RIF1** **U**

**2=2"** Width

**Series**
**GR8**=General Purpose T8 Commercial Troffer[1]

**Number of Lamps**[2]
**2** or **4** Lamps
(Not included)

**Wattage (Length)**
**32**=32W T8 (48")

**A**=#12 Pattern Acrylic
**A125**=#12 Pattern Acrylic (.125" Thick)
**A19/156**=#19 Pattern Acrylic (.156" Thick)
**IMA 48**=Injection Moldeed Acrylic (.150" Thick)
**PB1S**=Silver Parabolic Louver (1/2" x 1/2" x 1/2")
(Additional shielding media available, see accessory section)

**Voltage**[3]
**120V**=120 Volt
**277V**=277 Volt
**347V**=347 Volt
**UNV**=Universal Voltage 120-277[4]

**Options**
**GL**=Single Element Fuse
**GM**=Double Element Fuse
**Lamps**=Lamps Installed
**Flex**=Flex Installed
**Emergency**=EM Installed

**Ballast Type**[3]
**Blank**=Standard Magnetic Ballast (Biax & 20W)
**LEOC8**=T8 Magnetic Energy Saving
**ER8_**=T8 Electronic Program Rapid Start. Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
**EB8_**=T8 Electronic Instant Start. Total Harmonic Distortion < 20%
No. of Ballast 1, 2 or 3
**EB8_/PLUS**= T8 Electronic Instant Start. High Ballast Factor >1.13. Total Harmonic Distortion < 20%
No. of Ballast 1, 2 or 3
**TEB8_**=T8 Electronic Instant Start. Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
**DLS**=Digital Lighting System Dimming

**Options**
**FCS-24W-U**=Field Installed Flange Kit
**FR**=Suitable for Fire Rated Applications
**EQ**=T-BAR Safety Earthquake Clips[1]
(See options & accessories )

**Radio Interference Suppressor**

**Packaging**
**U**=Unit Pack

NOTES: [1]An EQ Grid Clip is recommended for all 9/16" ceiling systems. [2]Standard off-center ballast compartment on 3-lamp fixtures. [3]Products also available in non-US voltages and frequencies for international markets. [4]Not available when specifying emergencies, voltage must be specific.

For complete product data, reference the Fluorescent Specification binder. Specifications & dimensions subject to change without notice. Consult your Cooper Lighting Representative for availability and ordering information.

## SHIPPING INFORMATION

| Catalog No. | Wt. |
|---|---|
| 2GR8-232A | 29 lbs. |
| 2GR8-432A | 29 lbs. |

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** VT2-232DR-UNV-TEB81-WL<br>Notes: | **Type:** C<br>WK08-1600 |

# METALUX®

## DESCRIPTION

The VT2 Series is an energy efficient industrial Vaportite fixture that features rugged and durable construction. The VT2 incorporates a full metal fixture liner inside a reinforced fiberglass housing with a high impact diffuser. This Vaportite series is suitable for interior and exterior applications and can be surface or chain mounted .

## APPLICATION

The VT2 Series has been designed for maximum operation in commercial institutional and industrial environments where weathering, high temperature, humidity and dust or corrosive fumes are present.

| Catalog # | Type |
|---|---|
| Project | |
| Comments | |
| Prepared by | Date |

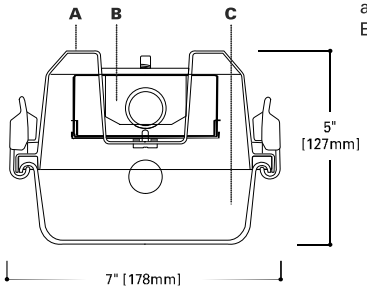
## SPECIFICATION FEATURES

### A···Construction

Fiberglass housing is reinforced polyester and self-extinguishing (ASTM-D635-74) plastic of a permanent pearl gray color. Top of housing has five embossments (2' unit), nine embossments (4' unit) and thirteen embossments (8' unit), providing mounting flexibility on uneven surfaces. A watertite hub for 1/2" conduit entry is provided at each end of housing (standard) for continuous feed. Polyurethane gasketing is formed in the housing providing a continuous seamless seal for the diffuser. Four sturdy cam latches (2' unit), six (4' unit) and twelve (8' and tandem unit) clamp diffuser tightly for a positive seal between housing, gasketing and diffuser.

### B···Electrical*

Unit has full metal liner (channel) secured by brass internal/external mounting studs for positive grounding, maximum protection and rigidity. Ballasts are CBM/ETL Class "P" certified suitable to plus 50°F. (Cold temperature ballasts are available suitable to 0°F, on special order) Pressure lock lamp holders. Electrical components and fixtures are UL/CUL listed for Wet Locations.** IP65 approved.




### C···Shielding

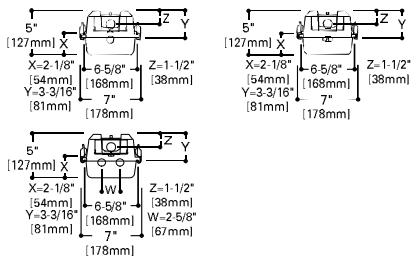
'DR" - Clear low brightness pattern acrylic with 15% high impact additive.
"DR-100" - Clear low brightness pattern acrylic with 100% high impact additive.
Example: VT2-240DR-100
"LEX" - High impact clear low brightness pattern polycarbonate. LEXAN
Example: VT2-240LEX.

**VT2**120
117, 220, 217
1BX40, 1BX50
140, 148, 132
240, 248
232

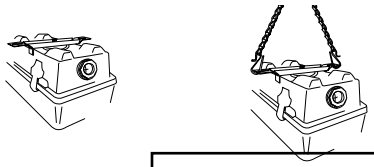
**2', 4' OR 8' INDUSTRIAL**
**1 OR 2 LAMPS**

Vaportight Industrial

## LAMP CONFIGURATIONS



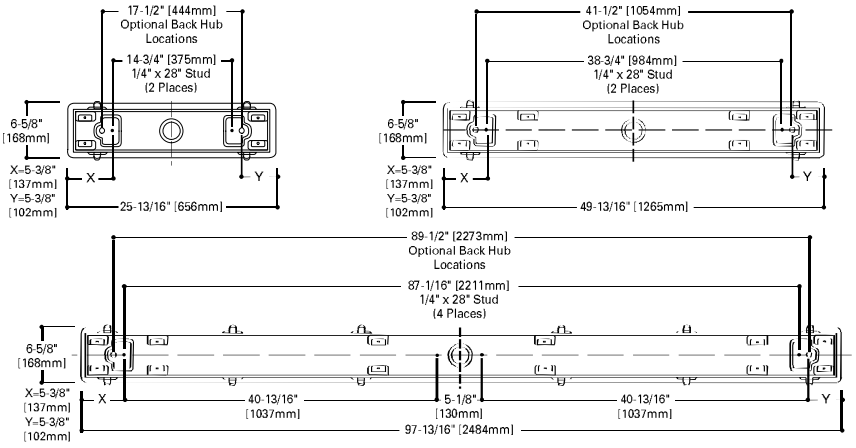

## INSTALLATION DATA



**MOUNTING BRACKETS**
Furnished
Two per 2' and 4' Unit
Four per 8' Unit

**OPTIONAL CHAIN HANGING SET**
(VT2-CHAIN/SET-U)
Includes 6 ft. of chain, 4 large S-Hooks and 4 small S-Hooks
Order One (1) Kit for each 2' or 4' Fixture
Two (2) Kits Recommended For 8' Fixture

## MOUNTING DATA




## ENERGY DATA

Input Watts:

**EB Ballast & STD Lamps**
117 (20)
1BX40 (43), 1BX50 (54)
140 (38), 132 (30)
217 (36)
240 (72)
232 (61)

**ES Ballast & STD Lamps**
117 (23), 140 (50)
132 (37), 220 (58)
217 (45), 240 (86)
232 (71)

**STD Ballast & STD Lamps**
120 (32), 220 (58)
1BX40 (49)

Luminaire Efficacy Rating
**LER = FI-73**
**Catalog Number:** VT2-232DR

**Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH** = $3.29

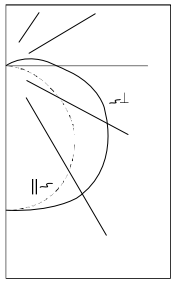
*Reference the lamp/ballast data in the Technical Section for specific lamp/ballast requirements.

**Not Suitable for Wet Locations if EL4 Option is added. Consult Pre Sales Technical Support.

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** VT2-232DR-UNV-TEB81-WL<br>Notes: | **Type:** C<br>WK08-1600 |



## PHOTOMETRICS



**VT2-232DR**
Electronic Ballast

F32T8/35K Lamps
2850 Lumens

Spacing criterion: (II) 1.3 x mounting height, (⊥) 1.5 x mounting height

Efficiency 78.9%

Test Report: VT2232DR.IES

LER = FI-73

Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH = $3.29

### Coefficients of Utilization

| Effective floor cavity reflectance | | | | | 20% | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| rc | 80% | | | | 70% | | | | 50% | | | 30% | | | 10% | | | 0% | |
| rw | 70 | 50 | 30 | 10 | 70 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 0 | |
| RCR | | | | | | | | | | | | | | | | | | | |
| 0 | 92 | 92 | 92 | 92 | 90 | 90 | 90 | 90 | 84 | 84 | 84 | 79 | 79 | 79 | 75 | 75 | 75 | 72 | |
| 1 | 83 | 78 | 74 | 71 | 80 | 76 | 72 | 69 | 71 | 68 | 66 | 67 | 65 | 62 | 63 | 61 | 59 | 57 | |
| 2 | 75 | 67 | 61 | 56 | 72 | 65 | 60 | 55 | 61 | 57 | 53 | 58 | 54 | 51 | 54 | 51 | 48 | 46 | |
| 3 | 68 | 59 | 52 | 46 | 65 | 57 | 51 | 46 | 54 | 48 | 44 | 51 | 46 | 42 | 48 | 44 | 41 | 39 | |
| 4 | 62 | 52 | 44 | 39 | 59 | 50 | 43 | 38 | 47 | 42 | 37 | 45 | 40 | 36 | 42 | 38 | 35 | 33 | |
| 5 | 56 | 45 | 38 | 32 | 54 | 44 | 37 | 32 | 42 | 35 | 31 | 39 | 34 | 30 | 37 | 33 | 29 | 27 | |
| 6 | 51 | 40 | 33 | 28 | 49 | 39 | 32 | 27 | 37 | 31 | 26 | 35 | 30 | 26 | 33 | 29 | 25 | 23 | |
| 7 | 47 | 36 | 29 | 24 | 46 | 35 | 28 | 23 | 33 | 27 | 23 | 32 | 26 | 22 | 30 | 25 | 22 | 20 | |
| 8 | 44 | 32 | 25 | 20 | 42 | 31 | 25 | 20 | 30 | 24 | 20 | 28 | 23 | 19 | 27 | 22 | 18 | 17 | |
| 9 | 40 | 29 | 22 | 17 | 39 | 28 | 22 | 17 | 27 | 21 | 17 | 25 | 20 | 16 | 24 | 19 | 16 | 14 | |
| 10 | 37 | 26 | 20 | 15 | 36 | 26 | 19 | 15 | 24 | 19 | 15 | 23 | 18 | 14 | 22 | 17 | 14 | 12 | |

### Candela

| Angle | Along II | 45° | Across ⊥ |
|---|---|---|---|
| 0 | 1049 | 1049 | 1049 |
| 10 | 1034 | 1047 | 1056 |
| 20 | 978 | 1030 | 1071 |
| 30 | 886 | 997 | 1075 |
| 40 | 762 | 934 | 1027 |
| 50 | 606 | 820 | 939 |
| 60 | 416 | 671 | 838 |
| 70 | 228 | 543 | 723 |
| 80 | 92 | 412 | 549 |
| 90 | 17 | 239 | 363 |
| 100 | 19 | 141 | 243 |
| 110 | 10 | 68 | 131 |
| 120 | 5 | 29 | 46 |
| 130 | 4 | 13 | 20 |
| 140 | 4 | 6 | 9 |
| 150 | 4 | 2 | 3 |
| 160 | 4 | 2 | 0 |
| 170 | 0 | 0 | 0 |
| 180 | 0 | 0 | 0 |

### Zonal Lumen Summary

| Zone | Lumens | %Lamp | %Fixture |
|---|---|---|---|
| 0-30 | 862 | 15.1 | 19.2 |
| 0-40 | 1462 | 25.7 | 32.5 |
| 0-60 | 2778 | 48.7 | 61.8 |
| 0-90 | 4130 | 72.4 | 91.8 |
| 90-180 | 369 | 6.5 | 8.2 |
| 0-180 | 4499 | 78.9 | 100.0 |

### Typical VCP Percentages

| | Height Along | | Height Across | |
|---|---|---|---|---|
| Room Size (Ft.) | 13.0′ | 16.0′ | 13.0′ | 16.0′ |
| 20 x 20 | 45 | 53 | 35 | 44 |
| 30 x 30 | 37 | 42 | 27 | 33 |
| 30 x 60 | 32 | 36 | 20 | 23 |
| 60 x 40 | 37 | 41 | 32 | 36 |
| 60 x 60 | 31 | 33 | 22 | 25 |

## ORDERING INFORMATION

**Universal # TU-B232IUNVHPB**

SAMPLE NUMBER: VT2-232DR-120V-EB81-WL-U

**VT2** | **2 32 DR** | **UNV** | **WL** | **U**

**Tandem**
**Blank**=4' Length
**8T**=8' Length

**Series**
**VT2**=Vapor-Tite

**Number of Lamps**[3]
**1** or **2** Lamps
(Not Included)

**Wattage (Length)**
**20**=20W (24")[1]
**17**=17W T8 (24")
**BX40**=40W Biaxial (24")
**BX50**=50W Biaxial (24")
**40**=40W (48")
**32**=32W T8 (48")
**48**=39W Slimline (48")

**Lens**
**DR**=Internal Prismatic Lens/15% DR High Impact Additive (Standard)
**DR-100**=100% High Impact Additive
**LEX**=High Impact Clear Polycarbonate LEXAN Lens/Low Brightness Pattern

**Starting Type**
**LTS**=Low Trigger Start (20 Watt only) (120V only)
**HTS**=High Trigger Start (20 Watt only)

**Voltage**[1]
**120V**=120 Volt
**277V**=277 Volt
**347V**=347 Volt
**UNV**=Universal Voltage 120-277[2]

**Options**
**GL**=Single Element Fuse
**GM**=Double Element Fuse
**Emergency**=EM Installed[4]

**Ballast Type**[1]
**Blank**=Standard Magnetic Ballast (Biax only)
**LE3**=T12 Magnetic Energy Saving
**LEOC8**=T8 Magnetic Energy Saving
**EB8_**=T8 Electronic Instant Start. Total Harmonic Distortion < 20%
  No. of Ballast 1, 2 or 3
**EB8_/PLUS**=T8 Electronic Instant Start. High Ballast Factor >1.13. Total Harmonic Distortion < 20%
  No. of Ballast 1, 2 or 3
**ER8_**=T8 Electronic Program Rapid Start. Total Harmonic Distortion < 10%
  No. of Ballast 1, 2 or 3
**TEB8_**=T8 Electronic Instant Start. Total Harmonic Distortion < 10%
  No. of Ballast 1, 2 or 3
**EB5_**=T5 Biax Electronic Instant Start. Total Harmonic Distortion < 20%
  No. of Ballast 1, 2 or 3
**TEB5_**=T5 Biax Electronic Instant Start. Total Harmonic Distortion < 10%
  No. of Ballast 1, 2 or 3
**EB2_**=T12 Electronic Rapid Start.
  No. of Ballast 1 or 2
**DLS**=Digital Lighting System Dimming

**WL**=Wet Label

**Options**
**RIF1**=Radio Interference Suppressor
**TH**=(2) Top Watertite Hubs
**TEH**=(2) Top & (2) End Watertite Hubs (All Watertite Hubs Have 1/2" Conduit Entry)
**TILW**=Tandem In-Line Wiring Option (Consult TILW Option Catalog Page)
**PI/CPI**=Plug-In Option
**RLS**=Rotor-Lock Socket (T8 Lamps Only)
(See options & accessories)

**Packaging**
**U**=Unit Pack

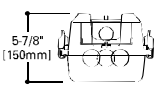
NOTES: [1]Products also available in non-US voltages and frequencies for international markets. [2]Not available when specifying emergencies, voltage must be specific. [3]3-lamp only available for 32W T8 lamps. [4]Not available for 2' units.

Specifications & dimensions subject to change without notice. Consult your Cooper Lighting Representative for availability and ordering information.

## DEEP DIFFUSER

(Available for 4' Fixture Length)

To Complement Deep Diffuser Depth of 8' Fixture




## SHIPPING INFORMATION

| Catalog No. | Wt. |
|---|---|
| VT2-117 DR-WL | 8 lbs. |
| VT2-217 DR-WL | 8 lbs. |
| VT2-1BX40 DR-WL | 8 lbs. |
| VT2-1BX50 DR-WL | 8 lbs. |
| VT2-132 DR-WL | 16 lbs. |
| VT2-148 DR-WL[1] | 16 lbs. |
| VT2-248 DR-WL[1] | 16 lbs. |
| 8TVT2-132 DR-WL | 31 lbs. |
| VT2-232 DR-WL | 16 lbs. |
| 8TVT2-232 DR-WL | 31 lbs. |

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** VT2-232DR-UNV-TEB81-WL<br>Notes: | **Type:** **C**<br>WK08-1600 |

# B232PUNVHP-A

APPLICATION and PERFORMANCE SPECIFICATION

**Description:** High frequency electronic ballast for (2/1) F32T8, (2/1) F32T8ES-30W, (2/1) F32T8ES-25W, (2/1) F28T8, (2) F25T8, or (2) F17T8. Also equivalent U-shaped lamps.

- Line Voltage: 108vac - 305vac, 50/60Hz
- Series Lamp Operation
- Programmed Rapid Start
- Active Power Factor Correction
- Operating Frequency: 66kHz

*60 Hz data

| Lamp Type | Lamp # | Volts | Input Watts | Nominal Line Amps | Power Factor | Ballast Factor | Ballast Efficacy Factor | Harmonic Total | Crest Factor |
|---|---|---|---|---|---|---|---|---|---|
| **F32T8** | **2** | **120** | **62** | **0.52** | **> .99** | **.88** | **1.42** | **< 10%** | **< 1.5** |
| **F32T8** | **2** | **277** | **60** | **0.22** | **> .98** | **.88** | **1.47** | **< 10%** | **< 1.5** |
| F32T8 | 1 | 120 | 32 | 0.27 | > .99 | 1.00 | 3.13 | < 10% | < 1.6 |
| F32T8 | 1 | 277 | 32 | 0.12 | > .95 | 1.00 | 3.13 | < 15% | < 1.6 |
| F32T8ES (30W) | 2 | 120 | 60 | 0.50 | > .99 | .88 | 1.47 | < 10% | < 1.6 |
| F32T8ES (30W) | 2 | 277 | 58 | 0.21 | > .98 | .88 | 1.52 | < 10% | < 1.6 |
| F32T8ES (30W) | 1 | 120 | 30 | 0.25 | > .99 | 1.00 | 3.33 | < 10% | < 1.6 |
| F32T8ES (30W) | 1 | 277 | 30 | 0.11 | > .95 | 1.00 | 3.33 | < 10% | < 1.6 |
| F32T8ES (25W) | 2 | 120 | 52 | 0.43 | > .99 | .88 | 1.69 | < 10% | < 1.6 |
| F32T8ES (25W) | 2 | 277 | 52 | 0.19 | > .98 | .88 | 1.69 | < 10% | < 1.6 |
| F32T8ES (25W) | 1 | 120 | 27 | 0.22 | > .99 | 1.00 | 3.70 | < 10% | < 1.6 |
| F32T8ES (25W) | 1 | 277 | 27 | 0.10 | > .94 | 1.00 | 3.70 | < 10% | < 1.6 |
| F28T8 | 2 | 120 | 56 | 0.47 | > .99 | .88 | 1.57 | < 10% | < 1.6 |
| F28T8 | 2 | 277 | 55 | 0.20 | > .98 | .88 | 1.60 | < 10% | < 1.6 |
| F28T8 | 1 | 120 | 30 | 0.25 | > .99 | 1.00 | 3.33 | < 10% | < 1.6 |
| F28T8 | 1 | 277 | 30 | 0.11 | > .95 | 1.00 | 3.33 | < 10% | < 1.6 |
| F25T8 | 2 | 120 | 47 | 0.40 | > .99 | .94 | 2.00 | < 10% | < 1.6 |
| F25T8 | 2 | 277 | 46 | 0.17 | > .97 | .94 | 2.04 | < 10% | < 1.6 |
| F17T8 | 2 | 120 | 34 | 0.28 | > .99 | .95 | 2.79 | < 10% | < 1.6 |
| F17T8 | 2 | 277 | 34 | 0.13 | > .95 | .95 | 2.79 | < 15% | < 1.6 |

Application and Performance Specification Information Subject to Change without Notification.

**Performance:**
- Meets ANSI Standard C82.11-1993
- Meets ANSI Standard C62.41-1991
- Meets FCC Part 18 (Class A) for EMI and RFI Non-Consumer Limits
- Meets CSA Standard 654 for Ballast Efficiency

**Safety:**
- No PCB's
- UL listed (Class P, Type 1 Outdoor, Type HL)
- CSA Certified

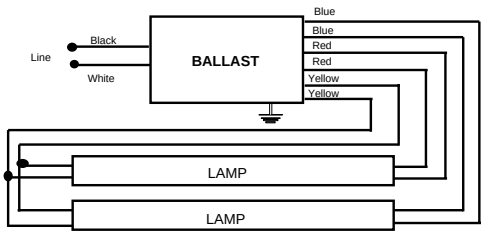
**Application:**
- Minimum Starting Temperature: 0° F, -18° C
  For ES & 28W Lamps: 60° F, 16° C
- Maximum Case Temperature: 167° F, 75° C
- Sound Rated: A
- Remote Mounting: 20 ft. max. lead length, 18 AWG

**Physical Parameters**

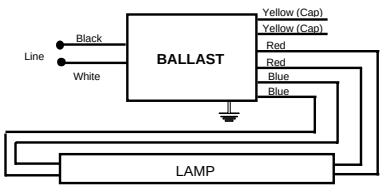
| | | |
|---|---|---|
| Length: | 9.50" | |
| Width: | 1.70" | |
| Height: | 1.18" | |
| Weight: | 1.70 lbs | |
| Lead Length: | Black, White | 25" (+/-1") |
| | Red, Blue | 33" (± 1") |
| | Yellow | 47" (± 1") |

**Warranty:**
Universal Lighting Technologies warrants to the purchaser that each electronic ballast will be free from defects in material or workmanship for a period of 5 years from date of manufacture when properly installed and under normal conditions of use. Call **1-800-BALLASTx800** for technical assistance.

**Manufactured in North America**



TWO LAMP APPLICATION



ONE LAMP APPLICATION
Cap unused yellow leads, insulate to 600 volts

**Ballast must be grounded in accordance with national and local electrical codes.**

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** 2FR8-232A-UNV-GL-TEB81-RIF1-U<br>Notes: | **Type:** D<br>WK08-1600 |

# METALUX®

## DESCRIPTION

The GR8 is a T8-dedicated lensed troffer designed to offer premium performance in a low profile housing. T8 dedication and optimized lamp to lens spacing provides the best in energy efficiency and optical control. The GR8's shallow, low profile housing is compatible with even highly restrictive plenums. Luminaires are compatible with today's popular ceiling systems.

| Catalog # | Type |
|---|---|
| Project | |
| Comments | |
| Prepared by | Date |

## APPLICATION

The GR8 offers great performance and great quality. The series is an excellent choice for commercial offices, schools, hospitals, retail merchandising and many other applications.

## SPECIFICATION FEATURES

**A···Construction**

Unitized low profile recessed housing is die formed of code gauge prime cold rolled steel with full length stiffeners and mechanical endplate attachment for added strength. Ballast cover is easily removed without tools. Die formed captive lampholder bracket fully encloses lampholder wiring for easy lampholder replacement. Ample KOs are provided for continuous row wiring. Built-in grid-lock feature for safety and convenience. Standard unit is NYC Approved. (No modifications necessary).

**B···Electrical****

Ballasts are CBM/ETL Class "P" and are positively secured by mounting bolts. Pressure lock lampholders. UL/CUL listed. Suitable for damp locations.

**C···Finish**

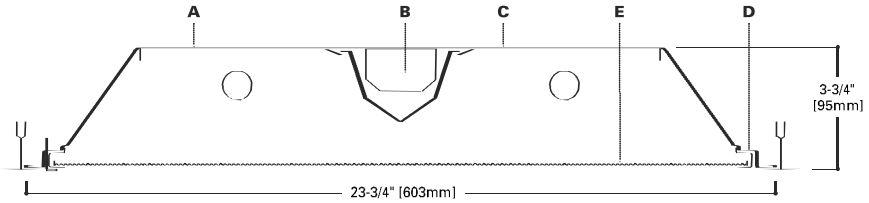
Multistage, iron phosphate pretreatment ensures maximum bonding and rust inhibition. Lighting grade baked white enamel finish with premium reflectance for high efficiency.

**D···Hinging/Latching**

Positive spring loaded cam action steel latches and safety lock T-hinges provide secure, high quality door fit and allow hinging and latching from either side.

**E···Frame/Shielding**

Heavy gauge flat steel door is die formed with reinforced mitered corners. Housing and door frame assemblies incorporate full length and width mechanical light traps. Light stabilized, acrylic prismatic lens.

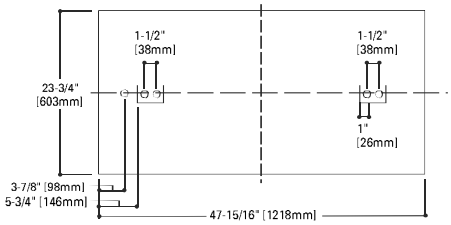


**2GR8**232
432

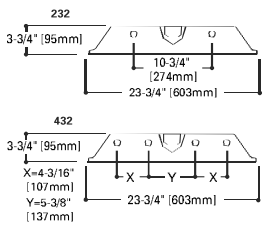
**2' X 4' TROFFER**
**2 OR 4 LAMP**

General Purpose
T8 Commercial Troffer

## MOUNTING DATA

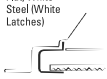



## LAMP CONFIGURATIONS



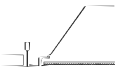

## DOOR FRAMES

2GR8
Flat, White
Steel (White
Latches)

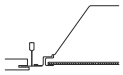


## CEILING COMPATIBILITY

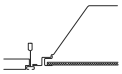
**G**
Grid/Lay-in
Standard



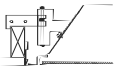
**G**
Concealed T



**G**
Slot Grid



**F**
Flange Trim
With Supporting
Swing Gates



| Ceiling Type | Trim Type |
|---|---|
| Exposed Grid | G |
| Concealed T | G |
| Slot Grid | G |
| Flange | G*** |

## ENERGY DATA

Input Watts:
**EB Ballast & STD Lamps**
232 (61)
432 (122)

**ES Ballast & STD Lamps**
232 (71)
432 (142)

Luminaire Efficacy Rating
**LER = FL-67**
**Catalog Number**: 2GR8-232A

**Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH** = $3.58

Luminaire Efficacy Rating
**LER = FL-68**
**Catalog Number**: 2GR8-432A

**Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH** = $3.53

*Standard G (Grid) Type Fixtures can be field converted by adding trim kits. See Compatibility Section or Consult Factory.

**Reference the lamp/ballast data in the Technical Section for specific lamp/ballast requirements.

***Order FCS-24W-U Flange Kit for installation in drywall ceiling. See options and accessories compatibility section.

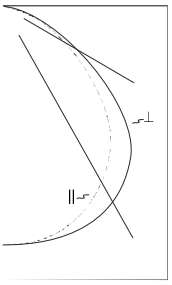
ADF012707

**COOPER LIGHTING**

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** 2FR8-232A-UNV-GL-TEB81-RIF1-U<br>Notes: | **Type:** D<br>WK08-1600 |



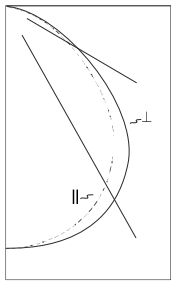
## PHOTOMETRICS



**2GR8-232A**
Electronic Ballast
F32T8/35K lamps
2800 lumens
Spacing criterion: (II) 1.2 x mounting height, (⊥) 1.4 x mounting height
Efficiency 79.8%
Test Report: 2GR8232A.IES
LER = FL-67
Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH = $3.58

**Candela**

| Angle | Along II | 45° | Across ⊥ |
|---|---|---|---|
| 0 | 1697 | 1697 | 1697 |
| 5 | 1689 | 1696 | 1705 |
| 10 | 1669 | 1685 | 1703 |
| 15 | 1636 | 1665 | 1694 |
| 20 | 1586 | 1632 | 1673 |
| 25 | 1518 | 1582 | 1634 |
| 30 | 1430 | 1512 | 1582 |
| 35 | 1320 | 1427 | 1517 |
| 40 | 1188 | 1318 | 1422 |
| 45 | 1031 | 1162 | 1271 |
| 50 | 843 | 964 | 1046 |
| 55 | 657 | 740 | 796 |
| 60 | 501 | 528 | 581 |
| 65 | 378 | 353 | 405 |
| 70 | 277 | 232 | 294 |
| 75 | 196 | 172 | 231 |
| 80 | 143 | 144 | 176 |
| 85 | 77 | 85 | 97 |
| 90 | 0 | 0 | 0 |



**2GR8-432A**
Electronic Ballast
F32T8/35K lamps
2800 lumens
Spacing criterion: (II) 1.2 x mounting height, (⊥) 1.4 x mounting height
Efficiency 75.5%
Test Report: 2GR8432A.IES
LER = FL-68
Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH = $3.53

**Candela**

| Angle | Along II | 45° | Across ⊥ |
|---|---|---|---|
| 0 | 3299 | 3299 | 3299 |
| 5 | 3281 | 3295 | 3310 |
| 10 | 3241 | 3274 | 3306 |
| 15 | 3176 | 3233 | 3284 |
| 20 | 3079 | 3164 | 3236 |
| 25 | 2946 | 3059 | 3145 |
| 30 | 2772 | 2911 | 3012 |
| 35 | 2555 | 2721 | 2841 |
| 40 | 2296 | 2480 | 2612 |
| 45 | 1989 | 2162 | 2293 |
| 50 | 1621 | 1770 | 1890 |
| 55 | 1262 | 1357 | 1442 |
| 60 | 957 | 970 | 1043 |
| 65 | 716 | 649 | 736 |
| 70 | 520 | 430 | 542 |
| 75 | 368 | 321 | 427 |
| 80 | 269 | 269 | 327 |
| 85 | 147 | 160 | 185 |
| 90 | 0 | 0 | 0 |

### Coefficients of Utilization

Effective floor cavity reflectance 20%

| rc | 80% | | | | 70% | | | | 50% | | | 30% | | | 10% | | | 0% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| rw | 70 | 50 | 30 | 10 | 70 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 0 |
| RCR | | | | | | | | | | | | | | | | | | |
| 0 | 95 | 95 | 95 | 95 | 93 | 93 | 93 | 93 | 89 | 89 | 89 | 85 | 85 | 85 | 81 | 81 | 81 | 80 |
| 1 | 88 | 85 | 82 | 79 | 86 | 83 | 80 | 78 | 79 | 77 | 75 | 76 | 74 | 73 | 73 | 72 | 71 | 69 |
| 2 | 81 | 75 | 70 | 66 | 79 | 74 | 69 | 66 | 71 | 67 | 64 | 68 | 65 | 63 | 66 | 64 | 61 | 60 |
| 3 | 75 | 67 | 62 | 57 | 73 | 66 | 61 | 56 | 64 | 59 | 55 | 62 | 58 | 55 | 60 | 56 | 54 | 52 |
| 4 | 69 | 60 | 54 | 49 | 67 | 59 | 53 | 49 | 57 | 52 | 48 | 56 | 51 | 47 | 54 | 50 | 47 | 45 |
| 5 | 63 | 54 | 47 | 42 | 62 | 53 | 47 | 42 | 51 | 46 | 42 | 50 | 45 | 41 | 48 | 44 | 41 | 39 |
| 6 | 58 | 48 | 42 | 37 | 57 | 48 | 41 | 37 | 46 | 41 | 36 | 45 | 40 | 36 | 44 | 39 | 36 | 34 |
| 7 | 54 | 44 | 37 | 32 | 53 | 43 | 37 | 32 | 42 | 36 | 32 | 41 | 35 | 32 | 40 | 35 | 31 | 30 |
| 8 | 50 | 39 | 32 | 28 | 48 | 39 | 32 | 28 | 38 | 32 | 28 | 37 | 31 | 28 | 36 | 31 | 27 | 26 |
| 9 | 46 | 35 | 29 | 24 | 45 | 35 | 28 | 24 | 34 | 28 | 24 | 33 | 28 | 24 | 32 | 27 | 24 | 22 |
| 10 | 42 | 32 | 26 | 21 | 41 | 31 | 25 | 21 | 31 | 25 | 21 | 30 | 25 | 21 | 29 | 24 | 21 | 20 |

### Zonal Lumen Summary

| Zone | Lumens | %Lamp | %Fixture |
|---|---|---|---|
| 0-30 | 1360 | 24.3 | 30.4 |
| 0-40 | 2249 | 40.2 | 50.3 |
| 0-60 | 3788 | 67.6 | 84.7 |
| 0-90 | 4471 | 79.8 | 100.0 |
| 0-180 | 4471 | 79.8 | 100.0 |

### Typical VCP Percentages

| Room Size (Ft.) | Height Along 8.5′ | Height Along 10.0′ | Height Across 8.5′ | Height Across 10.0′ |
|---|---|---|---|---|
| 20 x 20 | 73 | 77 | 71 | 75 |
| 30 x 30 | 68 | 72 | 65 | 69 |
| 30 x 60 | 60 | 63 | 56 | 59 |
| 60 x 30 | 69 | 73 | 68 | 71 |
| 60 x 60 | 60 | 63 | 57 | 60 |

### Coefficients of Utilization

Effective floor cavity reflectance 20%

| rc | 80% | | | | 70% | | | | 50% | | | 30% | | | 10% | | | 0% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| rw | 70 | 50 | 30 | 10 | 70 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 0 |
| RCR | | | | | | | | | | | | | | | | | | |
| 0 | 90 | 90 | 90 | 90 | 88 | 88 | 88 | 88 | 84 | 84 | 84 | 80 | 80 | 80 | 77 | 77 | 77 | 75 |
| 1 | 83 | 80 | 77 | 75 | 81 | 78 | 76 | 73 | 75 | 73 | 71 | 72 | 71 | 69 | 70 | 68 | 67 | 65 |
| 2 | 77 | 71 | 67 | 63 | 75 | 70 | 66 | 62 | 67 | 64 | 61 | 65 | 62 | 59 | 63 | 60 | 58 | 57 |
| 3 | 71 | 64 | 58 | 54 | 69 | 63 | 58 | 54 | 61 | 56 | 53 | 59 | 55 | 52 | 57 | 54 | 51 | 49 |
| 4 | 65 | 57 | 51 | 47 | 64 | 56 | 51 | 46 | 54 | 50 | 46 | 53 | 49 | 45 | 51 | 48 | 45 | 43 |
| 5 | 60 | 51 | 45 | 40 | 59 | 50 | 44 | 40 | 49 | 44 | 40 | 47 | 43 | 39 | 46 | 42 | 39 | 37 |
| 6 | 56 | 46 | 40 | 35 | 54 | 45 | 39 | 35 | 44 | 39 | 35 | 43 | 38 | 34 | 42 | 37 | 34 | 33 |
| 7 | 51 | 42 | 35 | 31 | 50 | 41 | 35 | 31 | 40 | 34 | 30 | 39 | 34 | 30 | 38 | 33 | 30 | 29 |
| 8 | 47 | 37 | 31 | 27 | 46 | 37 | 31 | 27 | 36 | 30 | 27 | 35 | 30 | 26 | 34 | 30 | 26 | 25 |
| 9 | 43 | 33 | 27 | 23 | 42 | 33 | 27 | 23 | 32 | 27 | 23 | 31 | 26 | 23 | 31 | 26 | 23 | 21 |
| 10 | 40 | 30 | 24 | 21 | 39 | 30 | 24 | 20 | 29 | 24 | 20 | 29 | 24 | 20 | 28 | 23 | 20 | 19 |

### Zonal Lumen Summary

| Zone | Lumens | %Lamp | %Fixture |
|---|---|---|---|
| 0-30 | 2634 | 23.5 | 31.2 |
| 0-40 | 4327 | 38.6 | 51.2 |
| 0-60 | 7184 | 64.1 | 85.0 |
| 0-90 | 8452 | 75.5 | 100.0 |
| 0-180 | 8452 | 75.5 | 100.0 |

### Typical VCP Percentages

| Room Size (Ft.) | Height Along 8.5′ | Height Along 10.0′ | Height Across 8.5′ | Height Across 10.0′ |
|---|---|---|---|---|
| 20 x 20 | 60 | 65 | 58 | 62 |
| 30 x 30 | 54 | 58 | 51 | 55 |
| 30 x 60 | 45 | 48 | 40 | 44 |
| 60 x 30 | 55 | 59 | 53 | 58 |
| 60 x 60 | 45 | 48 | 42 | 45 |

## ORDERING INFORMATION

**SAMPLE NUMBER: 2GR8-232A-120V-EB81-U**

**2=2'** Width

**Series**
**GR8**=General Purpose T8 Commercial Troffer[1]

**Number of Lamps**[2]
**2** or **4** Lamps
(Not included)

**Wattage (Length)**
**32**=32W T8 (48")

**A**=#12 Pattern Acrylic
**A125**=#12 Pattern Acrylic (.125" Thick)
**A19/156**=#19 Pattern Acrylic (.156" Thick)
**IMA 48**=Injection Moldeed Acrylic (.150" Thick)
**PB1S**=Silver Parabolic Louver (1/2" x 1/2" x 1/2")
(Additional shielding media available, see accessory section)

**Voltage**[3]
**120V**=120 Volt
**277V**=277 Volt
**347V**=347 Volt
**UNV**=Universal Voltage 120-277[4]

**Options**
**GL**=Single Element Fuse
**GM**=Double Element Fuse
**Lamps**=Lamps Installed
**Flex**=Flex Installed
**Emergency**=EM Installed

**Ballast Type**[3]
**Blank**=Standard Magnetic Ballast (Biax & 20W)
**LEOC8**=T8 Magnetic Energy Saving
**ER8_**=T8 Electronic Program Rapid Start. Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
**EB8_**=T8 Electronic Instant Start. Total Harmonic Distortion < 20%
No. of Ballast 1, 2 or 3
**EB8_/PLUS**= T8 Electronic Instant Start. High Ballast Factor >1.13. Total Harmonic Distortion < 20%
No. of Ballast 1, 2 or 3
**TEB8_**=T8 Electronic Instant Start. Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
**DLS**=Digital Lighting System Dimming

**Options**
**FCS-24W-U**=Field Installed Flange Kit
**FR**=Suitable for Fire Rated Applications
**EQ**=T-BAR Safety Earthquake Clips[1]
(See options & accessories )

RIF - Radio Interference Filter

**Packaging**
**U**=Unit Pack

NOTES: [1]An EQ Grid Clip is recommended for all 9/16" ceiling systems. [2]Standard off-center ballast compartment on 3-lamp fixtures. [3]Products also available in non-US voltages and frequencies for international markets. [4]Not available when specifying emergencies, voltage must be specific.

For complete product data, reference the Fluorescent Specification binder. Specifications & dimensions subject to change without notice. Consult your Cooper Lighting Representative for availability and ordering information.

## SHIPPING INFORMATION

| Catalog No. | Wt. |
|---|---|
| 2GR8-232A | 29 lbs. |
| 2GR8-432A | 29 lbs. |

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** SS-232-UNV-GL-TEB81-RIFI-U - WG/SS-4FT-B<br>Notes: | **Type:** **E**<br>WK08-1600 |

# METALUX®

## DESCRIPTION

The SS Series is a functional and multi-purpose wide strip family that incorporates premium performance and construction durability. The performance and application versatility of this series can be increased by incorporating symmetrical or asymmetrical reflectors. The SS Series can be installed using various mounting methods and numerous options and accessories are available.

| Catalog # | Type |
|---|---|
| Project | |
| Comments | |
| Prepared by | Date |

## APPLICATION

The SS Series can be the illumination solution in commercial, industrial, retail and residential applications. Fixtures can be used in storage/utility areas, coves, display cases, shops, task and general area lighting.

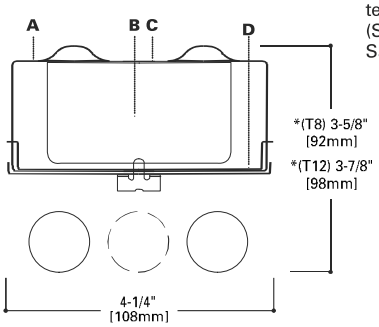
## SPECIFICATION FEATURES

**A···Construction**
Channel die formed code gauge prime cold rolled steel. Numerous KOs for ease of installation. End plate quickly converts to snap-in channel connector for continuous row alignment. Lampholder mounting brackets easily installed with snap-in action. Channel/wireway cover secured with quarter-turn fasteners.

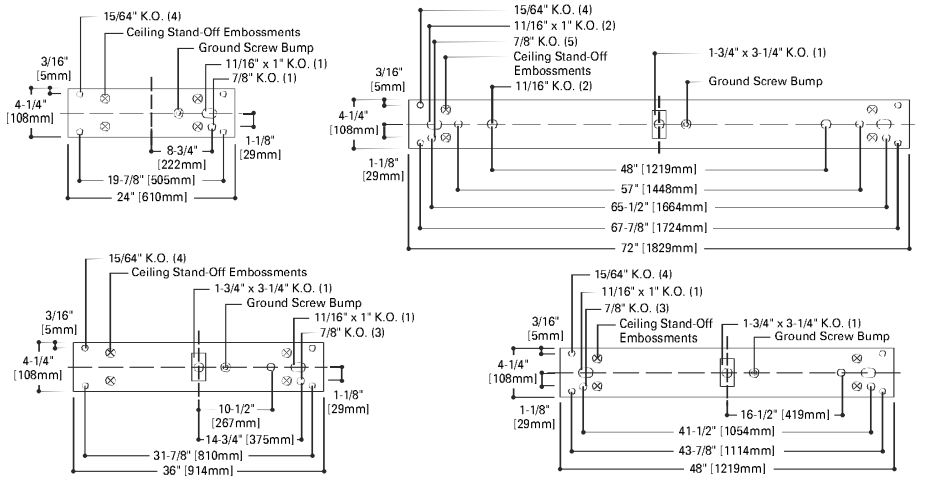
**B···Electrical***
Ballasts are CBM/ETL Class "P" and are positively secured by mounting bolts. Pressure lock lampholders. UL/CUL listed. Suitable for damp locations.

**C···Finish**
Multistage iron phosphate pretreatment ensures maximum bonding and rust inhibitor. Lighting upgrade, baked white enamel finish.

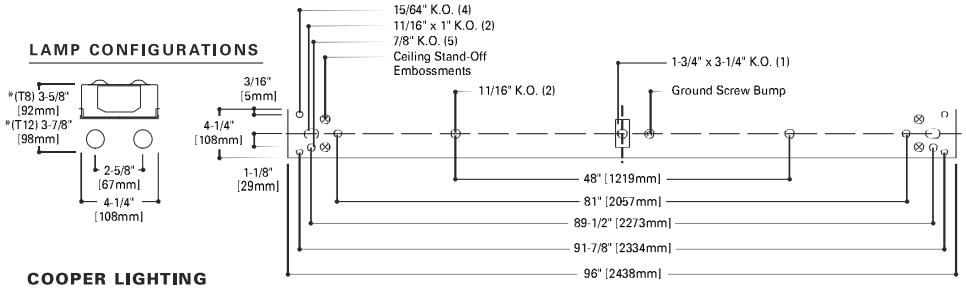
**D···Channel/Wireway Cover**
Die formed heavy gauge steel. Tight fit for ease of maintenance. Easily removed without use of tools. Optional reflector available incorporating silver technology enhancements. (Silver Lining) Consult Pre Sales Technical Support.




## MOUNTING DATA




## LAMP CONFIGURATIONS




**SS**120
117
140
132
220
217
230
225
240
232

**2' STRIP**
**1 OR 2 LAMP LTS OR HTS**

**3' OR 4' STRIP**
**1 OR 2 LAMP**

Standard Striplight

## ENERGY DATA

Input Watts:
**EB Ballast & STD Lamps**
117 (20), 217 (36), 130 (50), 125 (37)
140 (38), 132 (30), 230 (60), 225 (47)
240 (72), 232 (61)

**ES Ballast & STD Lamps**
125 (33), 140 (38), 132 (30), 117 (23)
217 (45), 230 (74), 225 (65), 240 (86)
232 (71)

**STD Ballast & STD Lamps**
120 (32), 220 (58)

Luminaire Efficacy Rating
**LER = FS-88**
**Catalog Number:** SS-232

**Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH** = $2.73

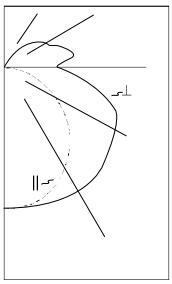
(*Reference the lamp/ballast data in the Technical Section for specific lamp/ballast requirements.

ADF020694
(Supersedes ADF991972)

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** SS-232-UNV-GL-TEB81-RIFI-U - WG/SS-4FT-B<br>Notes: | **Type:** E<br>WK08-1600 |

SS

## PHOTOMETRICS



**SS-232**
Electronic Ballast

FO32T8 Lamps
2900 Lumens

Spacing criterion: (II) 1.3 x mounting height, (⊥) 1.6 x mounting height

Efficiency 91.6%

Test Report: SS232.IES

LER = FS-88

Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH = $2.73

### Coefficients of Utilization

| Effective floor cavity reflectance | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| rc | 80% | | | | 70% | | | | 50% | | | 30% | | | 10% | | | 0% | | |
| rw | 70 | 50 | 30 | 10 | 70 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 0 | | |
| RCR | | | | | | | | | | | | | | | | | | | | |
| 0 | 105 | 105 | 105 | 105 | 100 | 100 | 100 | 100 | 92 | 92 | 92 | 84 | 84 | 84 | 77 | 77 | 77 | 74 | | |
| 1 | 93 | 87 | 83 | 78 | 88 | 84 | 79 | 75 | 76 | 73 | 70 | 70 | 67 | 64 | 64 | 61 | 59 | 56 | | |
| 2 | 83 | 74 | 67 | 61 | 79 | 71 | 65 | 59 | 65 | 60 | 55 | 59 | 55 | 51 | 54 | 51 | 47 | 44 | | |
| 3 | 75 | 64 | 56 | 49 | 71 | 62 | 54 | 48 | 56 | 50 | 45 | 51 | 46 | 42 | 47 | 42 | 39 | 36 | | |
| 4 | 68 | 56 | 48 | 41 | 65 | 54 | 46 | 40 | 49 | 43 | 37 | 45 | 39 | 35 | 41 | 36 | 32 | 30 | | |
| 5 | 62 | 50 | 41 | 35 | 59 | 48 | 40 | 34 | 44 | 37 | 32 | 40 | 34 | 30 | 37 | 32 | 28 | 25 | | |
| 6 | 57 | 44 | 36 | 30 | 54 | 43 | 35 | 29 | 39 | 32 | 27 | 36 | 30 | 26 | 33 | 28 | 24 | 22 | | |
| 7 | 53 | 40 | 32 | 26 | 50 | 38 | 31 | 25 | 35 | 29 | 24 | 33 | 27 | 22 | 30 | 25 | 21 | 19 | | |
| 8 | 49 | 36 | 28 | 23 | 47 | 35 | 27 | 22 | 32 | 26 | 21 | 30 | 24 | 20 | 27 | 22 | 19 | 17 | | |
| 9 | 46 | 33 | 25 | 20 | 44 | 32 | 25 | 20 | 30 | 23 | 19 | 27 | 22 | 18 | 25 | 20 | 17 | 15 | | |
| 10 | 43 | 30 | 23 | 18 | 41 | 29 | 22 | 18 | 27 | 21 | 17 | 25 | 20 | 16 | 23 | 18 | 15 | 13 | | |

### Zonal Lumen Summary

| Zone | Lumens | %Lamp | %Fixture |
|---|---|---|---|
| 0-30 | 830 | 14.3 | 15.6 |
| 0-40 | 1411 | 24.3 | 26.6 |
| 0-60 | 2753 | 47.5 | 51.8 |
| 0-90 | 4288 | 73.9 | 80.7 |
| 90-180 | 1023 | 17.6 | 19.3 |
| 0-180 | 5311 | 91.6 | 100.0 |

### Candela

| Angle | Along II | 45° | Across⊥ |
|---|---|---|---|
| 0 | 1017 | 1017 | 1017 |
| 10 | 1007 | 1010 | 1021 |
| 20 | 949 | 985 | 1030 |
| 30 | 857 | 951 | 1042 |
| 40 | 738 | 906 | 1029 |
| 50 | 588 | 830 | 978 |
| 60 | 422 | 727 | 920 |
| 70 | 252 | 632 | 834 |
| 80 | 104 | 456 | 601 |
| 90 | 0 | 253 | 393 |
| 100 | 0 | 320 | 518 |
| 110 | 0 | 246 | 430 |
| 120 | 0 | 199 | 353 |
| 130 | 0 | 131 | 263 |
| 140 | 0 | 69 | 167 |
| 150 | 0 | 17 | 76 |
| 160 | 0 | 1 | 7 |
| 170 | 0 | 0 | 0 |
| 180 | 0 | 0 | 0 |

## ORDERING INFORMATION

**SS** | **2** | **32** | **UNV** | **GL** | **EB81** | **RIF1** | **U**

**SS**=Series
**Tandem**
**Blank**=2', 3' or 4' Length
**6T**=6' Length
**8T**=8' Length

**Number of Lamps**
**1** or **2** lamps
(Not Included)

**Wattage (Length)**
**20**=20W T12 (24")
**17**=17W T8 (24")
**30**=30W T12 (36")
**25**=25W T8 (36")
**40**=40W T12 (48")
**32**=32W T8 (48")

**Starting Type**
**LTS**=Low Trigger Start (20W only) (120V only)
**HTS**=High Trigger Start (20W Only)

**Voltage** (1)
**120V**=120 Volt
**277V**=277 Volt
**347V**=347 Volt
**UNV**=Universal Voltage 120-277 (2)

**Options**
**GL**=Single Element Fuse
**GM**=Double Element Fuse
**Emergency**=EM Installed (3)

**Ballast Type** (1)
**LE3**=T12 Magnetic Energy Saving
**LEOC8**=T8 Magnetic Energy Saving
**EB8_**=T8 Electronic Instant Start. Total Harmonic Distortion < 20%
  No. of Ballast: 1, 2 or 3
**EB8_/PLUS**= T8 Electronic Instant Start. High Ballast Factor >1.13. Total Harmonic Distortion < 20%
  No. of Ballast: 1, 2 or 3
**ER8_**=T8 Electronic Program Rapid Start. Total Harmonic Distortion < 10%
  No. of Ballast: 1, 2 or 3
**TEB8_**=T8 Electronic Instant Start. Total Harmonic Distortion < 10%
  No. of Ballast: 1, 2 or 3
**EB2_**=T12 Electronic Rapid Start.
  No. of Ballast: 1 or 2
**DLS**=Digital Lighting System Dimming

**Options**
**RIF1**=Radio Interference Suppressor
**6-3/18 SJT-C&P-515P**= Cord & Plug (120V)
**6-3/18 SJT-C&P-L715P**=Cord & Plug (277V)
**PI/CPI**=Plug-In Option
**TILW**=Tandem In-Line Wiring Option (Consult TILW Option Catalog Page)
**RLS**=Rotor-Lock Socket (T8 Lamps Only)
(See options & accessories)

**Packaging**
**U**=Unit Pack
**4B**=4 Bulk

NOTES: (1)Products also available in non-US voltages and frequencies for international markets. (2)Not available when specifying emergencies, voltage must be specific. (3)Not available for 2' version. (4)For SilverLining reflector add SR in Catalog Number, Example: STN/SS-SR-SYM-6

Specifications & dimensions subject to change without notice. Consult your Cooper Lighting Representative for availability and ordering information.

## ACCESSORIES

**WG/SS-4FT-B**

(Order Separately)

**A1B**=Spacer
**GRP-SS**=Gripper Hanger (Use 2 Per Fixture)
**AYC-Chain/Set**=36" Chain Hanger (Use 1 Set Per Fixture)
**SCF**=Fixed Stem Set (Specify Length)
**SCS**=Swivel Stem Set (Specify Length)
**CLC**=Long Channel Connector
**STN/SS-ASY-3**(4)=3" Asymmetric Reflector (Specify 2', 3', or 4')
**STN/SS-ASY/REV-3**(4)=3" Asymmetric Reverse Reflector (Specify 2', 3', or 4')
**STN/SS-SYM-6**(4)=6" Symmetric Reflector Specify (2', 3', or 4')
**STN/SS-ASY-6**(4)=6" Asymmetric Reflector (Specify 2', 3', or 4')
**IC-4FT-REFL**(4)=12" Symmetric Reflector
**WG/SS-4FT**=Wire Guard

(Additional Accessories Available. See Options and Accessories Section.)

## SHIPPING INFORMATION

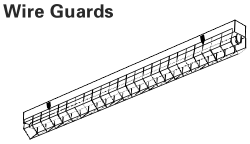
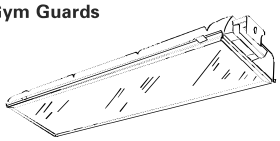
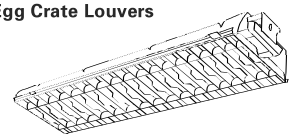
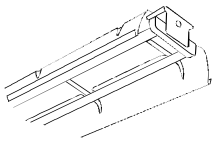
| Catalog No. | Wt. |
|---|---|
| SS-117 | 7 lbs. |
| SS-217 | 7 lbs. |
| SS-125 | 9 lbs. |
| 6TSS-125 | 16 lbs. |
| SS-225 | 9 lbs. |
| 6TSS-225 | 15 lbs. |
| SS-132 | 9 lbs. |
| 8TSS-132 | 16 lbs. |
| SS-232 | 7 lbs. |
| 8TSS-232 | 20 lbs. |

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** SS-232-UNV-GL-TEB81-RIFI-U - WG/SS-4FT-B<br>Notes: | **Type:** **E**<br>WK08-1600 |

# OPTIONS AND ACCESSORIES

**METALUX®**

STRIPS AND INDUSTRIALS

| REFLECTORS AND SHIELDING | DESIGNATION | DESCRIPTION |
|---|---|---|
| **Wire Guards**  | **WG/SN-4FT-U (SN)**<br>**WG/SS-4FT-U (SS, STN)**<br>**WG/IC-4FT-U (IA, IC)**<br>**WG/DI-4FT-U (DI, DIM, DIVM, EIM, EIVM)**<br>**WG/STM-4FT-U (STM)**<br>**WG/STW-4FT-U (STW)** | Baked white enamel finish. 14 gauge wire |
| **Gym Guards**  | **Gym Guard GG-DI**<br>(Wire Gym Guard)<br>**WG/PA-4FT**<br>(Wire Gym Guard/Acrylic Lens)<br>**DI-RS-AW/FRM** (use with Rapid Start lamps), **DI-SL-AW/FRM** (use with Slimline and HO lamps)<br>(Steel Frame/Acrylic Lens) | Baked white enamel finish. 11 gauge wire. Steel frame to support optional shielding.<br>(Use with DI, DIM, DIVM) |
| **Egg Crate Louvers**  | **MECL-DI/RS-49-3/4-U**<br>**MECL-DI/RS-99-1/2-U**<br>**MECL-DI/SL-48-U**<br>**MECL-DI/SL-96-U** | Baked white enamel finish. Sturdy cold rolled steel construction. 32° parallel shielding.<br>(Use with DI, DIM, DIVM) |
| **Optional Reflector Finishes**  | **POR (Porcelain)**<br>**POX (Porlux)**<br>**SS (SilverLining)**<br>**SR (SilverLining)** | Durable/Performance industrial reflector finishes. Available on DI, DIM, DIVM, EI, EIM and EIVM Series (Porcelain not available on IA/IC Series).<br>A silver coating applied to commercial bright, code gauge prime cold rolled steel. (SN and SS)<br>A silver coating applied to commercial bright, code gauge prime cold rolled steel. (STN and STW) |

Items listed are the major options and accessories available on Metalux Strips and Industrial Fixtures. Additional options and accessories are available. Consult Pre Sales Technical Support for additional information.

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** 2GR8-332A-UNV-GL-TEB82-RIF1-U<br>Notes: | **Type:** F<br>WK08-1600 |

# METALUX®

## DESCRIPTION

The GR8 is a T8-dedicated lensed troffer designed to offer premium performance in a low profile housing. T8 dedication and optimized lamp to lens spacing provides the best in energy efficiency and optical control. The GR8's shallow, low profile housing is compatible with even highly restrictive plenums. Luminaires are compatible with today's popular ceiling systems.

## APPLICATION

The GR8 offers great performance and great quality. The series is an excellent choice for commercial offices, schools, hospitals, retail merchandising and many other applications.

| Catalog # | Type |
|---|---|
| Project | |
| Comments | |
| Prepared by | Date |

## SPECIFICATION FEATURES

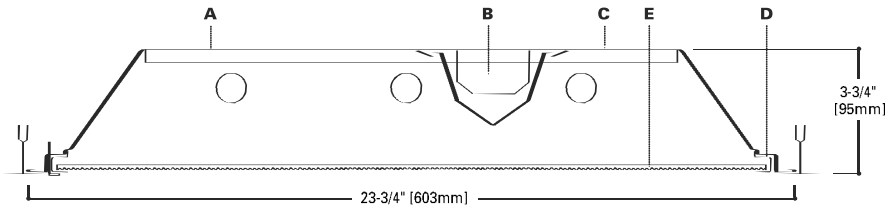
**A···Construction**
Unitized low profile recessed housing is die formed of code gauge prime cold rolled steel with full length stiffeners and mechanical endplate attachment for added strength. Off center, ballast cover is easily removed without tools. Die formed captive lampholder bracket fully encloses lampholder wiring for easy lampholder replacement. Ample KOs are provided for continuous row wiring. Built-in grid-lock feature for safety and convenience. Standard unit is NYC Approved. (No modifications necessary).

**B···Electrical****
Ballasts are CBM/ETL Class "P" and are positively secured by mounting bolts. Pressure lock lampholders. UL/CUL listed. Suitable for damp locations.

**C···Finish**
Multistage, iron phosphate pretreatment ensures maximum bonding and rust inhibition. Lighting grade baked white enamel finish with premium reflectance for high efficiency.

**D···Hinging/Latching**
Positive spring loaded cam action steel latches and safety lock T-hinges provide secure, high quality door fit and allow hinging and latching from either side.

**E···Frame/Shielding**
Heavy gauge flat steel door is die formed with reinforced mitered corners. Housing and door frame assemblies incorporate full length and width mechanical light traps. Light stabilized, acrylic prismatic lens.

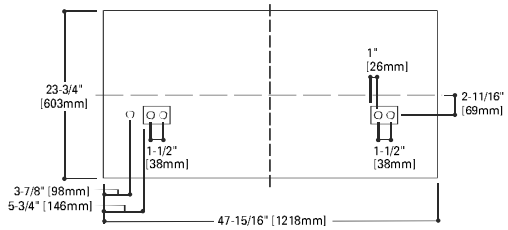


**2GR8**332

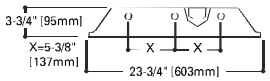
**2' X 4' TROFFER**
**3 LAMP**

General Purpose
T8 Commercial Troffer

## MOUNTING DATA

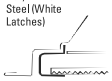



## LAMP CONFIGURATIONS



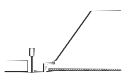

## DOOR FRAMES

2GR8
Flat, White
Steel (White
Latches)

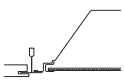


## CEILING COMPATIBILITY

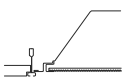
**G**
Grid/Lay-in
Standard



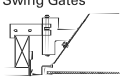
**G**
Concealed T



**G**
Slot Grid



**F**
Flange Trim
With Supporting
Swing Gates



| Ceiling Type | Trim Type |
|---|---|
| Exposed Grid | G |
| Concealed T | G |
| Slot Grid | G |
| Flange | G*** |

## ENERGY DATA

Input Watts:
**EB Ballast & STD Lamps**
332 (91)

**ES Ballast & STD Lamps**
332 (108)

Luminaire Efficacy Rating
**LER = FL-68**
**Catalog Number:** 2GR8-332A

**Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH** = $3.53

*Standard G (Grid) Type Fixtures can be field converted by adding trim kits. See Compatibility Section or Consult Factory.

**Reference the lamp/ballast data in the Technical Section for specific lamp/ballast requirements.

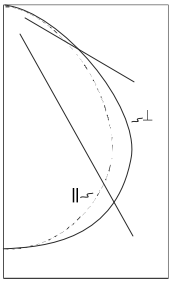
***Order FCS-24W-U Flange Kit for installation in drywall ceiling. See options and accessories compatibility section.

ADF012708

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** 2GR8-332A-UNV-GL-TEB82-RIF1-U<br>Notes: | **Type:** F<br>WK08-1600 |



## PHOTOMETRICS




**2GR8-332A**
Electronic Ballast

F32T8/35K lamps
2800 lumens

Spacing criterion: (||) 1.2 x mounting height, (⊥) 1.4 x mounting height

Efficiency 76.0%

Test Report: 2GR8332A.IES

LER = FL-68

Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH = $3.53

### Coefficients of Utilization

| Effective floor cavity reflectance | | | | | 20% | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| rc | 80% | | | | 70% | | | | 50% | | | 30% | | | 10% | | | 0% |
| rw | 70 | 50 | 30 | 10 | 70 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 0 |
| RCR | | | | | | | | | | | | | | | | | | |
| 0 | 91 | 91 | 91 | 91 | 88 | 88 | 88 | 88 | 84 | 84 | 84 | 81 | 81 | 81 | 78 | 78 | 78 | 76 |
| 1 | 84 | 81 | 78 | 75 | 82 | 79 | 76 | 74 | 76 | 74 | 72 | 73 | 71 | 69 | 70 | 69 | 67 | 66 |
| 2 | 77 | 72 | 67 | 63 | 75 | 70 | 66 | 63 | 68 | 64 | 61 | 65 | 62 | 60 | 63 | 61 | 59 | 57 |
| 3 | 71 | 64 | 59 | 54 | 70 | 63 | 58 | 54 | 61 | 57 | 53 | 59 | 55 | 52 | 57 | 54 | 51 | 50 |
| 4 | 66 | 58 | 52 | 47 | 64 | 57 | 51 | 47 | 55 | 50 | 46 | 53 | 49 | 45 | 51 | 48 | 45 | 43 |
| 5 | 60 | 51 | 45 | 40 | 59 | 51 | 45 | 40 | 49 | 44 | 40 | 48 | 43 | 39 | 46 | 42 | 39 | 37 |
| 6 | 56 | 46 | 40 | 35 | 54 | 46 | 40 | 35 | 44 | 39 | 35 | 43 | 38 | 35 | 42 | 38 | 34 | 33 |
| 7 | 51 | 42 | 35 | 31 | 50 | 41 | 35 | 31 | 40 | 34 | 31 | 39 | 34 | 30 | 38 | 33 | 30 | 29 |
| 8 | 47 | 37 | 31 | 27 | 46 | 37 | 31 | 27 | 36 | 30 | 27 | 35 | 30 | 26 | 34 | 30 | 26 | 25 |
| 9 | 44 | 34 | 27 | 23 | 43 | 33 | 27 | 23 | 32 | 27 | 23 | 31 | 26 | 23 | 31 | 26 | 23 | 21 |
| 10 | 41 | 30 | 24 | 20 | 40 | 30 | 24 | 20 | 29 | 24 | 20 | 29 | 24 | 20 | 28 | 23 | 20 | 19 |

### Zonal Lumen Summary

| Zone | Lumens | %Lamp | %Fixture |
|---|---|---|---|
| 0-30 | 1965 | 23.4 | 30.8 |
| 0-40 | 3239 | 38.6 | 50.7 |
| 0-60 | 5421 | 64.5 | 84.9 |
| 0-90 | 6386 | 76.0 | 100.0 |
| 0-180 | 6386 | 76.0 | 100.0 |

### Typical VCP Percentages

| | Height Along | | Height Across | |
|---|---|---|---|---|
| Room Size (Ft.) | 8.5′ | 10.0′ | 8.5′ | 10.0′ |
| 20 x 20 | 67 | 71 | 64 | 68 |
| 30 x 30 | 60 | 64 | 57 | 61 |
| 30 x 60 | 52 | 55 | 47 | 50 |
| 60 x 30 | 62 | 66 | 60 | 64 |
| 60 x 60 | 52 | 55 | 48 | 51 |

### Candela

| Angle | Along \|\| | 45° | Across ⊥ |
|---|---|---|---|
| 0 | 2460 | 2460 | 2460 |
| 5 | 2445 | 2456 | 2468 |
| 10 | 2416 | 2440 | 2464 |
| 15 | 2367 | 2409 | 2449 |
| 20 | 2295 | 2358 | 2413 |
| 25 | 2194 | 2281 | 2352 |
| 30 | 2063 | 2176 | 2266 |
| 35 | 1900 | 2045 | 2163 |
| 40 | 1705 | 1879 | 2015 |
| 45 | 1474 | 1650 | 1794 |
| 50 | 1200 | 1362 | 1474 |
| 55 | 932 | 1045 | 1122 |
| 60 | 710 | 745 | 811 |
| 65 | 533 | 497 | 566 |
| 70 | 389 | 326 | 416 |
| 75 | 275 | 243 | 327 |
| 80 | 201 | 204 | 251 |
| 85 | 110 | 122 | 143 |
| 90 | 0 | 0 | 0 |

## ORDERING INFORMATION

SAMPLE NUMBER: 2GR8-332A-120V-EB81-U

**2** **GR8** **3** **32** **A** **UNV** **GL** **EB82** **RIF1** **U**

**2**="2" Width

**Series**
**GR8**=General Purpose T8 Commercial Troffer[1]

**Number of Lamps**[2]
**3**=3 Lamps
(Not included)

**Wattage (Length)**
**32**=32W T8 (48")

**A**=#12 Pattern Acrylic
**A125**=#12 Pattern Acrylic (.125" Thick)
**A19/156**=#19 Pattern Acrylic (.156" Thick)
**IMA 48**=Injection Moldeed Acrylic (.150" Thick)
**PB1S**=Silver Parabolic Louver (1/2" x 1/2" x 1/2")
(Additional shielding media available, see accessory section)

**Voltage**[3]
**120V**=120 Volt
**277V**=277 Volt
**347V**=347 Volt
**UNV**=Universal Voltage 120-277[4]

**Options**
**GL**=Single Element Fuse
**GM**=Double Element Fuse
**Lamps**=Lamps Installed
**Flex**=Flex Installed
**Emergency**=EM Installed

**Ballast Type**[3]
**Blank**=Standard Magnetic Ballast (Biax & 20W)
**LEOC8**=T8 Magnetic Energy Saving
**ER8_**=T8 Electronic Program Rapid Start. Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
**EB8_**=T8 Electronic Instant Start. Total Harmonic Distortion < 20%
No. of Ballast 1, 2 or 3
**EB8_/PLUS**=T8 Electronic Instant Start. High Ballast Factor >1.13. Total Harmonic Distortion < 20%
No. of Ballast 1, 2 or 3
**TEB8_**=T8 Electronic Instant Start. Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
**DLS**=Digital Lighting System Dimming

**Options**
**FCS-24W-U**=Field Installed Flange Kit
**FR**=Suitable for Fire Rated Applications
**EQ**=T-BAR Safety Earthquake Clips[1]
(See options & accessories )

**Radio Interferance Suppressor**

**Packaging**
**U**=Unit Pack

NOTES: [1]An EQ Grid Clip is recommended for all 9/16" ceiling systems. [2]Standard off-center ballast compartment on 3-lamp fixtures. [3]Products also available in non-US voltages and frequencies for international markets. [4]Not available when specifying emergencies, voltage must be specific.

For complete product data, reference the Fluorescent Specification binder. Specifications & dimensions subject to change without notice. Consult your Cooper Lighting Representative for availability and ordering information.

## SHIPPING INFORMATION

| Catalog No. | Wt. |
|---|---|
| 2GR8-332A | 31 lbs. |

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** H285E-70PS<br>Notes: | **Type:** **G**<br>WK08-1600 |

**HALO®**

| | | |
|---|---|---|
| **Catalog #** | | **Type** |
| **Project** | | |
| **Comments** | | **Date** |
| **Prepared by** | | |

## DESCRIPTION

This compact fluorescent housing offers a universal voltage 120/277V electronic ballast. The H280 series offers the reliability and versatility of the H7 family with the operating efficiencies of higher wattage compact fluorescent operation. Fixtures with an "L" suffix are shipped with one compact fluorescent lamp included.

## DESIGN FEATURES

**A…Housing**

Aluminum single wall construction helps dissipate heat.

**B…Plaster Frame**

Housing adjusts 1-3/4" in plaster frame for different ceiling thicknesses. Includes locking screws for hanger bars and cutouts for crimping hanger bars in position.

**C…Junction Box**

- Junction Box is listed for through branch circuit wiring and has seven 1/2" knockouts and four non metallic (NM) sheathed cable knockouts with true pry out slots. NM sheathed cable knockouts include built in strain relief and require no additional clamps

**D…Got NAIL!™ Bar Hangers**

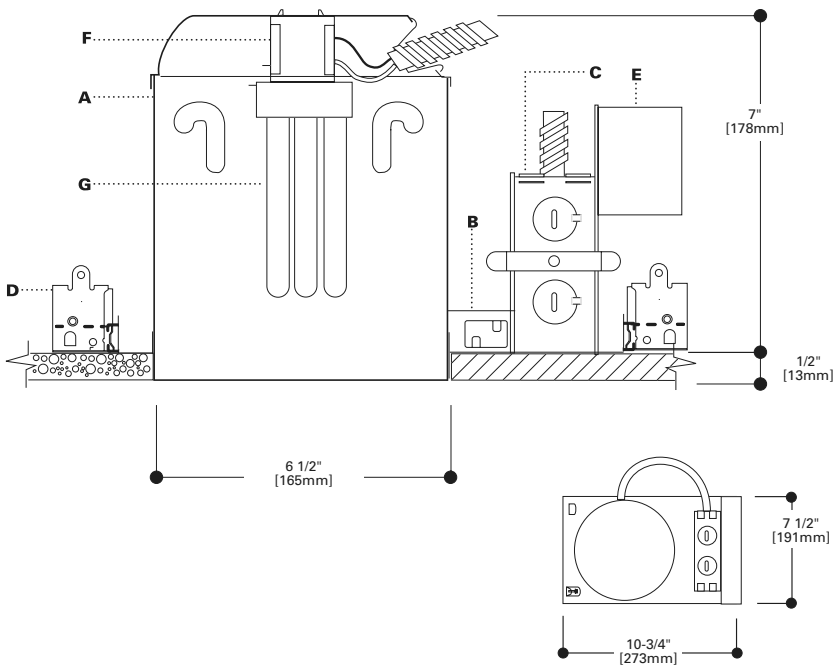
Bar Hanger Features include:
- Pre-installed nail easily installs in regular lumber, engineered lumber and laminated beams
- Safety and guidance system prevents snagging, ensures smooth straight nail penetration and allows bar hangers to be easily removed if necessary.
- Automatic levelling flange aligns the housing and lets you hold the housing in place with one hand while driving nails
- Housing can be positioned at any point within 24" joist span
- Bar hangers do not need to be removed from frame for shortening
- Score lines allow "tooless" shortening for 12" joists.
- Bar hangers can be repositioned 90° on plaster frame
- Integral T-bar clip snaps onto T-bars - no additional clips required

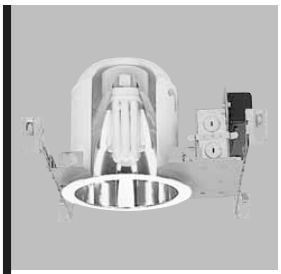
**E…Ballast:**

Electronic ballast is universal voltage 120V-277V, provides flicker free and noise free operation and quick starting. High ballast factor provides full light output while high power factor and low THD provide efficient electronic operation. End of life protection, sound rating A, and FCC non- consumer ratings are standard

**F…Replacement Lamps:**
26 Watt - Z126TE30, 4-pin, GX24q-3, 3000°K

**Listings**
- UL/cUL Damp Location
- UL/cUL Feed Through



# H285E
# H285EL

**26W Triple Twin Tube 4-pin**

**Electronic Compact Fluorescent Recessed Housing**

**7"**

**Non-Insulated Ceiling**

**7" TRIMS FOR USE IN NON-INSULATED CEILINGS OR INSULATED CEILINGS BUT INSULATION MUST BE KEPT 3" FROM ALL SIDES OF FIXTURE**

**ENERGY DATA**

**H285E, H285EL**
(1) 26W DTT or TTT 4-pin CFL
Type: CFQ26W/G24Q or CFTR26W/GX24q
Ballast: 120V-277V
Input Watts: 28
120V Line Amps: 0.25
277V Line Amps: 0.11
Power Factor: >0.98
Ballast Factor: 1.02
Min Start Temp: 0°F/-18°C
120V THD: <10%
277V THD:<15%
EMI/RFI: FCC 47CFR Part 18 Non-Consumer

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** H285E-70PS<br>Notes: | **Type:** **G**<br>WK08-1600 |



## TRIMS

## ORDERING INFORMATION

**SAMPLE NUMBER: H285E-406SC**

Order housing, trim and accessories separately.

### Housing

**H285E**=Compact Fluorescent Housing with 26W 120/277V Universal Voltage Electronic Ballast

**H285EL**=Compact Fluorescent Housing with 26W 120/277V Universal Voltage Electronic Ballast 26W CFL Lamp Included

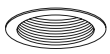
### Trims

**REFLECTORS**

**406**

**Specular Reflector**
**26W Double Twin Tube Compact Fluorescent Lamp**
406SC=Specular Clear
406RG=Residential Gold
OD: 7 1/4" (184mm)

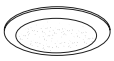
**REFLECTOR/ BAFFLES**



**406**

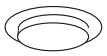
**Baffle with Reflector**
**26W Double Twin Tube Compact Fluorescent Lamp**
406BA=Black Baffle, White Trim Ring
406WB=White Baffle, White Trim Ring
OD: 7 1/4" (184mm)

**DIFFUSERS**



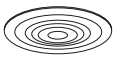
**70**

**Albalite Lens**
**26W Double Twin Tube Compact Fluorescent Lamp**
70P=Albalite Lens, White Trim Ring
70PS=Albalite Lens, White Trim Ring, Gasketed Shower Light
OD: 8" (203mm)



**71**

**Drop Opal Lens**
**26W Double Twin Tube Compact Fluorescent Lamp**
71P=Drop Opal Lens, White Trim Ring
71PS=Drop Opal Lens, White Trim Ring, Gasketed Shower Light
OD: 8" (203mm)



**73**

**Glass Fresnel Lens**
**26W Double Twin Tube Compact Fluorescent Lamp**
73P=Glass Fresnel Lens, White Trim Ring
73PS=Glass Fresnel Lens, White Trim Ring, Gasketed Shower Light
OD: 8" (203mm)

**75**

**All-Glas Diffuser**
**26W Double Twin Tube Compact Fluorescent Lamp**
75=Glass Diffuser
OD: 7 3/4" (197mm)

**424**

**Wall Wash**
**26W Double Twin Tube Compact Fluorescent Lamp**
424P=Wall Wash
OD: 7 1/4" (184mm)

**425**

**Wall Wash with Baffle**
**26W Double Twin Tube Compact Fluorescent Lamp**
425P=White Wall Wash, Black Baffle
425W=White Wall Wash, White Baffle
OD: 7 1/4" (184mm)

**270**

**Shower Light with Reflector**
**26W Double Twin Tube Compact Fluorescent Lamp**
270P=White Trim Ring, Clear Reflector, Frosted Lens,
OD: 7 3/4" (197mm)

### Accessories

**Metal Trim Rings**
Compatible with 406 (SC and RG only) 424, 425
**TRM6P**=White Metal
**TRM6PB**=Polished Brass
**TRM6C**=Chrome
**TRM6MB**=Black Metal
**TRM6SN**=Satin Nickel
**TRM6AC**=Antique Copper
**TRM6TBZ**=Tuscan Bronze
**TRM6SL**=Silver Metal
**TRP7MB**=Black Plastic

**Oversize Trim Rings**
For use when ceiling opening is cut too large. Compatible with406 (SC and RG only) 424, 425
**OT400P**=9 1/4" White Metal
**OT403P**= 8" White Plastic

**Note:** Specifications and Dimensions subject to change without notice.

**Visit our web site at www.cooperlighting.com**

COOPER Lighting

Customer First Center 1121 Highway 74 South Peachtree City, GA 30269 770.486.4800 FAX 770 486.4801 ADV070430
Cooper Lighting 5925 McLaughlin Rd. Mississauga, Ontario, Canada L5R 1B8 905.507.4000 FAX 905.568.7049

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** PD6-H1421DMARX-6HC<br>Notes: | **Type:** **H**<br>WK08-1600 |

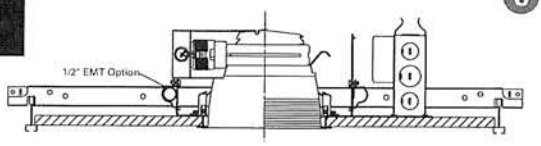


pds by Portfolio™

## HORIZONTAL 6" OPEN, CFL

6

[redacted]




**STANDARD** (Frame, socket adapter and reflector ship separately.)

| Frame | Socket Adapter | | Reflector |
|---|---|---|---|
| Example: PD6 | H1421D | | 6HC |
| PD6 | **H118**=1-18W DTT<br>**H126**=1-26W DTT<br>**H142**=1-26/32/42W TTT<br>**H218**=2-18W DTT<br>**H226**=2-26W DTT | E=120-277V, 50/60Hz Electronic Ballast<br>3E=347V, 60Hz Electronic Ballast<br>**1D**=120V Dimming, Advance Mark 10<br>**2D**=277V Dimming, Advance Mark 10 | **6HC**=6" Horizontal Clear<br>**6HBB**=6" Horizontal Black Baffle<br>**6HWB**=6" Horizontal White Baffle |

**EMERGENCY** (Frame and socket adapter/battery pack ship together. Reflector ships separately.)

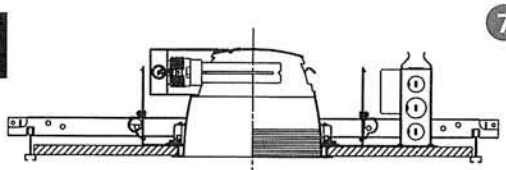
| Frame | Socket Adapter/Battery Pack | Reflector |
|---|---|---|
| Example: PD6 | H118EEM | 6HEMC |
| PD6 | **H118EEM**=1-18W DTT<br>**H126EEM**=1-26W DTT<br>**H142EEM**=1-26/32/42W TTT<br>**H218EEM**=2-18W DTT<br>**H226EEM**=2-26W DTT | **6HEMC**=6" Horizontal Clear<br>**6HEMBB**=6" Horizontal Black Baffle<br>**6HEMWB**=6" Horizontal White Baffle |

Other Standard, Dimming and EM ballasts available. Consult factory.

## HORIZONTAL 7" OPEN, CFL

7

[redacted]



**STANDARD** (Frame, socket adapter and reflector ship separately.)

| Frame | Socket Adapter | | Reflector |
|---|---|---|---|
| Example: PD7 | H1421D | | 7HC |
| PD7 | **H118**=1-18W DTT<br>**H126**=1-26W DTT<br>**H142**=1-26/32/42W TTT<br>**H218**=2-18W DTT<br>**H226**=2-26W DTT | E=120-277V, 50/60Hz Electronic Ballast<br>**3E**=347V, 50/60Hz Electronic Ballast<br>**1D**=120V Dimming, Advance Mark 10 Powerline<br>**2D**=277V Dimming, Advance Mark 10 Powerline | **7HC**=7" Horizontal Clear<br>**7HBB**=7" Horizontal Black Baffle<br>**7HWB**=7" Horizontal White Baffle |

**EMERGENCY** (Frame and socket adapter/battery pack ship together. Reflector ships separately.)

| Frame | Socket Adapter/Battery Pack | Reflector |
|---|---|---|
| Example: PD7 | H118EEM | 7HEMBB |
| PD7 | **H118EEM**= (1) 18W DTT<br>**H126EEM**=(1) 26W DTT<br>**H142EEM**=1-26/32/42 TTT<br>**H218EEM**=(2) 18W DTT<br>**H226EEM**=(2) 26W DTT | **7HEMC**=7" Horizontal Clear<br>**7HEMBB**=7" Horizontal Black Baffle<br>**7HEMWB**=7" Horizontal White Baffle |

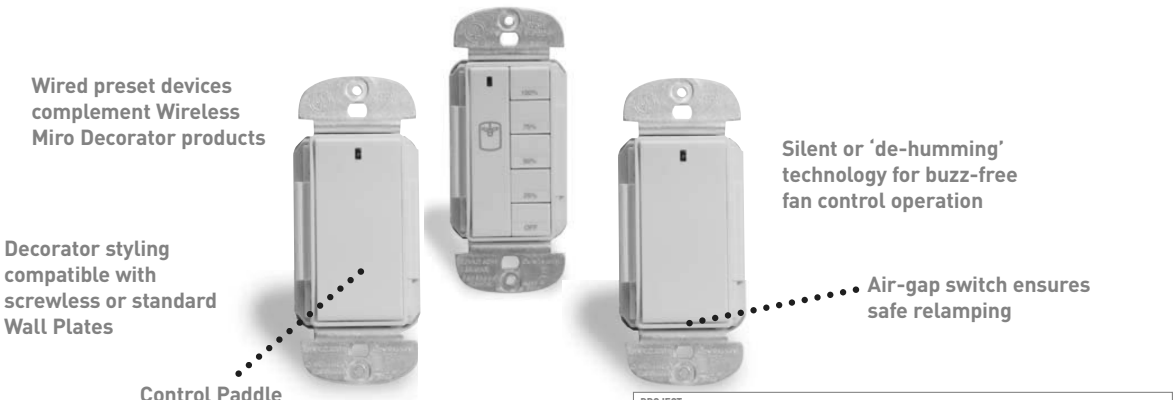
Other Standard, Dimming and EM ballasts available. Consult factory.

# PD6
# PD7
## Open Horizontal CFL

- Low iridescent, clear reflector
- White painted self flange
- Torsion springs pull reflector to ceiling
- One piece folded metal socket cap
- Universal voltage ballast
- 120V & 277V Advance Mark 10 dimming
- Universal 4-pin socket
- Galvanized steel frame with 1/2" plaster lip
- Accommodates ceilings up to 2" thick
- Bar hangers lock to T-bar with screwdrivers or pliers
- Galvanized J-box with multiple KO's, listed for twelve #12AWG 90C conductors
- cUL listed, damp location
- "EM" fixtures use internally mounted test switch/indicator light

MIRO

# Miro Decorator Dimmer, Fan Controller and Multilocation Controller




PROJECT

LOCATION/TYPE

## Product Overview

### Description

Miro Decorator Dimmer and Fan Controller operate most dimmable lighting loads and ceiling fans. Multilocation controllers provide convenient, easy-to-wire multi-way control. All devices feature decorator styling identical to Wireless Miro Decorator devices.

### Operation: Dimmers

Users operate dimmers by pressing up or down on the paddle to raise or lower light levels. Tapping once recalls the preset light level. Dimmers may be used as stand-alone replacements for single-pole light switches. Universal Dimmers are recommended for all applications except for locations without a neutral wire. An incandescent dimmer is available for two-wire applications. Multilocation controllers allow full control of dimmers from additonal locations.

### Operation: Fan Controllers

The Fan Controller offers pushbutton operation with four speeds and OFF, as well as speed control via the paddle. They are capable of operating two ceiling fans from a single location. Users may also turn fans ON and OFF or adjust fan speed from multilocation controllers.

### Deratings

Derate dimmers as follows:

| | Maximum Capacity | | |
|---|---|---|---|
| | Single Dimmer | Dimmer at end of multi-gang | Dimmer in middle of multi-gang |
| • Incandescent / Quartz Halogen | 600W | 500W | 400W |
| • Magnetic Low Voltage | 500W | 400W | 300W |
| • Electronic Low Voltage | 500W | 400W | 300W |
| • Cold Cathode / Neon | 500W | 400W | 300W |
| • Fluorescent: | | | |
| – 2 Wire | 500W | 400W | 300W |
| – Compact | 500W | 400W | 300W |

## Features

- Universal Dimmers are compatible with most load types
- Last level recall (preset)
- Patented overload and short-circuit protection
- Air-gap switch ensures safe relamping
- Square law dimming curve
- Multilocation controllers provide full control of Dimmers or Fan Controllers
- Soft start technology significantly extends lamp life by limiting inrush current
- Long life status LED
- Compatible with decorator wall plates

## Specifications

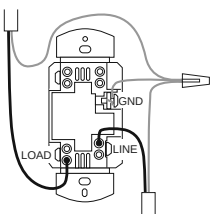
| Load Types | Incandescent Dimmer | Universal Dimmer | Fan Controller | Multilocation Controller |
|---|---|---|---|---|
| Incandescent | • | • | | |
| Dimmable magnetic low voltage | | • | | |
| Dimmable electronic low voltage | | • | | |
| Dimmable neon, cold-cathode | | • | | |
| Dimmable 2-wire fluorescent (Advance Mark X or equivalent) | | • | | |
| Ceiling fan(s) | | | • | |
| **Electrical Specifications** | | | | |
| 120 VAC | • | • | • | • |
| Neutral required | | • | • | • |
| Air-gap isolation switch | • | • | • | |
| Short-circuit protection | • | • | • | |
| **Operating Conditions** | | | | |
| Temperature: 32-104°F (0-40° C) | • | • | • | • |
| Humidity: 0-80%, non-condensing | • | • | • | • |
| **UL, CUL listed; Five-year warranty** | • | • | • | • |

**Dimensions**

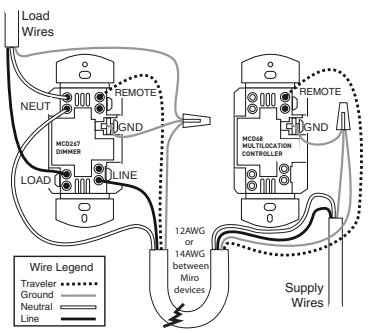
**DCD26 & DCD267**: 2.64"L x 1.75"W x 1.98"D; depth in wall 1.65" (67.1mm x 44.5mm x 50.3mm; D 41.9mm)
**DCF8**: 2.64"L x 1.75"W x 2.17"D; depth in wall 1.86" (67.1mm x 44.5mm x 55.2mm; D 47.2mm)
**DCD68**: 2.64"L x 1.75"W x 1.76"D; depth in wall 1.50" (67.1mm x 44.5mm x 54.6mm; D 38.1mm)

## Wiring & Operation

### Wiring Diagrams



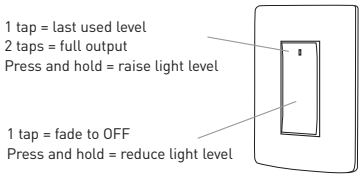

Incandescent Dimmer



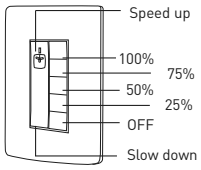

Wiring for Universal Dimmer (shown with Multilocation Controller)

Mounting in a deep electrical box is recommended but not required

### Dimmer and Multilocation Operation




### Fan Controller Operation




## Ordering Information

| Catalog No. | Product Description | Voltage | Min Load | Max Load |
|---|---|---|---|---|
| ☐ DCD26-x | Miro Decorator Incandescent Dimmer | 120 VAC | 60W | 600W* |
| ☒ DCD267-x | Miro Decorator Universal Dimmer | 120 VAC | 25W | 600W* |
| ☐ DCF8-x | Miro Decorator Fan Control | 120 VAC | na | 1.5A |
| ☐ DCD68-x | Miro Decorator Multilocation Controller | 120 VAC | na | na |

In place of -x, please specify color when ordering. Specify -A for Light Almond, -B for Black, -I for Ivory, -W for White.

*Subject to derating when more than 1 dimmer is ganged together or when using non-incandescent loads types. Please refer to chart shown earlier on this cut sheet.

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** BC-232-VOLT-EL-FBP140X-EB81-U<br>Notes: | **Type:** I<br>WK08-1600 |

# METALUX®

## DESCRIPTION

The BC Series is an energy efficient luminaire designed for versatility in application and performance. The BC Series features an opal white acrylic refractor that produces a 180° uniform light distribution pattern.

## APPLICATION

The versatile BC Series combines quality and economy in a multi-purpose wall bracket. The luminaire is perfect for illuminating corridors, stairwells, lavatories, dressing rooms, patient rooms, utility/task and area lighting.

| Catalog # | Type |
|---|---|
| Project | |
| Comments | |
| Prepared by | Date |

## SPECIFICATION FEATURES

**A···Construction**

Housing channel die formed code gauge prime cold rolled steel. Sturdy positive lampholder mounting bracket. Reflector/channel wireway cover secured by quarter-turn fastener for easy wireway access. Channel back has numerous KO's for easy installation. Decorative white opaque injection molded end plates.

**B···Electrical**

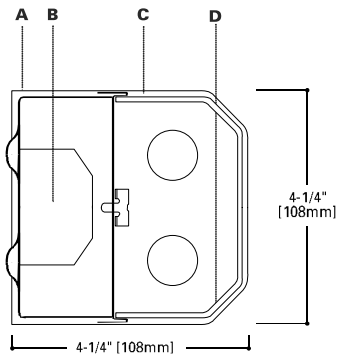
Ballast are CBM/ETL Class "P" and positively secured by mounting bolts. Pressure lock lampholders. UL/CUL listed. Suitable for damp locations.

**C···Finish**

Painted after fabrication. Electrostatically applied baked white polyester powder enamel finish. Multistage cleaning cycle, iron phosphate coating with rust inhibitor. Conveyorized application and baking time accurately controlled at an elevated temperature.

**D···Frame/Shielding**

Smooth opal 100% virgin acrylic refractor. 180° uniform light distribution (Uplight, Frontal & Downlight). Refractor is securely held in place by removable decorative injection molded white end plates. Refractor can be easily removed for installation and maintenance.



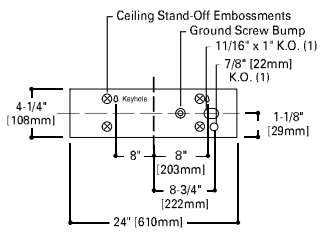
**BC**120
117
130
125
140
132
220
217
230
225
240
232

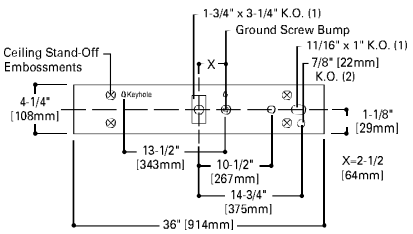
**ALL PURPOSE WALL BRACKET**

2' Wall Bracket
1or 2 Lamp LTS or HTS

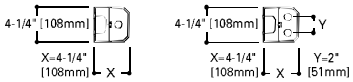
3' or 4' Wall Bracket
1 or 2 Lamp

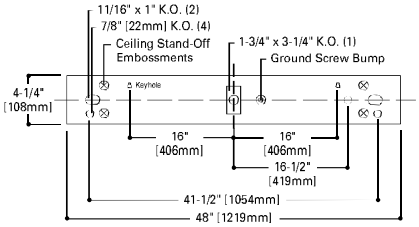
## MOUNTING DATA




## LAMP CONFIGURATIONS




## ENERGY DATA

Input Watts:
**EB Ballast & STD Lamps**
117 (20), 130 (31), 125 (28), 140 (38)
132 (30), 217 (36), 230 (60), 225 (47)
240 (72), 232 (61)

**ES Ballast & STD Lamps**
120 (32), 117 (23), 130 (46), 125 (33)
140 (38), 132 (30), 220 (58), 217 (45)
230 (74), 225 (65), 240 (86), 232 (71)

Luminaire Efficacy Rating
**LER = FL-65**
**Catalog Number:** BC-232A

**Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH** = $3.69

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** BC-232-VOLT-EL-FBP140X-EB81-U Notes: | **Type:** I WK08-1600 |



## PHOTOMETRICS

Energy Saving Ballast, F32T8/35K lamps rated at 2850 lumens. Spacing criterion: (II) 1.3 x mounting heights, (⊥) 1.5 x mounting height.

Light Loss Factor .74. For complete photometric report BC232A.IES

**BC-232A**

(II)Lamps (2) F32T8/35K

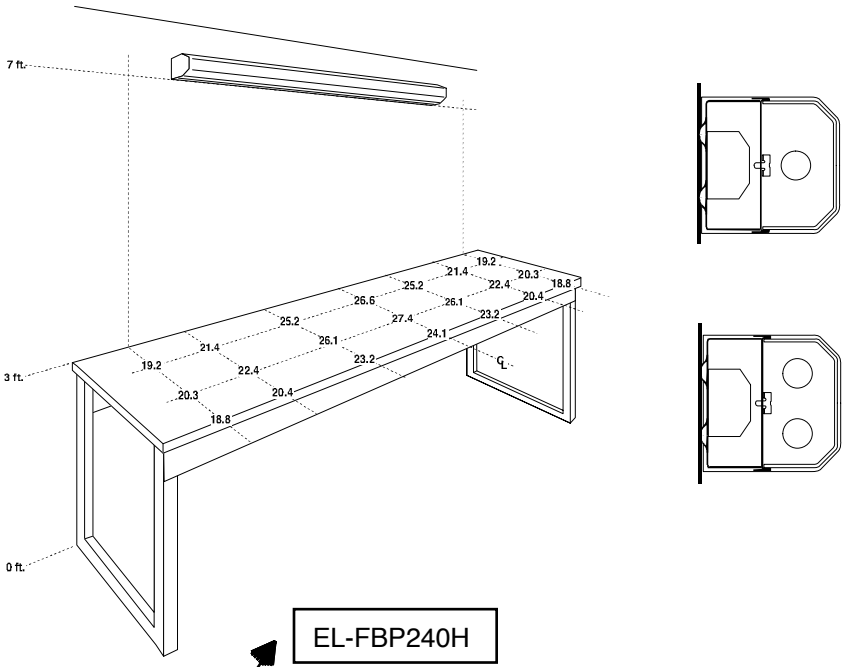
Lumens 2850 Each

Conditions

| | |
|---|---|
| Ceiling Height | 8′-0″ |
| Mounting Height | 7′-43/64″ |
| Work Plane | 12′-0″ |

Reflectance

| | |
|---|---|
| Ceiling | 80% |
| Walls | 50% |
| Floor | 20% |




Scale is Exaggerated on Fixture Application and Mounting

## ORDERING INFORMATION

BC 2 32 [VOLT] EL-FBP240H EB81 U

**BC**=Series

**Number of Lamps**
**1** or **2** Lamps
(Not included)

**Wattage (Length)**
**20**=20W T12 (24")
**17**=17W T8 (24")
**30**=30W T12 (36")
**25**=25W T8 (36")
**40**=40W T12 (48")
**32**=32W T8 (48")

**Starting Type**
**LTS**=Low Trigger Start (20 Watt only) (120V only)
**HTS**=High Trigger Start (20 Watt only)

**Voltage** [1]
**120V**=120 Volt
**277V**=277 Volt
**347V**=347 Volt
**UNV**=Universal Voltage 120-277 [2]

**Options**
**GL**=Single Element Fuse
**GM**=Double Element Fuse
**Emergency**=EM Installed [3]

**Ballast Type** [1]
**Blank**=Standard Magnetic Ballast (20W only)
**LE3**=T12 Magnetic Energy Saving
**LEOC8**=T8 Magnetic Energy Saving
**EB8_**=T8 Electronic Instant Start. Total Harmonic Distortion < 20%
No. of Ballast 1, 2 or 3
**EB8_/PLUS**= T8 Electronic Instant Start. High Ballast Factor >1.13. Total Harmonic Distortion < 20%
No. of Ballast 1, 2 or 3
**ER8_**=T8 Electronic Program Rapid Start. Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
**TEB8_**=T8 Electronic Instant Start. Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
**EB2_**=T12 Electronic Rapid Start.
No. of Ballast 1 or 2

**Options**
**CO**=Convenience Outlet (120V only)
**RS1**=Rotary Switch, One circuit (120V only)
**PS1**=Pull Switch, One circuit (120V only)
**RLS**=Rotor-Lock Socket (T8 Lamps Only)(Consult Pre Sales Technical Support) (See options & accessories )

**Packaging**
**U**=Unit Pack

NOTES: [1]Products also available in non-US voltages and frequencies for international markets. [2]Not available when specifying emergencies, voltage must be specific. [3]Non available for 2' version.

Specifications & dimensions subject to change without notice. Consult your Cooper Lighting Representative for availability and ordering information.

## SHIPPING INFORMATION

| Catalog No. | Wt. |
|---|---|
| BC-117 | 8 lbs. |
| BC-125 | 10 lbs. |
| BC-132 | 11 lbs. |
| BC-217 | 8 lbs. |
| BC-225 | 10 lbs. |
| BC-232 | 11 lbs. |

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** BC-232-VOLT-EL-FBP140X-EB81-U<br>Notes: | **Type:** I<br>WK08-1600 |

# COOPER LIGHTING - SURE-LITES®

## DESCRIPTION

In the event of AC power failure, the Sure-Lites FBP Emergency Battery Pack automatically switches to emergency mode. It maintains illumination of one or two lamps for a minimum of 90 minutes. UL listed for field retrofit installation and conforms to UL 924.

| Catalog # | Type |
|---|---|
| Project | |
| Comments | |
| Prepared by | Date |

## SPECIFICATION FEATURES

**Electronic**

Dual Voltage Input 120/277 VAC, 60Hz

Universal Voltage Input 120-277 VAC, 50/60Hz (FBP240HU)

Solid-state Charger

Overload/Short Circuit Protection

Test Switch/Power Indicator Light

**Battery**

Sealed Nickel Cadmium

Maintenance-free, Long Life

Full Recharge Time, 24 hours (max.)

**Code Compliance**

UL 924 Listed

UL Listed for Retrofit/Field Installation

Life Safety NFPA 101

NEC/OSHA

Most State and Local Codes

Chicago Approved

**Features**

Provides a minimum of 90 minutes of emergency illumination

Can be installed inside or on top of fixture

Low Profile Housing (FBP450LP)

Easy-to-follow instructions make installation quick and simple

May be used with switched or unswitched fixtures

Self-Diagnostics (FBP240HSD)

One lamp operation (FBP240D, FBP140X, FBP240U, FBP450LP); One or two lamp operation (FBP240M, FBP240H, FBP240C, FBP240HU, FBP240HSD)

Compatible with many different lamp types–consult ordering information below or consult your Cooper Lighting Representative regarding specific applications

Compatible with many ballast types including standard, rapid start, slimline, instant start, energy saving, dimming, and electronic AC ballasts–consult your Cooper Lighting Representative regarding specific applications

## *FBP SERIES

**FLUORESCENT EMERGENCY BATTERY PACK**

**Emergency Lighting**

## ORDERING INFORMATION

| Catalog No. | Lamp Type | Number of Lamps Operated in Emergency Mode | Initial Lumens |
|---|---|---|---|
| FBP140X | 20W-40W, 2'-4', T8-T12 U-shaped, circleline, 2D, energy saving, rapid start (4-pin, 2G11) long compact fluorescent | One | 350-450 |
| FBP240U | 17W-215W, 2'-8', T8-T12 HO, VHO, U-shaped, circleline, 2D, energy saving, rapid start (4-pin, 2G11) long compact fluorescent | One | 600-700 |
| FBP240M | 17W-215W, 2'-8', T8-T12 HO, VHO, U-shaped, circleline, 2D, energy saving, rapid start (4-pin, 2G11) long compact fluorescent | One–20W to 215W (2'-8')<br>One–20W to 39W long compact fluorescent<br>One or Two–20W to 40W (2'-4') | 600-700 |
| FBP240H | 17W-215W, 2'-8', T8-T12 HO, VHO, U-shaped, circleline, energy saving, rapid start (4-pin, 2G11 or G24q) long compact fluorescent | One or Two - 17W to 24W<br>One or Two - 32W to 40W (2'-4')<br>One - 40W to 215W (5'-8')<br>One or Two -18W to 39W long compact fluorescent<br>One or Two - 18W to 32W 4-Pin compact fluorescent | 1100-1400 (700-1000 for long compact fluorescent) |
| FBP240HSD | 17W-215W, 2'-8', T8-T12 HO, VHO, U-shaped, circleline, energy saving, rapid start (4-pin, 2G11, G24q, or GX24q) twin, quad and triple twin-tube compacts | One or Two-17W to 40W (2"-4")<br>One-40W to 215W (5'-8')<br>One or Two-18W to 39W long compact fluorescent<br>One-40W to 55W long compact fluorescent<br>One or Two-18W to 42W 4-pin compact fluorescent | 1100-1400 (700-1000 for long compact fluorescent) |
| FBP240HU | 17W-215W, 2'-8', T8-T12 HO, VHO, U-shaped, circleline, energy saving, rapid start (4-pin, 2G11, G24q, or GX24q) twin, quad and triple twin-tube compacts | One or Two-17W to 40W (2"-4")<br>One-40W to 215W (5'-8')<br>One or Two-18W to 39W long compact fluorescent<br>One-40W to 55W long compact fluorescent<br>One or Two-18W to 42W 4-pin compact fluorescent | 1100-1400 (700-1000 for long compact fluorescent) |
| *FBP240C | 6W-28W tubular without integral starter, 13W-42W 4-pin twin, quad, or triple twin-tube compact fluorescent without integral starters | One or Two–6W to 28W tubular<br>One or Two–13W to 39W or One–42W 4-pin compact fluorescent | 300-750 |
| *FBP240D | 18W-26W quad tube with integral starter in two pin base | One–18W to 26W compact fluorescent | 300-650 |
| *FBP3500 | 17W-215W, 2'-8', T-8-T12 HO, VHO, U-shaped circleline, energy saving and (4-pin, 2G11, G24q, or GX24q) twin, quad and triple twin-tube compacts | One or Two-17W to 40W (2"-4")<br>One-40W to 215W (5'-8')<br>One or Two-18W to 39W long compact fluorescent<br>One-40W to 55W long compact fluorescent<br>One or Two-18W to 42W 4-pin compact fluorescent | 1450-3500 |
| FBP450LP | 32W, 4', T8 | One | 450 |

*FBP240C, FBP240D and FBP3500 are only models with conduit.

## ORDERING INFORMATION

**SAMPLE NUMBER: FBP140X**

**See chart above**

**Accessories** (Order separately)

**FBP1WBC**=Wire Bundle Cover for external mount applications (2 required)

**Energy Data**

| Model No. | Input Power 120V |
|---|---|
| FBP140X | 4.5W |
| FBP240U | 5.3W |
| FBP240M | 5.3W |
| FBP240H | 5.8W |
| FBP240HSD | 4.0W |
| FBP240HU | 6.0W |
| FBP240C | 5.3W |
| FBP240D | 3.5W |
| FBP3500 | 8.0W |
| FBP450LP | 1.5W |

**COOPER LIGHTING**

ADX041643

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** BC-232-VOLT-EL-FBP140X-EB81-U Notes: | **Type:** I WK08-1600 |



## TECHNICAL DATA

**Solid-State Charger**

Unit is supplied with a 120/277 VAC, voltage regulated solid-state charger, immediately upon restoration of AC current after a power failure, the charger provides a high charge rate. The charge circuit reacts to the condition of the battery and alters the rate of charge in order to maintain peak battery capacity and maximize battery life. Solid-state construction recharges the battery following a power failure and prevents over and under charging.

**Solid-State Switching**

The switching circuit is designed to detect voltage irregularities and automatically switches lamp(s) into emergency operation. Upon restoration of the AC current, the lamp(s) will switch back to AC operation and the charger will automatically go into charge mode.

**Test Switch/Charge Indicator**

Easy-to-install test switch simulates interruption of AC power and illuminates the fluorescent lamp(s). LED charge indicator light indicates battery charger operation.

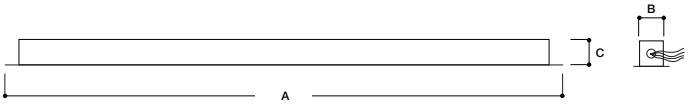
**Battery**

High temperature nickel cadmium battery pack is standard.

**Warranty**

All Sure-Lites products are backed by a firm one year warranty against defects in material and workmanship (excluding lamps).

## DIMENSIONS




| Model | Dimensions | | |
|---|---|---|---|
| | A | B | C |
| FBP140X | 9.4″ | 2.4″ | 1.5″ |
| FBP240U | 9.4″ | 2.4″ | 1.5″ |
| FBP240M | 9.4″ | 2.4″ | 1.5″ |
| FBP240H | 13.3″ | 2.4″ | 1.5″ |
| FBP240HU | 13.3″ | 2.4″ | 1.5″ |
| FBP240HSD | 13.3″ | 2.4″ | 1.5″ |
| FBP240C | 9.4″ | 2.4″ | 1.5″ (Flex=28″L) |
| FBP240D | 9.4″ | 2.4″ | 1.5″ (Flex=28″L) |
| FBP3500 | 16.3″ | 5.5″ | 1.7″ (Flex=28″L) |
| FBP450LP | 14.1″ | 1.5″ | 1.0″ |

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** HPIP-TM-250-MT-4-F1-U<br>Notes: | **Type:** J<br>WK08-1600 |

# COOPER LIGHTING - LUMARK®

energy solutions

**DESCRIPTION**

The IMPACT Trapezoid full cutoff wall luminaire makes an ideal complement to site design. U.L. and CUL Listed for wet locations in down mount applications and damp locations in up mounted applications.

Rugged construction and full cutoff classified optics provide facade and security lighting for light restricted zones surrounding schools, office complexes, apartments, and recreational facilities.

| | | Type |
|---|---|---|
| Catalog # | | |
| Project | | |
| Comments | | Date |
| Prepared by | | |

**SPECIFICATION FEATURES**

**Construction**
Durable two-piece die-cast aluminum housing and removable hinged door frame envelopes the optical enclosure from nature's elements. 1/8" clear, heat and impact resistant tempered flat glass lens combined with molded silicone gasket seals the integrated optical assembly to ensure peak optical performance. Captive stainless steel hardware secures the removable hinged door allowing for ease of installation and maintenance.

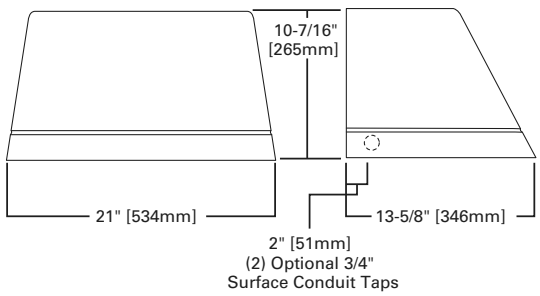
**Optical Systems**
Custom engineered highly reflective anodized aluminum reflectors provide high efficiency Type II, Type III and Type IV distributions. All Impact Wall Series reflectors classify as IESNA full cutoff in downlight only applications. Optional silk screened house-side flat glass shield provides decreased wall brightness. Optical assemblies are offered standard with horizontal medium or mogul-based metal halide [MH/MP], high pressure sodium [HP] or energy efficient 4-pin compact fluorescent [CF] lamps. Available 10% or 30% uplight options allow for architectural highlighting of building details.

**Electrical**
Integral hard mount electrical components are safely secured and grounded within the die-cast aluminum housing for optimal heat sinking and extended component life. All wiring is extended through a silicone grommet at the back of the housing to prevent entry of debris, moisture, dust and insects. UL listed high power factor ballasts are Class H insulation rated [metal halide: 150, 175W, 200, 250, 320, 350, 400W [-30°C /-20°F], [high pressure sodium: 250W, 400W [-40°C/-40°F]. High efficiency ballasts are available in a multitude of voltage configurations including 120V, 208V, 240V, 277V, 347V and 480V. Compact fluorescent high power factor ballasts are Class P insulation rated for 120V-277V and have a starting temperature of -18°C / 0°F.

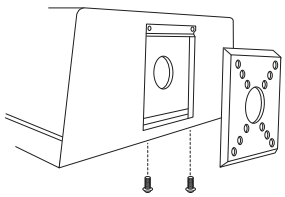
**Mounting**
Lumark's "Hook-N-Lock" gasketed and zinc plated rigid universal mounting assembly fits directly to a 4" junction box or wall. The "Hook-N-Lock" system allows for fast installation and mounting in both traditional downlighting [wet location] or inverted uplighting [damp location only] mounting positions.

**Ratings**
The Impact Wall Series is UL1598 wet location listed. Suitable for wet locations [damp location listed in inverted (lens up) orientation].

**Finish**
Housing and door are protected with a 5-stage premium TGIC dark bronze polyester powder coat paint. Premium TGIC powder coat finishes withstand extreme climate changes while providing optimal color and gloss retention over the fixture's installed life. Optional premium colors include black, white, grey, dark platinum and graphite metallic.




**HOOK-N-LOCK MOUNTING**



Mounting attachment included.
J-Box not included.

## IPTM
IMPACT
TRAPEZOID
MEDIUM

**175W - 400W**
**Pulse Start Metal Halide**
**High Pressure Sodium**
**Metal Halide**
**32 - 120W**
**Compact Fluorescent**

**FULL CUTOFF**
**WALL MOUNT LUMINAIRE**

**TECHNICAL DATA**

UL1598 Listed, CUL Listed
25°C Ambient Temperature,
40°C w/HAB Option
Down Mounted - Wet Location
Up Mounted - Damp Location
EISA Compliant Ⓔ

**ENERGY DATA**

**High Reactance Ballast Input Watts**
150W MP HPF (185 Watts)
250W HPS HPF (300 Watts)
400W HPS HPF (465 Watts)

**CWA Ballast Input Watts**
200W MP CWA (227 Watts) Ⓔ
250W MP CWA (283 Watts) Ⓔ
320W MP CWA (365 Watts) Ⓔ
350W MP CWA (400 Watts) Ⓔ
400W MP CWA (452 Watts) Ⓔ

**Electronic Ballast Input Watts**
32W CF HPF (36 Watts)
42W CF HPF (46 Watts)
57W CF HPF (59 Watts)
60W CF HPF (70 Watts)
70W CF HPF (75 Watts)
85W CF HPF (98 Watts)
120W CF HPF (139 Watts)

**SHIPPING DATA**

**Approximate Net Weight:**
42 lbs. (19 kgs.)

IMPACT Cutoff Wall Luminaires

DARK SKY COMPLIANT FCO Full Cutoff

**NOTE:** In down light applications only.

IESNA SYSTEMS CERTIFIED

COOPER Lighting
www.cooperlighting.com

**Specifications and Dimensions subject to change without notice.**
Consult your representative for additional options and finishes.

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| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** HPIP-TM-250-MT-4-F1-U<br>Notes: | **Type:** **J**<br>WK08-1600 |

**ORDERING INFORMATION**

**IPTM** IMPACT TRAPEZOID MEDIUM

**Sample Number: MPIP-TM-400-4-MT-LL**

**Lamp Type** [1]
- **MP** =Pulse Start Metal Halide
- **MH** =Metal Halide [1]
- **HP** =High Pressure Sodium
- **CF** =Compact Fluorescent

**Fixture Type**
- **IP** =Impact

**Fixture Shape**
- **TM** =Trapezoid Medium

**Lamp Wattage** [2]

MP
- **150** =150W
- **200** =200W
- **250** =250W
- **320** =320W
- **350** =350W
- **400** =400W

MH [1]
- **175** =175W
- **250** =250W
- **400** =400W

HP
- **250** =250W
- **400** =400W

Compact Fluorescent [3]
- **60** =(1) 60W
- **70** =(1) 70W
- **85** =(1) 85W
- **96** =(3) 32W
- **114** =(2) 57W
- **120** =(1) 120W
- **126** =(3) 42W

**Distribution**

HID
- **3** =Type III
- **4** =Type IV

CF
- **2** =Type II [3]
- **4** =Type IV [3]

**Voltage** [4, 5]
- **120V** =120V
- **208V** =208V
- **240V** =240V
- **277V** =277V
- **347V** =347V [4]
- **480V** =480V
- **DT** =Dual-Tap
- **MT** =Multi-Tap, wired 277V
- **TT** =Triple-Tap, [4] wired 347V
- **E** =Electronic (120-277V)

**Options**
- **F1** =Single Fuse, Specify Voltage (120, 277, or 347V)
- **F2** =Double Fuse, Specify Voltage (208 or 240V)
- **PE** =Button Photocontrol (Specify Voltage)
- **BK** =Black
- **WH** =White
- **AP** =Grey
- **GM** =Graphite Metallic
- **DP** =Dark Platinum
- **LL** =Lamp Included (Must Specify Wattage on CF)
- **TR** =Tamper Resistant Hardware (2 Screws)
- **UP10** =10% Uplight
- **UP30** =30% Uplight [6]
- **HS** =House-side Shield Glass [7]
- **SC** =Surface Conduit entry Taps (2) 3/4" NPT [8]
- **HAB** =High Ambient 40 Degrees C Fixture (HID Lamp) [9]
- **CSW** =Circuit Switching [10]
- **DIM** =CF Dimming Ballast (CF Lamp/Must Specify Number of Lamps) [11]
- **FR** =Frosted Glass [12]
- **Q** =Quartz Restrike (1)T4 Lamp [13, 14]
- **EM** =Emergency Quartz Restrike (1) T4 Lamp with Time Delay Relay [13, 14]
- **EM/SC** =Emergency Separate Circuit (1) T4 Lamp [13, 14, 15]
- **QMR** =Quartz Restrike (1) MR16 Lamp [14, 16]
- **2QMR** =Quartz Restrike (2) MR16 Lamps [14, 16]
- **2QMR/SC** =Quartz Restrike (1) MR16 Lamp and (1) Emergency Separate Circuit MR16 Lamp [14, 15, 16]
- **EMMR** =Emergency Quartz Restrike (1) MR16 Lamp with Time Delay Relay [14, 16]
- **2EMMR** =Emergency Quartz Restrike (2) MR16 Lamps with Time Delay Relay [14, 16]
- **EM/SC/MR** =Emergency Separate Circuit (1) MR16 Lamp [14, 15, 16]
- **2EM/SC/MR** =Emergency Separate Circuit (2) MR16 Lamps [14, 15, 16]
- **2EMMR/SC** =Emergency Quartz Restrike with Time Delay Relay (1) MR16 and (1) MR16 Emergency Separate Circuit Lamp [14, 15, 16]
- **EM/SC/12V** =Emergency Separate Circuit 12V Low Voltage (1) MR16 Lamp [14, 15, 17]
- **2EM/SC/12V** =Emergency Separate Circuit 12V Low Voltage (2) MR16 Lamps [14, 15, 17]
- **EMI40** =Emergency Cold Temperature (UL924 Listed) Power Pack -18 degrees C/0 degrees F, (1) CF Lamp, Specify Voltage [18]
- **EMI40-2L** =Emergency Cold Temperature (UL924 Listed) Power Pack (2) CF Lamps -18 degrees C/0 degrees F. (Specify Voltage) [19]
- **CF-EM** =Emergency CF Power Pack (UL924 Listed) (1) CF Lamp. 0 degrees C/32 degrees F. Specify Voltage. [20]
- **CF-EM/2L** =Emergency CF Power Pack (UL924 Listed) (2) CF Lamps, 0 Degrees C/32 Degrees F. Specify Voltage [21]

**Accessories**
- **WGITM** =Wire Guard [22]
- **VS/ITM** =Vandal Resistant Shield [23]

**Notes:**

1 Lamp type not available in all wattages - see wattage table. 175W, 250W and 400W available for non-U.S. markets only.
2 All HID Metal Halide lamps are mogul-base, reduced envelope ED-28 except 200W Pulse Start Metal Halide is T15. All HID High Pressure Sodium lamps are mogul-base ED-18.
3 Type II - 60, 70, 85, 96, 114 or 126W CF only. Type IV - 60, 85, 120W CF only. In cold temperatures, compact fluorescent lamps produce lower illumination levels.
4 Products also available in non-US voltages and 50HZ for international markets. Consult your Cooper Representative for availabiltiy and ordering information. 88% EISA Compliant MP fixtures not available in 347V and TT voltages.
5 Not available with SC option teamed with 320-400W, not available with 480V.
6 Type III only. Not available with CF lamps.
7 Not available with 320 thru 400W.
8 Not available in Type IV 320V through 400W. Not available in Type III with F1, F2 with 320W through 400W.
9 Rated for 40°C for 250W and below fixture. Not available with CF lamps..
10 Each ballast independently wired. Available on 96, 114 or 126W CF wattages.
11 Specify CF option 96 or 126W, not available with HS, FR, or VS options. Must specify number of lamps.
12 Not available with 320W thru 400W or 114 or 126W CF options.
13 (1) 120V Lamp, 150W maximum quartz lamp. Utility power may need to cycle to allow HID lamp to cool in warm climates.
14 Emergency lamps supplied by others.
15 Emergency lamp leads out of the back of the unit to auxillary 120V.
16 (1) or (2) 120V Lamps. GU10 base, 50W maximum each. Lamps supplied by others.
17 Power supplied by low voltage DC source (supplied by others). (1) or (2) 12V bi-pin socket GU5.3 base lamps, 35W maximum each.
18 Specify 120 or 277V, (-18°C) minimum temperature, not available with UP10 or CSW option, 70W CF maximum.
19 Specify 120 or 277V, (-18°C) minimum temperature, supports (2) 32W CF lamps, not available with UP10 or CSW option.
20 Specify 120 or 277V, (0°C) minimum, not available with UP10 or CSW option, 70W CF maximum.
21 Specify 120 or 277V, (0°C) minimum, not available with UP10 or CSW option, supports (2) 32W CF lamps.
22 Not available with VS option.
23 Not available with 320 thru 400W. Not available with wire guard.

| VOLTAGE CHART | |
|---|---|
| DT=Dual-Tap | 120/277 (wired 277V) |
| MT=Multi-Tap | 120/208/240/277 (wired 277V) |
| TT=Triple-Tap | 120/277/347 (wired 347V) |
| E=Electronic Ballast (CF only) | 120-277V (wired 277V) (50/60 HZ) |

| LAMP TYPE | WATTAGE | DISTRIBUTION |
|---|---|---|
| Pulse Start Metal Halide (MP) | 150, 200, 250, 320, 350, 400W | TYPE III, IV |
| Metal Halide (MH) | 175, 250, 400W | TYPE III, IV |
| High Pressure Sodium (HP) | 250, 400W | TYPE III, IV |
| Compact Fluorescent (CF) | (1) 60, (1) 70, (1) 85, (1) 120, (2) 57, (3) 32, (3) 42W | TYPE II, IV |

**STOCK SAMPLE NUMBER**

**SAMPLE NUMBER: MPITM25**

**MP** — **Lamp Type** — **MP** =Pulse Start Metal Halide

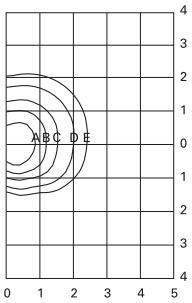
**ITM** — **Fixture Type** — **ITM** =Impact Trapezoid Medium

**Lamp Wattage**
- **25** =250W
- **32** =320W
- **40** =400W

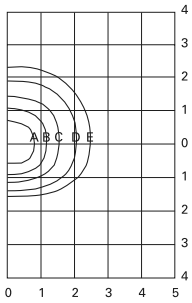
**Notes:**
Standard Type IV distribution, Bronze and Multi-Tap. Options not available with stock products. Refer to standard order information to add options. Refer to In-Stock Guide for availability.

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** HPIP-TM-250-MT-4-F1-U<br>Notes: | **Type:** **J**<br>WK08-1600 |

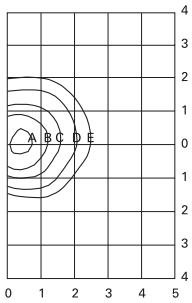
**PHOTOMETRICS [Complete IES files available at www.cooperlighting.com]**




**CFIP-TM-126-2**
126-Watt CF
[3] 9,600-Lumen Clear Lamp
Type II



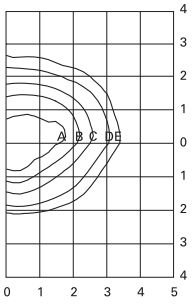

**CFIP-TM-114-2**
114-Watt CF
[2] 8,600-Lumen Clear Lamp
Type II



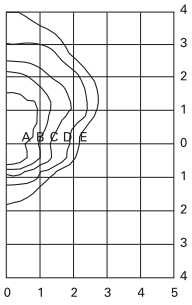

**CFIP-TM-85-2**
85-Watt CF
6,000-Lumen Clear Lamp
Type II

**FOOTCANDLE TABLE**
Select mounting height and read across for footcandle values of each isofootcandle line. Distance in units of mounting height.

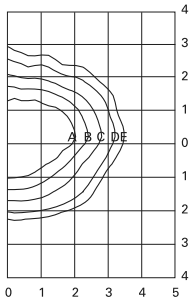
| Mounting Height | Footcandle Values for Isofootcandle Lines | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| **CFIP-TM-126-2 / CFIP-TM-114-2 / CFIP-TM-85-2** | | | | | |
| 18' | 2.46 | 1.23 | 0.62 | 0.25 | 0.12 |
| **20'** | **2.00** | **1.00** | **0.50** | **0.20** | **0.10** |
| 25' | 1.28 | 0.64 | 0.32 | 0.13 | 0.06 |




**MPIP-TM-150-3**
150-Watt MP
14,000-Lumen Clear Lamp
Type III



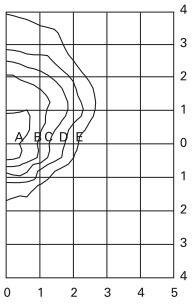

**MPIP-TM-150-4**
150-Watt MP
14,000-Lumen Clear Lamp
Type IV



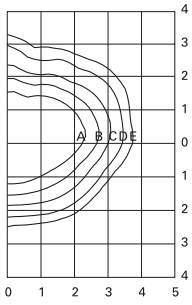

**MPIP-TM-250-3**
250-Watt MP
23,750-Lumen Clear Lamp
Type III

**FOOTCANDLE TABLE**
Select mounting height and read across for footcandle values of each isofootcandle line. Distance in units of mounting height.

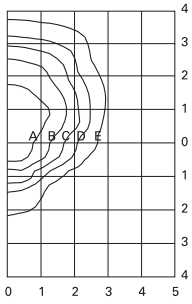
| Mounting Height | Footcandle Values for Isofootcandle Lines | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| **MPIP-TM-150-3 / MPIP-TM-150-4 / MPIP-TM-250-3** | | | | | |
| 18' | 2.46 | 1.23 | 0.62 | 0.25 | 0.12 |
| **20'** | **2.00** | **1.00** | **0.50** | **0.20** | **0.10** |
| 25' | 1.28 | 0.64 | 0.32 | 0.13 | 0.06 |




**MPIP-TM-250-4**
250-Watt MP
23,750-Lumen Clear Lamp
Type IV




**MPIP-TM-400-3**
400-Watt MP
40,000-Lumen Clear Lamp
Type III




**MPIP-TM-400-4**
400-Watt MP
40,000-Lumen Clear Lamp
Type IV

**FOOTCANDLE TABLE**
Select mounting height and read across for footcandle values of each isofootcandle line. Distance in units of mounting height.

| Mounting Height | Footcandle Values for Isofootcandle Lines | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| **MPIP-TM-400-3** | | | | | |
| 18' | 2.46 | 1.23 | 0.62 | 0.25 | 0.12 |
| **20'** | **2.00** | **1.00** | **0.50** | **0.20** | **0.10** |
| 25' | 1.28 | 0.64 | 0.32 | 0.13 | 0.06 |
| **MPIP-TM-250-4 / MPIP-TM-400-4** | | | | | |
| 18' | 6.15 | 2.46 | 1.23 | 0.62 | 0.25 |
| **20'** | **5.00** | **2.00** | **1.00** | **0.50** | **0.20** |
| 25' | 3.20 | 1.28 | 0.64 | 0.32 | 0.13 |

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** PD6-H142E-6HC<br>Notes: | **Type:** **M**<br>WK08-1600 |

pds
**by Portfolio™**

**CATALOG#:**

**TYPE:**

## DESCRIPTION

The Performance Downlight System (PDS) combines visually comfortable optics, energy efficiency and modularity with availability. Three key elements—reflector, socket adapter and frame—combine to form a feature-packed luminaire.

PDS reflectors boast equal 65° cutoff to lamp and lamp image. Low-iridescent clear reflector with white-painted self flange is standard.

PDS socket adapters provide modular flexibility and assure proper lamp orientation and lamp quantity to be used with each reflector. Lamp positions lock into place ensuring photometric performance. Electronic ballasts are standard.

PDS universal frames are dedicated to each aperture size and are used for compact fluorescent, metal halide and incandescent sources. No Fuss Bar Hangers™ speed installation of frames, minimizing labor costs on the job site.

## SPECIFICATION FEATURES

**A–Reflector**
One-piece optical reflector minimizes internal losses and light leaks. 5/8" overlapping flange provides gap-free aperture. Standard finish is low-iridescent clear with white painted self-flange. Torsion spring mounting pulls flange tight to ceiling.

**B–Baffles**
One-piece black or white baffle. Upper specular reflector maximizes light output. Self- flange of each is painted white.

**C–Socket Cap**
One-piece folded metal cap. Positive connection between cap and reflector.

**D–Socket and Socket Adapter**
4-pin G24q base with stainless steel spring for positive retention. Guide post inserts rejects two-pin bases to ensure proper lamping. Multi-voltage ballast accommodates 120V thru 277V.

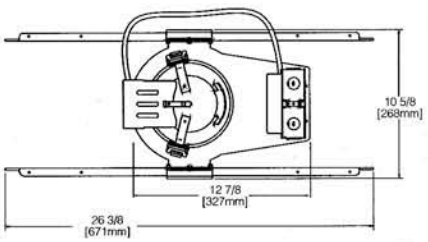
**E–Frame**
Galvanized steel frame with 1/2" plaster lip is standard. Accommodates ceilings up to 2" (50mm) thick.

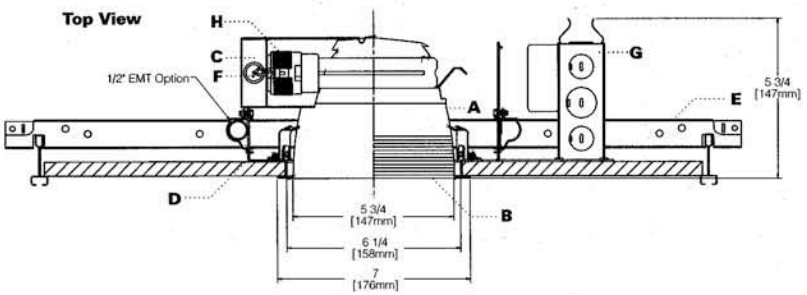
**F–No Fuss Bar Hanger**
Bar hanger locks to T-bar with a screwdriver or pliers. Centering mechanism allows consistent centering of fixtures. 2 1/2" vertical adjustment. Can be used with 1/2" EMT

**G–Junction Box**
Galvanized with (6) 1/2" and (2) 3/4" KOs.

**Insulation Detector**
Thermal protection deactivates unit if improper lamp type or wattage is used, or if insulation is placed too close to the fixture.

**Labels**
CUL listed, damp location, IBEW union made.




## ORDERING INFORMATION

**SAMPLE NUMBER: PD6-H142E-6HC**

Order frame, socket adapter and reflector separately for a complete unit.

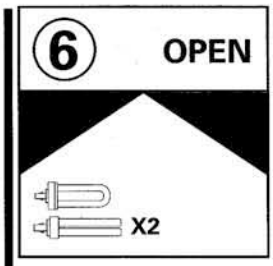
| Housing | Socket Adapter | Reflector |
|---|---|---|
| **PD6** | H142E | 6HC |

**PD6**

**H142E**=(1) 42, 32 or 26W Triple tube lamp, multi- voltage ballast, Horizontal Module
**H226E**=(2) 26W Quad Tube, multi-voltage ballast, Horizontal Module
**H126E**=(1) 26W Quad Tube, multi-voltage ballast, Horizontal Module
**H218E**=(2) 18W Quad Tube, multi-voltage ballast, Horizontal Module
**H118E**=(1) 18W Quad Tube, multi-voltage ballast, Horizontal Module

**6HC** =6" Horizontal Clear
**6HBB** =6" Horizontal Black Baffle
**6HWB** =6" Horizontal White Baffle

**COOPER LIGHTING**




# PD6-H142
# H226, H126
# H218, H118

**42W MAX TRIPLE**
**(2) 26W MAX QUAD**
Compact Fluorescent

**6"DOWNLIGHT**

## Energy Data

**H142E**

| | Voltage | Lamp wattage | System wattage | Open circuit |
|---|---|---|---|---|
| Input | 120V, | 42W : | 47.0W, | 0.39A |
| | 120V, | 32W : | 34.5W, | 0.30A |
| | 120V, | 26W : | 26.0W, | 0.22A |
| | 277V, | 42W : | 47.0W, | 0.13A |
| | 277V, | 32W : | 34.5W, | 0.13A |
| | 277V, | 26W : | 26.0W, | 0.09A |

Power Factor: >.98
THD: <10%:
Sound Rating: A
Min Starting Temp.: -0°C (20°F)

**H226E**

| | Voltage : | System wattage | Open circuit |
|---|---|---|---|
| Input | 120V : | 50.0W, | 0.45A |
| | 277V : | 50.0W, | 0.20A |

Power Factor: >.99
THD: <10%:
Sound Rating: A
Min Starting Temp.: -0°C (20°F)

**H126E**

| | Voltage : | System wattage | Open circuit |
|---|---|---|---|
| Input | 120V : | 27.0W, | 0.22A |
| | 277V : | 27.0W, | 0.09A |

Power Factor: >.99
THD: <10%:
Sound Rating: A
Min Starting Temp.: -0°C (20°F)

**H218E**

| | Voltage : | System wattage | Open circuit |
|---|---|---|---|
| Input | 120V : | 37.0W, | 0.32A |
| | 277V : | 37.0W, | 0.14A |

Power Factor: >.99
THD: <10%:
Sound Rating: A
Min Starting Temp.: -0°C (20°F)

**H118E**

| | Voltage : | System wattage | Open circuit |
|---|---|---|---|
| Input | 120V : | 19.0W, | 0.15A |
| | 277V : | 19.0W, | 0.07A |

Power Factor: >.99
THD: <10%:
Sound Rating: A
Min Starting Temp.: -0°C (20°F)

**ADV995024**

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** PD6-H142E-6HC<br>Notes: | **Type:** **M**<br>WK08-1600 |



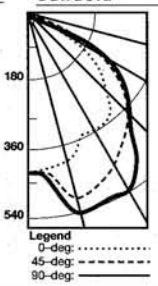
## PHOTOMETRICS

### PD6-H142E-6HC

**Test No. H22343**

Lamp=32W PLT Compact Fluorescent
Lumens=2400
Spacing Criteria=1.3, 1.6
Efficiency=53.6%

**Candela**




| Deg. | CD |
|---|---|
| 90 | 0 |
| 85 | 2 |
| 75 | 10 |
| 65 | 88 |
| 55 | 298 |
| 45 | 378 |
| 35 | 497 |
| 25 | 535 |
| 15 | 543 |
| 5 | 441 |
| 0 | 421 |

**Cone of Light**

| Distance to Illuminated Plane | Initial Nadir Footcandles | Beam Diameter |
|---|---|---|
| 5'6" | 14 | 8' |
| 6'6" | 10 | 9'6" |
| 8'0" | 7 | 11'6" |
| 10'0" | 4 | 14'6" |
| 12'0" | 3 | 17'6" |
| 14'0" | 2 | 20'6" |

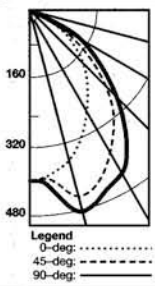
Beam diameter is to 50% of maximum footcandles, rounded to the nearest half-foot. Footcandle values are initial, apply appropriate light loss factors where necessary.

### PD6-H142E-6HBB

**Test No. H22348**

Lamp=32W PLT Compact Fluorescent
Lumens=2400
Spacing Criteria=1.1, 1.5
Efficiency=39.0%

**Candela**




| Deg. | CD |
|---|---|
| 90 | 0 |
| 85 | 1 |
| 75 | 5 |
| 65 | 50 |
| 55 | 180 |
| 45 | 282 |
| 35 | 402 |
| 25 | 459 |
| 15 | 484 |
| 5 | 410 |
| 0 | 394 |

**Cone of Light**

| Distance to Illuminated Plane | Initial Nadir Footcandles | Beam Diameter |
|---|---|---|
| 5'6" | 13 | 7' |
| 6'6" | 9 | 8'6" |
| 8'0" | 6 | 10'6" |
| 10'0" | 4 | 13' |
| 12'0" | 3 | 15'6" |
| 14'0" | 2 | 18' |

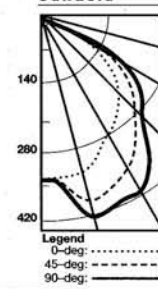
Beam diameter is to 50% of maximum footcandles, rounded to the nearest half-foot. Footcandle values are initial, apply appropriate light loss factors where necessary.

### PD6-H142E-6HC

**Test No. H22344**

Lamp=26W PLT Compact Fluorescent
Lumens=1800
Spacing Criteria=1.2, 1.6
Efficiency=55.5%

**Candela**




| Deg. | CD |
|---|---|
| 90 | 0 |
| 85 | 2 |
| 75 | 8 |
| 65 | 74 |
| 55 | 233 |
| 45 | 291 |
| 35 | 382 |
| 25 | 415 |
| 15 | 424 |
| 5 | 356 |
| 0 | 340 |

**Cone of Light**

| Distance to Illuminated Plane | Initial Nadir Footcandles | Beam Diameter |
|---|---|---|
| 5'6" | 11 | 7' |
| 6'6" | 8 | 8'6" |
| 8'0" | 5 | 10'6" |
| 10'0" | 3 | 13' |
| 12'0" | 2 | 15'6" |
| 14'0" | 1 | 18' |

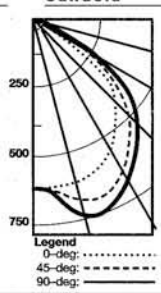
Beam diameter is to 50% of maximum footcandles, rounded to the nearest half-foot. Footcandle values are initial, apply appropriate light loss factors where necessary.

### PD6-H226E-6HC

**Test No. H22346**

Lamp=(2) 26W Quad Compact Fluorescent
Lumens=1800
Spacing Criteria=1.3, 1.4
Efficiency=42.9%

**Candela**




| Deg. | CD |
|---|---|
| 90 | 0 |
| 85 | 3 |
| 75 | 9 |
| 65 | 48 |
| 55 | 312 |
| 45 | 472 |
| 35 | 596 |
| 25 | 704 |
| 15 | 748 |
| 5 | 650 |
| 0 | 636 |

**Cone of Light**

| Distance to Illuminated Plane | Initial Nadir Footcandles | Beam Diameter |
|---|---|---|
| 5'6" | 21 | 7' |
| 6'6" | 15 | 8'6" |
| 8'0" | 10 | 10'6" |
| 10'0" | 6 | 13' |
| 12'0" | 4 | 15'6" |
| 14'0" | 3 | 18' |

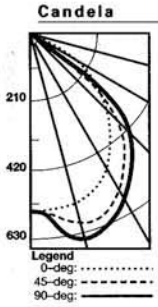
Beam diameter is to 50% of maximum footcandles, rounded to the nearest half-foot. Footcandle values are initial, apply appropriate light loss factors where necessary.

### PD6-H218E-6HC

**Test No. H22345**

Lamp=(2) 18W Quad Fluorescent
Lumens=1250
Spacing Criteria=1.2, 1.4
Efficiency=53.1%

**Candela**




| Deg. | CD |
|---|---|
| 90 | 0 |
| 85 | 2 |
| 75 | 7 |
| 65 | 40 |
| 55 | 259 |
| 45 | 428 |
| 35 | 526 |
| 25 | 616 |
| 15 | 648 |
| 5 | 564 |
| 0 | 554 |

**Cone of Light**

| Distance to Illuminated Plane | Initial Nadir Footcandles | Beam Diameter |
|---|---|---|
| 5'6" | 18 | 7' |
| 6'6" | 13 | 8'6" |
| 8'0" | 9 | 10'6" |
| 10'0" | 6 | 13' |
| 12'0" | 4 | 15'6" |
| 14'0" | 3 | 18' |

Beam diameter is to 50% of maximum footcandles, rounded to the nearest half-foot. Footcandle values are initial, apply appropriate light loss factors where necessary.

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** 8TIA-832G-UNV-L8835-EB81-RIF1 Notes: | **Type:** **N** WK08-1600 |

# METALUX®

## DESCRIPTION

The F-Bay I8 series is an outstanding solution for high mounting height industrial or retail applications. The F-Bay I8 optic has been optimized to provide maximum performance from the T8 lamps. Optional uplight component is provided to enable excellent ceiling uniformity. The I8's high lumen package allows the benefits of fluorescent to be applied at high mounting heights that were traditionally exclusive to H.I.D. The primary benefits include exceptional color rendering, high system efficacy, 95% lumen maintenance, long lamp life, instant on/instant re-strike, economical dimming, and uniform brightness control. Primary applications include "big box" retail, shopping malls, light industrial, school gymnasiums, etc.

| | | | |
|---|---|---|---|
| **Catalog #** | | **Type** | |
| **Project** | | | |
| **Comments** | | **Date** | |
| **Prepared by** | | | |

## SPECIFICATION FEATURES

**A···Construction**

Specification grade full body housing, end plates and socket tracks are die formed 20 gauge cold rolled steel in 4' or 8' lengths. The housing features an integral ballast channel that adds strength and provides numerous KO's for easy installation. Die formed high reflectance internal reflectors for efficiency and control. Uplight slots available as an option for nominal 8% uplight component.

**B···Electrical**

Ballasts are Class "P" and are positively secured by mounting bolts. Rotor-lock Bi-Pin lampholders. An optional top ballast access plate enables service from above without disturbing the internal optics. Optional modular power receptacle meets UL2459 and NEC 410.73 and is UL/cUL rated for make and break under load from outside the luminaire to speed maintenance. UL/CUL listed. Suitable for damp locations.

**C···Finish**

Electrostatically applied baked white enamel finish is preceded by a multistage cleaning cycle, iron phosphate coating with rust inhibitor.

**D···Downlight/Uplight Optics**

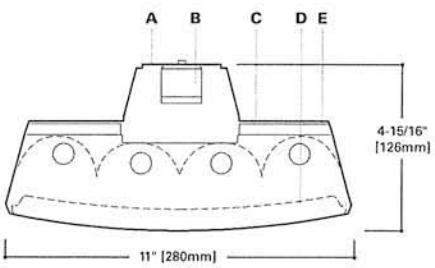
Optical modules are fully enclosed inside housing to protect against damage. Die formed reflectors are faceted with two optical distributions – medium and wide. Medium beam optical modules utilize 95% specular Miro powder coated finish. Open downlight design optimizes performance. An optional attractive thin blade white baffle adds longitudinal shielding. A clear or frosted white acrylic lens is also available. An optional heavy duty wireguard can be used with or without the lens or baffle. The uplight option is provided to enable ceiling uniformity. Latched retention of optics (safety leader restraints) allows for easy access.

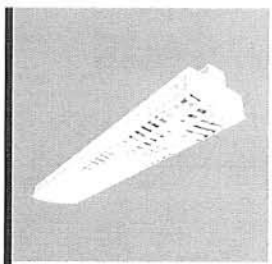
**E···Mounting**

The F-Bay I8 series is ideally suited for surface, suspension mounting with optional wire hook and chain set, stem or cable mounting. Top connector box mounting is also available. Narrow 11" housing allows mounting within 12" horizontally from the nearest edge of the sprinkler deflector.

**E···Options**

Integral Occupancy Sensor available and provides from 600 sq. ft. (MS) up to 1250 sq. ft. (MSO) of coverage at a maximum mounting height of 40'.



**F-BAY** I8 Series

4' OR 8'
4 LAMPS

T8 Linear Fluorescent Hi-Bay Lighting System

F-BAY
FLUORESCENT HIGH-BAY

## ENERGY DATA

Input Watts:
**EB Ballast**
432 = 109
8T432 = 218

**EB/Plus Ballast**
432 = 147
8T432 = 294

**ER Ballast**
432 = 112
8T432 = 224

**ER/Plus Ballast**
432 = 144
8T432 = 288

Luminaire Efficacy Rating
**LER =88**
**Catalog Number:** I8-432-UNV-UPL

**Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH = $2.74**

* Reference the lamp/ballast data in the Technical Section for specific lamp/ballast requirements

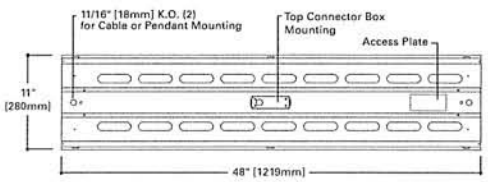
** Consult Pre Sales Technical Support

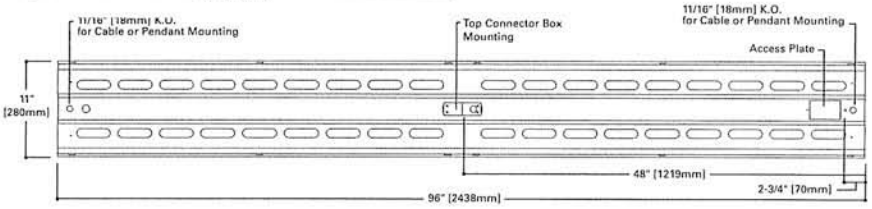
LAMPS CONTAIN MERCURY. DISPOSE ACCORDING TO LOCAL, STATE OR FEDERAL LAWS

**LINEAR DISCONNECT**
Safe and convenient means of disconnecting power.

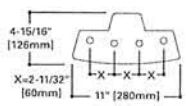
ADF052027

## MOUNTING DATA



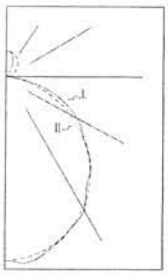




## LAMP CONFIGURATIONS




COOPER LIGHTING

## PHOTOMETRICS



**I8-432-UNV-EB81-UPL**
Electronic Ballast

F32T8-TL835 Lamps
3000 Lumens

Spacing criterion: (II) 1.2 x mounting height, (⊥) 1.3 x mounting height

Efficiency 91.2%

Test Report: 236P197C

LER = FL-88

Yearly Cost of 1000 lumens, 3000 hrs at .08 KWH = $2.74

### Coefficients of Utilization

Effective floor cavity reflectance 20%

| rc | 80% | | | | 70% | | | | 50% | | | 30% | | | 10% | | | 0% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| rw | 70 | 50 | 30 | 10 | 70 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 0 |
| RCR | | | | | | | | | | | | | | | | | | |
| 0 | 107 | 107 | 107 | 107 | 104 | 104 | 104 | 104 | 98 | 98 | 98 | 92 | 92 | 92 | 87 | 87 | 87 | 85 |
| 1 | 98 | 94 | 90 | 87 | 95 | 91 | 88 | 85 | 86 | 83 | 81 | 81 | 79 | 77 | 77 | 75 | 74 | 71 |
| 2 | 89 | 82 | 76 | 71 | 86 | 80 | 74 | 69 | 75 | 71 | 67 | 71 | 68 | 64 | 68 | 65 | 62 | 60 |
| 3 | 81 | 72 | 65 | 59 | 78 | 70 | 63 | 58 | 66 | 61 | 56 | 63 | 58 | 54 | 60 | 56 | 53 | 50 |
| 4 | 74 | 64 | 56 | 50 | 72 | 62 | 55 | 49 | 59 | 53 | 48 | 56 | 51 | 46 | 53 | 49 | 45 | 43 |
| 5 | 68 | 57 | 49 | 43 | 66 | 55 | 48 | 42 | 53 | 46 | 41 | 50 | 45 | 40 | 48 | 43 | 39 | 37 |
| 6 | 63 | 51 | 43 | 37 | 61 | 50 | 42 | 37 | 48 | 41 | 36 | 46 | 40 | 35 | 44 | 39 | 35 | 33 |
| 7 | 59 | 46 | 39 | 33 | 57 | 45 | 38 | 33 | 43 | 37 | 32 | 42 | 36 | 31 | 40 | 35 | 31 | 29 |
| 8 | 54 | 42 | 35 | 29 | 53 | 41 | 34 | 29 | 40 | 33 | 29 | 38 | 32 | 28 | 37 | 31 | 27 | 26 |
| 9 | 51 | 39 | 31 | 26 | 49 | 38 | 31 | 26 | 37 | 30 | 26 | 35 | 29 | 25 | 34 | 29 | 25 | 23 |
| 10 | 48 | 36 | 29 | 24 | 46 | 35 | 28 | 24 | 34 | 28 | 23 | 33 | 27 | 23 | 31 | 26 | 23 | 21 |

### Zonal Lumen Summary

| Zone | Lumens | %Lamp | %Fixture |
|---|---|---|---|
| 0-30 | 2861 | 23.8 | 26.1 |
| 0-40 | 4657 | 38.8 | 42.6 |
| 0-60 | 8121 | 67.7 | 74.2 |
| 0-90 | 10169 | 84.7 | 92.9 |
| 0-180 | 10943 | 91.2 | 100.0 |

### Typical VCP Percentages

| | Height Along | | Height Across | |
|---|---|---|---|---|
| Room Size (Ft.) | 8.5' | 10.0' | 8.5' | 10.0' |
| 20 x 20 | 28 | 33 | 25 | 31 |
| 30 x 30 | 24 | 26 | 23 | 24 |
| 30 x 60 | 24 | 24 | 24 | 22 |
| 60 x 30 | 28 | 29 | 27 | 27 |
| 60 x 60 | 27 | 25 | 28 | 25 |

### Candela

| Angle | Along II | 45° | Across ⊥ |
|---|---|---|---|
| 0 | 3644 | 3644 | 3644 |
| 5 | 3625 | 3677 | 3715 |
| 10 | 3574 | 3686 | 3667 |
| 15 | 3491 | 3577 | 3530 |
| 20 | 3379 | 3425 | 3400 |
| 25 | 3231 | 3254 | 3246 |
| 30 | 3056 | 3081 | 3115 |
| 35 | 2851 | 2886 | 2804 |
| 40 | 2615 | 2680 | 2594 |
| 45 | 2356 | 2346 | 2390 |
| 50 | 2076 | 2090 | 2112 |
| 55 | 1774 | 1834 | 1856 |
| 60 | 1460 | 1526 | 1642 |
| 65 | 1136 | 1281 | 1362 |
| 70 | 812 | 1007 | 1070 |
| 75 | 508 | 724 | 691 |
| 80 | 242 | 377 | 314 |
| 85 | 59 | 79 | 47 |
| 90 | 1 | 6 | 3 |

## ORDERING INFORMATION

SAMPLE NUMBER: 8TI8-432-TBW-120V-EBT1-UPL-U

**Length**
Blank=4' Length
8T=8' Length

**Series**
I8=T8 Industrial

**Mounting Arrangement**
Blank=Stand Alone
R=Continuous Row Mount

**No. of Lamps**
4=4 Lamps

**Lamp Type**
32=32W T8 (48")

**Distribution Optic**
Blank=Medium (Specular Aluminum)
G=Wide (High Reflectance White)

**Shielding Options**
Blank=Open
TBW=Thin White Baffle
FL=Frosted Acrylic Lens & Frame[2]
ASY= Asymmetric Directional Louver[2]
WG=Heavy Duty Wireguard

**Voltage[3]**
UNV=Universal 120/277 Voltage
UNC=Universal 347/480 Voltage (T5 linear only)[1]
120V=120 Volt
277V=277 Volt
347V=347 Volt
480V=480 Volt

**Options**
**I8 Lamps Installed**
L8830=T8 Lamp, 80CRI 3000K
L8835=T8 Lamp, 80CRI 3500K
L8841=T8 Lamp, 80CRI 4100K
L8850=T8 Lamp, 80CRI 5000K
GL=Single Element Fuse
GM=Double Element Fuse
Emergency=EM Installed[3]

**Ballast Type**
**T8 Systems**
EB8_=T8 Electronic Instant Start.[4] Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
EB8_/PLUS= T8 Electronic Instant Start. High Ballast[6] Factor >1.13. Total Harmonic Distortion < 20%
No. of Ballast 1, 2 or 3
ER8_=T8 Electronic Program Rapid Start.[4] Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
ER8_/PLUS= T8 Electronic Program Start. High Ballast Factor >1.13. Total Harmonic Distortion < 10%
No. of Ballast 1, 2 or 3
DIM=Dimming

**Options**
UPL=Uplight Apertures
PI/CPI=Plug-In (1, 2 or 3)[7] see ordreing information
TILW=Tandem Inline Wiring
MWS=Modular Wiring System
MS=Aisle Coverage Motion Sensor[5]
MSO=360° Coverage Motion Sensor[5]
C3=3' Power Cord
C6=6' Power Cord
MPR=Modular Power Receptacle[1] [3]
PC3-=3' Power Cord & Plug (Specify Voltage)[3]
PC6-=6' Power Cord & Plug (Specify Voltage)[3]
TAP=Top Access Plate
TCBP=Top Connector Box Plate[6]

**Packaging**
U=Unit Pack
PAL=Palletized Out of Carton
PALC=Palletized In Carton

**Accessories** (order separately)
TCB=Top Connector Box
RH-1=Retrofit Hanger
FH-1=Fixture Hook
FL-1=Fixture Loop
SHK=Hook w/ Safety Screw
AYC-CHAIN/SET/U=(2) Hooks, 36" Chain Sets w/S-Hooks[8]
GRIPPLE TOGGLE-=Single Toggle, #2 Cable (Specify 10' or 30')
GRIPPLE LOOP-=Loop Hanger, #2 Cable (Specify 10' or 30')
MC6=6' Modular Power Cord
MPC6=6' Modular Power Cord & Plug (Specify Voltage)
MMS-CPD1200H=Aisle Motion Sensor, Box, Modular Power Receptacle (120-277V)

**Doorframes** (order separately)
I5-FRM/LENS=Frosted Acrylic Lens & Frame (I5)
I5-FRM/CL PK=Clear Acrylic Lens & Frame (I8)
WG/I5-4FT-B=Heavy Duty Wireguard
90800PPK=Thin White Blade Baffle (I5)
BAFFLE 4FT I8=Thin White Blade Baffle (I8)
90801PPK=Asymmetrical Directional Louver

NOTES: [1]Requires use of voltage specific modular cord assembly. See accessories. [2]Use with wide distribution optic only. [3]Voltage must be specified when ordered with plugs, motion or emergency ballasts. [4]ER8 and EB8 ballast systems suitable for operation in ambient environments up to 50°C in open uplight configurations. [5]Specify voltage. [6]For use with Top Connector Box options. See accessories. [7]Cannot be combined with power cord or cord & plug option. See PI ordering information on next page. [8]Not for use in high abuse applications such as gymnasiums.

## SHIPPING INFORMATION

| Catalog No. | Wt. |
|---|---|
| I8-432-UNV-UPL | 15 lbs. |
| 8TI8-432-UNV-UPL | 30 lbs. |

## PI OPTION ORDERING INFORMATION

| Catalog Number Suffix | Number of Circuits | Circuit Wired To Ballast |
|---|---|---|
| PI 1 BLK | 1 | Black |
| PI 2 BLU | 2 | Blue |
| PI 2 BLK | 2 | Black |
| PI 3 RED | 3 | Red |
| PI 3 BLU | 3 | Blue |
| PI 3 BLK | 3 | Black |

### Catalog Numbering System

The PI System is available in sections up to 8' in length for continuous row wiring by simply plugging the sections together. Each PI section is factory wired to the ballast leads. Color coding of wires is as follows:

**PI-1** = One Circuit - 2 Wires: one black, one white
**PI-2** = Two Circuits - 3 Wires: one black, one blue, one white
**PI-3** = Three Circuits - 4 wires: one black, one blue, one red, one white

When ordering the PI2/PI3 System it is necessary to specify the number of fixtures required for each circuit. All wiring to external feeds, using cord or cord & plug, are responsibility of installing licensed contractor. Cord and cord & plug sets must be ordered separately if PI option is chosen.

### PI1 - Single Circuit Plug-In

SAMPLE NUMBER: PI1BLK-WG

- **PI1**= Single Circuit
- **BLK**=Black Hot
- **NG**= No Ground (ground provided by fixture body)
- **WG**= With Ground (separate ground wire in harness)

For complete product data, reference the Fluorescent Specification binder. Specifications & dimensions subject to change without notice. Consult your Cooper Lighting Representative for availability and ordering information.

### PI2 - Two Circuit Plug-In

SAMPLE NUMBER: PI2BLK-WG

- **PI2**= Two Circuit
- **BLK**=Black Hot
- **BLU**=Blue Hot
- **Leave Blank**=Single Neutral
- **/WHT**=White Neutral
- **/GRY**=Gray Neutral
- **Leave Blank**=Single Neutral
- **2NEU**=Two Neutrals
- **NG**= No Ground (ground provided by fixture body)
- **WG**= With Ground (separate ground wire in harness)

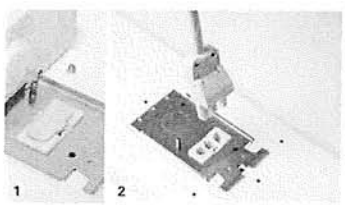
### PI3 - Three Circuit Plug-In

SAMPLE NUMBER: PI3BLK-WG

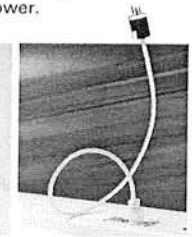
- **PI3**= Three Circuit
- **BLK**=Black Hot
- **BLU**=Blue Hot
- **RED**=Red Hot
- **Leave Blank**=Single Neutral
- **/WHT**=White Neutral
- **/GRY**=Gray Neutral
- **Leave Blank**=Single Neutral
- **2NEU**=Two Neutrals
- **NG**= No Ground (ground provided by fixture body)
- **WG**= With Ground (separate ground wire in harness)

## Modular F-Bay Power Supply

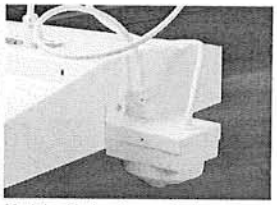
Cooper Lighting's F-Bay Modular Power Supply option allows external fixture access for safe and easy servicing. There is no need to remove lamps or reflectors to disconnect fixture power with F-Bay Modular Power Supply. Access to the individual fixtures power supply allows servicing without turning off all the fixtures disrupting occupants. F-Bay Modular Power Supply is a time saver in installation – simply plug & power.




1. Modular Power Supply Receptacle supplied mounted into fixture Access Plate.
2. Modular Power Cord & Plugs in 120, 277, 347, & 480V configurations for easy plug & power into existing supply.



No internal fixture access required for installation or disconnecting power.



Modular Motion Sensor Option supplied with Mounting Box and Modular Power Supply Receptacle.

### Code Compliance

- UL/cUL Certified for Make/Break under load (UL2549)
- Meets NEC requirements for ballast disconnect (NEC 410.73G)
- Allows for addition of Occupancy Sensor without hard connections
- Receptacles complete with insulating/dustcap

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** PD6-H126E-6HC<br>Notes: | **Type:** O<br>WK08-1600 |

pds
by Portfolio™

CATALOG#:

TYPE:

## DESCRIPTION

The Performance Downlight System (PDS) combines visually comfortable optics, energy efficiency and modularity with availability. Three key elements—reflector, socket adapter and frame—combine to form a feature-packed luminaire.

PDS reflectors boast equal 65° cutoff to lamp and lamp image. Low-iridescent clear reflector with white-painted self flange is standard.

PDS socket adapters provide modular flexibility and assure proper lamp orientation and lamp quantity to be used with each reflector. Lamp positions lock into place ensuring photometric performance. Electronic ballasts are standard.

PDS universal frames are dedicated to each aperture size and are used for compact fluorescent, metal halide and incandescent sources. No Fuss Bar Hangers™ speed installation of frames, minimizing labor costs on the job site.

## SPECIFICATION FEATURES

**A–Reflector**
One-piece optical reflector minimizes internal losses and light leaks. 5/8" overlapping flange provides gap-free aperture. Standard finish is low-iridescent clear with white painted self-flange. Torsion spring mounting pulls flange tight to ceiling.

**B–Baffles**
One-piece black or white baffle. Upper specular reflector maximizes light output. Self- flange of each is painted white.

**C–Socket Cap**
One-piece folded metal cap. Positive connection between cap and reflector.

**D–Socket and Socket Adapter**
4-pin G24q base with stainless steel spring for positive retention. Guide post inserts rejects two-pin bases to ensure proper lamping. Multi-voltage ballast accommodates 120V thru 277V.

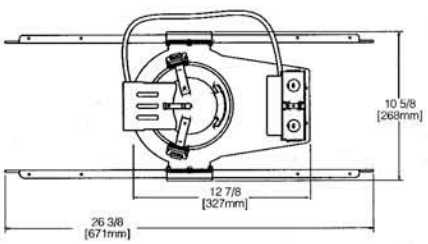
**E–Frame**
Galvanized steel frame with 1/2" plaster lip is standard. Accommodates ceilings up to 2" (50mm) thick.

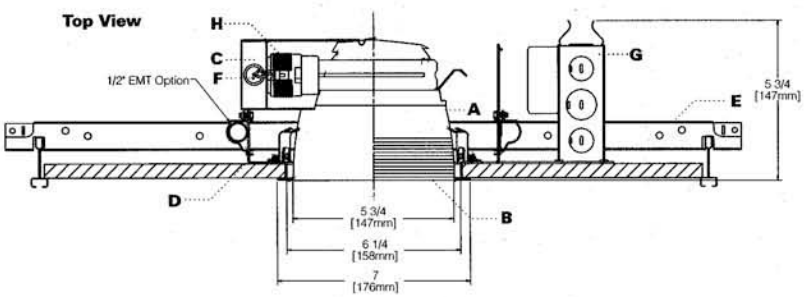
**F–No Fuss Bar Hanger**
Bar hanger locks to T-bar with a screwdriver or pliers. Centering mechanism allows consistent centering of fixtures. 2 1/2" vertical adjustment. Can be used with 1/2" EMT

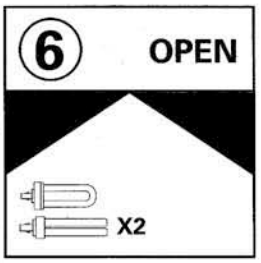
**G–Junction Box**
Galvanized with (6) 1/2" and (2) 3/4" KOs.

**Insulation Detector**
Thermal protection deactivates unit if improper lamp type or wattage is used, or if insulation is placed too close to the fixture.

**Labels**
CUL listed, damp location, IBEW union made.




# PD6-H142
# H226, H126
# H218, H118

**42W MAX TRIPLE**
**(2) 26W MAX QUAD**
Compact Fluorescent

**6"DOWNLIGHT**

## Energy Data

**H142E**

| | Voltage | Lamp wattage | System wattage | Open circuit |
|---|---|---|---|---|
| Input | 120V, | 42W : | 47.0W, | 0.39A |
| | 120V, | 32W : | 34.5W, | 0.30A |
| | 120V, | 26W : | 26.0W, | 0.22A |
| | 277V, | 42W : | 47.0W, | 0.13A |
| | 277V, | 32W : | 34.5W, | 0.13A |
| | 277V, | 26W : | 26.0W, | 0.09A |

Power Factor: >.98
THD: <10%:
Sound Rating: A
Min Starting Temp.: -0°C (20°F)

**H226E**

| | Voltage : | System wattage | Open circuit |
|---|---|---|---|
| Input | 120V : | 50.0W, | 0.45A |
| | 277V : | 50.0W, | 0.20A |

Power Factor: >.99
THD: <10%:
Sound Rating: A
Min Starting Temp.: -0°C (20°F)

**H126E**

| | Voltage : | System wattage | Open circuit |
|---|---|---|---|
| Input | 120V : | 27.0W, | 0.22A |
| | 277V : | 27.0W, | 0.09A |

Power Factor: >.99
THD: <10%:
Sound Rating: A
Min Starting Temp.: -0°C (20°F)

**H218E**

| | Voltage : | System wattage | Open circuit |
|---|---|---|---|
| Input | 120V : | 37.0W, | 0.32A |
| | 277V : | 37.0W, | 0.14A |

Power Factor: >.99
THD: <10%:
Sound Rating: A
Min Starting Temp.: -0°C (20°F)

**H118E**

| | Voltage : | System wattage | Open circuit |
|---|---|---|---|
| Input | 120V : | 19.0W, | 0.15A |
| | 277V : | 19.0W, | 0.07A |

Power Factor: >.99
THD: <10%:
Sound Rating: A
Min Starting Temp.: -0°C (20°F)

## ORDERING INFORMATION

**SAMPLE NUMBER: PD6-H142E-6HC**
Order frame, socket adapter and reflector separately for a complete unit.

| Housing | Socket Adapter | Reflector |
|---|---|---|
| PD6 | H126E | 6HC |

**PD6**

**Socket Adapter**
- **H142E**=(1) 42, 32 or 26W Triple tube lamp, multi- voltage ballast, Horizontal Module
- **H226E**=(2) 26W Quad Tube, multi-voltage ballast, Horizontal Module
- **H126E**=(1) 26W Quad Tube, multi-voltage ballast, Horizontal Module
- **H218E**=(2) 18W Quad Tube, multi-voltage ballast, Horizontal Module
- **H118E**=(1) 18W Quad Tube, multi-voltage ballast, Horizontal Module

**Reflector**
- **6HC** =6" Horizontal Clear
- **6HBB** =6" Horizontal Black Baffle
- **6HWB** =6" Horizontal White Baffle

**COOPER LIGHTING**

**ADV995024**

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** PD6-H126E-6HC<br>Notes: | **Type:** O<br>WK08-1600 |



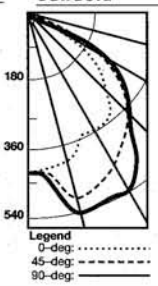
## PHOTOMETRICS

### PD6-H142E-6HC

**Test No. H22343**

Lamp=32W PLT Compact Fluorescent
Lumens=2400
Spacing Criteria=1.3, 1.6
Efficiency=53.6%

**Candela**




| Deg. | CD |
|---|---|
| 90 | 0 |
| 85 | 2 |
| 75 | 10 |
| 65 | 88 |
| 55 | 298 |
| 45 | 378 |
| 35 | 497 |
| 25 | 535 |
| 15 | 543 |
| 5 | 441 |
| 0 | 421 |

**Cone of Light**

| Distance to Illuminated Plane | Initial Nadir Footcandles | Beam Diameter |
|---|---|---|
| 5'6" | 14 | 8' |
| 6'6" | 10 | 9'6" |
| 8'0" | 7 | 11'6" |
| 10'0" | 4 | 14'6" |
| 12'0" | 3 | 17'6" |
| 14'0" | 2 | 20'6" |

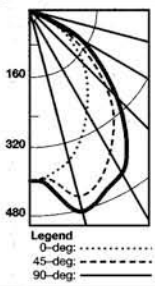
Beam diameter is to 50% of maximum footcandles, rounded to the nearest half-foot.
Footcandle values are initial, apply appropriate light loss factors where necessary.

### PD6-H142E-6HBB

**Test No. H22348**

Lamp=32W PLT Compact Fluorescent
Lumens=2400
Spacing Criteria=1.1, 1.5
Efficiency=39.0%

**Candela**




| Deg. | CD |
|---|---|
| 90 | 0 |
| 85 | 1 |
| 75 | 5 |
| 65 | 50 |
| 55 | 180 |
| 45 | 282 |
| 35 | 402 |
| 25 | 459 |
| 15 | 484 |
| 5 | 410 |
| 0 | 394 |

**Cone of Light**

| Distance to Illuminated Plane | Initial Nadir Footcandles | Beam Diameter |
|---|---|---|
| 5'6" | 13 | 7' |
| 6'6" | 9 | 8'6" |
| 8'0" | 6 | 10'6" |
| 10'0" | 4 | 13' |
| 12'0" | 3 | 15'6" |
| 14'0" | 2 | 18' |

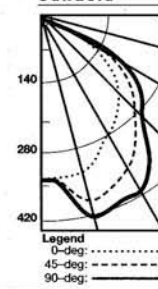
Beam diameter is to 50% of maximum footcandles, rounded to the nearest half-foot.
Footcandle values are initial, apply appropriate light loss factors where necessary.

### PD6-H142E-6HC

**Test No. H22344**

Lamp=26W PLT Compact Fluorescent
Lumens=1800
Spacing Criteria=1.2, 1.6
Efficiency=55.5%

**Candela**




| Deg. | CD |
|---|---|
| 90 | 0 |
| 85 | 2 |
| 75 | 8 |
| 65 | 74 |
| 55 | 233 |
| 45 | 291 |
| 35 | 382 |
| 25 | 415 |
| 15 | 424 |
| 5 | 356 |
| 0 | 340 |

**Cone of Light**

| Distance to Illuminated Plane | Initial Nadir Footcandles | Beam Diameter |
|---|---|---|
| 5'6" | 11 | 7' |
| 6'6" | 8 | 8'6" |
| 8'0" | 5 | 10'6" |
| 10'0" | 3 | 13' |
| 12'0" | 2 | 15'6" |
| 14'0" | 1 | 18' |

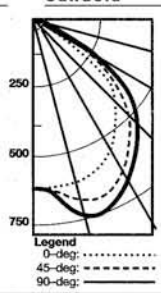
Beam diameter is to 50% of maximum footcandles, rounded to the nearest half-foot.
Footcandle values are initial, apply appropriate light loss factors where necessary.

### PD6-H226E-6HC

**Test No. H22346**

Lamp=(2) 26W Quad Compact Fluorescent
Lumens=1800
Spacing Criteria=1.3, 1.4
Efficiency=42.9%

**Candela**




| Deg. | CD |
|---|---|
| 90 | 0 |
| 85 | 3 |
| 75 | 9 |
| 65 | 48 |
| 55 | 312 |
| 45 | 472 |
| 35 | 596 |
| 25 | 704 |
| 15 | 748 |
| 5 | 650 |
| 0 | 636 |

**Cone of Light**

| Distance to Illuminated Plane | Initial Nadir Footcandles | Beam Diameter |
|---|---|---|
| 5'6" | 21 | 7' |
| 6'6" | 15 | 8'6" |
| 8'0" | 10 | 10'6" |
| 10'0" | 6 | 13' |
| 12'0" | 4 | 15'6" |
| 14'0" | 3 | 18' |

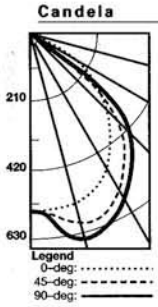
Beam diameter is to 50% of maximum footcandles, rounded to the nearest half-foot.
Footcandle values are initial, apply appropriate light loss factors where necessary.

### PD6-H218E-6HC

**Test No. H22345**

Lamp=(2) 18W Quad Fluorescent
Lumens=1250
Spacing Criteria=1.2, 1.4
Efficiency=53.1%

**Candela**




| Deg. | CD |
|---|---|
| 90 | 0 |
| 85 | 2 |
| 75 | 7 |
| 65 | 40 |
| 55 | 259 |
| 45 | 428 |
| 35 | 526 |
| 25 | 616 |
| 15 | 648 |
| 5 | 564 |
| 0 | 554 |

**Cone of Light**

| Distance to Illuminated Plane | Initial Nadir Footcandles | Beam Diameter |
|---|---|---|
| 5'6" | 18 | 7' |
| 6'6" | 13 | 8'6" |
| 8'0" | 9 | 10'6" |
| 10'0" | 6 | 13' |
| 12'0" | 4 | 15'6" |
| 14'0" | 3 | 18' |

Beam diameter is to 50% of maximum footcandles, rounded to the nearest half-foot.
Footcandle values are initial, apply appropriate light loss factors where necessary.

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** 240BXVT-TB<br>Notes: | **Type:** **P**<br>WK08-1600 |

# VT & VTTB SERIES

ELP
ENGINEERED LIGHTING PRODUCTS

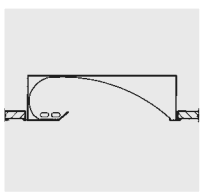
## Recessed 2´x 2´ Indirect Video/Tele Conference Fixtures for Drywall and T-Bar

Project
Econolite Control Products, Inc.
Anaheim, California

Specifier
Leelite Design
Tustin, California

Photographer
Dell'Aquila Photography & Video
Long Beach, California

Lighting
250BXVT-TB, 110 watts
150BXWW-AKTB, 50 watts



*Comfortably illuminates the participants while rendering an excellent video image.*

## System

Video/Tele Conference fixtures. Unique, indirect 2´ x 2´ fluorescent fixtures provide even vertical illumination in three directions. They comfortably illuminate participants with minimal facial shadowing while keeping direct light/glare off of the monitor and camera.

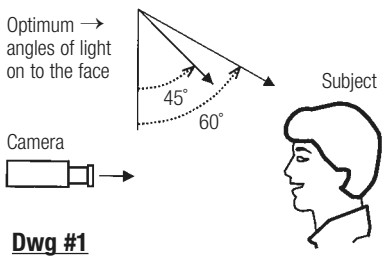
| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** 240BXVT-TB<br>Notes: | **Type:** P<br>WK08-1600 |

# VT & VTTB SERIES

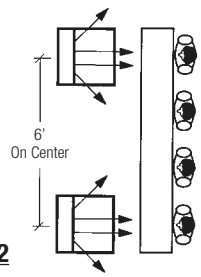
Recessed 2´x 2´ Indirect Video/Tele Conference Fixtures for Drywall and T-Bar

The task of providing proper lighting for a Video conference space is very simple – Ask us to do it for you! But if you would rather do it yourself, here are the problems and some suggested solutions.

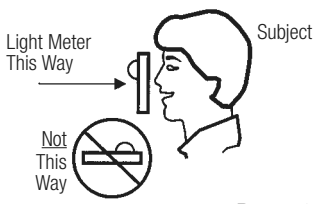
1) **Provide lighting for the camera in the proper quantity, quality and angle.** The light should come from an angle between 45˚ and 60˚ vertical (Dwg #1). Horizontally, light should also be cast on the face from an angle in addition to front (Dwg #2). This will assure that minimum shadows are created in the eye sockets and under the nose and chin.




**Dwg #1**




**Dwg #2**

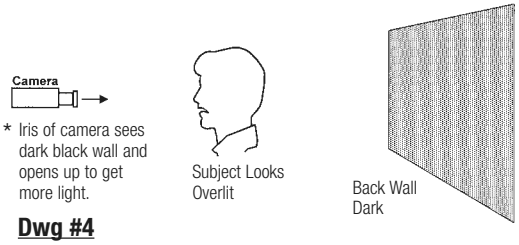



**Dwg #3**

The amount of light falling on the face of the subject measured vertically should be 50-75 F.C. (Dwg #3). The quality of light can be assured by using fluorescent lamps of 3000˚ K or 3500˚ K (Color Temperature) with a CRI (Color Rendering Index) of 82+. The use of high color temperature lamps (5700˚ K and higher) is not necessary for video cameras and the strong blue component makes most skin tones look bad (blue). [ Note: Daylight film requires the high color temperature light.]

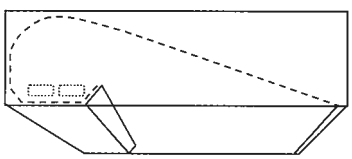
2) **Provide minimal lighting for the screen or monitor for good screen contrast and image sharpness.** The wall where the screen or monitor is located should have as little illumination as possible. No reflected glare should appear on the screen or monitor to inhibit viewing.

3) **Provide lighting for the back wall and to a lesser extent, the side walls to balance the brightness with the rest of the room.** Doing this will prevent the camera from irising* on the back or side walls that are too dark or too bright and then allowing too much or too little light in the camera resulting in the appearance of over or under lighting the subject (Dwg #4). Generally the wall finishes and furniture should be very neutral. The reflectance value of these colors and surfaces should be around 30-40%. Light levels ratios from the participant to the back wall should be within 3 to 1 while the side walls can be 5 to 1.

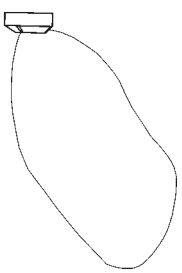



**Dwg #4**

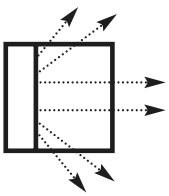
**Solutions** – To accomplish the above requires light fixtures that provide a wide horizontal component. The VT Series fixture ENGINEERED LIGHTING PRODUCTS has designed for this use is a recessed, indirect 2´ x 2´ with two 40, 50 or 55 watt Biax lamps (Dwg #5). This fixture produces an asymmetric distribution (Dwg #6) that provides a large horizontal throw in three directions (Dwg #7). The tri-directional performance of this product often eliminates the need for additional lighting on back and side walls, so the second consideration is handled also. Very little light is directed behind the VT Series fixtures so they do not wash out the viewing screen or glare into the camera. A lighting layout has been provided on the back of this cut for your perusal.



**Dwg #5**




**Dwg #6**




**Dwg #7**

**Dual Function and Participant Comfort** – The VT Series is provided standard with a dimming ballast so you may adjust the light levels for good picture quality and have low light level illumination for standard conferencing functions. Combining the low heat of fluorescent lamps with an indirect optical system, the participants in the room will have optimum comfort visually and environmentally.

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| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** 240BXVT-TB<br>Notes: | **Type:** P<br>WK08-1600 |

# VT & VTTB SERIES

Recessed 2´x 2´ Indirect Video/Tele Conference Fixtures for Drywall and T-Bar

## Specification

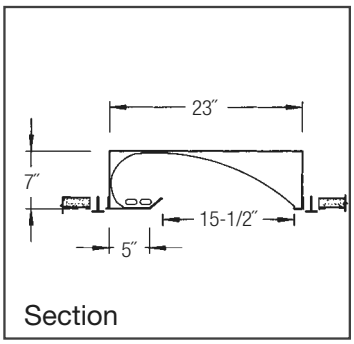
Recessed, indirect 2´ x 2´ compact fluorescent fixture for Drywall and T-Bar ceiling installations. Unit utilizes one or two 40, 50, or 55 watt Biax lamps. The formed reflector combines white diffuse with high purity aluminum (99.9%) reflector material with 95% reflectance. The optical design allows energy efficient lighting layouts with excellent visual comfort for the speaker, the camera and the audience.

The spot weld construction housing is 22 gauge CRS and post painted with a white TGIC polyester powder coat. Cover and knock-outs provided for through wiring. All fluorescent fixtures are supplied standard with Luminaire Disconnect. Drywall fixture has extruded aluminum trim.

UL/CUL Damp Location listed.

## Options

| | |
|---|---|
| Ballast | 120 or 200 Electronic Dimming (Standard)<br>Alternate Dimming Ballasts |
| Finish | White (Standard)<br>Custom -Custom |
| Louver | Diffuser Silver Parallel Blade -LV<br>(Not Recommended) |



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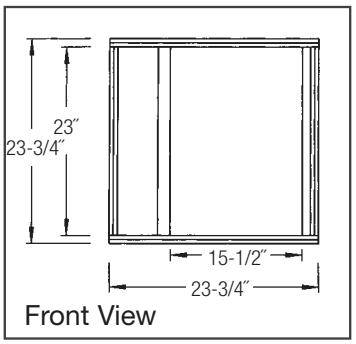
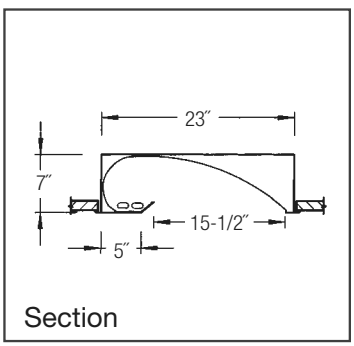


Front View

## VTTB Series for T-Bar Installations

| Model No. | Standard Dimming Ballast | Lamp |
|---|---|---|
| 140BXVT-TB | Lutron Eco (3-Wire) | (1) 40 watt Biax |
| 150BXVT-TB | Lutron Eco (3-Wire) | (1) 50 watt Biax |
| 155BXVT-TB | Mark X (2-Wire) | (1) 55 watt Biax |
| 240BXVT-TB | Lutron Eco (3-Wire) | (2) 40 watt Biax |
| 250BXVT-TB | Lutron Eco (3-Wire) | (2) 50 watt Biax |
| 255BXVT-TB | Mark X (2-Wire) | (2) 55 watt Biax |



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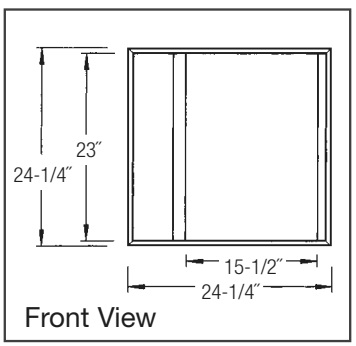
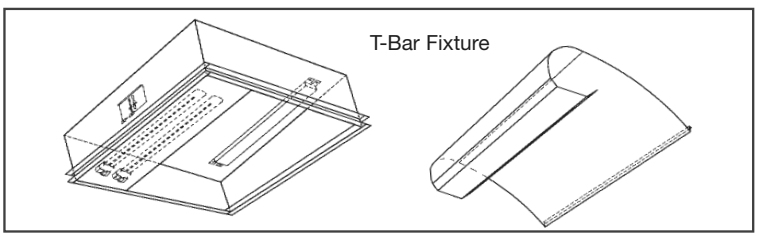


Front View

## VT Series for Drywall Installations

| Model No. | Standard Dimming Ballast | Lamp |
|---|---|---|
| 140BXVT | Lutron Eco (3-Wire) | (1) 40 watt Biax |
| 150BXVT | Lutron Eco (3-Wire) | (1) 50 watt Biax |
| 155BXVT | Mark X (2-Wire) | (1) 55 watt Biax |
| 240BXVT | Lutron Eco (3-Wire) | (2) 40 watt Biax |
| 250BXVT | Lutron Eco (3-Wire) | (2) 50 watt Biax |
| 255BXVT | Mark X (2-Wire) | (2) 55 watt Biax |

Rough-In Dimensions are 23-3/4″ x 23-3/4″

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| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** 240BXVT-TB<br>Notes: | **Type:** **P**<br>WK08-1600 |

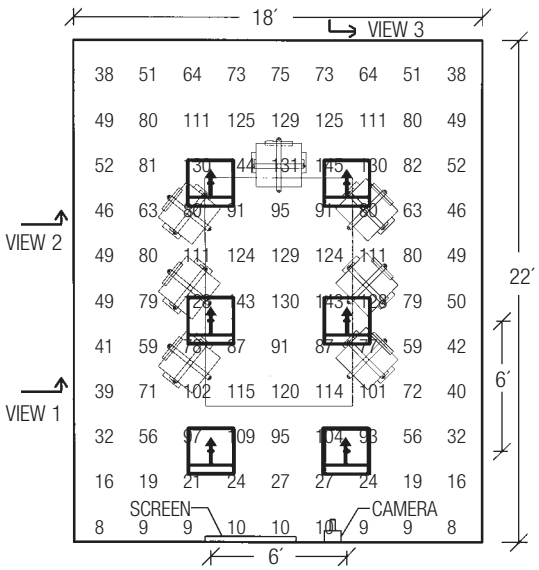
# VT & VTTB SERIES

Recessed 2´x 2´ Indirect Video/Tele Conference Fixtures for Drywall and T-Bar

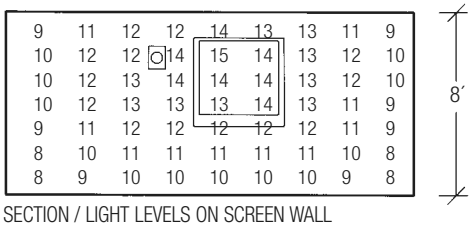
## Photometrics

**MODEL 255BXVT**

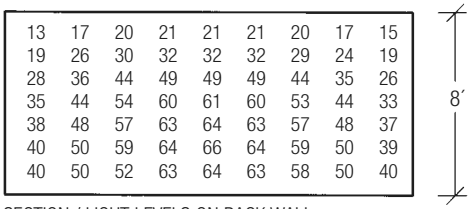
Vertical light levels on participants should be a minimum of 50 to 75 fc for successful Video Conferencing. Light readings are shown in footcandles and were calculated with Lighting Analysts' *AGI 32* utilizing independent test lab photometric file #1015A.IES. Readings are initial levels and the reflectances of the room for calculation purposes were Ceiling: .80, Walls: .50 and Floor: .20. To convert levels to Lux use the conversion factor of 1 fc = 10.765 Lux. Original photometric data on file at the factory. Specifications subject to change without notice or obligation.



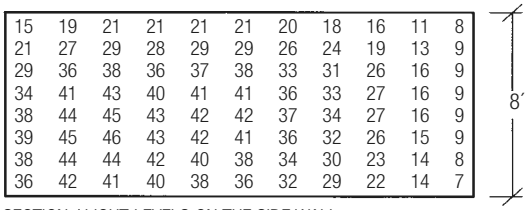

PLAN / LIGHT LEVELS AT 2´-6˝ HEIGHT



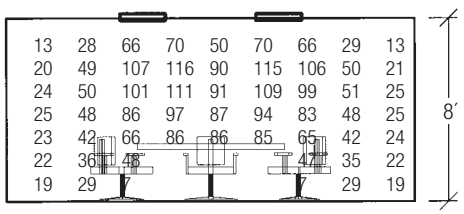

SECTION / LIGHT LEVELS ON SCREEN WALL



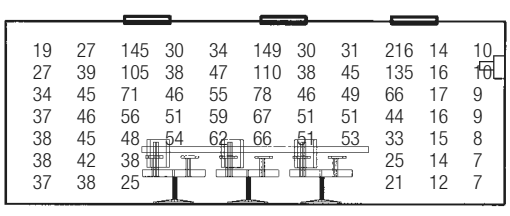

SECTION / LIGHT LEVELS ON BACK WALL



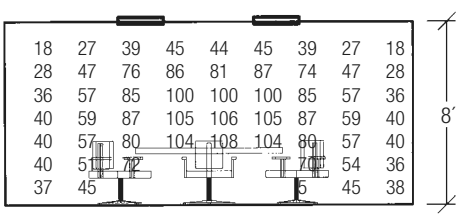

SECTION / LIGHT LEVELS ON THE SIDE WALL




SECTION / LIGHT LEVELS AT VIEW 1



SECTION / LIGHT LEVELS AT VIEW 3




SECTION / LIGHT LEVELS AT VIEW 2

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| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** LPX60RWH<br>Notes: | **Type:** **EXIT**<br>WK08-1600 |

# COOPER LIGHTING - SURE-LITES®

## DESCRIPTION

The LPX Series LED Exit is an economical, yet attractive, alternative to metal exits. Its contemporary round corner styling, designer white finish, and consistent family appearance enables it to blend with any decor. The tough injection molded polycarbonate materials resist discoloration. All components, including canopy and chevron directional indicators, are of snap-fit construction to facilitate installation. The under 5-minute installation time of the LPX Series Exit makes it the fastest installed exit on the market today. All LPX Series Exits are available in universal configurations.

| | | | |
|---|---|---|---|
| Catalog # | | Type | |
| Project | | | |
| Comments | | Date | |
| Prepared by | | | |

## SPECIFICATION FEATURES

**Electrical**
- Dual Voltage Input 120/277 VAC, 60Hz, isolation transformer
- Push-in AC power connectors facilitate installation
- Optional 2C (Two circuit, FTBR) available in 120/277 VAC in standard and emergency operation

**Housing Construction**
- All components are injection molded, color stable, high impact UL 94-5VA rated polycarbonate material
- Designer white or black textured finish standard
- Components are of snap-fit construction to facilitate under 5-minute installation
- Reinforcing ribs throughout to provide maximum strength

**Housing Construction Cont.**
- Molded-in wireways facilitate internal wire routing and connections
- All components are located inside the exit housing
- Snap-out or snap-in chevron directional indicators have full 3/4" stroke
- Universal exits can be field configured as single face or double face
- Knockout provided on housing for surface conduit attachment
- Snap-fit canopy with captive mounting screws included with all exits
- Exit can be ceiling, wall, or end mounted
- Universal J-box mounting pattern

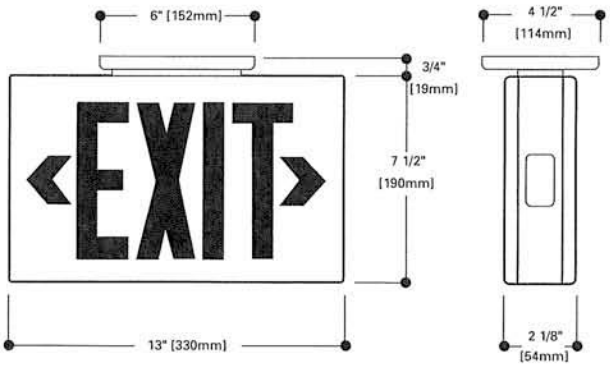
**Code Compliance**
- Damp Location Listed
- UL 924 Listed
- Life Safety NFPA 101
- CSA Certified
- NEC/OSHA
- Most State and Local Codes
- Suitable for Floor Proximity Installation
- UL Listed for Two Circuit (FTBR)

**Warranty**
- Exit: 1-Year

**Lamp Data**
- AC LED: Long-life LED lamps provide uniform diffused illumination

**LPX**
SERIES

POLYCARBONATE EXIT
AC ONLY
LED LAMPS
Exit Lighting




TOTALLY PREDICTABLE RELIABILITY

## ENERGY DATA

**LED Exits - Red**
Input Power:
120V = 2.4W
277V = 2.5W

Input Current (Max.):
120V = .03A
277V = .02A

Power Factor:
120V = > .78
277V = > .73

T.H.D.:
120V = < 33%
277V = < 48%

**LED Exits - Green**
Input Power:
120V = 5.6W
277V = 5.9W

Input Current (Max.):
120V = .08A
277V = .04A

Power Factor:
120V = > .55
277V = > .53

T.H.D.:
120V = < 43%
277V = < 45%

**Premium Deep Green**
Input Power:
120V = 2.6W
277V = 2.6W

Input Current (Max.):
120V = .08A
277V = .04A

Power Factor:
120V = > .28
277V = > .28

T.H.D.:
120V = < 51%
277V = < 53%

## ORDERING INFORMATION

SAMPLE NUMBER: LPX60RWH

**LPX** | **6** | **0** | | **R** | **WH**

Family
LPX=Polycarbonate Exit

Series
6=AC only with LED

Face Options
0=Universal

Battery
Blank=No Battery

Letter Colors
R=Red
G=Green (White Only)
DG=Premium Deep Green

Housing Finishes
WH=White
BK=Black

Options
2C=Two Circuit Option (FTBR)

Accessories (order separately)
CCX18PKWH=18" Pendant Kit, White
CCX18PKHTWH=18" Hang True Pendant Kit, White
CCX18PKBK=18" Pendant Kit, Black
CCX18PKHTBK=18" Hang True Pendant Kit, Black
WG10=Surface, Wire Guard
WGS11=Ceiling, End Wire Guard
VS1=Polycarbonate Vandal Shield
VS1WP=Polycarbonate Vandal Shield Weather Proof

COOPER Lighting
www.cooperlighting.com

**Specifications and Dimensions subject to change without notice.**
Consult your representative for additional options and finishes.

ADX040873
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| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** LPX60RWH<br>Notes: | **Type:** **EXIT**<br>WK08-1600 |



## TECHNICAL DATA

### Lamps

AC Only LED versions of the LPX Series Exits use energy efficient, long life LED lamps to provide uniform, diffuse illumination of the exit face. These red LED modules require no maintenance and consume as little as 2.5 watts. The Green LEDs have two shade options to meet any specification requirement. The low operating costs and zero maintenance requirement makes LED lamps the wisest choice for exit signs today.

### Housing Construction

Rugged, durable, injection molded polycarbonate materials are used throughout the LPX Series Exits. All structural components are designed with reinforcing ribs to add additional rigidity and to maximize structural integrity. These materials are impact and scratch resistant, and they resist discoloration due to age and ultraviolet radiation.

All components are designed to be of snap-fit construction - no mechanical fasteners - to facilitate installation in under 5-minutes. Any components required for installation (wirenuts, wire leads, universal metal J-box bracket, etc.) are all included with each exit. The universal design of the LPX Series Exits enables universal exits to be configured as single or double face in the field. All AC Only LPX Series Exits can be wall, ceiling, or end mounted; a rugged, snap-fit, low profile canopy with captive screws is included with every exit for ceiling and end mounting applications.

### Lens

Lenses for AC Only LED versions of LPX Series Exits are made from durable impact resistant polycarbonate. All exit faces are designed with full 3/4" stroke snap-out or snap-in chevron directional indicators to insure maximum visibility and compliance with the latest codes.

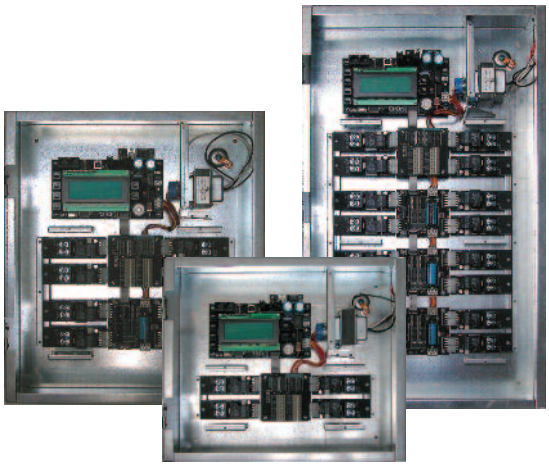
### Warranty

All Sure-Lites products are backed by a firm one-year warranty against defects in material and workmanship (including lamps).

# Apprentice II

## Programmable Lighting Control

- 365-day programmable Lighting Control Panel
- Removable hinged locking door standard
- ILC LightSync™ switch and accessory ready
- Network up to 48 control points
- Panel sizes to accomodate 4, 8, and 16 relay outputs
- Available with 4 to 48 hardwired inputs
- 48 programmable relay groups, presets, timers
- Uses ILC's new cost-effective Softcross™ or APII 2-pole relay
- All ON/All OFF push buttons for relay override
- Daylight Savings Time adjustment and Astro Clock standard
- Optional Add-on Modules
- UL 916 Listed FCC approval for commercial use
- Title 24 certified, ASHRAE 90.1 compliant



## Overview

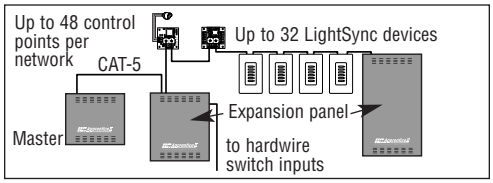
The next generation ILC Apprentice II programmable lighting control panel is redesigned with the best in mind. Network up to 48 control points and up to 32 LightSync™ devices via RJ-45 ports, connect to your PC via a on-board USB 2.0 port and control via Apprentice II Pro software– these are just a few of the updates built into the ILC Apprentice II. Add-on cards are easy to install and add capabilities like: BACnet, LonWorks, N2 or MODBUS interface, TCP/IP or modem interface, DMX control and DTMF telephone switching. The ILC Apprentice II lighting control panel retains the same friendly interface, solid reliability, the flexibility to easily comply with energy codes and ships complete.

## Features

*(see Apprentice II Catalog for more details and optional devices)*

### Programming Options
- Integral keypad with 4-line LCD display
- Apprentice II Pro software

### Apprentice Network Capable
- Link multiple Apprentice II panels via CAT-5 cable to include up to 48 control points
- Supports up to 32 LightSync devices per network




### Relay Groups
- Relays may be assigned to any of 48 available groups
- Relay groups may be assigned to multiple Timers, Switch Inputs, and other panel functions

### Relay Presets
- Relays may be programmed to any of 48 presets available
- Presets may be controlled by Switch Inputs and Timers

### Open/Close Times
- Lighting Control Schedules may adjust based on business (retail) Open/Close hours
- Seven standard Open/Close times and 365 custom daily Open/Close times available
- Scheduled event may be programmed to occur before, after or at Open/Close times

### Relay Functions
- Each relay may be programmed for ON only, OFF only or ON/OFF control
- HID multilevel control (specialized output control for multilevel HID ballasts including warm-up sequence)

### Switch Types
- The ILC Apprentice II may be programmed to accept virtually any type of switch input, momentary or maintained
- Easy direct connection to motion and photo sensing devices via dry contact input or CAT-5
- Override inputs can Force ON, Force OFF or Hold Status any relay or group of relays
- Input disable based on time of day

### Switch Input to Relay Output Mapping
- All switch to relay settings are completely soft, requiring no field rewiring when changes are required
- Any switch can control any combination of 1 to 48 relays

### Automatic Power-Up Settings
- Relays may be programmed to automatically return ON or OFF after a power outage

### After Hours Sweeps
- Individual relay or groups of relays may be programmed to be swept OFF during non-operational hours

### Daylight Saving Time Adjustment
- Automatic adjustment for daylight saving changes (may be enabled or disabled from keypad or software)

### Astronomical Clock
- Automatic calculation of Sunrise and Sunset based on date and geographic position
- Scheduled events may be programmed to occur before, after or on an astro event

### Blink Alert
- Prior to a scheduled OFF event, lighting loads programmed for a Blink Alert will be momentarily turned OFF then back ON to alert occupants. To avoid the pending OFF sweep, the user simply turns their local switch ON again during the adjustable period (default is 5 min.) prior to the OFF sweep.

### Add-On Modules
- Easy to install add-on modules for applications requiring: DMX 512 control, Modicon® MODBUS BACnet, LonWorks, Metasys® N2 interface, ethernet, modem or DTMF telephone switching

INTELLIGENT LIGHTING CONTROLS, INC.

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Minneapolis. Minnesota 55439
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1-800-922-8004
www.ilc-usa.com

# ILC Apprentice II

Programmable Lighting Control

## Specifications

**Physical:**
- Apprentice lighting controllers are provided with pre-drilled mounting holes for easy mounting to unistrut framing or directly to wall
- All panels provided with a removable hinged locking door standard
- UL, NEMA-1 enclosure

**Electrical:**
- 120 or 277 VAC power supply ready

**ILC SoftCross™ Single Pole Relays:**
- 20 Amp ballast, 120 or 277 VAC
- 20 Amp resistive load, 120 or 277 VAC
- Available in Normally Open (NO) or Normally Closed (NC) configuration

**ILC 2-Pole Relays:**
- 20 Amp ballast
- 20 Amp resistive load
- 20 Amp general
- Up to 277 VAC/pole controlling 208/240/480 VAC circuits
- Normally Open (NO) contacts

**Operating Environment:**
- Location: Interior space
- Operating Temp.: 0° to 40° C
- Relative Humidity: 10% to 90% Non-condensing

**Certifications:**
- UL, CUL
- FCC approval for commercial use
- California Title 24

**Capacities:**
- 4, 8 or 16 ILC SoftCross™ (SR-1) or APII 2-Pole (2PR) relays

**Options:**
- Additional switch input board(s)
- Add-on Modules: easy to install modules for applications requiring Modicon® MODBUS, BACnet, LonWorks, Metasys® N2 interface, DMX 512 control, ethernet, modem or DTMF telephone switching
- Flush mount enclosure border

**Configuration:**
- Soft configuration with greater than 50 year EEPROM memory retention in absence of power
- Minimum 45 day clock retention

## Ordering

Order the **ILC Apprentice II** controller

**ILC-APII** - (1) __ - (2) __ - (3) __ - (4) __ __ - (5) __ __ - (6) __ __

Sample: Order No. ILC-APII-04-0-A-TL-SR1-NO-FT = ILC Apprentice II standard controller in a size 04 enclosure with DTMF Telephone inteface module, standard NO relays and flush trim ring.

(1) Consult the chart to determine the enclosure size required. All enclosures are NEMA-1 type with hinged locking cover standard. Fill in the size panel your installation requires; 04, 08 or 16

**Enclosure Size Options**

| Enclosure Type | Relays | Width | Height | Depth |
|---|---|---|---|---|
| Apprentice II 04 | 04 | 14 in. | 12 in. | 4 in. |
| Apprentice II 08 | 08 | 14 in. | 16 in. | 4 in. |
| Apprentice II 16 | 16 | 14 in. | 24 in. | 4 in. |

(2) Fill in the number of additional AP II 4-input hardwire switch interface boards (ILC Part no. AP4I) if required (panels ship with one AP4I 4-input board installed); 08 will accept one additional, 16 will accept three (not applicable for 04 size)

(3) Indicate if this is to be a standard (with display and keypad) or a network expansion panel (no display or keypad).
A= Standard controller panel
X= Network expansion panel

(4) Use this space to order an optional add-on card to your Apprentice II.
BAC = BACnet
LON = LonWorks
MB = MODBUS
MX = DMX 512
N2 = N2 Metasys
MD = modem
TL = DTMF
ETH = ethernet

(5) Indicate relay type: (NO or NC refers to default state of the relays in the event of a power out).
SR1-NO= Single, Normally Open
SR1-NC= Single, Normally Closed
NOTE: SR1 Relays are shipped as NO unless otherwise specified
2PR = 2-Pole Relay, Normally Open
NOTE: 2PR 2-pole relays are only available Normally Open

(6) Indicate optional flush mount trim ring:
FT = include Flush Trim Ring
NA = no Flush Trim Ring

*A full line of compatible products including control software, photosensors, a wide variety of momentary or maintained switches, custom engraved plates and more are available. Consult factory or your local ILC Representative for more information.*

INTELLIGENT LIGHTING CONTROLS, INC.

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FAX 952 829 1901
1-800-922-8004
www.ilc-usa.com

# 2R7 & 2R9 Relay Operational Summary

Magnetically Latched Relays

***2R7C Relay***

***2R9C Relay***
*(Status feedback capable)*

2R7 and 2R9 split coil relay's unique construction has only one movable part (the contacts). This reliable relay design has a proven failure rate of less than .001 percent. It offers both the popular GE RR7 relay footprint and functionality (3 wire control) along with extreme reliability.

The following describes the actual internal operation of the 2R7 and 2R9 relay. To understand the proven durability of this product, we offer the following explanation of its simple magnetic latching operation.

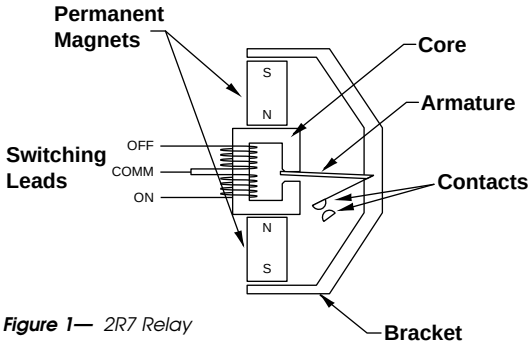



***Figure 1—*** *2R7 Relay*

Figure 1 is a drawing of the 2R7 showing the basic parts of the magnetic circuit. The leads of the split coil are color coordinated: Red (ON), Black (OFF), and Blue (COMMON).

The relay section of the 2R7 consists of two permanent magnets, a split coil switching winding, a steel bracket, a moving armature that supports the moving contacts, and a set of stationary contacts (90% silver, 10% cadmium).

Figures 2 and 3 show the magnetic activity when no switching is being applied. As can be observed, the contacts are held in a steady state condition by the permanent magnets (during a power failure the relays will maintain their state).

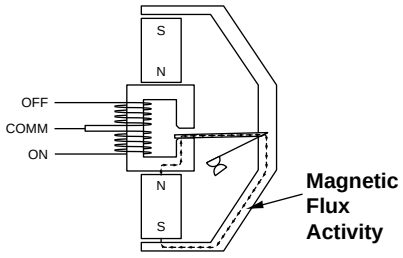



***Figure 2—*** *Magnets holding the contacts closed*

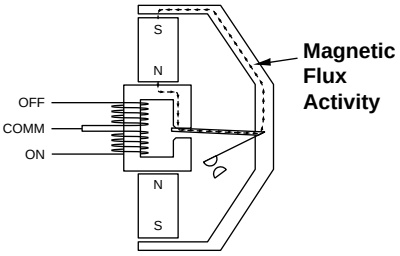



***Figure 3—*** *Magnets holding the contacts open*

# 2R7 & 2R9 Relay Operational Summary

Magnetically Latched Relays

## Magnetism Theory

By convention, magnetism "flows" FROM the north pole TO the south pole. When a diode is placed between the switching leads, an electromagnet is created across the gap. By using two coils in opposite directions to each other, the 2R Relay is able to create two magnetic polarities opposite to each other.

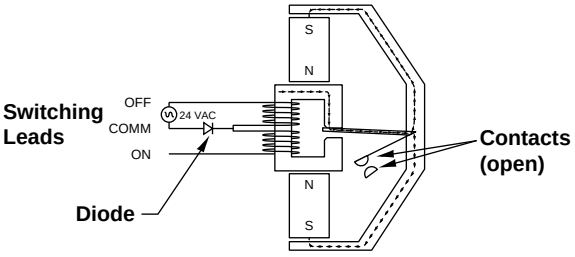



***Figure 4—*** *The electromagnet and the permanent magnets combine to switch the contacts to the closed position.*

Figure 4 shows the magnetism that is applied to the gap of the core to CLOSE the contacts.

When a half wave rectified source is placed between the switching leads (current from the Red wire towards the Blue wire), the flux that is produced sets up a magnetic field on both surfaces of the gap (top North and bottom South). Because the flipper arm is always connected to the North sides of the permanent magnets, the flipper arm is repelled from the North surface and is attracted to the South surface. The contact arm is connected to the flipper arm and, therefore, the contacts will close.

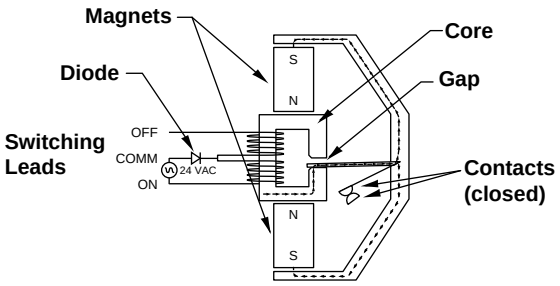



***Figure 5—*** *The electromagnet and the permanent magnets combine to switch the contacts to the open position.*

Figure 5 shows the magnetism that is applied to the gap of the core to OPEN the contacts.

When a half wave rectified source is placed between the switching leads (current from the Black wire towards the Blue wire), the flux that is produced sets up a magnetic field on both surfaces of the gap (top North and bottom South). Because the flipper arm is always connected to the North sides of the permanent magnets, the flipper arm is repelled from the North surface and is attracted to the South surface. The contact arm is connected to the flipper arm and, therefore, the contacts will open.

As can be seen by examining Figure 4 and 5, the electromagnet reverses its polarity to switch the relay ON and OFF.

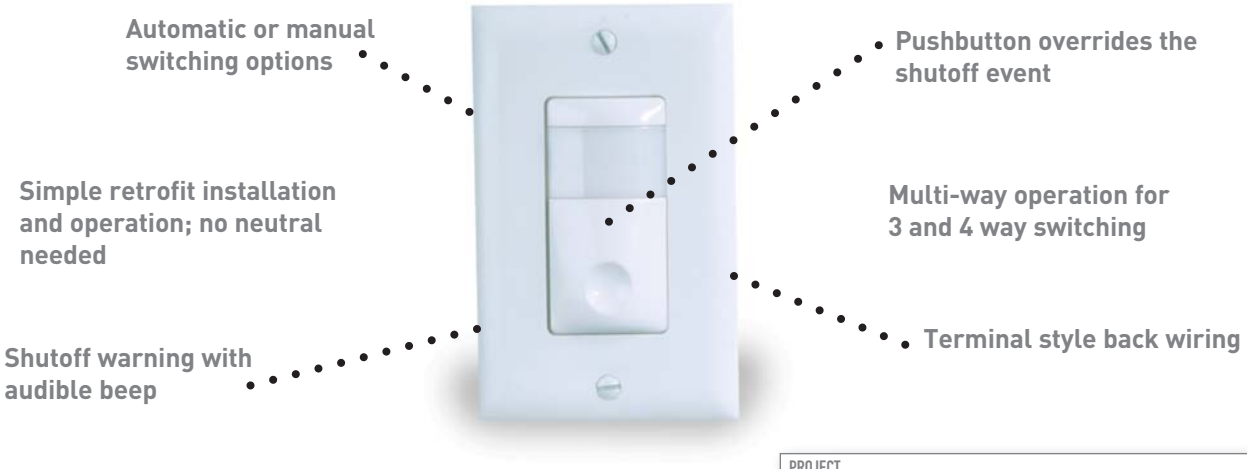
## Performance

The 2R7 and 2R9 relays have been proven in both the test lab and field applications. Intelligent Lighting Controls has over a decade of proven products and service to the commercial building industry with thousands of installations nationwide. To discuss your application requirements, call 1-800-922-8004 to talk with one of our applications engineers.


INTELLIGENT LIGHTING CONTROLS, INC.

5229 Edina Industrial Boulevard
Minneapolis. Minnesota 55439
Phone 952 829 1900
FAX 952 829 1901
1-800-922-8004
www.ilc-usa.com

# AS-100 Automatic Control Switch




PROJECT

LOCATION/TYPE

## Product Overview

### Description

The InteliSwitch® AS-100 Automatic Control Switch operates as both a manual and automatic control device. Manually, it allows users to control loads on/off. Automatically, it receives signals to turn lighting on or off from lighting control panels or other lighting control systems.

### Operation

The AS-100 replaces a standard wall switch. Occupants turn the lights on and off manually by its pushbutton. However, when a timed power interrupt signal is received from a lighting control panel, the AS is automatically commanded to turn on, turn off or delay off. The duration of the power interrupt signal determines how the AS-100 will operate (see back).

Used with a lighting control panel, the AS-100 allows users to manually turn lighting on in private offices, while lighting in common areas turns on automatically. After hours, if lights were not shut off by users, a signal from the control panel would command the switch to delay off. A shutoff signal

### Operation (continued)

warns users that lights will turn off in five minutes. The locator LED on the AS-100 blinks and an audible beep sounds (if enabled). If the button is pushed during this five minutes, the shutoff will be cancelled and the switch will remain on until the next commanded shutoff signal.

### Applications

Since signaling is accomplished through power interruption, the AS-100 does not require additional signal wiring from a lighting control system or panel. It is designed for easy retrofit of lighting shutoff control in buildings. This greatly reduces installation labor and costs, making it an economical and effective lighting control strategy.

## Features

- Settings are selected with the front pushbutton using configuration LEDs; face plate does not need to be removed for setup
- Users can select automatic ON operation, and an audible beep warning
- Selectable beep warning sounds every minute during last five minutes, and every five seconds during last minute
- Five minute delay OFF time with user ability to cancel impending shutoff
- Self-adjusting zero crossing switching for consistent, reliable operation of high inrush loads
- Can be used in 3-way, 4-way and multi-way switching applications
- Compatible with all electronic ballasts and motor loads
- Microcontroller enhances reliability
- Command OFF without delay OFF time

## Specifications

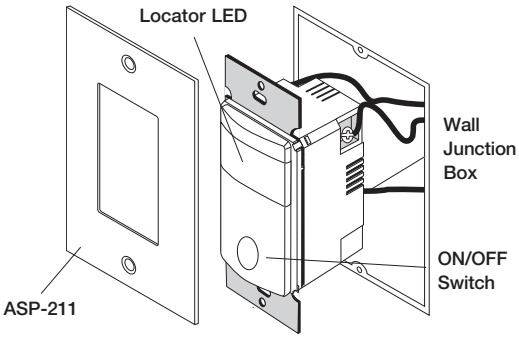
- Dual voltage 120/277 VAC, 60 Hz
- No minimum load requirements
- Power interruption signal resolution ± 0.1 seconds
- Dimensions: 2.69" x 1.75" x 1.81" (68.0mm x 45.0mm x 46.0mm) LxWxD
- UL and CUL listed; five year warranty

## Power Interruption Signals

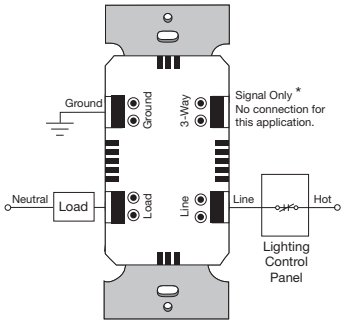
| Duration | Operation | Operation description |
|---|---|---|
| Normal Operating Mode | | |
| 1-2 sec | Delay off | Initiates 5 minute delay before shutting load off. Locator light blinks and audible beep sounds (if enabled). Pushing the button cancels shut off from occurring. |
| 3 sec | Turn on | Turns load on if automatic on feature is enabled |
| 5 sec | Turn off | Turns load off |

## Installation & Wiring

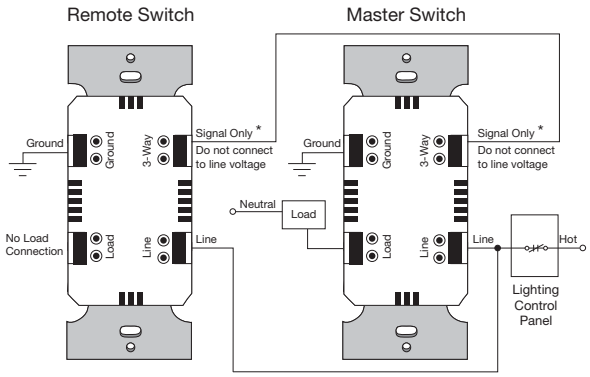
### Installation




### Single Switch Wiring with Panel

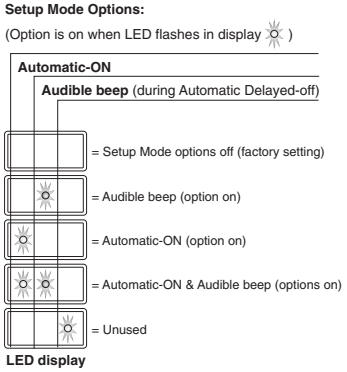



### Multi-way Switch Wiring with Panel




Each switch wired for multi-way operation has the ability to turn on, turn off or override a shutoff signal.

### Setup Mode Options




## Ordering Information

| Catalog No. | Color | Description | Load Requirement |
|---|---|---|---|
| ☐ AS-100-W | White | 120 VAC, 60 Hz or 277 VAC, 60 Hz | 0-1300W @ 120 V Watt Ballast & Tungsten or 0-3000W @ 277 V Watt Ballast |
| ☐ AS-100-A | Lt. Almond | | |
| ☐ AS-100-I | Ivory | | |

One ASP-211 single-gang cover plate included. Order ASP-422 for blank 2-gang cover plate, ASP-432 for 2-gang cover plate with switch option (specify color).

Pub. No. 14806

SECTION 26 56 00

EXTERIOR LIGHTING
**07/06**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO LTS | (2001; Am 2002, Am 2003, Am 2006) Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals |

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI C136.21 | (2004) Roadway Lighting Equipment - Vertical Tenons Used with Post-Top-Mounted Luminairesk |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 153/A 153M | (2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| ASTM B 108/B 108M | (2008) Standard Specification for Aluminum-Alloy Permanent Mold Castings |

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

| | |
|---|---|
| IESNA HB-9 | (2000; Errata 2004; Errata 2005) IES Lighting Handbook |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C2 | (2007; Errata 2007; INT 2008) National Electrical Safety Code |
| IEEE Std 100 | (2000) The Authoritative Dictionary of IEEE Standards Terms |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA 250 | (2003) Enclosures for Electrical Equipment (1000 Volts Maximum) |
| NEMA ANSLG C78.42 | (2007) Standard for High-Pressure Sodium Lamps |
| NEMA C136.13 | (2004) Roadway Lighting Equipment, Metal |

| | |
|---|---|
| | Brackets for Wood Poles |
| NEMA C136.3 | (2005) Roadway and Area Lighting Equipment Luminaire Attachments |
| NEMA C82.4 | (2002) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type) |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

| | |
|---|---|
| Energy Star | (1992; R 2006) Energy Star Energy Efficiency Labeling System |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1029 | (1994; Rev thru Dec 2007) Standard for Safety High-Intensity-Discharge Lamp Ballasts |
| UL 1598 | (2008) Luminaires |

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

b. Average life is the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

c. Groundline section is that portion between one foot above and 2 feet below the groundline.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Energy Efficiency

Luminaires; G

Lamps; G

Ballasts; G

Aluminum poles; G

Brackets

SD-05 Design Data

Design Data for luminaires; G

1.4 QUALITY ASSURANCE

1.4.1 Design Data for Luminaires

a. Distribution data according to IESNA classification type as defined in IESNA HB-9.

b. Computerized horizontal illumination levels in footcandles at ground level, taken every 10 feet. Include average maintained footcandle level and maximum and minimum ratio.

c. Amount of shielding on luminaires.

1.4.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.4.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

## 1.5 DELIVERY, STORAGE, AND HANDLING

### 1.5.1 Aluminum Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

## 1.6 SUSTAINABLE DESIGN REQUIREMENTS

### 1.6.1 Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products. Submit data indicating lumens per watt efficiency and color rendition index of light source.

## 1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

# PART 2 PRODUCTS

## 2.1 PRODUCT COORDINATION

Products and materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 33 71 02.00 20 UNDERGROUND UNDERGROUND TRANSMISSION AND DISTRIBUTION, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in Section 26 51 00 INTERIOR LIGHTING.

## 2.2 LUMINAIRES

UL 1598. Provide luminaires as indicated. Provide luminaires complete with lamps of number, type, and wattage indicated.

### 2.2.1 Lamps

#### 2.2.1.1 High-Pressure Sodium (HPS) Lamps

NEMA ANSLG C78.42. Wattage as indicated. HPS lamps shall have average rated life of 16,000 hours (minimum) for 35 watt lamps and 24,000 hours (minimum) for all higher wattage lamps. 150 watt lamps, if required, shall be 55 volt lamps. Lamps shall have Luminaire Efficiency Ratings (LER) as follows:

a. Upward efficiency of 0%

    1. 150-399 watts: minimum 58 LER for closed fixture; minimum 68 for open fixture

    2. 400-999 watts: minimum 63 LER for closed fixture; minimum 84 for open fixture

b. Upward efficiency of 1%-10%

    1. 150-399 watts: minimum 64 LER for closed fixture; minimum 63 for

open fixture

2. 400-999 watts: minimum 82 LER for closed fixture; minimum 89 for open fixture

3. 1000+ watts: minimum 109 LER for open fixture

c. Upward efficiency of 11% to 20%

1. 150-399 watts: minimum 78 LER for open fixture

2. 400-999 watts: minimum 94 for open fixture

d. Upward efficiency greater than 20%

1. 150-399 watts: minimum 75 LER for closed fixture; minimum 77 for open fixture

2.2.2 Ballasts for High-Intensity-Discharge (HID) Luminaires

UL 1029 and NEMA C82.4, and shall be constant wattage autotransformer (CWA) or regulator, high power-factor type (minimum 90%). Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

a. Designed to operate on voltage system to which they are connected.

b. Constructed so that open circuit operation will not reduce the average life.

HID ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 10,000 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C.

2.3 POLES

Provide poles designed for wind loading of 130 miles per hour determined in accordance with AASHTO LTS while supporting luminaires and all other appurtenances indicated. The effective projected areas of luminaires and appurtenances used in calculations shall be specific for the actual products provided on each pole. Poles shall be anchor-base type designed for use with underground supply conductors. Poles shall have oval-shaped handhole having a minimum clear opening of 2.5 by 5 inches. Handhole cover shall be secured by stainless steel captive screws. Metal poles shall have an internal grounding connection accessible from the handhole near the bottom of each pole. Scratched, stained, chipped, or dented poles shall not be installed.

2.3.1 Aluminum Poles

Provide aluminum poles manufactured of corrosion resistant aluminum alloys conforming to AASHTO LTS for Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys and Alloy 356-T4 (3,5) for cast alloys. Poles shall be seamless extruded or spun seamless type with minimum 0.188 inch wall thickness. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Tops of shafts shall be fitted with a round or tapered cover. Base shall be anchor bolt mounted, made of cast 356-T6 aluminum alloy in accordance with ASTM B 108/B 108M and shall be machined to receive the lower end of shaft. Joint between shaft and base shall be

welded. Base cover shall be cast 356-T6 aluminum alloy in accordance with ASTM B 108/B 108M. Hardware, except anchor bolts, shall be either 2024-T4 anodized aluminum alloy or stainless steel. Aluminum poles and brackets for walkway lighting shall have a dark anodic bronze finish to match fixtures and shall not be painted. Manufacturer's standard provision shall be made for protecting the finish during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

## 2.4 BRACKETS AND SUPPORTS

NEMA C136.3, NEMA C136.13, and ANSI C136.21, as applicable. Pole brackets shall be not less than 1 1/4 inch aluminum secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to luminaires provided, and brackets for use with one type of luminaire shall be identical. Brackets for pole-mounted street lights shall correctly position luminaire no lower than mounting height indicated. Mount brackets not less than 24 feet above street. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with luminaire head.

## 2.5 POLE FOUNDATIONS

Anchor bolts shall be steel rod having a minimum yield strength of 50,000 psi; the top 12 inches of the rod shall be galvanized in accordance with ASTM A 153/A 153M. Concrete shall be as specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE.

## 2.6 EQUIPMENT IDENTIFICATION

### 2.6.1 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

### 2.6.2 Labels

Provide labeled luminaires in accordance with UL 1598 requirements. Luminaires shall be clearly marked for operation of specific lamps and ballasts according to proper lamp type. The following lamp characteristics shall be noted in the format "Use Only _____":

a. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.

b. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.

c. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.

d. ANSI ballast type (M98, M57, etc.) for HID luminaires.

e. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

Markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Ballasts shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

## 2.7 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

### 3.1.1 Aluminum Poles

Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end. Provide ornamental covers to match pole and galvanized nuts and washers for anchor bolts. Concrete for anchor bases, polyvinyl chloride (PVC) conduit ells, and ground rods shall be as specified in Section 33 71 02.00 20 UNDERGROUND UNDERGROUND TRANSMISSION AND DISTRIBUTION. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.

### 3.1.2 Pole Setting

Depth shall be as indicated. Poles in straight runs shall be in a straight line. Dig holes large enough to permit the proper use of tampers to the full depth of the hole. Place backfill in the hole in 6 inch maximum layers and thoroughly tamp. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.

### 3.1.3 GROUNDING

Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures as specified in Section 33 71 02.00 20 UNDERGROUND UNDERGROUND TRANSMISSION AND DISTRIBUTION. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

### 3.1.4 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

## 3.2 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test to show that the equipment operates in accordance with the requirements of this section.

-- End of Section --

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** HPTR-3S-400-MT-F1-LL<br>Notes: | **Type:** K<br>WK08-1600 |

# Ⓔ COOPER LIGHTING - LUMARK®

energy solutions

**DESCRIPTION**

The Lumark Tribute is the most versatile, functionally designed, universally adaptable outdoor luminaire available. The Tribute brings outstanding performance to walkways, parking lots, roadways, loading docks, building areas, and any security lighting application. U.L. listed and CSA certified for wet locations. IP55 Rating.

| | | Type |
|---|---|---|
| Catalog # | | |
| Project | | |
| Comments | | Date |
| Prepared by | | |

**SPECIFICATION FEATURES**

**Construction**
Rugged one-piece die-cast aluminum housing and door frame. One-piece silicone gasket protects the optical chamber from performance degrading contaminants. One (1) stainless spring latch and two (2) stainless hinges allow toolless opening and removal of door frame.

**Reflector**
Choice of nine (9) high efficiency optical distributions, including five (5) segmented optical systems constructed of premium 95% reflective anodized aluminum sheet. Optical segments are rigidly mounted inside a thick gauge aluminum housing for superior protection. All segment faces are clean of rivet heads, tabs or other means of attachment which may cause streaking in the light distribution. Optical modules are field rotatable in 90° increments and offered standard with mogul-base lampholders for 150-400W assemblies or medium-base lampholders for 100W and below.

**Electrical**
Ballast and related electrical componentry are hard mounted to die-cast housing for optimal heat transfer and operating efficiency. Optional swing-down galvanized steel power tray with integral handle and quick disconnects allows tray to be completely removed from housing providing ample room for fixture installation and maintenance.

**Mounting**
Extruded 8" aluminum arm features internal bolt guides for easy positioning of fixture during installation to pole or wall surface. Standard single carton packaging of housing, square pole arm and round pole adapter allow for consolidated product arrival to site. Optional internal mast arm mount accepts a 1 1/4" to 2 3/8" O.D. horizontal tenon, while a 4-bolt clamping mechanism secures fixture. Cast-in leveling guides provide +/-5° vertical leveling adjustment.

**Finish**
Housing and arm finished in a 5 stage premium TGIC bronze polyester powder coat paint. Optional colors include black, grey, white, dark platinum and graphite metallic. RAL and custom color matches available.

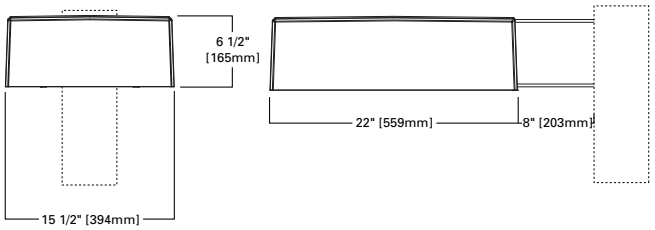
**TR**
TRIBUTE

**70 - 400W**
**High Pressure Sodium**
**Pulse Start Metal Halide**
**Metal Halide**

**AREA LUMINAIRE**

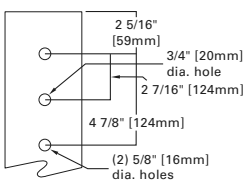
DARK SKY COMPLIANT FCO Full Cutoff

**DIMENSIONS**

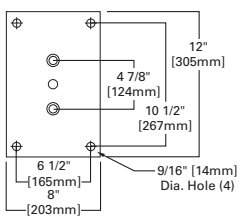



**DRILLING PATTERNS**

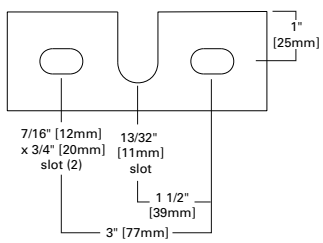
**TYPE "M"**




**WALL MOUNT**




**TRUNNION MOUNT**




**TECHNICAL DATA**
UL Wet Locations Listed
CSA Certified
IP55 Rated
EISA Compliant Ⓔ

**ENERGY DATA**
**Hi-Reactance Ballast Input Watts**
70W HPS HPF (95 Watts)
100W HPS HPF (130 Watts)
150W HPS HPF (190 Watts)
150W MP HPF (185 Watts)

**CWI Ballast Input Watts**
250W HPS HPF (300 Watts)

**CWA Ballast Input Watts**
175W MH HPF (210 Watts)
200W MP HPF (227 Watts) Ⓔ
200W HPS HPF (250 Watts)
250W MH HPF (295 Watts)
250W MP HPF (283 Watts) Ⓔ
320W MP HPF (365 Watts) Ⓔ
350W MP HPF (397 Watts) Ⓔ
400W MP HPF (452 Watts) Ⓔ
400W MH HPF (455 Watts)
400W HPS HPF (465 Watts)

**EPA**
**Effective Projected Area:** (Sq. Ft.)
**Without Arm:** 1.19

**SHIPPING DATA**
**Approximate Net Weight:**
39 lbs. (17.73 kgs.)

ISO 9001 CERTIFIED SYSTEMS

COOPER Lighting
www.cooperlighting.com

**Specifications and Dimensions subject to change without notice.**
Consult your representative for additional options and finishes.

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** HPTR-3S-400-MT-F1-LL<br>Notes: | **Type:** **K**<br>WK08-1600 |

**TR** TRIBUTE

**ORDERING INFORMATION**

**Sample Number: MHTR-SL-400-MT-LL**

**Lamp Type**
**MP** =Pulse Start Metal Halide
**MH** =Metal Halide
**HP** =High Pressure Sodium

**Series** [1]
**TR** =Tribute (Arm Included)

**Distribution**
**2F** =Type II Formed
**2S** =Type II Segmented
**3F** =Type III Formed
**3S** =Type III Segmented
**4F** =Type IV Formed
**4S** =Type IV Segmented
**5F** =Type V Formed
**5S** =Type V Segmented
**SL** =Spill Light Eliminator

**Lamp Wattage** [2]
MP
**70** = 100W
**100** = 100W
**150** = 150W
**200** = 200W
**250** = 250W
**320** = 320W
**350** = 350W
**400** = 400W
MH [3]
**175** = 175W
**250** = 250W
**400** = 400W
HPS
**70** = 70W
**100** = 100W
**150** = 150W
**250** = 250W
**400** = 400W

**Voltage** [5]
**120V** =120V
**208V** =208V
**240V** =240V
**277V** =277V
**347V** =347V [6]
**480V** =480V
**DT** =Dual-Tap
**MT** =Multi-Tap, wired 277V
**TT** Triple-Tap, [6] wired 347V
**5T** =5 Tap Wired [5] 480V

**Options** [7, 8]
**F1** =Single Fuse (120, 277 or 347V [9] only)
**F2** =Double Fuse (208, 240 or 480V [9] only)
**Q** =Quartz Restrike (Hot Strike [10] Only)
**EM** =Quartz Restrike with ''Delay [10] Relay'' (Quartz lamp strikes at both hot and cold starts)
**EM/SC** =Emergency Separate [10] Circuit
**LL** =Lamp Included
**S** =1 1/4" - 2 3/8" Internal Mast Arm Mount
**TM** =Trunnion Mount
**PT** =Electrical Power Tray
**HS** =House Side Cutoff [11]
**LA** =Less Arm (Order Mounting Separately)
**PER** =NEMA Twistlock Photocontrol Receptacle
**PC** =Button Type Photocontrol
**WH** =White
**BK** =Black
**AP** =AP Grey
**DP** =Dark Platinum
**GM** =Graphite Metallic

**Accessories** [12]
**MA1201-XX** =Direct Wall Mount Kit [1]
**MA1218-XX** =Direct Mount for Pole [1]
**MA1219-XX** =Wall Mounting Plate
**OA1090-XX** =Adjustable slipfitter Arm for Tenon Mount 2 3/8" O.D. [1]
**MA1221-XX** = External House Side Shield Kit (EPA= 0.38)
**MA1222** = Internal House Side Shield Kit for 2S/3S
**MA1223** = Internal House Side Shield Kit 4S
**MA1224** = Internal House Side Shield Kit for 2F/3F
**MA1225** = Internal House Side Shield Kit for 4F
**MA1010-XX** = SingleTenon Adapter for 3 1/2" O.D. Tenon
**MA1011-XX** = 2 @ 180 degrees Tenon Adapter for 3 1/2" O.D.Tenon
**MA1012-XX** = 3 @ 120 degrees Tenon Adaptor for 3 1/2" O.D. Tenon
**MA1013-XX** = 4 @ 90 degrees Tenon Adapter for 3 1/2" O.D. Tenon
**MA1014-XX** = 2 @ 90 degrees Tenon Adapter for 3 1/2" O.D. Tenon
**MA1015-XX** = 2 @ 120 degrees Tenon Adapter for 3 1/2" O.D. Tenon
**MA1016-XX** = 3 @ 90 degrees Tenon Adapter for 3 1/2" O.D. Tenon
**MA1017-XX** = Single Tenon Adapter for 2 3/8 " O.D. Tenon
**MA1018-XX** = 2 @ 180 degrees Tenon Adapter for 2 3/8" O.D. Tenon
**MA1019-XX** = 3 @ 120 degrees Tenon Adapter for 2 3/8" O.D. Tenon
**MA1045-XX** = 4 @ 90 degrees Tenon Adapter for 2 3/8" O.D. Tenon
**MA1048-XX** = 2 @ 90 degrees Tenon Adapter for 2 3/8" O.D.Tenon
**MA1049-XX** = 3 @ 90 degrees Tenon Adapter for 2 3/8" O.D. Tenon
**OARA1016** = Photoelectric Control 105-285V NEMA Type
**OARA1027** = Photoelectric Control 480V NEMA Type
**OA/RA1021** = Photoelectric Control 347V NEMA Type
**OARA1013** = Shorting Cap
**TR/VS** =Field Installed Vandal Shield [13]

1 8 Inch Arm and pole adapter included with fixture. Specify Less Arm "LA" option when mounting accessory is ordered separately.
2 Standard with mogul-base socket for 150-400W and medium-base socket 100W and below.
3 175W, 250W, 400W MH available for non-US markets only.
4 Requires reduced envelope lamp.
5 Products also available in non-US voltages and 50HZ for international markets. Consult factory for availabiltiy and ordering information. 5T only available in 400W MH.
6 88% Efficient EISA Compliant MP fixtures not available in 347V or TT voltages.
7 Custom and RAL color matching available upon request. Consult Cooper Lighting Representative for further information.
8 Add as a suffix.
9 Must specify voltage.
10 Quartz options not available with SL optics.
11 House side shield not available on 5S, 5F, or SL optics.
12 Order separately/replace XX with color specification.
13 Not available with SLE or House Side Sheild.

**STOCK SAMPLE NUMBER (Lamp Included)**

**SAMPLE NUMBER:** MPTR2340

| MP | TR | 23 | |
|---|---|---|---|
| **Lamp Type**<br>**MP**=Pulse Start Metal Halide<br>**HP**=High Pressure Sodium [2] | **Series** [1]<br>**TR**=Tribute | **Distribution**<br>**23**=Type II/III Formed | **Lamp Wattage**<br>**15**=150W<br>**25**=250W<br>**32**=320W<br>**40**=400W |

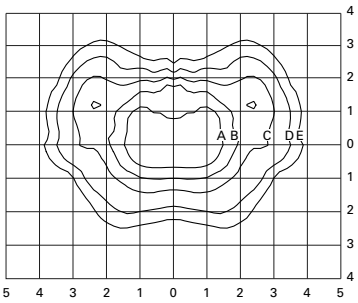
**NOTES:**
[1] Short logic fixtures are finished bronze include multi-tap ballast, lamp, arm and round pole adapter. Other options not available. Refer to standard ordering logic. [2] Available in 150, 250 and 400 Watt. Refer to In Stock Guide for availability.

| LAMP TYPE | WATTAGE |
|---|---|
| **Pulse Start Metal Halide** | 70, 100, 150, 250, 320, 350, 400W |
| **Metal Halide** | 175, 250, 400W |
| **High Pressure Sodium** | 70, 100, 150, 250, 400W |

| VOLTAGE CHART | |
|---|---|
| DT=Dual-Tap | 120/277 (wired 277V) |
| MT=Multi-Tap | 120/208/240/277 (wired 277V) |
| TT=Triple-Tap | 120/277/347 (wired 347V) |
| 5T=5-Tap | 120/208/240/277/480 (wired 480V) |

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** HPTR-3S-400-MT-F1-LL<br>Notes: | **Type:** **K**<br>WK08-1600 |

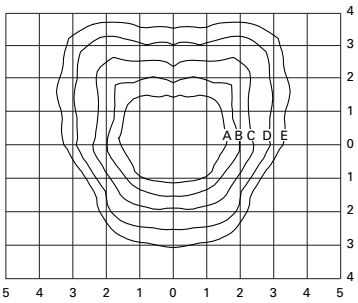
**PHOTOMETRICS [Complete IES files available at www.cooperlighting.com]**




**MPTR-3S-320**
320—Watt MP
30,000—Lumen Clear Lamp
Type III Segmented

**Footcandle Table**
Select mounting height and read across for footcandle values of each isofootcandle line. Distance in units of mounting height.

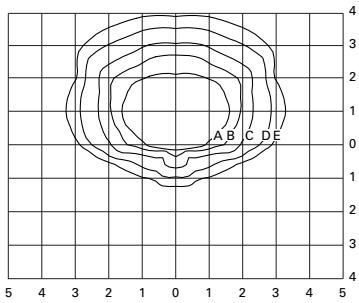
| Mounting Height | Footcandle Values for Isofootcandle Lines | | | | |
|---|---|---|---|---|---|
| | **A** | **B** | **C** | **D** | **E** |
| 20' | 3.00 | 1.50 | 0.75 | 0.30 | 0.15 |
| **25'** | **2.00** | **1.00** | **0.50** | **0.20** | **0.10** |
| 30' | 1.38 | 0.69 | 0.34 | 0.13 | 0.06 |




**MPTR-4S-400**
400—Watt MP
40,000—Lumen Clear Lamp
Type IV Segmented

**Footcandle Table**
Select mounting height and read across for footcandle values of each isofootcandle line. Distance in units of mounting height.

| Mounting Height | Footcandle Values for Isofootcandle Lines | | | | |
|---|---|---|---|---|---|
| | **A** | **B** | **C** | **D** | **E** |
| 20' | 3.00 | 1.50 | 0.75 | 0.30 | 0.15 |
| **25'** | **2.00** | **1.00** | **0.50** | **0.20** | **0.10** |
| 30' | 1.38 | 0.69 | 0.34 | 0.13 | 0.06 |




**MPTR-SL-400**
400—Watt MP
40,000—Lumen Clear Lamp
Spill Light Eliminator

**Footcandle Table**
Select mounting height and read across for footcandle values of each isofootcandle line. Distance in units of mounting height.

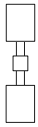
| Mounting Height | Footcandle Values for Isofootcandle Lines | | | | |
|---|---|---|---|---|---|
| | **A** | **B** | **C** | **D** | **E** |
| 20' | 3.00 | 1.50 | 0.75 | 0.30 | 0.15 |
| **25'** | **2.00** | **1.00** | **0.50** | **0.20** | **0.10** |
| 30' | 1.38 | 0.69 | 0.34 | 0.13 | 0.06 |

**MOUNTING CONFIGURATIONS**

Wall Mount

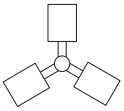
Arm Mount Single
EPA: 1.62

Arm Mount 2 @ 180
EPA: 3.24

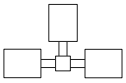


Arm Mount 2 @ 90
EPA: 3.24

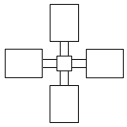
Arm Mount 3 @ 120
(Round Pole Only)
EPA: 4.43



Arm Mount 3 @ 90
EPA: 4.43



Arm Mount 4 @ 90
EPA: 5.03



| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** RTA-845303-DX-BRZ<br>Notes: | **Type:** K<br>WK08-1600 |

# ALUMINUM LIGHTING STANDARDS

## UNITED LIGHTING STANDARDS, INC.

23171 Groesbeck Hwy. • Warren, MI 48089
Tel: 586/774-5650 FAX: 586/774-5706

## Aluminum Light Pole Specifications

### Pole Shaft

Shaft material for aluminum poles is 6063 alloy and tempered to meet the Aluminum Association T6 standards. All pole shafts tapered and non-tapered are of one-piece, seamless tubing with no long seam or circumferential welds, other than the anchor base to shaft weld.

### Anchor Base

Bases cast from A356 aluminum alloy and tempered to Aluminum Association T6 standards are used for all tapered and non-tapered poles.

### Base

Bases for 4, 5 and 6-inch square and round poles have tamper-proof closures offering a clean, aesthetic appearance. On 7 and 8-inch round poles, nut covers are supplied as standard.

### Anchor Bolts

Anchor bolts are fabricated from structural quality, hot rolled carbon steel bar, having a minimum yield strength of 50,000 psi. Bolts have an "L" bend on the end. The threads plus 3 inches are galvanized. Anchor bolts come with two nuts and washers.

### Handhole

An extruded handhole to facilitate ease of wiring is standard. A cover with tamper resistant hardware is provided.

### Finish

Standard finish is dark bronze (DB) powder coat. Also available as standard in powder coat is black. Optional powder coat finishes include grey (GR), silver (SL) and white (WH).

### Mounting Configuration

Pole top tenons or side mount drilling for 1 to 4 fixtures is available. We reserve the right to use a pole top adaptor for the use of direct mounting of fixtures as deemed necessary.

### Vibration Dampeners

Vibration dampeners are available as an option. They are suggested for use on poles 30 feet and over.

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** RTA-845303-DX-BRZ<br>Notes: | **Type:** K<br>WK08-1600 |

# DESIGN RTA

## UNITED LIGHTING STANDARDS, INC.

23171 Groesbeck Hwy. • Warren, MI 48089
Tel: 586/774-5650 FAX: 586/774-5706

### Pole Shaft Specifications

The shaft is spun tapered from all new seamless 6063 alloy aluminum tubing and heat-treated to produce a T6 temper. Each shaft has a 6" long straight section at the top which may be drilled to manufacturer's specifications for mounting luminaires.* The shaft is gracefully cone tapered to the butt diameter.

***We reserve the right to use a pole top adaptor for the use of direct mounting of fixtures as deemed necessary.**

### Anchor Base

Cast from A356 alloy aluminum, the anchor base shall be heat-treated to produce a T6 condition. The shaft shall be inserted into the anchor base casting. The anchor base casting and shaft shall be joined by a continuous circumferential weld at the outside top and inside bottom of the anchor base. Aluminum nut covers are supplied to cover exposed bolt and nut.

**Drill Mount for 2 fixtures**
**Bronze finish**

## Round Tapered Aluminum Poles

| Catalog No. | Mounting Height (Ft.) | *Effective Projected Area (Sq. Ft.) | | | | Shaft Size | | Wall Thickness | Bolt Circle (") | Bolt Size (") | Base Plate Size (L x W) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 80 | 90 | 100 | 120 | Butt (") | Top (") | | | | |
| RTA-745202 | 20 | 15.9 | 12.2 | 9.7 | 6.2 | 7 | 4.5 | .156 | 10.5 | 1 x 40 | 11.5 x 11.5 |
| RTA-745222 | 22 | 12.3 | 9.2 | 7.2 | 4.7 | 7 | 4.5 | .156 | 10.5 | 1 x 40 | 11.5 x 11.5 |
| RTA-745252 | 25 | 10.3 | 7.6 | 5.9 | 3.7 | 7 | 4.5 | .156 | 10.5 | 1 x 40 | 11.5 x 11.5 |
| RTA-845252 | 25 | 15.3 | 11.7 | 9.2 | 5.7 | 8 | 4.5 | .156 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845272 | 27 | 12.0 | 9.2 | 7.1 | 4.1 | 8 | 4.5 | .156 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845273 | 27 | 15.6 | 11.9 | 9.4 | 6.0 | 8 | 4.5 | .188 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845302 | 30 | 10.2 | 7.7 | 5.9 | 3.5 | 8 | 4.5 | .156 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845303 | 30 | 13.3 | 10.4 | 7.9 | 5.0 | 8 | 4.5 | .188 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845304 | 30 | 19.4 | 14.9 | 11.7 | 7.4 | 8 | 4.5 | .250 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845353 | 35 | 9.2 | 6.8 | 5.1 | 2.8 | 8 | 4.5 | .188 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845354 | 35 | 14.1 | 10.7 | 8.3 | 4.9 | 8 | 4.5 | .250 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845393 | 39 | 6.5 | 4.6 | 3.2 | 1.4 | 8 | 4.5 | .188 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845394 | 39 | 10.8 | 7.9 | 6.1 | 3.3 | 8 | 4.5 | .250 | 11.5 | 1 x 40 | 12.0 x 12.0 |

***EPA ratings include 1.3 gust factor.**
**Anchor Bolts should be set using factory supplied anchor bolt templates.**
**Vibration dampeners are suggested for poles 30 feet and above.**

## Round Tapered Aluminum Poles 20-39 Ft.

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** HPTR-5S-400-MT-F1-LL<br>Notes: | **Type:** L<br>WK08-1600 |

# Ⓔ COOPER LIGHTING - LUMARK®

energy solutions

**DESCRIPTION**

The Lumark Tribute is the most versatile, functionally designed, universally adaptable outdoor luminaire available. The Tribute brings outstanding performance to walkways, parking lots, roadways, loading docks, building areas, and any security lighting application. U.L. listed and CSA certified for wet locations. IP55 Rating.

| | | Type |
|---|---|---|
| Catalog # | | |
| Project | | |
| Comments | | Date |
| Prepared by | | |

**SPECIFICATION FEATURES**

**Construction**
Rugged one-piece die-cast aluminum housing and door frame. One-piece silicone gasket protects the optical chamber from performance degrading contaminants. One (1) stainless spring latch and two (2) stainless hinges allow toolless opening and removal of door frame.

**Reflector**
Choice of nine (9) high efficiency optical distributions, including five (5) segmented optical systems constructed of premium 95% reflective anodized aluminum sheet. Optical segments are rigidly mounted inside a thick gauge aluminum housing for superior protection. All segment faces are clean of rivet heads, tabs or other means of attachment which may cause streaking in the light distribution. Optical modules are field rotatable in 90° increments and offered standard with mogul-base lampholders for 150-400W assemblies or medium-base lampholders for 100W and below.

**Electrical**
Ballast and related electrical componentry are hard mounted to die-cast housing for optimal heat transfer and operating efficiency. Optional swing-down galvanized steel power tray with integral handle and quick disconnects allows tray to be completely removed from housing providing ample room for fixture installation and maintenance.

**Mounting**
Extruded 8" aluminum arm features internal bolt guides for easy positioning of fixture during installation to pole or wall surface. Standard single carton packaging of housing, square pole arm and round pole adapter allow for consolidated product arrival to site. Optional internal mast arm mount accepts a 1 1/4" to 2 3/8" O.D. horizontal tenon, while a 4-bolt clamping mechanism secures fixture. Cast-in leveling guides provide +/-5° vertical leveling adjustment.

**Finish**
Housing and arm finished in a 5 stage premium TGIC bronze polyester powder coat paint. Optional colors include black, grey, white, dark platinum and graphite metallic. RAL and custom color matches available.

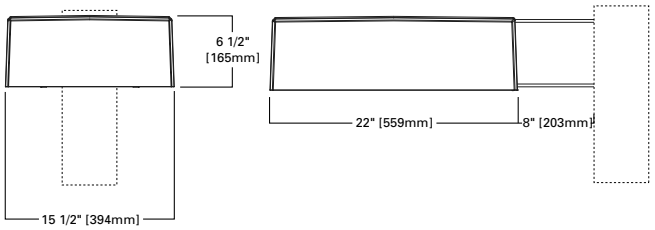
**TR**
TRIBUTE

**70 - 400W**
**High Pressure Sodium**
**Pulse Start Metal Halide**
**Metal Halide**

**AREA LUMINAIRE**

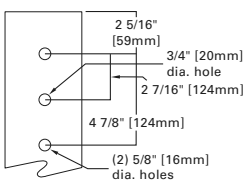
DARK SKY COMPLIANT FCO Full Cutoff

**DIMENSIONS**

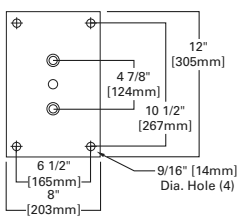



**DRILLING PATTERNS**

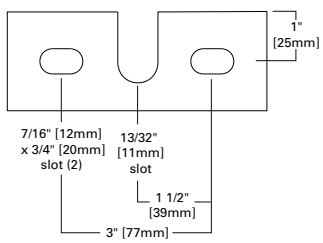
**TYPE "M"**




**WALL MOUNT**




**TRUNNION MOUNT**




**TECHNICAL DATA**
UL Wet Locations Listed
CSA Certified
IP55 Rated
EISA Compliant Ⓔ

**ENERGY DATA**
**Hi-Reactance Ballast Input Watts**
70W HPS HPF (95 Watts)
100W HPS HPF (130 Watts)
150W HPS HPF (190 Watts)
150W MP HPF (185 Watts)

**CWI Ballast Input Watts**
250W HPS HPF (300 Watts)

**CWA Ballast Input Watts**
175W MH HPF (210 Watts)
200W MP HPF (227 Watts) Ⓔ
200W HPS HPF (250 Watts)
250W MH HPF (295 Watts)
250W MP HPF (283 Watts) Ⓔ
320W MP HPF (365 Watts) Ⓔ
350W MP HPF (397 Watts) Ⓔ
400W MP HPF (452 Watts) Ⓔ
400W MH HPF (455 Watts)
400W HPS HPF (465 Watts)

**EPA**
**Effective Projected Area:** (Sq. Ft.)
**Without Arm:** 1.19

**SHIPPING DATA**
**Approximate Net Weight:**
39 lbs. (17.73 kgs.)

ISO 9001 SYSTEMS CERTIFIED

COOPER Lighting
www.cooperlighting.com

**Specifications and Dimensions subject to change without notice.**
Consult your representative for additional options and finishes.

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** HPTR-5S-400-MT-F1-LL<br>Notes: | **Type:** **L**<br>WK08-1600 |

**TR** TRIBUTE

## ORDERING INFORMATION

**Sample Number: MHTR-SL-400-MT-LL**

**Lamp Type**
**MP** =Pulse Start Metal Halide
**MH**=Metal Halide
**HP**=High Pressure Sodium

**Series** [1]
**TR**=Tribute (Arm Included)

**Distribution**
**2F**=Type II Formed
**2S**=Type II Segmented
**3F**=Type III Formed
**3S**=Type III Segmented
**4F**=Type IV Formed
**4S**=Type IV Segmented
**5F**=Type V Formed
**5S**=Type V Segmented
**SL**=Spill Light Eliminator

**Lamp Wattage** [2]
MP
**70** = 100W
**100** = 100W
**150** = 150W
**200** = 200W
**250** = 250W
**320** = 320W
**350** = 350W
**400** = 400W
MH [3]
**175** = 175W
**250** = 250W
**400** = 400W
HPS
**70** = 70W
**100** = 100W
**150** = 150W
**250** = 250W
**400** = 400W

**Voltage** [5]
**120V** =120V
**208V** =208V
**240V** =240V
**277V** =277V
**347V** =347V [6]
**480V** =480V
**DT**=Dual-Tap
**MT**=Multi-Tap, wired 277V
**TT** Triple-Tap, [6] wired 347V
**5T**=5 Tap Wired [5] 480V

**Options** [7, 8]
**F1** =Single Fuse (120, 277 or 347V [9] only)
**F2** =Double Fuse (208, 240 or 480V [9] only)
**Q**=Quartz Restrike (Hot Strike [10] Only)
**EM**=Quartz Restrike with ''Delay [10] Relay'' (Quartz lamp strikes at both hot and cold starts)
**EM/SC**=Emergency Separate [10] Circuit
**LL**=Lamp Included
**S**=1 1/4" - 2 3/8" Internal Mast Arm Mount
**TM**=Trunnion Mount
**PT**=Electrical Power Tray
**HS**=House Side Cutoff [11]
**LA**=Less Arm (Order Mounting Separately)
**PER**=NEMA Twistlock Photocontrol Receptacle
**PC**=Button Type Photocontrol
**WH**=White
**BK**=Black
**AP**=AP Grey
**DP**=Dark Platinum
**GM**=Graphite Metallic

**Accessories** [12]
**MA1201-XX** =Direct Wall Mount Kit [1]
**MA1218-XX** =Direct Mount for Pole [1]
**MA1219-XX** =Wall Mounting Plate
**OA1090-XX** =Adjustable slipfitter Arm for Tenon Mount 2 3/8" O.D. [1]
**MA1221-XX** = External House Side Shield Kit (EPA= 0.38)
**MA1222** = Internal House Side Shield Kit for 2S/3S
**MA1223** = Internal House Side Shield Kit 4S
**MA1224** = Internal House Side Shield Kit for 2F/3F
**MA1225** = Internal House Side Shield Kit for 4F
**MA1010-XX** = SingleTenon Adapter for 3 1/2" O.D. Tenon
**MA1011-XX** = 2 @ 180 degrees Tenon Adapter for 3 1/2" O.D.Tenon
**MA1012-XX** = 3 @ 120 degrees Tenon Adaptor for 3 1/2" O.D. Tenon
**MA1013-XX** = 4 @ 90 degrees Tenon Adapter for 3 1/2" O.D. Tenon
**MA1014-XX** = 2 @ 90 degrees Tenon Adapter for 3 1/2" O.D. Tenon
**MA1015-XX** = 2 @ 120 degrees Tenon Adapter for 3 1/2" O.D. Tenon
**MA1016-XX** = 3 @ 90 degrees Tenon Adapter for 3 1/2" O.D. Tenon
**MA1017-XX** = Single Tenon Adapter for 2 3/8 " O.D. Tenon
**MA1018-XX** = 2 @ 180 degrees Tenon Adapter for 2 3/8" O.D. Tenon
**MA1019-XX** = 3 @ 120 degrees Tenon Adapter for 2 3/8" O.D. Tenon
**MA1045-XX** = 4 @ 90 degrees Tenon Adapter for 2 3/8" O.D. Tenon
**MA1048-XX** = 2 @ 90 degrees Tenon Adapter for 2 3/8" O.D.Tenon
**MA1049-XX** = 3 @ 90 degrees Tenon Adapter for 2 3/8" O.D. Tenon
**OARA1016** = Photoelectric Control 105-285V NEMA Type
**OARA1027** = Photoelectric Control 480V NEMA Type
**OA/RA1021** = Photoelectric Control 347V NEMA Type
**OARA1013** = Shorting Cap
**TR/VS**=Field Installed Vandal Shield [13]

1 8 Inch Arm and pole adapter included with fixture. Specify Less Arm "LA" option when mounting accessory is ordered separately.
2 Standard with mogul-base socket for 150-400W and medium-base socket 100W and below.
3 175W, 250W, 400W MH available for non-US markets only.
4 Requires reduced envelope lamp.
5 Products also available in non-US voltages and 50HZ for international markets. Consult factory for availabiltiy and ordering information. 5T only available in 400W MH.
6 88% Efficient EISA Compliant MP fixtures not available in 347V or TT voltages.
7 Custom and RAL color matching available upon request. Consult Cooper Lighting Representative for further information.
8 Add as a suffix.
9 Must specify voltage.
10 Quartz options not available with SL optics.
11 House side shield not available on 5S, 5F, or SL optics.
12 Order separately/replace XX with color specification.
13 Not available with SLE or House Side Sheild.

## STOCK SAMPLE NUMBER (Lamp Included)

**SAMPLE NUMBER:** MPTR2340

| MP | TR | 23 | |
|---|---|---|---|
| **Lamp Type**<br>**MP**=Pulse Start Metal Halide<br>**HP**=High Pressure Sodium [2] | **Series** [1]<br>**TR**=Tribute | **Distribution**<br>**23**=Type II/III Formed | **Lamp Wattage**<br>**15**=150W<br>**25**=250W<br>**32**=320W<br>**40**=400W |

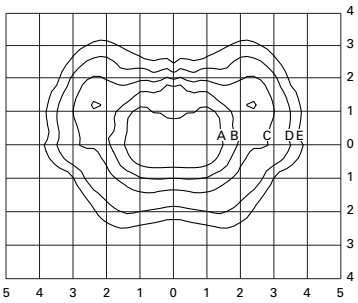
**NOTES:**
[1] Short logic fixtures are finished bronze include multi-tap ballast, lamp, arm and round pole adapter. Other options not available. Refer to standard ordering logic. [2] Available in 150, 250 and 400 Watt. Refer to In Stock Guide for availability.

| LAMP TYPE | WATTAGE |
|---|---|
| **Pulse Start Metal Halide** | 70, 100, 150, 250, 320, 350, 400W |
| **Metal Halide** | 175, 250, 400W |
| **High Pressure Sodium** | 70, 100, 150, 250, 400W |

| VOLTAGE CHART | |
|---|---|
| DT=Dual-Tap | 120/277 (wired 277V) |
| MT=Multi-Tap | 120/208/240/277 (wired 277V) |
| TT=Triple-Tap | 120/277/347 (wired 347V) |
| 5T=5-Tap | 120/208/240/277/480 (wired 480V) |

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** HPTR-5S-400-MT-F1-LL<br>Notes: | **Type:** **L**<br>WK08-1600 |

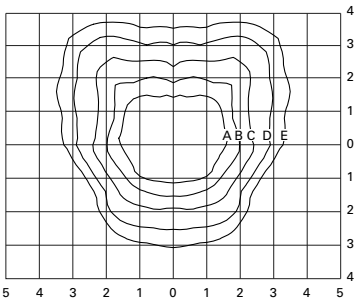
**PHOTOMETRICS [Complete IES files available at www.cooperlighting.com]**




**MPTR-3S-320**
320—Watt MP
30,000—Lumen Clear Lamp
Type III Segmented

**Footcandle Table**
Select mounting height and read across for footcandle values of each isofootcandle line. Distance in units of mounting height.

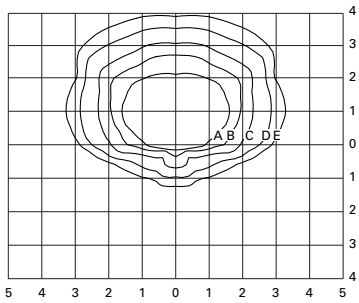
| Mounting Height | Footcandle Values for Isofootcandle Lines | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| 20' | 3.00 | 1.50 | 0.75 | 0.30 | 0.15 |
| **25'** | **2.00** | **1.00** | **0.50** | **0.20** | **0.10** |
| 30' | 1.38 | 0.69 | 0.34 | 0.13 | 0.06 |




**MPTR-4S-400**
400—Watt MP
40,000—Lumen Clear Lamp
Type IV Segmented

**Footcandle Table**
Select mounting height and read across for footcandle values of each isofootcandle line. Distance in units of mounting height.

| Mounting Height | Footcandle Values for Isofootcandle Lines | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| 20' | 3.00 | 1.50 | 0.75 | 0.30 | 0.15 |
| **25'** | **2.00** | **1.00** | **0.50** | **0.20** | **0.10** |
| 30' | 1.38 | 0.69 | 0.34 | 0.13 | 0.06 |




**MPTR-SL-400**
400—Watt MP
40,000—Lumen Clear Lamp
Spill Light Eliminator

**Footcandle Table**
Select mounting height and read across for footcandle values of each isofootcandle line. Distance in units of mounting height.

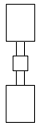
| Mounting Height | Footcandle Values for Isofootcandle Lines | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| 20' | 3.00 | 1.50 | 0.75 | 0.30 | 0.15 |
| **25'** | **2.00** | **1.00** | **0.50** | **0.20** | **0.10** |
| 30' | 1.38 | 0.69 | 0.34 | 0.13 | 0.06 |

**MOUNTING CONFIGURATIONS**

Wall Mount

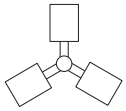
Arm Mount Single
EPA: 1.62

Arm Mount 2 @ 180
EPA: 3.24

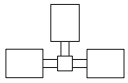


Arm Mount 2 @ 90
EPA: 3.24

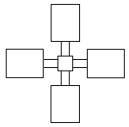
Arm Mount 3 @ 120
(Round Pole Only)
EPA: 4.43



Arm Mount 3 @ 90
EPA: 4.43



Arm Mount 4 @ 90
EPA: 5.03



| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** RTA-845303-DX-BRZ<br>Notes: | **Type:** L<br>WK08-1600 |

# ALUMINUM LIGHTING STANDARDS

## UNITED LIGHTING STANDARDS, INC.

23171 Groesbeck Hwy. • Warren, MI 48089
Tel: 586/774-5650 FAX: 586/774-5706

## Aluminum Light Pole Specifications

### Pole Shaft

Shaft material for aluminum poles is 6063 alloy and tempered to meet the Aluminum Association T6 standards. All pole shafts tapered and non-tapered are of one-piece, seamless tubing with no long seam or circumferential welds, other than the anchor base to shaft weld.

### Anchor Base

Bases cast from A356 aluminum alloy and tempered to Aluminum Association T6 standards are used for all tapered and non-tapered poles.

### Base

Bases for 4, 5 and 6-inch square and round poles have tamper-proof closures offering a clean, aesthetic appearance. On 7 and 8-inch round poles, nut covers are supplied as standard.

### Anchor Bolts

Anchor bolts are fabricated from structural quality, hot rolled carbon steel bar, having a minimum yield strength of 50,000 psi. Bolts have an "L" bend on the end. The threads plus 3 inches are galvanized. Anchor bolts come with two nuts and washers.

### Handhole

An extruded handhole to facilitate ease of wiring is standard. A cover with tamper resistant hardware is provided.

### Finish

Standard finish is dark bronze (DB) powder coat. Also available as standard in powder coat is black. Optional powder coat finishes include grey (GR), silver (SL) and white (WH).

### Mounting Configuration

Pole top tenons or side mount drilling for 1 to 4 fixtures is available. We reserve the right to use a pole top adaptor for the use of direct mounting of fixtures as deemed necessary.

### Vibration Dampeners

Vibration dampeners are available as an option. They are suggested for use on poles 30 feet and over.

| Submitted by Wells Keown Associates | | | |
|---|---|---|---|
| | **Job Name:** Riverine & Combatant - | **Catalog Number:** RTA-845303-DX-BRZ<br>Notes: | **Type:** L<br>WK08-1600 |

# DESIGN RTA

## UNITED LIGHTING STANDARDS, INC.

23171 Groesbeck Hwy. • Warren, MI 48089
Tel: 586/774-5650 FAX: 586/774-5706

### Pole Shaft Specifications

The shaft is spun tapered from all new seamless 6063 alloy aluminum tubing and heat-treated to produce a T6 temper. Each shaft has a 6" long straight section at the top which may be drilled to manufacturer's specifications for mounting luminaires.* The shaft is gracefully cone tapered to the butt diameter.

***We reserve the right to use a pole top adaptor for the use of direct mounting of fixtures as deemed necessary.**

### Anchor Base

Cast from A356 alloy aluminum, the anchor base shall be heat-treated to produce a T6 condition. The shaft shall be inserted into the anchor base casting. The anchor base casting and shaft shall be joined by a continuous circumferential weld at the outside top and inside bottom of the anchor base. Aluminum nut covers are supplied to cover exposed bolt and nut.

**Drill Mount for 2 fixtures**
**Bronze finish**

## Round Tapered Aluminum Poles

| Catalog No. | Mounting Height (Ft.) | *Effective Projected Area (Sq. Ft.) | | | | Shaft Size | | Wall Thickness | Bolt Circle (") | Bolt Size (") | Base Plate Size (L x W) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 80 | 90 | 100 | 120 | Butt (") | Top (") | | | | |
| RTA-745202 | 20 | 15.9 | 12.2 | 9.7 | 6.2 | 7 | 4.5 | .156 | 10.5 | 1 x 40 | 11.5 x 11.5 |
| RTA-745222 | 22 | 12.3 | 9.2 | 7.2 | 4.7 | 7 | 4.5 | .156 | 10.5 | 1 x 40 | 11.5 x 11.5 |
| RTA-745252 | 25 | 10.3 | 7.6 | 5.9 | 3.7 | 7 | 4.5 | .156 | 10.5 | 1 x 40 | 11.5 x 11.5 |
| RTA-845252 | 25 | 15.3 | 11.7 | 9.2 | 5.7 | 8 | 4.5 | .156 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845272 | 27 | 12.0 | 9.2 | 7.1 | 4.1 | 8 | 4.5 | .156 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845273 | 27 | 15.6 | 11.9 | 9.4 | 6.0 | 8 | 4.5 | .188 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845302 | 30 | 10.2 | 7.7 | 5.9 | 3.5 | 8 | 4.5 | .156 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845303 | 30 | 13.3 | 10.4 | 7.9 | 5.0 | 8 | 4.5 | .188 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845304 | 30 | 19.4 | 14.9 | 11.7 | 7.4 | 8 | 4.5 | .250 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845353 | 35 | 9.2 | 6.8 | 5.1 | 2.8 | 8 | 4.5 | .188 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845354 | 35 | 14.1 | 10.7 | 8.3 | 4.9 | 8 | 4.5 | .250 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845393 | 39 | 6.5 | 4.6 | 3.2 | 1.4 | 8 | 4.5 | .188 | 11.5 | 1 x 40 | 12.0 x 12.0 |
| RTA-845394 | 39 | 10.8 | 7.9 | 6.1 | 3.3 | 8 | 4.5 | .250 | 11.5 | 1 x 40 | 12.0 x 12.0 |

***EPA ratings include 1.3 gust factor.**
**Anchor Bolts should be set using factory supplied anchor bolt templates.**
**Vibration dampeners are suggested for poles 30 feet and above.**

## Round Tapered Aluminum Poles 20-39 Ft.

SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM
**01/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D 709 | (2001; R 2007) Laminated Thermosetting Materials |

CONSUMER ELECTRONICS ASSOCIATION (CEA)

| | |
|---|---|
| CEA-310-E | (2005) Racks, Panels, and Associated Equipment |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE Std 100 | (2000) The Authoritative Dictionary of IEEE Standards Terms |

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

| | |
|---|---|
| ICEA S-90-661 | (2002) Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cable for Use in General Purpose and LAN Communications Wiring Systems |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

| | |
|---|---|
| TIA J-STD-607-A | (2002) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications |
| TIA/EIA-568-B.1 | (2001 Addendums 2001, 2003, 2003, 2003, 2004, 2007) Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements |
| TIA/EIA-568-B.2 | (2001) Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cabling Components |
| TIA/EIA-568-B.3 | (2000; Addendum 2002) Optical Fiber Cabling Components Standard |

| | |
|---|---|
| TIA/EIA-569-A | (1998; Addenda 2000, 2001) Commercial Building Standards for Telecommunications Pathways and Spaces |
| TIA/EIA-604-3A | (2000) FOCUS 3 Fiber Optic Connector Intermateability Standard |
| TIA/EIA-606-A | (2002) Administration Standard for the Telecommunications Infrastructure |

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

| | |
|---|---|
| FCC Part 68 | Connection of Terminal Equipment to the Telephone Network (47 CFR 68) |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1286 | (2008) Office Furnishings |
| UL 1863 | (2004; Rev thru Aug 2008) Communication Circuit Accessories |
| UL 444 | (2008; Rev thru Jul 2008) Communications Cables |
| UL 467 | (2007) Standard for Grounding and Bonding Equipment |
| UL 50 | (2007) Standard for Enclosures for Electrical Equipment |
| UL 514C | (1996; Rev thru Jul 2008) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers |
| UL 969 | (1995; Rev thru Dec 2006) Marking and Labeling Systems |

## 1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and Section 33 82 00 TELECOMMUNICATIONS, OUTSIDE PLANT, apply to this section with additions and modifications specified herein.

## 1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3, TIA/EIA-569-A, TIA/EIA-606-A and IEEE Std 100 and herein.

### 1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)

### 1.3.2 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which

connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)

1.3.3 Floor Distributor (FD)

A distributor used to connect horizontal cable and cabling subsystems or equipment. (International expression for horizontal cross-connect (HC).)

1.3.4 Telecommunications Room (TR)

An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.

1.3.5 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

1.3.6 Entrance Room (ER) (Telecommunications)

A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.7 Open Cable

Cabling that is not run in a raceway as defined by NFPA 70. This refers to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.

1.3.8 Open Office

A floor space division provided by furniture, moveable partitions, or other means instead of by building walls.

1.3.9 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

The building telecommunications cabling and pathway system shall include permanently installed backbone and horizontal cabling, horizontal and backbone pathways, service entrance facilities, work area pathways, telecommunications outlet assemblies, conduit, raceway, and hardware for splicing, terminating, and interconnecting cabling necessary to transport telephone and data (including LAN) between equipment items in a building. The horizontal system shall be wired in a star topology from the telecommunications work area to the floor distributor or campus distributor at the center or hub of the star. The backbone cabling and pathway system includes intrabuilding and interbuilding interconnecting cabling, pathway, and terminal hardware. The intrabuilding backbone provides connectivity from the floor distributors to the building distributors or to the campus distributor and from the building distributors to the campus distributor as required. The backbone system shall be wired in a star topology with the

campus distributor at the center or hub of the star. The interbuilding backbone system provides connectivity between the campus distributors and is specified in Section 33 82 00, TELECOMMUNICATIONS OUTSIDE PLANT. Provide telecommunications pathway systems referenced herein as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

## 1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telecommunications drawings; G

Telecommunications Space Drawings; G

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Telecommunications cabling (backbone and horizontal); G

Telecommunications outlet/connector assemblies; G

Equipment support frame; G

Connector blocks; G

Spare Parts; G

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Include performance and characteristic curves. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Telecommunications cabling testing; G

SD-07 Certificates

Telecommunications Contractor Qualifications; G

Key Personnel Qualifications; G

Manufacturer Qualifications; G

Test plan; G

SD-09 Manufacturer's Field Reports

Factory reel tests; G

SD-10 Operation and Maintenance Data

Telecommunications cabling and pathway system Data Package 5; G

SD-11 Closeout Submittals

Record Documentation; G

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

In exception to Section 01 33 00, SUBMITTAL PROCEDURES, submit shop drawings a minimum of 14 by 20 inches in size using a minimum scale of 1/8 inch per foot. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Drawings

Provide drawings in accordance with TIA/EIA-606-A. The identifier for each termination and cable shall appear on the drawings. Drawings shall depict final telecommunications installed wiring system infrastructure in accordance with TIA/EIA-606-A. The drawings should provide details required to prove that the distribution system shall properly support connectivity from the EF telecommunications and ER telecommunications, CD's, and BD's to the telecommunications work area outlets. The following drawings shall be provided as a minimum:

a. T1 - Layout of complete building per floor - Building Area/Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways. Layout of complete building per floor. The drawing indicates location of building areas, serving zones, vertical backbone diagrams, telecommunications rooms, access points, pathways, grounding system, and other systems that need to be viewed from the complete building perspective.

b. T2 - Serving Zones/Building Area Drawings - Drop Locations and Cable Identification (ID'S). Shows a building area or serving zone. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas.

c. T4 - Typical Detail Drawings - Faceplate Labeling, Firestopping, Americans with Disabilities Act (ADA), Safety, Department of Transportation (DOT). Detailed drawings of symbols and typicals such as faceplate labeling, faceplate types, faceplate population installation procedures, detail racking, and raceways.

#### 1.6.1.2 Telecommunications Space Drawings

Provide T3 drawings in accordance with TIA/EIA-606-A that include telecommunications rooms plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, rack, backboard and wall elevations. Drawings shall show layout of applicable equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks, patch panels and equipment spaces and cabinet/racks. Drawings shall include a complete list of equipment and material, equipment rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Drawings may also be an enlargement of a congested area of T1 or T2 drawings.

### 1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

#### 1.6.2.1 Telecommunications Contractor

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor.

#### 1.6.2.2 Key Personnel

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.

In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication

system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The Contracting Officer.

#### 1.6.2.3 Minimum Manufacturer Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with TIA/EIA-568-B.1, TIA/EIA-568-B.2 and TIA/EIA-568-B.3.

### 1.6.3 Test Plan

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the UTP and optical fiber components and accessories 60 days prior to the proposed test date. Include procedures for certification, validation, and testing.

### 1.6.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

### 1.6.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

#### 1.6.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

#### 1.6.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

## 1.7 DELIVERY AND STORAGE

Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.

## 1.8 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

## 1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

## 1.10 MAINTENANCE

### 1.10.1 Operation and Maintenance Manuals

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications cabling and pathway system. Submit operations and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data package 5, include the requirements of paragraphs TELECOMMUNICATIONS DRAWINGS, TELECOMMUNICATIONS SPACE DRAWINGS, and RECORD DOCUMENTATION.

### 1.10.2 Record Documentation

Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA/EIA-606-A. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided in hard copy format. Provide the following T5 drawing documentation as a minimum:

a. Cables - A record of installed cable shall be provided in accordance with TIA/EIA-606-A. The cable records shall include only the required data fields in accordance with TIA/EIA-606-A. Include manufacture date of cable with submittal.

b. Termination Hardware - A record of installed patch panels, cross-connect points, distribution frames, terminating block arrangements and type, and outlets shall be provided in accordance with TIA/EIA-606-A. Documentation shall include the required data fields in accordance with TIA/EIA-606-A.

### 1.10.3 Spare Parts

In addition to the requirements of Section 01 78 23, OPERATION AND MAINTENANCE DATA, provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

## PART 2 PRODUCTS

### 2.1 COMPONENTS

UL or third party certified. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard. Provide a complete system of telecommunications cabling and pathway components using star topology. Provide support structures and pathways, complete with outlets, cables, connecting hardware and telecommunications cabinets/racks. Cabling and interconnecting hardware and components for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.

### 2.2 TELECOMMUNICATIONS PATHWAY

Provide telecommunications pathways in accordance with TIA/EIA-569-A and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide system furniture pathways in accordance with UL 1286.

### 2.3 TELECOMMUNICATIONS CABLING

Cabling shall be UL listed for the application and shall comply with TIA/EIA-568-B.1 and NFPA 70. Provide a labeling system for cabling as

required by TIA/EIA-606-A and UL 969. Ship cable in boxes bearing manufacture date for UTP in accordance with ICEA S-90-661 for all cable used on this project. Cabling manufactured more than 12 months prior to date of installation shall not be used.

2.3.1 Horizontal Cabling

Provide horizontal cable in compliance with NFPA 70 and performance characteristics in accordance with TIA/EIA-568-B.1.

2.3.1.1 Horizontal Copper

Provide horizontal copper cable in accordance with TIA/EIA-568-B.2, UL 444, ICEA S-90-661 UTP (unshielded twisted pair), 100 ohm. Provide four each individually twisted pair, 24 AWG conductors, Category 5e, with a blue or red thermoplastic jacket. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) at regular intervals not to exceed 2 feet. The word "FEET" or the abbreviation "FT" shall appear after each length marking. Provide communications general purpose (CM or CMG), communications plenum (CMP) or communications riser (CMR) rated cabling in accordance with NFPA 70. Type CMP and CMR may be substituted for type CM or CMG and type CMP may be substituted for type CMR in accordance with NFPA 70.

2.4 TELECOMMUNICATIONS SPACES

Provide connecting hardware and termination equipment in the telecommunications entrance facility to facilitate installation as shown on design drawings for terminating and cross-connecting permanent cabling. Provide telecommunications interconnecting hardware color coding in accordance with TIA/EIA-606-A.

2.4.1 Backboards

Provide void-free, interior grade plywood 3/4 inch thickas indicated. Backboards shall be fire rated. Backboards shall be provided on a minimum of two walls in the telecommunication spaces. Do not cover the fire stamp on the backboard.

2.4.2 Equipment Support Frame

Provide in accordance with CEA-310-E and UL 50.

b. Racks, floor mounted modular type, 16 gauge steel construction, minimum, treated to resist corrosion. Provide rack with vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug. Rack shall be compatible with 19 inch panel mounting.

2.4.3 Connector Blocks

Provide insulation displacement connector (IDC) Type 110 for Category 5e systems. Provide blocks for the number of horizontal and backbone cables terminated on the block plus 25 percent spare.

2.4.4 Cable Guides

Provide cable guides specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on 19 inch equipment racks and telecommunications backboards. Cable guides of ring or bracket type devices mounted on racks, panels, and backboard for horizontal cable management and individually mounted for vertical cable management. Mount cable guides with screws, and/or nuts and lockwashers.

2.4.5 Patch Panels

2.4.5.1 Fiber Optic Patch Panel

Provide panel for maintenance and cross-connecting of optical fiber cables. Panel shall be constructed of 16 gauge steel minimum and shall be rack mounted and compatible with a CEA-310-E 19 inch equipment rack. Each panel shall provide 12 single-mode adapters as duplex SC in accordance with TIA/EIA-604-3A with zirconia ceramic alignment sleeves. Provide dust cover for unused adapters. The rear of each panel shall have a cable management tray a minimum of 8 inches deep with removable cover, incoming cable strain-relief and routing guides. Panels shall have each adapter factory numbered and be equipped with laminated plastic nameplates above each adapter.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

2.5.1 Outlet/Connector Copper

Outlet/connectors shall comply with FCC Part 68EIA TIA/EIA-568-B.1, and TIA/EIA-568-B.2. UTP outlet/connectors shall be UL 1863 listed, non-keyed, 8-pin modular, constructed of high impact rated thermoplastic housing and shall be third party verified and shall comply with TIA/EIA-568-B.2 Category 5erequirements. Outlet/connectors provided for UTP cabling shall meet or exceed the requirements for the cable provided. Outlet/connectors shall be terminated using a Type 110 IDC PC board connector, color-coded for both T568A and T568B wiring. Each outlet/connector shall be wired T568A. UTP outlet/connectors shall comply with TIA/EIA-568-B.2 for 200 mating cycles.

2.5.2 Cover Plates

Telecommunications cover plates shall comply with UL 514C, and TIA/EIA-568-B.1; flush design constructed of high impact thermoplastic material white in color. Provide labeling in accordance with the paragraph LABELING in this section.

2.6 GROUNDING AND BONDING PRODUCTS

Provide in accordance with UL 467, TIA J-STD-607-A, and NFPA 70. Components shall be identified as required by TIA/EIA-606-A. Provide ground rods, bonding conductors, and grounding busbars as specified in Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM.

2.7 FIRESTOPPING MATERIAL

Provide as specified in Section 07 84 00, FIRESTOPPING.

## 2.8 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

## 2.9 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

## 2.10 TESTS, INSPECTIONS, AND VERIFICATIONS

### 2.10.1 Factory Reel Tests

Provide documentation of the testing and verification actions taken by manufacturer to confirm compliance with TIA/EIA-568-B.1, TIA/EIA-568-B.3 for UTP cables.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Install telecommunications cabling and pathway systems, including the horizontal and backbone cable, pathway systems, telecommunications outlet/connector assemblies, and associated hardware in accordance with TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-569-A, NFPA 70, and UL standards as applicable. Provide cabling in a star topology network. Pathways and outlet boxes shall be installed as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Install telecommunications cabling with copper media in accordance with the following criteria to avoid potential electromagnetic interference between power and telecommunications equipment. The interference ceiling shall not exceed 3.0 volts per meter measured over the usable bandwidth of the telecommunications cabling. Cabling shall be run with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

### 3.1.1 Cabling

Install Category 5e UTP telecommunications cabling system as detailed in TIA/EIA-568-B.1. Screw terminals shall not be used except where specifically indicated on plans. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations. Do not untwist Category 5e UTP cables more than one half inch from the point of termination to maintain cable geometry. Provide service loop on each end of the cable, 10 ft. in the telecommunications room, and 12 inches in the work area outlet. Do not exceed manufacturers' cable pull tensions for copper and optical fiber cables. Provide a device to monitor cable pull tensions. Do not exceed 25 pounds pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not over cinch cables, or

crush cables with staples. For UTP cable, bend radii shall not be less than four times the cable diameter. Cables shall be terminated; no cable shall contain unterminated elements. Cables shall not be spliced. Label cabling in accordance with paragraph LABELING in this section.

3.1.1.1 Open Cable

Use only where specifically indicated on plans for use in cable trays, or below raised floors. Install in accordance with TIA/EIA-568-B.1, TIA/EIA-568-B.2. Do not exceed cable pull tensions recommended by the manufacturer.

3.1.1.2 Horizontal Cabling

Install horizontal cabling as indicated on drawings between the floor distributors and the telecommunications outlet assemblies at workstations.

3.1.2 Pathway Installations

Provide in accordance with TIA/EIA-569-A and NFPA 70. Provide building pathway as specified in Section 26 20 00, INTERIOR DISTRIBUTION SYSTEMS.

3.1.3 Service Entrance Conduit, Underground

Provide service entrance underground as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEMS.

3.1.4 Cable Tray Installation

Install cable tray as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEMS.

3.1.5 Work Area Outlets

3.1.5.1 Terminations

Terminate UTP cable in accordance with TIA/EIA-568-B.1, TIA/EIA-568-B.2 and wiring configuration as specified.

3.1.5.2 Cover Plates

As a minimum, each outlet/connector shall be labeled as to its function and a unique number to identify cable link in accordance with the paragraph LABELING in this section.

3.1.5.3 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 12 inches of slack cable loosely coiled into the telecommunications outlet boxes or at cabletray breakout. Minimum manufacturer's bend radius for each type of cable shall not be exceeded.

3.1.5.4 Pull Cords

Pull cords shall be installed in conduit serving telecommunications outlets that do not have cable installed.

3.1.6 Telecommunications Space Termination

Install termination hardware required for Category 5e system. An insulation displacement tool shall be used for terminating copper cable to insulation displacement connectors.

3.1.6.1 Connector Blocks

Connector blocks shall be wall mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Install in accordance with industry standard wire routing guides in accordance with TIA/EIA-569-A.

3.1.6.2 Patch Panels

Patch panels shall be mounted in equipment racks with sufficient ports to accommodate the installed cable plant plus 25 percent spares.

a. Fiber Optic Patch Panel. Fiber optic cable loop shall be 3 feet in length. The outer jacket of each cable entering a patch panel shall be secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.

3.1.6.3 Equipment Support Frames

Install in accordance with TIA/EIA-569-A:

b. Racks, floor mounted modular type. Permanently anchor rack to the floor in accordance with manufacturer's recommendations.

3.1.7 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings as specified in Section 07 84 00, FIRESTOPPING.

3.1.8 Grounding and Bonding

Provide in accordance with TIA J-STD-607-A, NFPA 70 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEMS.

3.2 LABELING

3.2.1 Labels

Provide labeling in accordance with TIA/EIA-606-A. Handwritten labeling is unacceptable. Stenciled lettering for voice and data circuits shall be provided using laser printer.

3.2.2 Cable

Cables shall be labeled using color labels on both ends with identifiers in accordance with TIA/EIA-606-A.

3.2.3 Termination Hardware

Workstation outlets and patch panel connections shall be labeled using color coded labels with identifiers in accordance with TIA/EIA-606-A.

## 3.3 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

## 3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

## 3.5 TESTING

### 3.5.1 Telecommunications Cabling Testing

Perform telecommunications cabling inspection, verification, and performance tests in accordance with TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3. Perform optical fiber field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.

#### 3.5.1.1 Inspection

Visually inspect UTP and optical fiber jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for T568A or T568B pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1, TIA/EIA-568-B.2, and TIA/EIA-568-B.3. Visually confirm Category 5e marking of outlets, cover plates, outlet/connectors, and patch panels.

#### 3.5.1.2 Verification Tests

UTP backbone copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connected.

#### 3.5.1.3 Performance Tests

Perform testing for each outlet and MUTOA as follows:

a. Perform Category 5e link tests in accordance with TIA/EIA-568-B.1 and TIA/EIA-568-B.2. Tests shall include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay and delay skew.

#### 3.5.1.4 Final Verification Tests

Perform verification tests for UTP systems after the complete telecommunications cabling and workstation outlet/connectors are installed.

a. Data Tests. These tests assume the Information Technology Staff has a network installed and are available to assist with testing. Connect to the network interface device at the demarcation point. Log

onto the network to ensure proper connection to the network.

-- End of Section --

# DataPipe™

## ANSI/TIA/EIA 568 Category 5e
## ISO/IEC 11801
## 4 Twisted Pair Cable
## Part Number: Plenum5E55/Non-Plenum5EN5
## Plenum: ETL Type CMP,C(ETL)CMP
## Non-Plenum: ETL Type CMR, C(ETL)CMG
## ETL Verified Electrical Performance

CommScope®
1100 CommScope Place SE
PO Box 1729
Hickory, NC 28603-1729
(800) 982-1708
(828) 324-2200
Fax: (828) 328-3400
Int'l Fax: (828) 323-4989
ISO 9001 REGISTERED
www.commscope.com

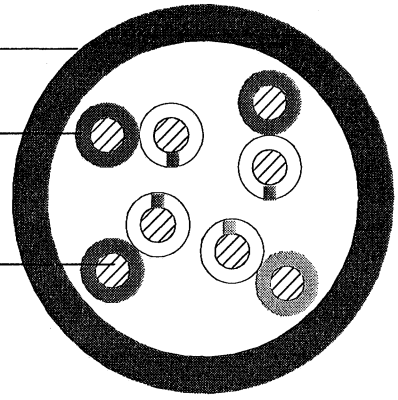


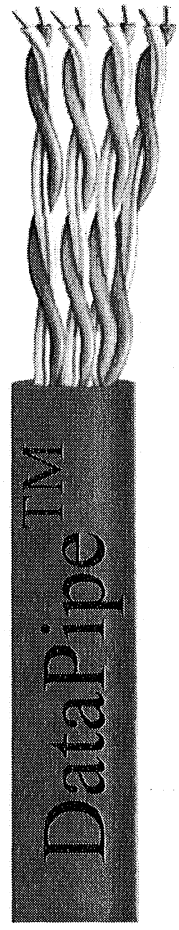
**4 Twisted Pair Cable**

**Outer Jacket**
Plenum: CommFlex

**Pair Insulation**
Plenum: FEP
PE
Non-Plenum: PE

24 AWG Solid Copper






**Pair Identification**

| | |
|---|---|
| Pair 1 | Blue/White w/Co-Extruded Blue Stripe on White Single |
| Pair 2 | Orange/White w/Co-Extruded Orange Stripe on White Single |
| Pair 3 | Green/White w/Co-Extruded Green Stripe on White Single |
| Pair 4 | Brown/White w/Co-Extruded Brown Stripe on White Single |

| Mechanical Specification | Plenum | Non-Plenum |
|---|---|---|
| Nominal Jacket OD | 0.175" | 0.200" |
| Nominal Jacket Thickness | 0.016" | 0.022" |
| Jacket Minimum Spot Thickness | 0.012" | 0.018" |
| Installation Temperature 0°C to 60°C | | |
| Operation Temperature -20°C to 60°C | | |

**Available Packaging: Reel in a box, Reel or Compak**

RoHS COMPLIANT

Uniprise® SOLUTIONS

Drawings not to Scale
Specifications subject to change
Revision: 11/17/08

# DataPipe™

## ANSI/TIA/EIA 568 Category 5e
## ISO/IEC 11801
## 4 Twisted Pair Cable
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### Electrical Performance

| Frequency MHz | Attenuation (dB/100m) Max | Pair to Pair | | Return Loss (dB) Min | ACR (dB) Min | Power Sum | | |
|---|---|---|---|---|---|---|---|---|
| | | NEXT (dB) Min | ELFEXT (dB/100m) Min | | | NEXT (dB) Min | ELFEXT (dB/100m) Min | ACR (dB) Min |
| .772 | 1.8 | 67.0 | 66.0 | NA | 65.2 | 64.0 | 63.0 | 62.0 |
| 1.0 | 2.0 | 65.3 | 63.8 | 20.0 | 63.3 | 62.3 | 60.8 | 60.3 |
| 4.0 | 4.1 | 56.3 | 51.7 | 23.0 | 52.2 | 53.3 | 48.7 | 49.2 |
| 8.0 | 5.8 | 51.8 | 45.7 | 24.5 | 46.0 | 48.8 | 42.7 | 43.0 |
| 10.0 | 6.5 | 50.3 | 43.8 | 25.0 | 43.8 | 47.3 | 40.8 | 40.8 |
| 16.0 | 8.2 | 47.3 | 39.9 | 25.0 | 39.0 | 44.3 | 36.7 | 36.0 |
| 20.0 | 9.2 | 45.8 | 37.7 | 25.0 | 36.5 | 42.8 | 34.7 | 33.5 |
| 25.0 | 10.4 | 44.3 | 35.8 | 24.3 | 33.9 | 41.3 | 32.8 | 30.9 |
| 31.25 | 11.7 | 42.9 | 33.9 | 23.6 | 31.2 | 39.9 | 30.9 | 28.2 |
| 62.5 | 17.0 | 38.4 | 27.8 | 21.5 | 21.4 | 35.4 | 24.8 | 18.4 |
| 100.0 | 22.0 | 35.3 | 23.8 | 20.1 | 13.3 | 32.3 | 20.8 | 10.3 |
| 155.0 | 28.1 | 32.5 | 19.9 | 18.8 | 4.4 | 29.5 | 16.9 | 1.4 |
| 200.0 | 32.4 | 30.8 | 17.7 | 18.0 | NS | 27.8 | 14.7 | NS |

(All tests include swept frequency measurements)

| | |
|---|---|
| Characteristic Impedance | 100 ohms ± 15% |
| Capacitance | 14 pf/ft nominal |
| DC Resistance/Unbalance | 28.6 ohms/1000' Max/5% Max |
| Dielectric Breakdown | 2500 Volts DC Conductor to Conductor |
| Nom. Velocity of Propagation | FEP = 74%<br>PE = 71% |
| Maximum Skew | 5E55 = 15ns @ 100 meters 5EN5 = 11ns @ 100 meters |

RoHS COMPLIANT

Uniprise® SOLUTIONS

Drawings not to Scale
Specifications subject to change
Revision: 11/17/08

## MAX® FACEPLATES

**MAX Modular Faceplates**

MX-FP-S-01-(XX).....Single gang faceplate for one MAX module
MX-FP-S-02-(XX).....Single gang faceplate for two MAX modules
MX-FP-S-03-(XX).....Single gang faceplate for three MAX modules
MX-FP-S-04-(XX).....Single gang faceplate for four MAX modules

**10G 6A™ MAX Modular Faceplates**

10GMX-FPS02-(XX) .....Single gang 10G faceplate for two 10G 6A MAX modules
10GMX-FPS04-(XX) .....Single gang 10G faceplate for four 10G 6A MAX modules

*Use (XX) to specify color for all MAX faceplates:*
*20 = ivory, 80 = light ivory*

MX-FP-S-02-(XX)

10GMX-FPS02-(XX)

MX-FP-S-04-(XX)

10GMX-FPS04-(XX)

## MAX MODULES

**10G 6A MAX Modules**

10GMX-F(XX) .....Flat 10G 6A MAX module, T568A/B

**MAX 6 Modules**

MX6-F(XX).....Flat category 6 MAX module, T568A/B

**MAX 5e Modules**

MX5-F(XX).....Flat category 5e MAX module, T568A/B

**MAX Coax Modules**

MX-F-FA-(XX).....Flat MAX module with one 75 ohm F-type adapter

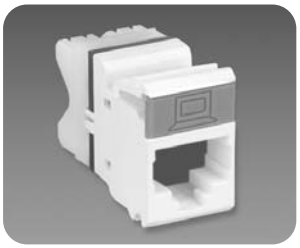
*All outlets include one red, one blue and one color matching icon for color coding*

**MAX Blanks**

MX-BL-(XX) .....Blank module, bag of 10

*Use (XX) to specify color for all MAX modules:*
*20 = ivory, 80 = light ivory*

10GMX-F(XX)


MX6-F(XX)

MX-F-FA-(XX)

MX5-F(XX)

## CONNECTORS

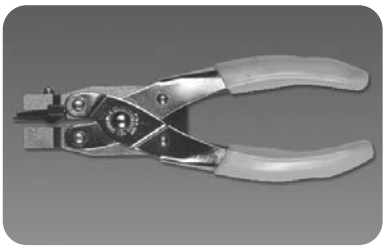
**RG6 F-Type Compression Connector**

RG6C.....RG6 F-Type compression connector

**RG6 F-Type Compression Tool**

RG6C-T .....RG6 F-Type compression tool

RG6C


RG6C-T

## MAX® Series Stainless Steel Faceplates:

Single and double gang stainless steel MAX faceplates for use with flat and angled MAX modules. Brushed finish on plates mask minor scratches and scuffs that may occur during day-to-day use.

MX-FP-S-(XX)-SS .....Single gang stainless steel faceplate
MX-FP-S-(XX)-SS-L .....Single gang stainless steel faceplate with labels and label holders

*Use (XX) to specify number of ports:*
*01=1-port, 02=2-ports, 03=3-ports, 04=4-ports, 06=6-ports*
*Faceplate includes mounting screws*

MX-FP-D-(XX)-SS .....Double gang stainless steel faceplate
MX-FP-D-(XX)-SS-L.....Double gang stainless steel faceplate with labels and label holders

*Use (XX) to specify number of ports:*
*06=6-ports, 08=8-ports, 12=12-ports*

## MAX Modular Furniture Adapters:

The MAX modular furniture adapter accepts 4 angled or flat MAX modules and snap directly into communication outlet openings* in most major modular furniture systems, including Steelcase, Hon Industries, Haworth, Kimball and DRG. Adapters include designation label and clear label cover to allow for circuit identification.

MX-MFP-(XX).....Modular furniture adapter for standard openings including steelcase
MX-MFP-KNL-(XX) .....Modular furniture adapter for Knoll Group openings (not available in white or ivory)
MX-MFP-HME-(XX) .....Modular furniture adapter for Herman Miller Ethospace Beltline openings (not available in white or ivory)
MX-MFP-HMA-(XX).....Modular furniture adapter for Herman Miller Action Office Series 2 and Ethospace base openings
MX-MFP-AO3-(XX) .....Modular furniture adapter for Herman Miller Action Office Series 3 base opening

*MAX Modular Furniture adapters mount into modular furniture openings, providing superior density with proper circuit designation.*

*Use (XX) to specify color: 01 = black, 02 = white, 04 = gray, 20 = ivory, 80 = light ivory*
*Note: For Herman Miller Action Office Series 3 152mm (6 in.) vertical panel, use our MX-FP-S-(XX)-(XX) to mount up to six MAX modules.*
**Furniture outlet openings, panel thickness, and raceway clearance may vary. Please consult furniture manufacturer for actual dimensions to determine compatibility.*

## Tamper-Proof MAX Faceplate:

Siemon's tamper-proof MAX faceplates provide a secure, low profile solution for mounting our complete line of MAX modules. The design features a one-piece base which accepts up to six angled MAX modules and is secured by a solid cover and a choice of tamper-proof star or standard slotted head screw. The base mounts to any single gang outlet (including Siemon's fiber outlet box).

MX-TFP-S-06-(XX).....Single gang, tamper-proof faceplate for six angled MAX modules

*Use (XX) to specify color: 01 = black, 02=white, 04=gray, 20 = ivory, 25 = bright white, 80=light ivory*
*Faceplate includes mounting screws*

## Wall Phone Faceplates:

MX-WP-(XX)-SS.....MAX Series Stainless Steel Wall Phone Faceplate with Keystone MAX Module included
WPJP .....Plastic Wall Phone Faceplate with 4-pair USOC jack included

*Use (XX) to specify wiring option:*
*K6 = Category 6, T568A/B*
*K5 = Category 5e, T568A/B*
*KU3 = 3-pair, 6-position USOC*
*KU4 = 4-pair, 8-position USOC*

MX-WP-(XX)-SS

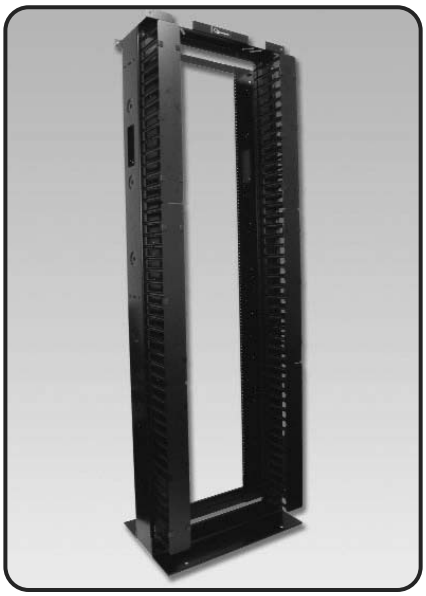
WPJP

# ORDERING INFORMATION

## RS3 Cable Management Rack System:

RS3-07.....2.1m x 0.48m (7 ft. x 19 in.) aluminum enhanced cable management rack system, 45 RMS. Includes rack assembly hardware, vertical cable management channels with hinged covers, and ground lug

*height: 2.1m (7 ft.)*
*width: 685.0mm (27 in.)*
*depth: 457.2mm (18 in.)*



*Add "-S" for steel.*

*Note: Aluminum racks are intended for use with connecting hardware and cable managers only. For mounting active equipment, steel racks are recommended.*

*Note: 1 RMS = 44.5mm (1.75 in.)*

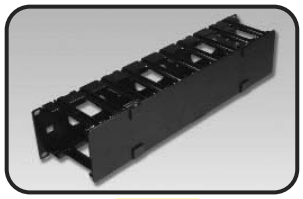
## Related Products:

### RS3 Series Horizontal Cable Managers

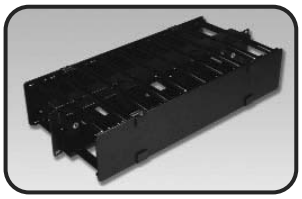
These new horizontal cable managers are designed for use with Siemon's RS3 series racks and use the same covered design as the vertical managers. The hinged front cover snaps easily over cable managers and provides a concealed routing patch into the vertical cable management of the RS3, providing a clean patching environment.

RS3-RWM-2 .....Single-sided 19 in. cable manager, 2 RMS

RS3-RWM-2DS .....Double-sided 19 in. cable manager, 2 RMS



*RS3-RWM-2*



*RS3-RWM-2DS*

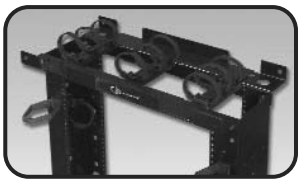
### Rack Accessories

RS-P04 .....1.2m (4 ft.) power strip for rear of rack, ten 15A outlets, resettable fuse (includes mounting hardware)

RS-TRAY .....Rack top cable tray [includes roll of 9 black 457.2mm (18 in.) hook and loop cable managers and 9 quarter-turn mounting clips]

SCREW-1224 .....#12-24 Slotted head screws with washers, black, bag of 200

*RS-P04*



*RS-TRAY*

*SCREW-1224*

### CABLE MANAGER CAPACITY TABLE

The following capacity table is provided for planning purposes. The values shown reflect a combination of actual and calculated capacity and represent a 100% fill. These values were derived using properly dressed cables and can be adversely affected by poor cable routing practices.

| PART NUMBER | CABLE DIAMETER (SQ. IN.) 0.15 | 0.17 | 0.19 | 0.21 | 0.23 | 0.25 | 0.27 | 0.29 | 0.31 |
|---|---|---|---|---|---|---|---|---|---|
| **HORIZONTAL MANAGERS** | | | | | | | | | |
| RS3-RWM-2 | 332 | 258 | 207 | 169 | 141 | 119 | 102 | 88 | 77 |
| RS3-RWM-2DS | 332 | 258 | 207 | 169 | 141 | 119 | 102 | 88 | 77 |
| **RACKS & VERTICAL CABLE MANAGERS** | | | | | | | | | |
| RS3 (Channel) | 834 | 649 | 519 | 425 | 354 | 300 | 257 | 223 | 195 |
| RS3 (Front) | 527 | 410 | 329 | 269 | 224 | 190 | 162 | 141 | 123 |

*Because we continuously improve our products, Siemon reserves the right to change specifications and availability without prior notice.*

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PROD-SS-RS3 Rev. A 2/05

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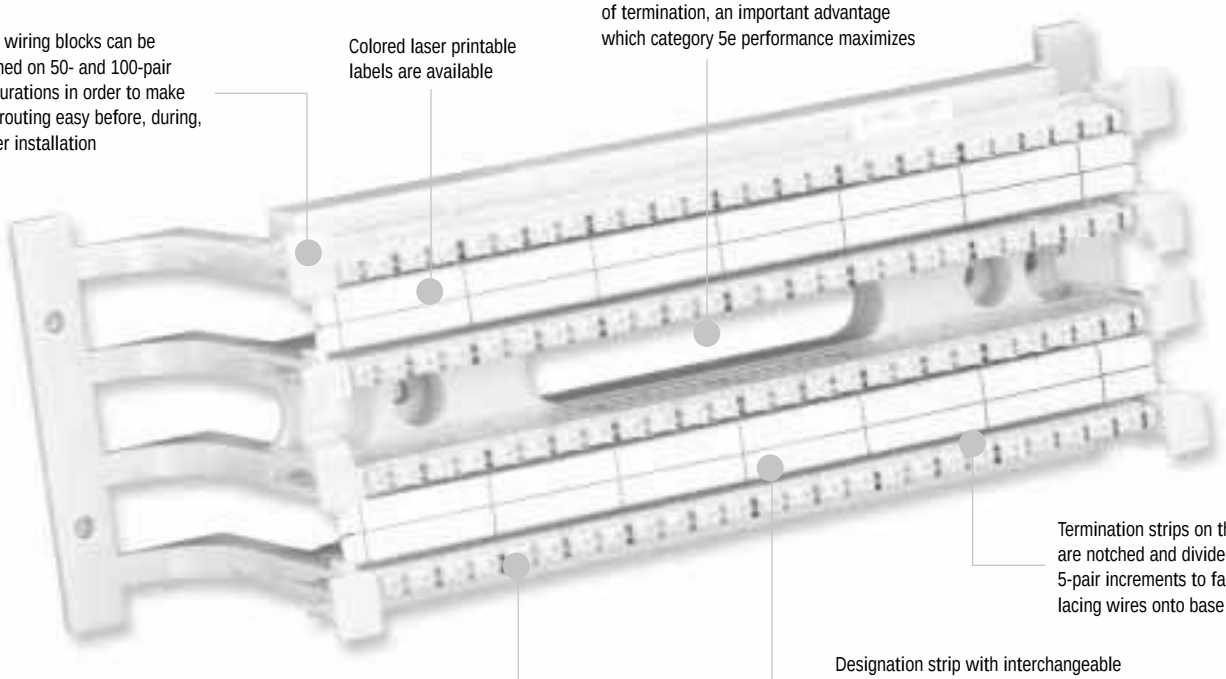
# S110® Wiring Block

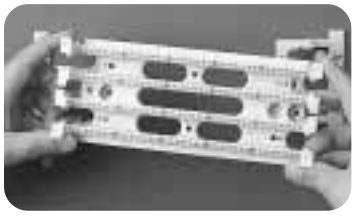
**Siemon's S110® field termination blocks combine category 5e performance with unparalleled installation features, and are ideal for use in cross-connect and consolidation point applications.**

**25-, 50-, 75-, and 100-pair blocks are available without legs for mounting directly to walls. If cable routing is required behind the blocks, 50-, 100-, 200- and 300-pair sizes are available with mounting legs. The 50- and 100-pair sizes offer detachable mounting legs to assist in routing cables behind blocks during and after installation.**

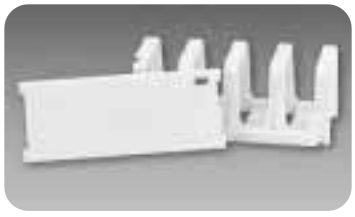
**The 100-pair blocks (also used in 200- and 300-pair sizes) have been enhanced to add additional strength to assist when terminating cables using blocks with legs.**

PATENTED
ENHANCED



*The tabs for removing the detachable legs on the 100-pair block are located on the face of the block to simplify removal*

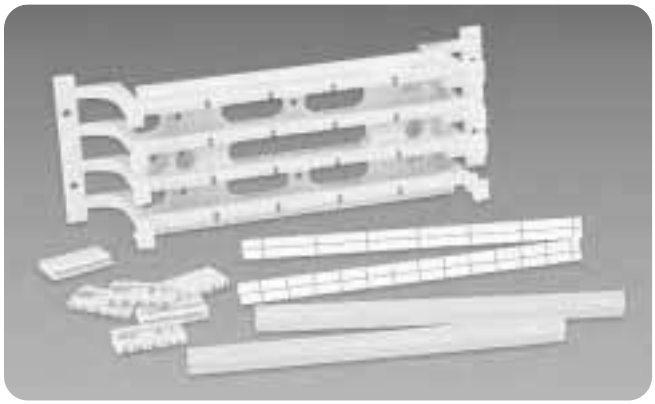


*1 or 2 RMS S110® cable managers can be ordered with or without mounting legs. Optional covers are available separately for 50- and 100-pair sizes*

SIEMON cabling® SYSTEM

## Ordering Information

### S110® Field Termination Kits:



Complete S110® installation kits are available which include S110® wiring blocks with detachable legs*, S110® connecting blocks, and label holders with white designation labels.
*Legs detachable on 50- and 100-pair version only.
S110A(X)1-50FT .....50-pair S110® field termination kit
S110A(X)2-100FT .....100-pair S110® field termination kit
S110A(X)2-300FT .....300-pair S110® field termination kit
*Use (X) to specify the connecting blocks:*
*A = S110C-5, 5-pair connecting blocks*
*B = S110C-4, 4-pair connecting blocks*
*C = S110C-3, 3-pair connecting blocks*
*D = S110C-2, 2-pair connecting blocks*
*Each kit includes adequate connecting blocks to complete each 25-pair termination strip on the S110® wiring block (e.g. S110AB2-100FT) would include five 4-pair and one 5-pair connecting block per 25-pair termination strip, or a total of twenty 4-pair and four 5-pair connecting blocks)*

### S110® Connecting Blocks:

S110C-2A .....2-pair connecting block, blue/orange
S110C-2B .....2-pair connecting block, green/brown
S110C-3.....3-pair connecting block, blue/orange/green
S110C-4.....4-pair connecting block, blue/orange/green/brown
S110C-5.....5-pair connecting block blue/orange/green/brown/slate

S110C-2A

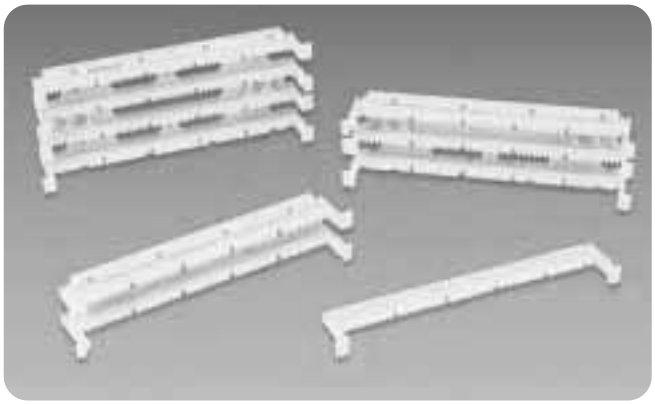
S110C-2B

S110C-3

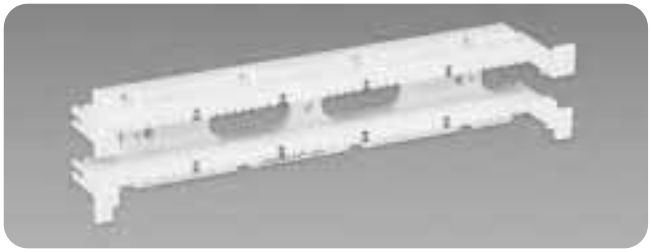
S110C-4

S110C-5

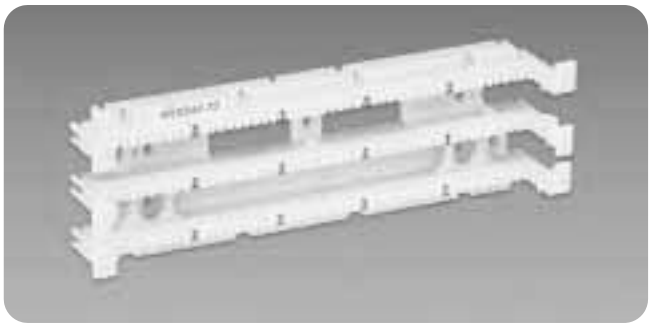
### S110® Wiring Blocks Without Legs:



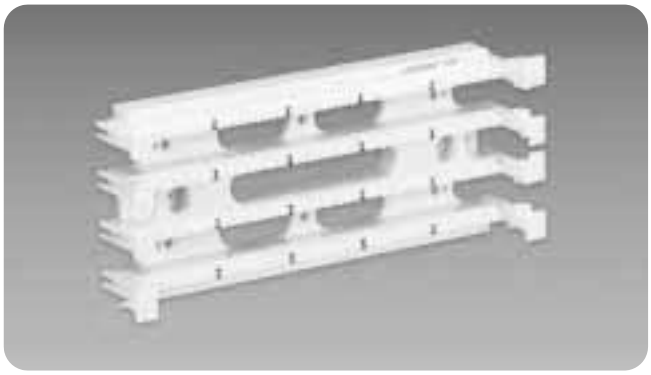
S110DW1-25.....25-pair, S110® wiring block



S110DW1-50.....50-pair, S110® wiring block



S110DW1-75.....75-pair, S110® wiring block



S110DW2-100.....100-pair, S110® wiring block

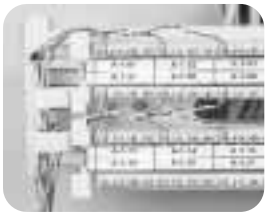
## Related Products

### S110® Test Adapters:

TAP-110-U1 .....1-pair, USOC
TAP-110-E2.....2-pair, 10BASE-T
TAP-110-UT.....2-pair, USOC/Token Ring
TAP-110-U3 .....3-pair, USOC
TAP-110-U4 .....4-pair, USOC
TAP-110-T4.....4-pair category 5, T568A
TAP-110-A4 .....4-pair, category 5, T568B

### S100A2 Wire Manager:

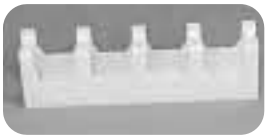
S100A2.....Snap on S110® wire manager, white
S100A2-01.....Snap on S110® wire manager, black



### Wall Mount S110® Cable Managers:

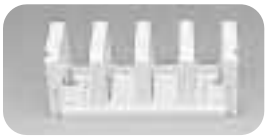
S110B1RMS.....White cable manager without legs, 1 RMS
S110B2RMS.....White cable manager without legs, 2 RMS
S110A1RMS.....White cable manager with legs, 1 RMS
S110A2RMS.....White cable manager with legs, 2 RMS

*Note: 1 RMS = 44.5mm (1.75 in.)*



S110B1RMS

S110A1RMS



S110B2RMS

S110A2RMS

### Tools:

S788J1 .....5-pair termination tool
S788J5B.....Replacement cutting blades for 5-pair tool
S788J5H .....Replacement head for 5-pair impact tool
S788J4 .....4-pair termination tool
S788J4B.....Replacement cutting blades for 4-pair tool
S788J4H .....Replacement head for 4-pair impact tool

### S110® Cable Assemblies:

S110P1-P1-(XX).....1-pair, double-ended S110® patch cord
S110P2-P2-(XX).....2-pair double-ended S110® patch cord
S110P3-P3-(XX).....3-pair double-ended S110® patch cord
S110P4-P4-(XX).....Category 5e compatible, 4-pair double-ended S110® patch cord
S110P4-T4-(XX).....Category 5e compatible, 4-pair S110®-to-modular plug, T568A
S110P4-A4-(XX) .....Category 5e compatible, 4-pair S110®-to-modular plug, T568B
S110P1-U1-(XX) .....1-pair, S110®-to-modular plug, USOC
S110P2-E2-(XX).....2-pair, S110®-to-modular plug, 10BASE-T
S110P2-UT-(XX).....2-pair, S110®-to-modular plug, Token Ring

*Use (XX) to specify length: 03 = 0.91m (3 ft.), 05 = 1.5m (5 ft.), 07 = 2.13m (7 ft.), 10 = 3.05m (10 ft.), 15 = 4.57m (15 ft.), 20 = 6.10m (20 ft.), 25 = 7.65m (25 ft.)*

*Custom lengths, colors and wiring configurations available upon request.*

### S110® Patch Plugs:

S110P1.....Field-terminated, 1-pair, S110® patch plug
S110P2.....Field-terminated, 2-pair, S110® patch plug with red and blue oval icon
S110P3.....Field-terminated, 3-pair, S110® patch plug with red and blue oval icon
S110P4.....Category 5e, field-terminated, 4-pair, S110® patch plug with red and blue oval icon

S110P1

S110P3

S110P2

S110P4

### For related product information request Spec Sheet(s):

S110® Tap® Test Adapter (PROD-SS-TAP)
S110® Disconnect System (PROD-SS-10T)
S110® Category 5e Modular Jack Panel (PROD-SS-10J)
S110® Rack Mount Series (PROD-SS-10W)
S110® Category 5 Patch Plug (PROD-SS10P)

PROD-SS-110 Rev. G 8/00

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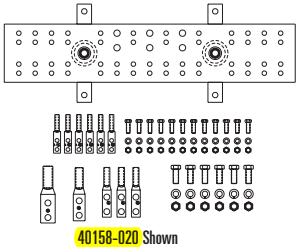


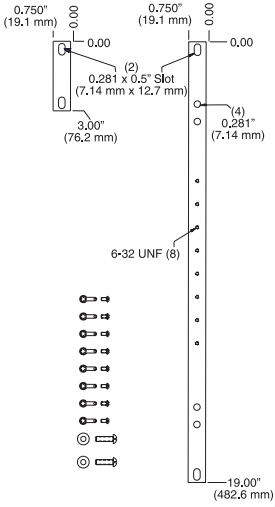
40158-020 Shown

# Busbar Assemblies With Lug Kits

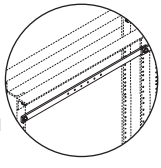
Busbar Assemblies with Lug Kits contain the CPI 13622 series Telecommunications Grounding Busbar (TGB) or the CPI 40153 series Telecommunications Main Grounding Busbar (TMGB) along with required stainless steel hardware to fasten the two-hole ground lugs to the Busbar.

- #6 lugs are 2-hole lugs with 1/4" hardware
- #2, 2/0 and 4/0 lugs are 2-hole lugs with 3/8" hardware
- UL Listed

| Part Number | Description | Size | #6 Lug | #2 Lug | 2/0 Lug | 4/0 Lug | Shipping Weight |
|---|---|---|---|---|---|---|---|
| 40156-012 | TGB Pattern | 2"W x 1/4"H x 12"L (50 mm x 6.4 mm x 300 mm ) | 6 ea | 3 ea | 1 ea | 0 | 5 lb (2.3 kg) |
| 40158-012 | TMGB Pattern | 4"W x 1/4"H x12"L (100 mm x 6.4 mm x 300 mm) | 6 ea | 3 ea | 1 ea | 1 ea | 8 lb (3.6 kg) |
| 40158-020 | TMGB Pattern | 4"W x 1/4"H x 20"L (100 mm s 6.4 mm x 510 mm) | 6 ea | 3 ea | 1 ea | 1 ea | 11 lb (5.0 kg) |




19" rack width Busbar shown



Shown mounted to rack

# Horizontal Rack Busbar

Horizontal Rack Busbar for consolidating equipment grounds. Constructed of 3/16"-thick x 3/4"H (4.763 mm x 19.1 mm) hard-drawn electrolytic tough pitch 110 alloy copper bar with eight #6-32 tapped lug mounting holes on 1" (25.4 mm) centers and two pairs of 5/16" (7.938 mm) diameter holes spaced 3/4" (19.1 mm) apart for attaching ground jumpers.

- Other configurations available on request
- UL Listed

**Part number consists of Busbar and a hardware kit that includes:**

- (1) splice plate bar, 3"L (80 mm)
- (2) #12-24 copper machine screws
- (2) #12 copper flat washers
- (8) #6-32 copper machine screws
- (8) #6 ring terminals

| Part Number | Description | Rack Width | Shipping Weight |
|---|---|---|---|
| 10610-019 | Horizontal Rack Busbar | 19" | 2 lb (0.9 kg) |
| 10610-023 | Horizontal Rack Busbar | 23" | 3 lb (1.4 kg) |
| 10610-035 | Horizontal Rack Busbar | 35" | 4 lb (1.8 kg) |

SECTION 27 54 00.00 20

COMMUNITY ANTENNA TELEVISION (CATV) SYSTEMS
**04/06**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C2 | (2007; Errata 2007; INT 2008) National Electrical Safety Code |
| IEEE C62.41.1 | (2002) IEEE Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits |
| IEEE C62.41.2 | (2002) IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits |

NATIONAL CABLE AND TELECOMMUNICATIONS ASSOCIATION (NCTA)

| | |
|---|---|
| NCTA RP | (2003) NCTA Recommended Practices for Measurements on Cable Television Systems |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 47 CFR 76.605 | Technical Standards |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1581 | (2001; Rev thru Jul 2008) Reference Standard for Electrical Wires, Cables, and Flexible Cords |
| UL 1666 | (2007) Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts |
| UL 969 | (1995; Rev thru Nov 2008) Marking and Labeling Systems |

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, applies to this section with the additions and modifications specified herein.

## 1.3 DEFINITIONS

### 1.3.1 CATV

Community antenna television (CATV) system, commonly referred to as cable television, is a network of cables, headend, electronic and passive components that process and amplify television (TV) signals for distribution from the headend equipment to the individual television outlets.

### 1.3.2 Headend

The connection point between CATV system equipment and equipment provided by the local CATV company.

### 1.3.3 Distribution System

Distribution system transports and delivers adequate signals to each receiver. Provides distortion-free signal to TV sets by isolating each receiver from the system and by providing proper amount of signal to each set.

### 1.3.4 Cable

Trunk and feeder cables are low-loss cables used to transport the desired signal from the headend equipment to the communications closet in the area to be served. These cables are used to transport signal from the headend equipment into close proximity to a number of user locations in excess of 200 feet from the headend equipment. Drop cables are used to transport the desired signal used from the headend equipment to the wall outlet.

## 1.4 SYSTEM DESCRIPTION

### 1.4.1 Headend

Contractor shall provide interior equipment up to headend and including the main amplifier located at the interior CATV backboard.

### 1.4.2 Distribution System

Distribution system shall be star topology with each outlet connected to headend equipment with the drop cable.

### 1.4.3 Cable

Provide drop cables to transport the desired signal from the headend equipment to the outlet.

### 1.4.4 System Components

System shall provide high quality TV signals to all outlets. Provide any combination of items specified herein to achieve required performance, subject to approvals, limitations, acceptance test, and other requirements specified herein. System shall include amplifiers, splitters, combiners, line taps, cables, outlets, tilt compensators and all other parts, components, and equipment necessary to provide a complete and usable system.

1.4.4.1 System Bandwidth

a. Downstream: 50-750 MHz minimum.

b. Upstream 5-40 MHz minimum.

1.4.5 System Performance

System shall be in compliance with 47 CFR 76.605.

1.4.5.1 Receiver Termination Signal Level

Each termination for a TV receiver must have a minimum signal level of 0 decibel millivolts (dBmV) (1000 microvolts) at 55 MHz and of 0 dBmV (1000 microvolts) at 750 MHz and a maximum signal of 15 dBmV or a level not to overload the receiver for the entire system bandwidth.

1.4.5.2 Distribution System

a. Modulation distortion at power frequencies: 4 percent or less hum distortion;

b. Composite third order distortion for:

(1) CW carriers: 53 dB.

(2) Modulated carriers: 59 dB.

c. Subscriber terminal isolation: 18 dB or greater.

d. Carrier to second order beat ratio: 60 dB.

e. Amplitude characteristic shall be within a range of plus or minus 2 decibels from 0.75 MHz to 5.0 MHz above the lower boundary frequency of the cable television channel, referenced to the average of the highest and lowest amplitudes within these frequency boundaries.

f. Visual, aural carrier level - 24-hour variation: 47 CFR 76.605, subpart (a), rules (4), (5), and (6).

g. Frequency determination: 47 CFR 76.605, subpart (a), rules (1),(2), and (3).

1.4.5.3 All New System Tolerance

The system shall not show a serious loss of carrier to noise when the system levels are lowered 3 dB below normal or a significant distortion when the levels are increased 3 dB above normal, as observed on a TV set located at the far end extremities of the system.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

CATV system wiring diagrams and installation details; G

CATV system components; G

SD-03 Product Data

Attenuators; G

Amplifiers, including headend, trunk, bridging, and distribution; G

Cables; G

Terminators; G

Splitters/combiners; G

Line Taps; G

Outlets; G

Connectors; G

Tilt compensator; G

Grounding block; G

Submittals for each manufactured item shall be the current manufacturer's descriptive literature of catalog products, equipment drawings, diagrams, performance and characteristics curves, and catalog cuts.

SD-05 Design Data

CATV System Loss Calculations; G

SD-06 Test Reports

Operational test plan; G

Operational test procedures; G

System pretest; G

Acceptance tests; G

SD-08 Manufacturer's Instructions

Connector Installation; G

1.6 QUALITY ASSURANCE

1.6.1 Wiring Diagrams and Installation Details

Illustrate how each item of equipment functions in the system and include an overall system schematic indicating the relationship of CATV units on one diagram. Drawings shall include wiring diagrams and installation details of equipment indicating proposed locations, layout and arrangements, and other items that must be shown to ensure coordinated

installation.

### 1.6.2 CATV System Loss Calculations

Calculations shall verify that the system does not exceed the loss values specified in dBmV at the receiver terminations. Provide a drawing displaying all distribution network calculations. The drawing should accurately show taps, splitters, outlets, and the type and length of all drop cables. The drawing shall show how many taps, splitters, or outlets are served by each tap or splitter.

### 1.6.3 Operational Test Plan

Test plan shall define tests required to ensure that the system meets technical, operational, and performance specifications. Test plan shall be based on NCTA RP and be in accordance with FCC proof of performance requirements. Test plan shall include plan for testing for signal leakage. Provide test requirements and guidelines.

### 1.6.4 Operational Test Procedures

Use test plan and design documents to develop test procedures. Procedures shall consist of detailed instructions for a test setup, execution, and evaluation of test results.

### 1.6.5 Connector Installation

Provide manufacturer's instructions for installing connectors.

## PART 2 PRODUCTS

### 2.1 ELECTRONIC EQUIPMENT

Electronic components of similar type shall be produced and designed by the same manufacturer as major components of the equipment and shall have the manufacturer's name and model permanently attached. Equipment shall function properly as a complete integrated system. Equipment shall be shielded. The system shall be designed to operate within 5 to 1000 MHz bandwidth using 1000 MHz passive devices and a minimum of 750 MHz active devices.

### 2.2 HEADEND EQUIPMENT

#### 2.2.1 Headend Amplifiers

Provide broadband distribution amplifiers. Amplifiers shall amplify broadband signals from 40 to 750 MHz and provide an amplified return path for signals from 5 to 40 MHz for 75 ohms impedance. Amplifiers shall be bidirectional with variable slope and gain control.

#### 2.2.2 Attenuators

Provide attenuators to equalize signal levels, when required. Variable attenuators are not permitted.

#### 2.2.3 Power Supplies

Power supplies shall contain a current limiter circuit to protect against short circuits on the radio frequency (RF) line. Provide overvoltage

protection to protect solid state equipment from line surges and induced voltages, in accordance with IEEE C62.41.1 and IEEE C62.41.2.

## 2.3 DISTRIBUTION EQUIPMENT

### 2.3.1 Distribution Amplifiers

Distribution amplifiers shall be equipped for 75 ohms input and output impedance. Electronic equipment exposed to weather shall be equipped with weatherproof housings. Amplifiers shall be bidirectional with variable slope and gain control and shall amplify broadband signals from 50 to 750 MHz and provide an amplified return path for signals from 5 to 40 MHz for 75 ohms impedance.

#### 2.3.1.1 Trunk Amplifiers

Trunk amplifiers shall have automatic level and slope control features.

#### 2.3.1.2 Bridging Amplifiers

Bridging amplifiers shall be used to connect feeder cables to trunk cables.

### 2.3.2 Cables and Associated Hardware

Cabling shall be UL listed for the application and shall comply with NFPA 70. Provide a labeling system for cabling as required by UL 969. Cabling manufactured more than 12 months prior to date of installation shall not be used.

#### 2.3.2.1 Trunk Cable

UL 1666. Provide trunk cable with an NFPA 70 rating of CATVR.

a. Provide RG-11 coaxial cable with the following characteristics:

(1) #14 AWG copper-clad steel center conductor.

(2) Gas injected foam polyethylene dielectric with nominal 0.28 inches outer diameter.

(3) Bonded foil inner-shield and 60 percent aluminum braid or quad shield.

(4) 75 ohms impedance.

(5) 82 to 85 percent nominal velocity of propagation.

(6) Black PVC jacket

(7) Maximum attenuation characteristics:

| MHz | DB/100 ft | MHz | DB/100 ft |
|---|---|---|---|
| 5 | 0.38 | 600 | 3.18 |
| 55 | 0.96 | 750 | 3.65 |
| 300 | 2.25 | 1000 | 4.35 |
| 350 | 2.42 | | |
| 450 | 2.86 | | |

| MHz | DB/100 ft | MHz | DB/100 ft |
|---|---|---|---|
| 500 | 2.90 | | |

b. Provide 625 Series cable with an NFPA 70 rating of CATVR and the following characteristics:

(1) Copper-clad aluminum center conductor

(2) Seamless aluminum tubing shield

(3) Expanded polyethylene dielectric

(4) 75 ohms impedance

(5) Nominal diameter over outer conductor: 0.625 inches.

(6) Maximum attenuation at 20 degrees C and 1000 MHz: 2.07 dB/100 feet

(7) Black medium density polyethylene jacket

(8) Nominal 87 percent velocity of propagation

2.3.2.2 Feeder Cable

UL 1581, provide RG-11 coaxial trunk cable with an NFPA 70 rating of CATV and the following characteristics:

a. #14 AWG copper-clad steel center conductor.

b. Gas injected foam polyethylene dielectric with .28 inches nominal outer diameter.

c. Bonded foil inner-shield and a minimum of 60 percent aluminum braid or quad shield.

d. 75 ohms impedance.

e. 81 to 84 percent nominal velocity of propagation.

f. Black PVC jacket.

g. Maximum attenuation characteristics:

| | CATV |
|---|---|
| MHz | DB/100 ft |
| 50 | .95 |
| 100 | 1.3 |
| 200 | 1.9 |
| 400 | 2.7 |
| 700 | 3.9 |
| 1000 | 4.8 |

2.3.2.3 Drop Cable

UL 1581. Provide RG 6 coaxial cable with an NFPA 70 rating of CATV and

with the following characteristics:

a. No. 18 AWG copper-clad steel center conductor.

b. Bonded foil inner-shield and 90 percent aluminum braid.

c. Characteristic impedance of 75 ohms.

d. Gas injected foam polyethylene dielectric

e. Nominal capacitance, conductor to shield, of 16.2 pf per 100 ft .

f. Maximum operating voltage of 350 V RMS.

g. Maximum attenuation:

CATV

| MHz | DB/100 ft | MHz | DB/100 ft |
|---|---|---|---|
| 10 | 0.81 | 700 | 6.0 |
| 50 | 1.46 | 1000 | 7.3 |
| 100 | 2.05 | | |
| 200 | 2.83 | | |
| 400 | 4.0 | | |
| 500 | 4.53 | | |

h. Black polyvinyl chloride (PVC) jacket.

i. 100 percent sweep testing from 5 MHz to a minimum of 1000 MHz.

2.3.3 Terminators

Terminators shall be rated for 75 ohms and 1/4 watt.

2.3.4 Splitters/Combiners

Use splitters/combiners with characteristics equal to or exceeding the characteristics listed in this paragraph over the entire operating band. All unused outlets must be terminated with 75-ohm terminators.

a. Peak to Valley: Not to exceed 1 dB across bandwidth of device.

b. Return loss: 18 dB minimum.

c. Bandwidth: 5-1000 Mhz

2.3.5 Line Taps

Line taps shall have 18 dB minimum isolation from each tap to the thru-line. Pressure tapoffs are not permitted. Taps shall be rated from 5 to 1000 MHz and shall have a peak to valley not to exceed 1 dB to 1 GHz.

2.3.6 Outlets

Provide flush mounted, 75-ohm, F-type connector outlets rated from 5 to

1000 MHz in standard electrical outlet boxes.

2.3.7 Connectors

Provide one piece connectors. Drop cable connectors shall be feed thru type.

2.3.8 Tilt Compensator

Provide tilt compensators as required.

2.4 GROUNDING AND BONDING

Provide ground rods and connections in accordance with Section 26 20 00, "Interior Distribution System".

2.4.1 Grounding Block

Provide grounding block suitable for indoor installation.

2.5 BACKBOARDS

Provide void-free, fire rated interior grade plywood, 3/4 inch thick, as indicated. Backboards shall be painted with a gray, nonconductive fire-resistant overcoat. Do not cover the fire stamp on the backboard.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Distribution System

Distribution system shall conform to requirements specified herein. Installation shall be in accordance with IEEE C2 and NFPA 70.

3.1.1.1 Raceway

Provide cable installed in raceways such as conduit and cable trays in compliance with NFPA 70. Raceway shall comply with Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM.

3.1.1.2 Grounding System

Provide the grounding block at the main CATV backboard. Ground this device according to the requirements of IEEE C2 and NFPA 70.

3.1.1.3 Trunk, Feeder, and Drop Cable

Provide cable to grounding blocks, to line taps, and to outlets.

3.2 FIELD QUALITY CONTROL

3.2.1 System Pretest

Upon completing installation of the CATV system, the Contractor shall align and balance the system and shall perform complete pretesting. During the system pretest, Contractor, utilizing the approved spectrum analyzer or signal level meter, shall verify that the system is fully operational and meets all the system performance requirements of the specification.

Contractor shall test the signal loss in dBmV at 55, 151, 547, and 750 MHz. The signal levels shall be 0 dBmV (1000 microvolts), minimum. The signal shall not exceed 15 dBmV over the entire system bandwidth. Any deficiencies found shall be corrected and revalidated by follow up testing. Contractor shall measure and record the video and audio carrier levels at each of the frequency levels specified at each of the following points in the system:

a. Furthest outlet from each communication closet.

b. A random sampling of 25 percent of the outlets.

d. Headend amplifier inputs and outputs.

### 3.2.2 Acceptance Tests

Contractor shall notify the Contracting Officer of system readiness 10 days prior to the date of acceptance testing. Contractor shall also coordinate with the local CATV provider and allow them to attend witness tests. CATV system shall be tested in accordance with the approved test plan in the presence of the Contracting Officer's representative to certify acceptable performance. System test shall verify that the total system meets all the requirements of the specification and complies with the specified standards. Contractor shall verify that no signal leakage exists in conformance with NCTA RP and 47 CFR 76.605. System leakage shall also be tested at the headend location with signal applied to system. Deficiencies revealed by the testing shall be corrected on the outlets sampled as well as on the outlets not sampled and revalidated by follow-up testing. Contractor shall conduct testing at each of the following points in the system:

a. Furthest outlet from each communication closet.

b. A random sampling of 25 percent of the outlets from each communication closet as designated by the Contracting Officer.

d. Headend amplifier inputs and outputs.

-- End of Section --

# Video/RF Cable

## Broadband CATV Coaxial Cables
## Series 6 (RG-6/U Type)

| Description | Part No. | UL NEC/ C(UL) CEC Type | Standard Lengths | | Standard Unit Weight | | Conductor (stranding) Diameter Nom. DCR | Nominal Core OD | | Shielding Materials Nom. DCR | Nominal OD | | Nom. Imp. (Ω) | Nom. Vel. of Prop. | Nominal Capacitance | | Nominal Attenuation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ft. | m | Lbs. | kg | | Inch | mm | | Inch | mm | | | pF/Ft. | pF/m | MHz | dB/ 100 Ft. | dB/ 100m |

**Series 6 • 18 AWG** Solid .040″ Bare Copper-covered Steel Conductor • Duobond® II* + Aluminum Braid Shield (60% Coverage)

**Gas-injected Foam Polyethylene Insulation • PVC Jacket** (Available in Black, White or White Neutral)

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 80°C | **9116** | NEC: CATV CM CEC: CM | U-1000▲ 1000 | U-304.8 304.8 | 30.0 31.0 | 13.6 14.1 | 18 AWG (solid) .040″ BCCS 28.0Ω/M′ 91.9Ω/km | .180 | 4.57 | Duobond II* + 60% Aluminum Braid 9.0Ω/M′ 29.5Ω/km | .270 | 6.86 | 75 | 83% | 16.2 | 53.2 | See Chart on page 6.92 | | |

▲U-1000 ft. put-up also available in Beige.

**Gas-injected Foam Polyethylene Insulation • PVC Jacket** (Available in Black, White, Gray or Neutral)

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 80°C | **1829A** | NEC: CATV CM CEC: CM | U-1000 1000 | U-304.8 304.8 | 29.0 29.0 | 13.2 13.2 | 18 AWG (solid) .040″ BCCS 28.0Ω/M′ 91.9Ω/km | .180 | 4.57 | Duobond II + 60% Aluminum Braid 9.0Ω/M′ 29.5Ω/km | .270 | 6.86 | 75 | 83% | 16.2 | 53.2 | 5 | .5 | 1.6 |
| | | | | | | | | | | | | | | | | | 55 | 1.4 | 4.6 |
| | | | | | | | | | | | | | | | | | 211 | 2.6 | 8.5 |
| | | | | | | | | | | | | | | | | | 500 | 4.1 | 13.5 |
| | | | | | | | | | | | | | | | | | 750 | 5.1 | 16.7 |
| | | | | | | | | | | | | | | | | | 862 | 5.5 | 18.0 |
| | | | | | | | | | | | | | | | | | 1000 | 6.0 | 19.7 |
| | | | | | | | | | | | | | | | | | 1450 | 7.8 | 25.6 |
| | | | | | | | | | | | | | | | | | 1800 | 8.6 | 28.2 |
| | | | | | | | | | | | | | | | | | 2250 | 9.8 | 32.2 |
| | | | | | | | | | | | | | | | | | 3000 | 11.3 | 37.1 |
| 80°C | **1829R** new | NEC: CATVR, CMR CEC: CMG FT4 | U-1000◆ | U-304.8 | 29.0 | 13.2 | 18 AWG (solid) .040″ BCCS 28.0Ω/M′ 91.9Ω/km | .180 | 4.57 | Duobond II + 60% Aluminum Braid 9.0Ω/M′ 29.5Ω/km | .270 | 6.86 | 75 | 83% | 16.2 | 53.2 | 5 | .5 | 1.6 |
| | | | | | | | | | | | | | | | | | 55 | 1.4 | 4.6 |
| | | | | | | | | | | | | | | | | | 211 | 2.6 | 8.5 |
| | | | | | | | | | | | | | | | | | 500 | 4.1 | 13.5 |
| | | | | | | | | | | | | | | | | | 750 | 5.1 | 16.7 |
| | | | | | | | | | | | | | | | | | 862 | 5.5 | 18.0 |
| | | | | | | | | | | | | | | | | | 1000 | 6.0 | 19.7 |
| | | | | | | | | | | | | | | | | | 1450 | 7.8 | 25.6 |
| | | | | | | | | | | | | | | | | | 1800 | 8.6 | 28.2 |
| | | | | | | | | | | | | | | | | | 2250 | 9.8 | 32.2 |
| | | | | | | | | | | | | | | | | | 3000 | 11.3 | 37.1 |

Sweep tested 950 MHz to 2.25 GHz.

◆U-1000 ft. put-up not available in Neutral.

**Plenum • Foam FEP Insulation • Natural Flamarrest® Jacket**

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75°C | **1829P** new | NEC: CATVP, CMP CEC: CMP FT6 | U-1000 1000 | U-304.8 304.8 | 27.0 27.0 | 12.3 12.3 | 18 AWG (solid) .040″ BCCS 28.0Ω/M′ 91.9Ω/km | .170 | 4.32 | Duobond II + 60% Aluminum Braid 9.0Ω/M′ 29.5Ω/km | .235 | 5.97 | 75 | 83% | 16.3 | 53.5 | 1 | .3 | 1.0 |
| | | | | | | | | | | | | | | | | | 10 | .7 | 2.2 |
| | | | | | | | | | | | | | | | | | 50 | 1.5 | 4.9 |
| | | | | | | | | | | | | | | | | | 100 | 2.1 | 6.9 |
| | | | | | | | | | | | | | | | | | 200 | 3.0 | 9.8 |
| | | | | | | | | | | | | | | | | | 400 | 4.4 | 14.4 |
| | | | | | | | | | | | | | | | | | 700 | 6.1 | 20.0 |
| | | | | | | | | | | | | | | | | | 900 | 7.2 | 23.6 |
| | | | | | | | | | | | | | | | | | 1000 | 7.6 | 24.9 |
| | | | | | | | | | | | | | | | | | 1450 | 9.6 | 31.5 |
| | | | | | | | | | | | | | | | | | 1800 | 11.0 | 36.1 |
| | | | | | | | | | | | | | | | | | 2250 | 12.7 | 41.7 |
| | | | | | | | | | | | | | | | | | 3000 | 15.1 | 49.5 |

Sweep tested 5 MHz to 3.0 GHz.

**Series 6 • 18 AWG** Solid .040″ Bare Copper-covered Steel Conductor • Duobond® IV* Quad Shield (60% and 40% Coverage)

**Gas-injected Foam Polyethylene Insulation • PVC Jacket** (Available in Black or White)

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 80°C | **1189A** | NEC: CATV CM CEC: CM | U-500 U-1000 1000▼ | U-152.4 U-304.8 304.8 | 18.0 35.0 35.0 | 8.2 15.9 15.9 | 18 AWG (solid) .040″ BCCS 28.0Ω/M′ 91.9Ω/km | .180 | 4.57 | Duobond IV 60% & 40% Aluminum Braids 4.8Ω/M′ 15.7Ω/km | .298 | 7.57 | 75 | 83% | 16.2 | 53.2 | See Chart on page 6.88 | | |

Sweep tested 5 MHz to 1 GHz.

▼1000 ft. put-up also available in Beige or Neutral.

**Plenum • Foam FEP Insulation • Natural Flamarrest Jacket**

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75°C | **1189AP** | NEC: CATVP CMP CEC: CMP FT6 | 1000† | 304.8 | 32.0 | 14.5 | 18 AWG (solid) .040″ BCCS 28.0Ω/M′ 91.9Ω/km | .170 | 4.32 | Duobond IV 60% & 40% Aluminum Braids 4.8Ω/M′ 15.7Ω/km | .248 | 6.30 | 75 | 83% | 16.3 | 53.5 | 1 | .3 | 1.0 |
| | | | | | | | | | | | | | | | | | 10 | .7 | 2.2 |
| | | | | | | | | | | | | | | | | | 50 | 1.6 | 5.2 |
| | | | | | | | | | | | | | | | | | 100 | 2.2 | 7.2 |
| | | | | | | | | | | | | | | | | | 200 | 3.0 | 9.8 |
| | | | | | | | | | | | | | | | | | 400 | 4.6 | 15.1 |
| | | | | | | | | | | | | | | | | | 700 | 6.6 | 21.7 |
| | | | | | | | | | | | | | | | | | 900 | 7.7 | 25.3 |
| | | | | | | | | | | | | | | | | | 1000 | 8.2 | 26.9 |

Sweep tested 5 MHz to 1 GHz.

BCCS = Bare Copper-covered Steel • DCR = DC Resistance

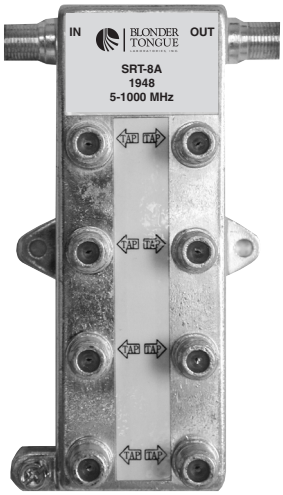
*Duobond II = Bonded Duofoil® (100% coverage) + aluminum braid (60% coverage).
Duobond IV = Duobond II + 60% aluminum braid + Duofoil® tape + 40% aluminum braid.

†Spools and/or UnReel® cartons are one piece, but length may vary ±10% for spools and ±5% for UnReel from length shown.

Contact the Belden Customer Service Department for a Comprehensive Connector Cross Reference. **1-800-BELDEN-1**.
For additional selection of Belden® Video Cables, refer to the Coaxial and Broadcast Cables sections of this catalog.

# SRT-2,4, & 8A

## Solder Back Directional Couplers




### ❍ Features & Benefits

- 1 GHz Bandwidth
- 2,4 and 8 Port Models
- 120 dB RFI Shielding
- Diecast Housing
- Built-in Ground Block

### ❍ Specifications

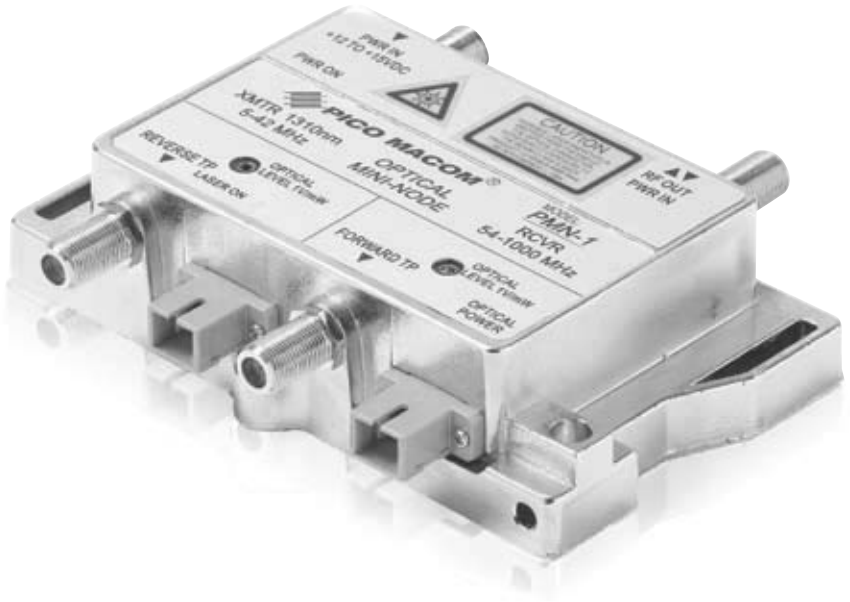
**SRT-2A**

| Tap Value | 4 | 8 | 11 | 14 | 17 | 20 | 23 | 26 | 29 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|
| Tap Loss (± dB) | | | | | | | | | | |
| 5 - 450 MHz: | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 450 - 750 MHz: | 1.0 | 1.0 | 1.0 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| 750 - 1000 MHz: | 1.0 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 2.0 | 2.0 | 2.0 |
| Insertion Loss (dB) | | | | | | | | | | |
| 5 - 50 MHz: | * | 3.0 | 2.3 | 1.2 | 1.0 | 0.9 | 0.7 | 0.7 | 0.7 | 0.7 |
| 50 - 450 MHz: | * | 3.2 | 2.5 | 1.2 | 1.0 | 0.9 | 0.7 | 0.7 | 0.7 | 0.7 |
| 450 - 750 MHz: | * | 3.3 | 2.6 | 1.5 | 1.3 | 1.2 | 1.2 | 1.0 | 1.0 | 1.0 |
| 750 - 1000 MHz: | * | 3.5 | 3.0 | 2.2 | 1.8 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| Isolation Tap-to-Tap (dB): | | | | | | | | | | |
| 5 - 10 MHz: | | | | | | 22 | | | | |
| 10 - 450 MHz: | | | | | | 26 | | | | |
| 450 -750 MHz: | | | | | | 25 | | | | |
| 750 - 1000 MHz: | | | | | | 22 | | | | |
| Isolation Out-to-Tap (dB) | | | | | | | | | | |
| 5 - 50 MHz: | - | 26 | 31 | 33 | 35 | 36 | 38 | 38 | 38 | 40 |
| 50 - 450 MHz: | - | 23 | 26 | 28 | 32 | 33 | 35 | 35 | 35 | 35 |
| 450 - 750 MHz: | - | 23 | 26 | 26 | 28 | 30 | 30 | 30 | 32 | 35 |
| 750 - 1000 MHz: | - | 22 | 24 | 25 | 26 | 29 | 30 | 30 | 32 | 35 |
| Return Loss (IN/OUT) (dB) | | | | | | | | | | |
| 5 - 10 MHz: | 18 | 16 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 |
| 10 - 50 MHz: | 20 | 18 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| 50 -750 MHz: | 18 | 18 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| 750 - 1000 MHz: | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 |
| Return Loss (Tap) (dB) | | | | | | | | | | |
| 5 - 10 MHz: | | | | | | 16 | | | | |
| 10 - 50 MHz: | | | | | | 18 | | | | |
| 50 -750 MHz: | | | | | | 20 | | | | |
| 750 - 1000 MHz: | | | | | | 18 | | | | |

* Terminated

Blonder Tongue 's SRT Series of indoor 1GHz taps are the standard for directional couplers used in broadband systems such as those in educational, correctional, commercial, and MDU's. Models are available with 2, 4, and 8 tap ports and have tap values from 35 dB to 4 dB (model dependant) in 3 dB increments. All models have die-cast housings and provide RFI shielding of 120 dB.

PICO MACOM®
A STEREN COMPANY




# PMN-1 Mini-Indoor Optical Node

The Pico Macom model **PMN-1** is a compact, cost-effective and fully featured indoor optical node specifically designed for the delivery of analog and digital video, high-speed data and telephony signals into homes. This unit has diverse applications in MDU, industrial, government and educational institutions for the delivery of current and future broadband CATV services. The fiber core employed in the unit design is a 1310/1550 nm optical receiver with a wide optical input window of -6 to 3dBm. The **PMN-1** has an integrated optical attenuator and equalizer and a precision LED to indicate received optical power. The power is provided through coaxial cable (line) or an external wall mount power adaptor. The unit employs GaAs amplifier technology for excellent broadband RF performance and spurious-free RF output.

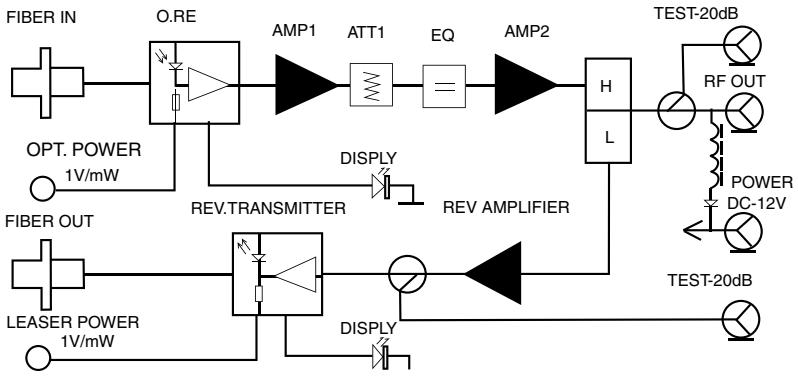
## Features

- Compact, 5˝ x 3˝ x 1.3˝ precision aluminum die-cast case guarantees excellent mechanical integrity, ease of installation and shielding effectiveness.
- Bi-directional operation with forward bandwidth from 54~1000MHz (analog and digital) and reverse bandwidth from 5~42MHz.
- Wide optical input range (-6dBm to 3dBm) provides excellent operation at low optical input levels.
- Full 25dBmV typical RF output for superior C/N performance.
- Return loss guarantees excellent impedance match across the frequency band with minimal reflection and cross coupling between ports.
- Optical power monitoring for optimal optical input and output power range indication.
- Calibrated 1V/mW optical input test point for signal monitoring.
- 12Vdc line powered with a wall mounted 20/240Vac wall adaptor. Integrated high linearit optical receiver and transmitter for two-way operation.

## Ordering Information

**PMN-1** Mini-Indoor Optical Node


6260 Sequence Drive San Diego, CA 92121
Ph: 858-546-5050 Toll Free: 800-421-6511 Fax: 858-546-5051




**PMN-1**

## Forward Receiver

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| λ | Optical Wavelength | - | 1290 | - | 1600 | nm |
| $V_{Opt. In.}$ | Monitor Voltage | λ=1310 | - | 1 | - | V/mW |
| $P_{in}$ | Optical Input Power | Continuous | -6 | 1 | 3 | dBm |
| f | Frequency Range | - | 54 | - | 1000 | MHz |
| FL | Freq. Response Flatness | f=53~1000MHz | - | ±0.5 | - | dB |
| *S22* | Output Return Loss | f=53~1000MHz | 15 | 16 | - | dB |
| $V_o$ | Output Level | - | - | 25 | - | dBmV |
| | Optical Return Loss | - | 45 | - | - | dB |
| CTB | Composite Triple Beat | 99chs flat, | - | - | -61 | dB |
| CSO | Composite Second Order | fm=859.25MHz | - | - | -60 | dB |

* Test results are typical and were performed at our San Diego test center.

## Return Transmitter

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| λ | Optical Wavelength | - | - | 1310 | - | nm |
| $W_{Out}$ | Optical Output Power | Continuous | 0.5 | 1 | 3 | dBm |
| $V_{Opt. In.}$ | Monitor Voltage | λ=1310 | - | 1 | - | V/mW |
| $V_{rin.}$ | RF Input Level | - | - | 15 | - | dBmV |
| f | Frequency Range (option) | - | 5 | - | 42 | MHz |
| FL | Freq. Response Flatness | f=5~42MHz | - | ±0.5 | - | dB |
| S11 | Input Return Loss | f=5~42MHz | 15 | 16 | - | dB |
| | Optical Output Return Loss | - | - | 45 | - | dB |

## General

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{tot}$ | Total Current Consumption | V+=12V | - | 350 | - | mA |

**Dimensions:** 7.5″ L x 4.2″ W x 3.3″ H
**Weight:** 0.75 lbs

PICO MACOM®
A STEREN COMPANY

PICO MACOM
5 YEAR WARRANTY

# PFT *Series* | 1310nm Optical Transmitters

The Pico Macom **PFT** Series of optical transmitters is available in nine output power levels, from 6 to 14dBm, allowing flexibility in numerous CATV applications. Each unit takes various combinations of input modulated RF signals and converts them to light for distribution to nodes. With an optical wavelength of 1310nm and a bandwidth of 54~860MHz, the transmitter supports transmission of NTSC and QAM RF signals over a single-mode optical fiber. The **PFT** Series optical fiber transmitters are 19″ wide and rack mounted with a height of 1RU.

## Features

- Wide bandwidth, 54~860MHz, high-performance single-mode 1310nm optical fiber transmitter.
- Supports analog and QAM digital applications.
- Wide range laser options, from 6dBm to 14dBm (4mW to 26mW), for multiple broadband applications.
- Optical power monitoring of input RF and laser status.
- RS232 port.
- Manual or automatic gain controls RF input level.
- Automatic gain controlled input allows unit to maintain the same optical output with varying inputs without distortion.
- Input voltage between 90-260Vac.
- Unit can be used for NTSC and PAL systems.
- Front panel RF test port -20dB.
- Low power consumption.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PICO MACOM®
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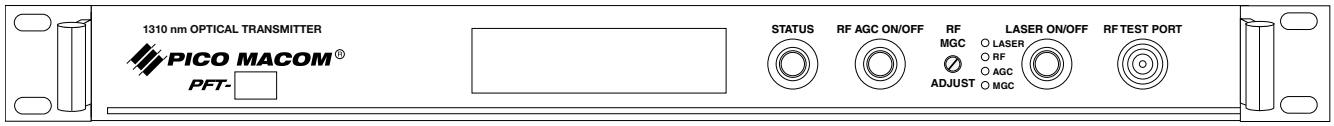
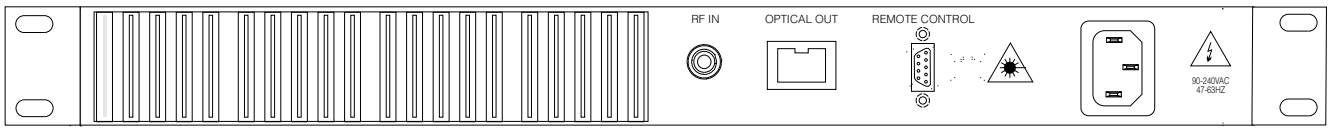
# Fiber Optic Series




**Front View**




**Rear View**

## Specifications

| | |
|---|---|
| **Optical Output** | |
| **Power in dBm:** | 6, 7, 8, 9, 10, 11, 12, 13, 14 dBm |
| **Optical Wavelength:** | 1310nm |
| **Laser Type:** | DFB |
| **Optical Connector Type:** | SC/APC (FC/APC Optional) |
| **RF Frequency Range:** | 50~860 MHz |
| **RF Input Level Range:** | +15 to 20dBmV |
| **RF Input Impedance:** | 75Ω |
| **In-Band Flatness:** | ±1dB |
| **Input Return Loss:** | >15dB |
| **Carrier-to-Noise *(CNR)**:** | >50dB |
| **Composite Second Order *(CSO)**:** | >60dB |
| **Composite Triple Beat *(CTB)**:** | >65dB |
| **AGC Control Range:** | ±5dB |
| **MGC Control Range:** | ±5dB |
| **Power Supply Range:** | 90-264 Vac |
| **Power Consumption (typical):** | 30 watts |
| **Operating Temperature:** | 0° to 50°C |
| **Storage Temperature:** | -20° to +65°C |
| **Relative Humidity:** | <10% |
| **Dimensions:** | 19˝W x 13˝D x 1.75˝H |
| **Weight:** | 9.15 lbs. |

## Ordering Information

| | |
|---|---|
| **PFT - 6** | (6dBm or 4mW) - 1310nm Optical Transmitter |
| **PFT - 7** | (7dBm or 5mW) - 1310nm Optical Transmitter |
| **PFT - 8** | (8dBm or 7mW) - 1310nm Optical Transmitter |
| **PFT - 9** | (9dBm or 8mW) - 1310nm Optical Transmitter |
| **PFT - 10** | (10dBm or 10mW) - 1310nm Optical Transmitter |
| **PFT - 11** | (11dBm or 14mW) - 1310nm Optical Transmitter |
| **PFT - 12** | (12dBm or 16mW) - 1310nm Optical Transmitter |
| **PFT - 13** | (13dBm or 20mW) - 1310nm Optical Transmitter |
| **PFT - 14** | (14dBm or 26mW) - 1310nm Optical Transmitter |

* **Test results are typical and were performed at our San Diego test center using an 80 channel NTSC Matrix generator as the RF source, appropriate optical loss budget for the 1310nm transmitter being tested and optical receiver input level of -1dBm.**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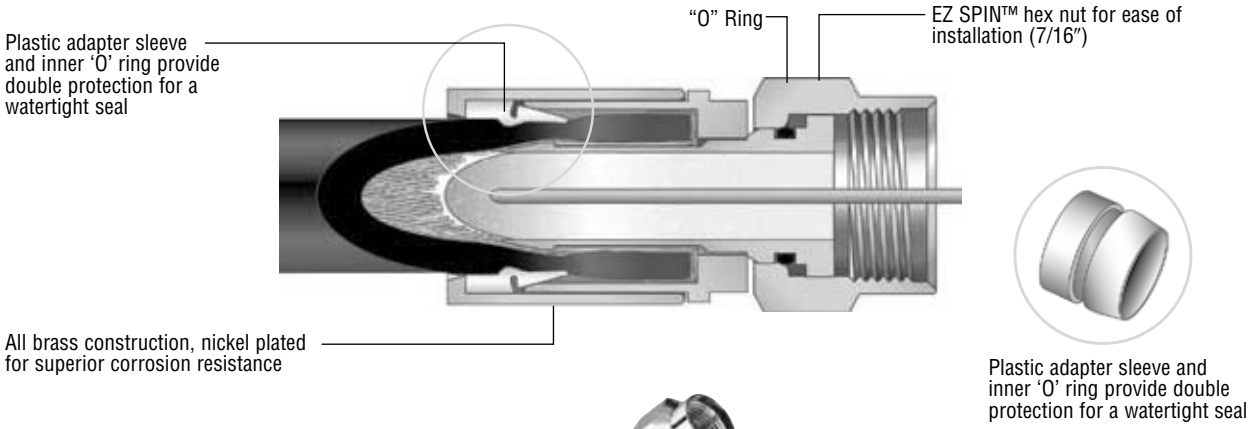
Rev. 9/07 Ph: 858-546-5050 Toll Free: 800-421-6511 Fax: 858-546-5051 www.picomacom.com

# RTQ Universal Compression Connectors

IDEAL Compression Connectors are all single piece designs that are manufactured to meet the demands and expectations of the satellite and cable TV industry. All series of connectors are effortlessly positioned onto properly stripped coax and are permanently connected when terminated with an IDEAL OmniSeal Compression Tool. All IDEAL compression F-connectors use a standard 1/4″, 1/4″ strip. Multiple package quantities and connector features ensure that you will have the right connector for your application.

- Connectors to fit RG-59, RG-6, Plenum RG-6 & RG-11 coaxial cable
- Designated connectors fit regular (dual shield), tri and quad shield cables
- Approved for indoor/outdoor use



| Cat. No. | Description | PKG QTY |
|---|---|---|
| **92-610** | **RG-59 Reg/Tri/Quad** Compression F-Connectors | 50/jar |
| **92-619** | | 1000/box |
| **92-654** | **RG-6 Reg/Tri/Quad** Compression F-Connectors | 4 pack |
| **92-651** | | 10 pack |
| **92-650** | | 50/jar |
| **92-656** | | 100/jar |
| **92-659** | | 1000/box |
| **92-660** | **RG-6 Plenum**, Dual Shield Compression F-Connectors | 50/jar |
| **92-669** | | 1000/box |
| **89-211** | **RG-11**, Dual Shield Compression F-Connectors | 10 pack |
| **89-1211** | | 500/box |

| Operation Specifications | |
|---|---|
| Bandwidth: | 0 MHz - 3 GHz |
| Impedance: | 75 Ohms (nominal) |
| Return Loss: | Minimum -30 dB @ 3 GHz |
| Tightening Torque: | 30 in-lbs. |
| Operating Temperature Range: | -40°F to +140°F |
| Cable Range: | 60% through Quad Shield, PE and PVC jackets |
| Cable Retention: | 40 lbs. minimum |

| Tooling Requirements: | |
|---|---|
| Data T®-Cutter | 45-074 |
| 1/4″ - 1/4″ RG-6, RG-59 & Quad Cable Stripper | 45-603, 45-526, 45-262, 45-282, 45-111 |
| Compression Tool | 30-603, 30-793 |
| F-Connector Tool | 35-046 |

SECTION 28 31 76

INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM
**11/08**

PART 1 GENERAL

1.1 RELATED SECTIONS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, applies to this section, with the additions and modifications specified herein. In addition, refer to the following sections for related work and coordination:

Section 21 13 13.00 20 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION.

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS.

Section 07 84 00 FIRESTOPPING for additional work related to firestopping.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

| | |
|---|---|
| ASA S3.2 | (1989; R 1999) Method for Measuring the Intelligibility of Speech Over Communication Systems (ASA 85) |

FM GLOBAL (FM)

| | |
|---|---|
| FM P7825a | (2005) Approval Guide Fire Protection |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C62.41.1 | (2002) IEEE Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits |
| IEEE C62.41.2 | (2002) IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits |

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

| | |
|---|---|
| IEC 60268-16 | (2003) Sound System Equipment - Part 16: Objective Rating Of Speech Intelligibility By Speech Transmission Index |

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

| | |
|---|---|
| ISO 7240-16 | (2007) Fire Detection And Alarm Systems — Part 16: Sound System Control And |

Indicating Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 170 | (2005) Fire Safety Symbols |
| NFPA 241 | (2004) Safeguarding Construction,Alteration, and Demolition Operations |
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |
| NFPA 72 | (2006) National Fire Alarm Code |
| NFPA 90A | (2008) Standard for the Installation of Air Conditioning and Ventilating Systems |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 47 CFR 15 | Radio Frequency Devices |
| 47 CFR 90 | Private Land Mobile Radio Services |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1480 | (2003; Rev thru Dec 2006); Standard for Safety Speakers for Fire Alarm, Emergency, and Commercial and Professional Use |
| UL 1971 | (2002; Rev thru May 2006) Signaling Devices for the Hearing Impaired |
| UL 2017 | (2000; Rev thru Aug 2005) Standard for Safety for General-Purpose Signaling Devices and Systems |
| UL 268 | (2006) Standard for Smoke Detectors for Fire Alarm Signaling Systems |
| UL 268A | (1998; Rev thru Apr 2006) Smoke Detectors for Duct Application |
| UL 464 | (2003; Rev thru Feb 2008) Standard for Audible Signal Appliances |
| UL 864 | (2003; Rev thru May 2007) Control Units and Accessories for Fire Alarm Systems |
| UL Electrical Constructn | (2008) Electrical Construction Equipment Directory |
| UL Fire Prot Dir | (2008) Fire Protection Equipment Directory |

## 1.3 DEFINITIONS

Wherever mentioned in this specification or on the drawings, the equipment, devices, and functions shall be defined as follows:

a. Analog/Addressable System: A system where multiple signals are transmitted via the same conduction path to a remote fire alarm control unit and fire alarm control panel, decoded and separated so that each signal will initiate the specified response.

b. Hard Wired System: A system where alarm and supervisory initiating devices are directly connected, through individual dedicated conductors, to a central control panel without the use of analog/addressable circuits or devices.

c. Interface Device: An addressable device that interconnects hard wired systems or devices to an analog/addressable system.

d. Remote Fire Alarm and Mass Notification Control Unit: A control panel, electronically remote from the fire alarm and mass notification control panel, that receives inputs from automatic and manual fire alarm devices; may supply power to detection devices and interface devices; may provide transfer of power to the notification appliances; may provide transfer of condition to relays or devices connected to the control unit; and reports to and receives signals from the fire alarm control panel.

e. Fire Alarm and Mass Notification Control Panel (FACP/FMCP): A master control panel having the features of a fire alarm and mass notification control unit and fire alarm and mass notification control units are interconnected. The panel has central processing, memory, input and output terminals.

f. Terminal Cabinet: A steel cabinet with locking, hinge-mounted door that terminal strips are securely mounted.

## 1.4 SYSTEM DESCRIPTION

### 1.4.1 Scope

a. This work includes completion of design and providing a new, complete, analog/addressable fire alarm and mass notification system as described herein and on the contract drawings for the buildings 2440, 2441, and 2442. Include in the system wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, control equipment, alarm, and supervisory signal initiating devices, alarm notification appliances, supervising station fire alarm system transmitter, and other accessories and miscellaneous items required for a complete operating system even though each item is not specifically mentioned or described. Provide systems complete and ready for operation.

b. Provide equipment, materials, installation, workmanship, inspection, and testing in strict accordance with the required and advisory provisions of NFPA 72, ISO 7240-16, IEC 60268-16, except as modified herein. A single fire alarm control panel is indicated in building 2440 and 2442.

### 1.4.2 Technical Data and Computer Software

Technical data and computer software (meaning technical data that relates to computer software) that are specifically identified in this project, and may be defined/required in other specifications, shall be delivered, strictly in accordance with the CONTRACT CLAUSES. Identify data delivered by reference to the particular specification paragraph against which it is

furnished. Data to be submitted shall include complete system, equipment, and software descriptions. Descriptions shall show how the equipment will operate as a system to meet the performance requirements of this contract. The data package shall also include the following:

a. Identification of programmable portions of system equipment and capabilities.

b. Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.

c. Provision of operational software data on all modes of programmable portions of the fire alarm and detection system.

d. Description of Fire Alarm And Mass Notification Control Panel (FACP/FMCP) equipment operation.

e. Description of auxiliary and remote equipment operations.

f. Library of application software.

g. Operation and maintenance manuals.

1.4.3 Keys

Keys and locks for equipment shall be identical. Provide not less than six keys of each type required.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Annotated catalog data, in table format on the drawings, showing manufacturer's name, model, voltage, and catalog numbers for equipment and components. Submitted shop drawings shall not be smaller than ISO A1.

Wiring Diagrams; G

Point-to-point wiring diagrams showing the points of connection and terminals used for electrical field connections in the system, including interconnections between the equipment or systems that are supervised or controlled by the system. Diagrams shall show connections from field devices to the FACP and remote fire alarm control units, initiating circuits, switches, relays and terminals.

Complete riser diagrams indicating the wiring sequence of devices and their connections to the control equipment. Include a color code schedule for the wiring. Include floor plans showing the locations of devices and equipment.

System Layout; G

Plan view drawing showing device locations, terminal cabinet locations, junction boxes, other related equipment, conduit routing, wire counts, circuit identification in each conduit, and circuit layouts for all floors. Drawings shall comply with the requirements of NFPA 170, Fire Safety Symbols.

System Operation; G

A complete list of device addresses and corresponding messages.

Notification Appliances; G

Data on each circuit to indicate that there is at least 25 percent spare capacity for notification appliances, 25 percent spare capacity for initiating devices. Annotate data for each circuit on the drawings.

Amplifiers; G

Data to indicate that the amplifiers have sufficient capacity to simultaneously drive all notification speakers at the maximum rating plus 50 percent spare capacity. Annotate data for each circuit on the drawings.

As-Built Drawings

Six sets of detailed as-built drawings. Furnish one set of CD or DVD discs containing software back-up and CAD based drawings in latest version of AutoCad and DXF format of as-built drawings and schematics. The drawings shall include complete wiring diagrams showing connections between devices and equipment, both factory and field wired. Include a riser diagram and drawings showing the as-built location of devices and equipment. The drawings shall show the system as installed, including deviations from both the project drawings and the approved shop drawings. These drawings shall be submitted within two weeks after the final acceptance test of the system. At least one set of as-built (marked-up) drawings shall be provided at the time of, or prior to the final acceptance test.

SD-03 Product Data

UL or FM listing cards for equipment provided.

Technical Data And Computer Software; G
Fire Alarm And Mass Notification Control Panel (FACP/FMCP); G
Manual stations; G
Batteries; G
Battery chargers; G
Smoke sensors; G
Wiring and cable; G
Notification appliances; G
Addressable interface devices; G
Amplifiers; G
Tone generators; G
Digitalized voice generators; G
Radio transmitter and interface panels; G
Terminal Cabinets; G

SD-05 Design Data

System Operation; G

A complete description of the system operation on the drawings.

Battery power; G

Battery calculations as required in paragraph Battery Power Calculations.

SD-06 Test Reports

Field Quality Control
Testing Procedures; G
Smoke sensor testing procedures; G

SD-07 Certificates

Installer

SD-09 Manufacturer's Field Reports

Mass Notification System

A unique identifier for each device, including the control panel and initiating and indicating devices, with an indication of test results, and signature of the factory-trained technician of the control panel manufacturer and equipment installer. With reports on preliminary tests, include printer information. Include the NFPA 72 Record of Completion and NFPA 72 Inspection and Testing Form, with the appropriate test reports.

SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions; G

Six copies of the Operation and Maintenance Instructions, indexed and in booklet form. The Operation and Maintenance Instructions shall be a single volume or in separate volumes, and may be submitted as a Technical Data Package. Manuals shall be approved prior to training.

Original and backup copies of all software delivered for this project, on each type of CD/DVD media utilized.

Instruction of Government Employees

The installers training history for the employees involved with this contract.

1.6 QUALITY ASSURANCE

Equipment and devices shall be compatible and operable with existing station fire alarm system and shall not impair reliability or operational functions of existing supervising station fire alarm system.

a. In NFPA publications referred to herein, consider advisory provisions to be mandatory, as though the word "shall" had been

substituted for "should" wherever it appears; interpret reference to "authority having jurisdiction" to mean the Naval Facilities Engineering Command.

b. The recommended practices stated in the manufacturer's literature or documentation shall be considered as mandatory requirements.

c. Devices and equipment for fire alarm service shall be listed by UL Fire Prot Dir or approved by FM P7825a.

1.6.1 Qualifications

1.6.1.1 Design Services

Installations requiring completion of installation drawings and specification or modifications of fire detection, fire alarm, mass notification system, fire suppression systems or mass notification systems shall require the services and review of a qualified engineer. For the purposes of meeting this requirement, a qualified engineer is defined as an individual meeting one of the following conditions:

a. A registered professional engineer having a Bachelor of Science or Masters of Science Degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of four years work experience in fire protection engineering.

b. A registered professional engineer (P.E.) in fire protection engineering.

c. Registered Professional Engineer with verification of experience and at least four years of current experience in the design of the fire protection and detection systems.

d. A NICET Level 4 Fire Alarm Technicians.

1.6.1.2 Supervisor

The installing Contractor shall provide the following: NICET Fire Alarm Technicians to perform the installation of the system. A NICET Level 4 Fire Alarm Technician shall supervise the installation of the fire alarm system/mass notification system. The Fire Alarm technicians supervising the installation of equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.6.1.3 Technician

The installing Contractor shall provide the following: Fire Alarm Technicians with a minimum of four years of experience utilized to assist in the installation and terminate fire alarm/mass notification devices, cabinets and panels. The Fire Alarm technicians installing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.6.1.4 Installer

The installing Contractor shall provide the following: Fire Alarm installer with a minimum of two years of experience utilized to assist in the installation of fire alarm/mass notification devices, cabinets and

panels. An electrician shall be allowed to install wire or cable and to install conduit for the fire alarm system/mass notification system. The Fire Alarm installer shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.6.1.5 Test Personnel

The installing Contractor shall provide the following: Fire Alarm Technicians with a minimum of eight years of experience utilized to test and certify the installation of the fire alarm/mass notification devices, cabinets and panels. The Fire Alarm technicians testing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.6.1.6 Manufacturer's Representative

The fire alarm and mass notification equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

1.6.1.7 Manufacturer

Components shall be of current design and shall be in regular and recurrent production at the time of installation. Provide design, materials, and devices for a protected premises fire alarm system, complete, conforming to NFPA 72, except as otherwise or additionally specified herein.

1.6.2 Regulatory Requirements

1.6.2.1 Requirements for Fire Protection Service

Equipment and material shall have been tested by UL and listed in UL Fire Prot Dir or approved by FM and listed in FM P7825a. Where the terms "listed" or "approved" appear in this specification, they shall mean listed in UL Fire Prot Dir or FM P7825a. The omission of these terms under the description of any item of equipment described shall not be construed as waiving this requirement. All listings or approval by testing laboratories shall be from an existing ANSI or UL published standard.

1.6.2.2 Mass Notification System

The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory for the intended use. All listings or approval by testing laboratories shall be from an existing ANSI or UL published standard.

1.6.2.3 Testing Services or Laboratories

Fire alarm and fire detection equipment shall be constructed in accordance with UL Fire Prot Dir, UL Electrical Constructn, or FM P7825a.

1.7 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather, humidity, and temperature variation, dirt and dust, and other contaminants.

## 1.8 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

The Interior Fire Alarm And Mass Notification System Operation and Maintenance Instructions shall include:

a. "Manufacturer Data Package 5" as specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA.

b. Operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features.

c. Maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed.

d. The manuals shall include complete procedures for system revision and expansion, detailing both equipment and software requirements.

e. Software delivered for this project shall be provided, on each type of CD/DVD media utilized.

f. Printouts of configuration settings for all devices.

g. Routine maintenance checklist. The routine maintenance checklist shall be arranged in a columnar format. The first column shall list all installed devices, the second column shall state the maintenance activity or state no maintenance required, the third column shall state the frequency of the maintenance activity, and the fourth column for additional comments or reference.

## 1.9 EXTRA MATERIALS

### 1.9.1 Repair Service/Replacement Parts

Repair services and replacement parts for the system shall be available for a period of 10 years after the date of final acceptance of this work by the Contracting Officer. During guarantee period, the service technician shall be on-site within 24 hours after notification. All repairs shall be completed within 24 hours of arrival on-site.

### 1.9.2 Interchangeable Parts

Spare parts furnished shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be suitably packaged and identified by nameplate, tagging, or stamping. Spare parts shall be delivered to the Contracting Officer at the time of the final acceptance testing.

### 1.9.3 Spare Parts

Furnish the following spare parts and accessories:

a. Four fuses for each fused circuit

1.9.4 Special Tools

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to the Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Standard Products

Provide materials, equipment, and devices that have been tested by a nationally recognized testing laboratory, such as UL or FM, and listed or approved for fire protection service when so required by NFPA 72 or this specification. Select material from one manufacturer, where possible, and not a combination of manufacturers, for any particular classification of materials. Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least two years prior to bid opening.

2.1.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, installing Contractor's name and address, and the contract number provided on a new plate permanently affixed to the item or equipment. Major components include, but are not limited to, the following:

a. FACPs

b. Automatic transmitter

Furnish nameplates to obtain approval by the Contracting Officer before installation. Obtain approval by the Contracting Officer for installation locations. Nameplates shall be etched metal or plastic, permanently attached by screws to panels or adjacent walls.

2.2 GENERAL PRODUCT REQUIREMENT

All fire alarm and mass notification equipment shall be listed for use under the applicable reference standards. Interfacing of Listed UL 864 or similar approved industry listing with Mass Notification Panels listed to UL 2017 or equal shall be done in a laboratory listed configuration, if the software programming features can not provide a listed interface control. If a field modification is needed, such as adding equipment like relays, the manufacturer of the panels being same or different brand from manufacturer shall provide the installing contractor for review and confirmation by the installing contractor. The installing contractor shall, as part of the submittal documents, provide this information.

2.3 SYSTEM OPERATION

The Addressable Interior Fire Alarm and Mass Notification System shall be a complete, supervised, noncoded, analog/addressable fire alarm and mass notification system conforming to NFPA 72, UL 864 Ninth Edition, and UL 2017. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and

restored to normal. The system may be placed in the alert mode by local micrphones or remotely from authorized locations/users.

2.3.1 Alarm Initiating Devices

Connect alarm initiating devices to initiating device circuits (IDC), Style B, to signal line circuits (SLC), Style 6, and installed in accordance with NFPA 72.

a. Alarm notification appliances shall be connected to notification appliance circuits (NAC), Voice Notification System, Style Z in accordance with NFPA 72. A looped conduit system shall be provided so that if the conduit and all conductors within are severed or exposed to fire at any point, all IDC, NAC and SLC will remain functional. Should the design or building layout preclude separation then a fire rated separation shall be provided in accordance with NFPA 72. The return portion of the loop shall be remote from the supply portion of the loop.

b. The system shall operate in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until initiating device(s) are reset and the fire alarm control panel is manually reset and restored to normal. The conduit loop requirement is not applicable to the signal transmission link from the local panels (at the protected premises) to the Supervising Station (fire station, fire alarm central communication center). Audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system/mass notification system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc.

2.3.2 Functions and Operating Features

The system shall provide the following functions and operating features:

a. The FACP/FMCP and fire alarm and mass notification control units, if used, shall provide power, annunciation, supervision, and control for the system. Addressable systems shall be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits with sufficient memory to perform as specified.

b. Provide Style B initiating device circuits.

c. Provide Style 6 signaling line circuits for each floor.

d. Provide Style 6 signaling line circuits for the network.

e. Provide Style Z notification appliance circuits. The visual alarm notification appliances shall have the flash rates synchronized.

f. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.

g. Provide an audible and visual trouble signal to activate upon a single break or open condition, or ground fault. The trouble signal shall also operate upon loss of primary power (AC) supply, absence of a battery supply, low battery voltage, or removal of alarm or supervisory panel modules. Provide a trouble alarm silence feature that shall silence the audible trouble signal, without affecting the visual indicator. After the system returns to normal operating conditions,

the trouble signal shall again sound until the trouble is acknowledged. A smoke sensor in the process of being verified for the actual presence of smoke shall not initiate a trouble condition.

h. Provide a notification appliance silencing switch, that when activated, will silence the audible signal appliance, but will not affect the visual alarm indicator, the liquid crystal display, or the automatic notification of the fire department. This switch shall be overridden upon activation of a subsequent alarm.

i. Provide alarm verification capability for smoke sensors. Alarm verification shall initially be set for 3 seconds.

j. Provide program capability via switches in a locked portion of the FACP to bypass the automatic notification appliance circuits, fire reporting system features. Operation of this programming shall indicate this action on the FACP display.

k. Alarm, supervisory, and/or trouble signals shall be automatically transmitted to the fire department.

l. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.

m. The system shall be capable of being programmed from the panels keyboard. Programmed information shall be stored in non-volatile memory.

n. The system shall be capable of operating, supervising, and/or monitoring both addressable and non-addressable alarm and supervisory devices.

o. There shall be no limit, other than maximum system capacity, as to the number of addressable devices, that may be in alarm simultaneously.

p. Where the fire alarm system is responsible for initiating an action in another emergency control device or system, such as an HVAC system, the addressable fire alarm relay shall be within 3 feet of the emergency control device.

q. An alarm signal shall automatically initiate the following functions:

(1) Transmission of an alarm signal to the fire department.

(2) Visual indication of the device operated on the fire alarm control panel (FACP) and remote annunciator.

(3) Continuous actuation of all alarm notification appliances, except those in stairs or in elevator cabs.

(4) Recording of the event electronicly in the history log of the fire control system unit.

(5) Release of power to electric locks on doors that are part of the means of egress.

(6) Operation of a duct smoke sensor shall shut down the appropriate air handler in accordance with NFPA 90A in addition to

other requirements of this paragraph.

r. A supervisory signal shall automatically initiate the following functions:

(1) Visual indication of the device operated on the FACP, and on the remote annunciator, and sound the audible alarm at the respective panel.

(2) Transmission of a supervisory signal to the fire department.

(3) Recording of the event electronicly in the history log of the fire control system unit.

s. A trouble condition shall automatically initiate the following functions:

(1) Visual indication of the system trouble on the FACP, and on the remote annunciator, and sound the audible alarm at the respective panel.

(2) Transmission of a trouble signal to the fire department.

(3) Recording of the event electronicly in the history log of the fire control system unit.

t. The maximum permissible elapsed time between the actuation of an initiating device and its indication at the FACP shall be 10 seconds.

u. The maximum elapsed time between the occurrence of the trouble condition and its indication at the FACP shall not exceed 200 seconds.

## 2.4 SYSTEM MONITORING

### 2.4.1 Valves

Each valve affecting the proper operation of a fire protection system, including automatic sprinkler control valves, standpipe control valves, sprinkler service entrance valve, valves at fire pumps, isolating valves for pressure type waterflow or supervision switches, and valves at backflow preventers, whether supplied under this contract or existing, shall be electrically monitored to ensure its proper position. Each tamper switch shall be provided with a separate address, unless they are within the same room, then a maximum of five can use the same address.

## 2.5 MASS NOTIFICATION SYSTEM FUNCTIONS

### 2.5.1 Notification Appliance Network

The notification appliance network consists of audio speakers located to provide intelligible instructions at all locations in the building. The Mass Notification System announcements shall take priority over all other function of the system including the audible and visual output of the fire alarm system in a normal or alarm state. All fire alarm system functions shall continue in an alarm state except for the output signals of the audible and visual notification appliances.

2.5.2 Strobes

Strobes are also provided to alert hearing-impaired occupants.

2.5.3 Voice Notification

An autonomous voice notification control unit is used to monitor and control the notification appliance network and provide consoles for local operation. Using a console, personnel in the building can initiate delivery of pre-recorded voice messages, provide live voice messages and instructions, and initiate visual strobe and (optional) textual message notification appliances. The autonomous voice notification control unit will temporarily override audible fire alarm notification while delivering Mass Notification messages to ensure they are intelligible.

2.6 OVERVOLTAGE AND SURGE PROTECTION

2.6.1 Signaling Line Circuit Surge Protection

For systems having circuits located outdoors, communications equipment shall be protected against surges induced on any signaling line circuit and shall comply with the applicable requirements of IEEE C62.41.1 and IEEE C62.41.2. Cables and conductors, that serve as communications links, shall have surge protection circuits installed at each end that meet the following waveform(s):

a. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes. Protection shall be provided at the equipment. Additional triple electrode gas surge protectors, rated for the application, shall be installed on each wireline circuit within 3 feet of the building cable entrance. Fuses shall not be used for surge protection.

2.6.2 Sensor Wiring Surge Protection

Digital and analog inputs and outputs shall be protected against surges induced by sensor wiring installed outdoors and as shown. The inputs and outputs shall be tested with the following waveforms:

a. A 10 by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes. Fuses shall not be used for surge protection.

2.7 ADDRESSABLE INTERFACE DEVICES

The initiating device being monitored shall be configured as a Style B initiating device circuits. The system shall be capable of defining any module as an alarm module and report alarm trouble, loss of polling, or as a supervisory module, and reporting supervisory short, supervisory open or loss of polling such as waterflow switches, valve supervisory switches, fire pump monitoring, independent smoke detection systems, relays for output function actuation, etc. The module shall be UL or FM listed as compatible with the control panel. The monitor module shall provide

address setting means compatible with the control panel's SLC supervision and store an internal identifying code. Monitor module shall contain an integral LED that flashes each time the monitor module is polled. Pull stations with a monitor module in a common backbox are not required to have an LED.

## 2.8 ADDRESSABLE CONTROL MODULE

The control module shall be capable of operating as a relay (dry contact form C) for interfacing the control panel with other systems, and to control door holders or initiate elevator fire service. The module shall be UL or FM listed as compatible with the control panel. The indicating device or the external load being controlled shall be configured as a Style Y notification appliance circuits. The system shall be capable of supervising, audible, visual and dry contact circuits. The control module shall have both an input and output address. The supervision shall detect a short on the supervised circuit and shall prevent power from being applied to the circuit. The control model shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. The control module shall contain an integral LED that flashes each time the control module is polled. Control Modules shall be located in environmental areas that reflect the conditions to which they were listed.

## 2.9 ISOLATION MODULES

Provide isolation modules to subdivide each signaling line circuit into groups of not more than 20 addressable devices between adjacent isolation modules.

## 2.10 SMOKE SENSORS

### 2.10.1 Photoelectric Smoke Sensors

Provide addressable photoelectric smoke sensors as follows:

a. Provide analog/addressable photoelectric smoke sensors utilizing the photoelectric light scattering principle for operation in accordance with UL 268. Smoke sensors shall be listed for use with the fire alarm control panel.

b. Provide self-restoring type sensors that do not require any readjustment after actuation at the FACP to restore them to normal operation. Sensors shall be UL listed as smoke-automatic fire sensors.

c. Components shall be rust and corrosion resistant. Vibration shall have no effect on the sensor's operation. Protect the detection chamber with a fine mesh metallic screen that prevents the entrance of insects or airborne materials. The screen shall not inhibit the movement of smoke particles into the chamber.

d. Provide twist lock bases for the sensors. The sensors shall maintain contact with their bases without the use of springs. Provide companion mounting base with screw terminals for each conductor. Terminate field wiring on the screw terminals. The sensor shall have a visual indicator to show actuation.

e. The sensor address shall identify the particular unit, its location within the system, and its sensitivity setting. Sensors shall be of

the low voltage type rated for use on a 24 VDC system.

f. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each initiating device.

(1) Primary status

(2) Device type

(3) Present average value

(4) Present sensitivity selected

(5) Sensor range (normal, dirty, etc.)

2.10.2 Projected Beam Smoke Detectors

Detectors shall be designed for detection of abnormal smoke densities. Detectors shall consist of separate transmitter and receiver units. The transmitter unit shall emit an infrared beam to the receiver unit. When the signal at the receiver falls below a preset sensitivity, the detector shall initiate an alarm. The receiver shall contain an LED that is powered upon an alarm condition. Long-term changes to the received signal caused by environmental variations shall be automatically compensated. Detectors shall incorporate features to assure that they are operational; a trouble signal shall be initiated if the beam is obstructed, the limits of the compensation circuit are reached, or the housing cover is removed. Detectors shall have multiple sensitivity settings in order to meet UL listings for the different distances covered by the beam. In the event of beam interference for more than three seconds a trouble alarm shall be transmitted.

2.10.3 Duct Smoke Sensors

Duct-mounted photoelectric smoke detectors shall be furnished and installed where indicated and in accordance with NFPA 90A. Units shall consist of a smoke detector as specified in paragraph Photoelectric Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have a manual reset. Detectors shall be rated for air velocities that include air flows between 500 and 4000 fpm. Detectors shall be powered from the fire alarm panel.

a. Sampling tubes shall run the full width of the duct. The duct detector package shall conform to the requirements of NFPA 90A, UL 268A, and shall be UL listed for use in air-handling systems. The control functions, operation, reset, and bypass shall be controlled from the fire alarm control panel.

b. Lights to indicate the operation and alarm condition; and the test and reset buttons shall be visible and accessible with the unit installed and the cover in place. Detectors mounted above 6 feet and those mounted below 6 feet that cannot be easily accessed while standing on the floor, shall be provided with a remote detector indicator panel containing test and reset switches.

c. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall

provide for control of auxiliary contacts that provide control, interlock, and shutdown functions specified in Section 23 09 23 DIRECT DIGITAL CONTROL FOR HVAC AND OTHER LOCAL BUILDING SYSTEMS. Auxiliary contacts provide for this function shall be located within 3 feet of the controlled circuit or appliance. The detectors shall be supplied by the fire alarm system manufacturer to ensure complete system compatibility.

2.10.4 Smoke Sensor Testing

Smoke sensors shall be tested in accordance with NFPA 72 and manufacturer's recommended calibrated test method. Submit smoke sensor testing procedures for approval.

2.11 ELECTRIC POWER

2.11.1 Primary Power

Power shall be 120 VAC service for the FACP from the emergency AC service to the building.

2.11.2 Generator

Where any emergency generator provides a standby power supply for life safety system circuits, provide a connection from one of the circuits for the fire alarm system.

2.12 EMERGENCY POWER SUPPLY

Provide for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power shall be automatic and shall not cause transmission of a false alarm.

2.12.1 Batteries

Provide sealed, maintenance-free, gel cell batteries as the source for emergency power to the FACP. Batteries shall contain suspended electrolyte. The battery system shall be maintained in a fully charged condition by means of a solid state battery charger. Provide an automatic transfer switch to transfer the load to the batteries in the event of the failure of primary power.

2.12.1.1 Capacity

Provide the batteries with sufficient capacity to operate the system under supervisory and trouble conditions, including audible trouble signal devices for 4 hours and audible and visual signal devices under alarm conditions for an additional 15 minutes.

2.12.1.2 Battery Power Calculations

a. Verify that battery capacity exceeds supervisory and alarm power requirements.

1). Substantiate the battery calculations for alarm, alert, and supervisory power requirements. Ampere-hour requirements for each system component and each panel component, and the battery-recharging period shall be included.

2). Provide complete battery calculations for both the alarm, alert, and supervisory power requirements. Ampere-hour requirements for each system component shall be submitted with the calculations.

3). A voltage drop calculation to indicate that sufficient voltage is available for proper operation of the system and all components, at the minimum rated voltage of the system operating on batteries.

b. For battery calculations use the following assumptions: Assume a starting voltage of 24 VDC for starting the calculations to size the batteries. Calculate the required Amp-Hours for the specified standby time, and then calculate the required Amp-Hours for the specified alarm time. Calculate the nominal battery voltage after operation on batteries for the specified time period. Using this voltage perform a voltage drop calculation for circuit containing device and/or appliances remote from the power sources.

### 2.12.2 Battery Chargers

Provide a solid state, fully automatic, variable charging rate battery charger. The charger shall be capable of providing 150 percent of the connected system load and shall maintain the batteries at full charge. In the event the batteries are fully discharged (18 Volts dc), the charger shall recharge the batteries back to 95 percent of full charge within 48 hours. Provide pilot light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high rate switch is provided.

## 2.13 FIRE ALARM AND MASS NOTIFICATION CONTROL PANEL (FACP/FMCP)

Provide a complete control panel fully enclosed in a lockable steel enclosure as specified herein. Operations required for testing or for normal care and maintenance of the systems shall be performed from the front of the enclosure. If more than a single unit is required at a location to form a complete control panel, the unit enclosures shall match exactly. If more than a single unit is required, and is located in the lobby/entrance, notify the Naval Facilities Engineering Command prior to installing the equipment.

a. Each control unit shall provide power, supervision, control, and logic for the entire system, utilizing solid state, modular components, internally mounted and arranged for easy access. Each control unit shall be suitable for operation on a 120 volt, 60 hertz, normal building power supply. Provide each panel with supervisory functions for power failure, internal component placement, and operation.

b. Visual indication of alarm, supervisory, or trouble initiation on the fire alarm control panel shall be by liquid crystal display or similar means with a minimum of 80 characters, that at least 32 are field changeable. The MNS Control panel shall have the capability of temporarily deactivate the fire alarm audible notification appliances while delivering voice messages. Provide conductor integrity monitoring for strobe, display, temporary deactivation of fire alarm audible notification appliances and speaker wiring.

c. Provide secure operator console for initiating recorded messages,

strobes and displays; and for delivering live voice messages. Provide capacity for at least four pre-recorded messages. Provide the ability to automatically repeat pre-recorded messages. Provide a secure microphone for delivering live messages. Provide adequate discrete outputs to temporarily deactivate fire alarm audible notification, and initiate/synchronize strobes. Provide a complete set of self-diagnostics for controller and appliance network. Provide local diagnostic information display and local diagnostic information and system event log file.

2.13.1 Cabinet

Install control panel components in cabinets large enough to accommodate all components and also to allow ample gutter space for interconnection of panels as well as field wiring. The enclosure shall be identified by an engraved laminated phenolic resin nameplate. Lettering on the nameplate shall say "Fire Alarm and Mass Notification Control Panel" and shall not be less than one inch high. Provide prominent rigid plastic or metal identification plates for lamps, circuits, meters, fuses, and switches. The cabinet shall be provided in a sturdy steel housing, complete with back box, hinged steel door with cylinder lock, and surface mounting provisions.

2.13.2 Control Modules

Provide power and control modules to perform all functions of the FACP. Provide audible signals to indicate any alarm, supervisory, or trouble condition. The alarm signals shall be different from the trouble signal. Connect circuit conductors entering or leaving the panel to screw-type terminals with each terminal marked for identification. Locate diodes and relays, if any, on screw terminals in the FACP. Circuits operating at 24 VDC shall not operate at less than 21.6 volts. Circuits operating at any other voltage shall not have a voltage drop exceeding 10 percent of nominal voltage.

2.13.3 Silencing Switches

a. Alarm Silencing Switch: Provide an alarm silencing switch at the FACP that shall silence the audible signal but not affect the visual alarm indicator. This switch shall be overridden upon activation of a subsequent alarm.

b. Supervisory/Trouble Silencing Switch: Provide supervisory and trouble silencing switch that shall silence the audible trouble and supervisory signal, but not extinguish the visual indicator. This switch shall be overridden upon activation of a subsequent alarm, supervision, or trouble condition. Audible trouble indication must resound automatically every 24 hours after the silencing feature has been operated.

2.13.4 Non-Interfering

Power and supervise each circuit such that a signal from one device does not prevent the receipt of signals from any other device. Circuits shall be manually reset by switch from the FACP after the initiating device or devices have been restored to normal.

2.13.5 Voice Notification System

The Voice Notification System shall comply with the requirements of NFPA 72

for Emergency Voice/Alarm Communications System requirements ISO 7240-16, IEC 60268-16, except as specified herein. The system shall be a one-way multi-channel voice notification system incorporating user selectability of a minimum 8 distinct sounds for tone signaling, and the incorporation of a voice module for delivery of prerecorded messages. Textual audible appliances shall produce a slow whoop tone for three cycles followed by a voice message that is repeated until the control panel is reset or silenced. Automatic messages shall be broadcast through speakers on appropriate floors, but not in stairs or elevator cabs. The visual strobes and audible message shall automatically be broadcast on all floors. A live voice message shall override the automatic audible output through use of a microphone input at the control panel.

a. When using the microphone, live messages shall be broadcast through speakers in stairs, in elevator cabs, and throughout a selected floor or floors. The system shall be capable of operating all speakers at the same time. The digitalized voice message shall consist of a non-volatile (EPROM) microprocessor based input to the amplifiers. The microprocessor shall actively interrogate circuitry, field wiring, and digital coding necessary for the immediate and accurate rebroadcasting of the stored voice data into the appropriate amplifier input. Loss of operating power, supervisory power, or any other malfunction that could render the digitalized voice module inoperative shall automatically cause the slow whoop tone to take over all functions assigned to the failed unit.

b. The Mass Notification functions shall override the manual or automatic fire alarm notification. The system shall have the capability of utilizing a remote microphone station with redundant controls of the notification system control panel. Class "A" Notification Appliance Circuits (NAC) shall be provided for the activation of strobe appliances. The activation of the NAC Circuits shall follow the operation of the speaker NAC circuits. Audio output shall be selectable for line level (600 ohms), 25, 70.7 or 100 volt output. The audio amplifier outputs shall be not greater than 100 watts RMS output. The strobe NAC Circuits shall provide at least 2 amps of 24 VDC power to operate strobes and have the ability to synchronize all strobes. A hand held microphone shall be provided and, upon activation, shall take priority over any tone signal, recorded message, while maintaining the strobe NAC Circuits activation.

All outputs and operational modules shall be fully supervised with on-board diagnostics and trouble reporting circuits. Form "C" contacts shall be provided for system alarm and trouble conditions. Circuits shall be provided for operation of auxiliary appliance during trouble conditions. During a Mass Notification event the panel shall not generate nor cause any trouble alarms to be generated with the Fire Alarm system. The Control Panel for the Voice Notification System shall be independent of the Fire alarm system and shall be capable of autonomous operation. The system shall be housed in the same panel with the fire alarm system. Mass Notification functions shall take precedence over all other functions performed by the Voice Notification System. Messages shall utilize a male voice and shall be similar to the following:

1) 1000 Hz tones (1 sec on, 1/2 second off, 1 second on, 1/2 second off, 1 second on)

"May I have your attention please. May I have your attention please. A fire emergency has been reported in the building.

Please leave the building by the nearest exit or exit stairway. Do not use the elevators." (Provide a 2 second pause.) "May I have your attention please, (repeat the message)."

2) 1000 Hz tones (1 sec on, 1/2 second off, 1 second on, 1/2 second off, 1 second on)

"Alert! This is the Mass Notification System.
There is an emergency situation.
DO NOT evacuate the building! Stay in your current location!
Stay tuned for further instructions."
(repeat message 2 times)

3) 1000 Hz tones (1 sec on, 1/2 second off, 1 second on, 1/2 second off, 1 second on)

"Alert, This is the Mass Notification System.
There is a chemical gas emergency.
Turn off all HVAC equipment, seal all doors and windows with wet fabric, Don protective gear.
DO NOT evacuate the building, Act now!
Listen to the MNS system for further instructions".
(repeat message 2 times)

4) 1000 Hz tones (1 sec on, 1/2 second off, 1 second on, 1/2 second off, 1 second on)

"Alert, this is the Mass Notification System.
There is a explosive blast risk along the South wall of your building.
Quietly move towards the north side of the building, and exit from the north stairs.
Move away from the building heading north to the north parking area.
(repeat message 2 times).

a. The Remote Microphone station shall incorporate a Push-To-Talk (PTT) microphone, redundant controls and system status indicators of/for the system. The unit shall incorporate microphone override of any tone generation or prerecorded messages. The unit shall be fully supervised from the control panel. The housing shall contain a lock that is keyed identical to the fire alarm system for the building.

b. Auxiliary Input Module shall be designed to be an outboard expansion module to either expand the number of optional remote microphone stations, or allow a telephone interface.

2.13.6 Memory

Provide each control unit with non-volatile memory and logic for all functions. The use of long life batteries, capacitors, or other age-dependent devices shall not be considered as equal to non-volatile processors, PROMS, or EPROMS.

2.13.7 Field Programmability

Provide control units and control panels that are fully field programmable for control, initiation, notification, supervisory, and trouble functions of both input and output. The system program configuration shall be menu

driven. System changes shall be password protected and shall be accomplished using personal computer based equipment. Any proprietary equipment and proprietary software needed by qualified technicians to implement future changes to the fire alarm system shall be provided as part of this contract.

2.13.8 Input/Output Modifications

The FACP shall contain features that allow the bypassing of input devices from the system or the modification of system outputs. These control features shall consist of a panel mounted keypad. Any bypass or modification to the system shall indicate a trouble condition on the FACP.

2.13.9 Resetting

Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm, supervisory or trouble condition on the system still exists.

2.13.10 Instructions

Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the instructions on the interior of the FACP. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory, and trouble. The instructions shall be approved by the Contracting Officer before being posted.

2.13.11 Walk Test

The FACP shall have a walk test feature. When using this feature, operation of initiating devices shall result in limited system outputs, so that the notification appliances operate for only a few seconds and the event is indicated on the system printer, but no other outputs occur.

2.13.12 History Logging

In addition to the required printer output, the control panel shall have the ability to store a minimum of 400 events in a log. These events shall be stored in a battery-protected memory and shall remain in the memory until the memory is downloaded or cleared manually. Resetting of the control panel shall not clear the memory.

2.13.13 RS-232-C Output

Each local control panel shall be capable of operating remote service type cathode ray tubes (CRTs), printers, and/or modems. The output shall be paralleled ASCII from an EIA RS-232-C connection with a baud rate of 1200 or 2400 to allow use of any commonly available CRT, printer, or modem.

2.14 AMPLIFIERS, PREAMPLIFIERS, TONE GENERATORS

Any amplifiers, preamplifiers, tone generators, digitalized voice generators, and other hardware necessary for a complete, operational, textual audible circuit conforming to NFPA 72 shall be housed in a fire alarm control unit, terminal cabinet, or in the fire alarm control panel. The system shall automatically operate and control all building fire alarm speakers except those installed in the stairs and within elevator cabs. The speakers in

the stairs and elevator cabs shall operate only when the microphone is used to deliver live messages. Each amplifier shall be single output channel.

2.14.1 Construction

Amplifiers shall utilize computer grade solid state components and shall be provided with output protection devices sufficient to protect the amplifier against any transient up to 10 times the highest rated voltage in the system.

2.14.2 Inputs

Each system shall be equipped with separate inputs from the tone generator, digitalized voice driver and panel mounted microphone. Microphone inputs shall be of the low impedance, balanced line type. Both microphone and tone generator input shall be operational on any amplifier.

2.14.3 Tone Generator

The tone generator shall be of the modular, plug-in type with securely attached labels to identify the component as a tone generator and to identify the specific tone it produces. The tone generator shall produce a slow whoop tone, that shall slowly ascend from low (500 hertz) to high (1200 hertz), and shall be constantly repeated until interrupted by either the digitalized voice message, the microphone input, or the alarm silence mode as specified. Each slow whoop cycle shall last approximately 4 seconds. The tone generator shall be single channel with an automatic backup generator per channel such that failure of the primary tone generator causes the backup generator to automatically take over the functions of the failed unit and also causes transfer of the common trouble relay.

2.14.4 Protection Circuits

Each amplifier shall be constantly supervised for any condition that could render the amplifier inoperable at its maximum output. Failure of any component shall cause automatic transfer to a designated backup amplifier, illumination of a visual "amplifier trouble" indicator on the control panel, appropriate logging of the condition on the system printer, and other actions for trouble conditions as specified.

2.15 MANUAL STATIONS

Provide metal or plastic, semi-flush mounted, double action, addressable manual stations, that are not subject to operation by jarring or vibration. Stations shall be equipped with screw terminals for each conductor. Stations that require the replacement of any portion of the device after activation are not permitted. Stations shall be finished in fire-engine red with molded raised lettering operating instructions of contrasting color. The use of a key or wrench shall be required to reset the station. Manual stations shall be mounted at 48 inches. Stations shall have a separate screw terminal for each conductor.

2.16 NOTIFICATION APPLIANCES

2.16.1 Fire Alarm/Mass Notification Speakers

Audible appliances shall conform to the applicable requirements of UL 464. Appliances shall be connected into notification appliance circuits.

Audible appliances shall generate a unique audible sound from other devices provided in the building and surrounding area. Surface mounted audible appliances shall be painted red. Recessed audible appliances shall be installed with a grill that is painted red.

a. Speakers shall conform to the applicable requirements of UL 1480. Speakers shall have six different sound output levels and operate with audio line input levels of 100 Vac, 70 Vac, 7 Vac, and 25 Vac, by means of selectable tap settings. Tap settings shall include taps of 1/4, 1/2, 1, 2, and 8 watt. Speakers shall incorporate a high efficiency speaker for maximum output at minimum power across a frequency range of 400Hz to 4000Hz, and shall have a sealed back construction. Speakers shall be capable of installation on standard 4 inch square electrical boxes. Where speakers and strobes are provided in the same location, they may be combined into a single wall mounted or ceiling mounted unit. All inputs shall be polarized for compatibility with standard reverse polarity supervision of circuit wiring via the Fire Alarm Control Panel.

b. Provide speaker mounting plates constructed of cold rolled steel having a minimum thickness of 16 gauge and equipped with mounting holes and other openings as needed for a complete installation. Fabrication marks and holes shall be ground and finished to provide a smooth and neat appearance for each plate. Each plate shall be primed and painted.

2.16.2 Visual Notification Appliances

Visual notification appliances shall conform to the applicable requirements of UL 1971 and conform to the Americans With Disabilities Act (ADA). Fire Alarm/Mass Notification Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light and be marked "ALERT" in red letters. The light pattern shall be disbursed so that it is visible above and below the strobe and from a 90 degree angle on both sides of the strobe. Strobe flash rate shall be 1 flash per second and a minimum of 15 candela based on the UL 1971 test. Strobe shall be semi-flush mounted. Where more than two appliances are located in the same room or corridor, provide synchronized operation.

2.16.3 Fire Alarm Horns

Provide surface mounted electronic multi-tone horns that produce a minimum of four distinct sounds, suitable for use in an electrically supervised circuit. Horns shall have a rating of 90 dBA at 10 feet when tested in accordance with UL 464 while emitting a slow whoop tone. Output from the horn shall be the slow whoop tone. Where horns and strobes are provided in the same location, they may be combined into a single unit. Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles.

2.16.4 Connections

Provide screw terminals for each notification appliance. Terminals shall be designed to accept the size conductors used in this project without modification.

2.17 ENVIRONMENTAL ENCLOSURES OR GUARDS

Environmental enclosures shall be provided to permit Fire Alarm or Mass Notification components to be used in areas that exceed the environmental

limits of the listing. The enclosure shall be listed for the device or appliance as either a manufactured part number or as a listed compatible accessory for the UL category that the component is currently listed. Guards required to deter mechanical damage shall be either a listed manufactured part or a listed accessory for the category of the initiating device or notification appliance.

## 2.18 INTERFACE TO THE BASE WIDE MASS NOTIFICATION NETWORK

### 2.18.1 Radio

The radio transceiver shall be bi-direction and meet all the requirements of paragraph, RADIO TRANSMITTER AND INTERFACE PANELS as specified in this Specification Section. The transceiver utilized in the Mass Notification System shall be capable of the following:

a. Communication with the Central Control/Monitoring System to provide supervision of communication link and status changes are reported by automatic and manual poll/reply/acknowledge routines.

b. All monitored points/status changes are transmitted immediately and at programmed intervals until acknowledged by the Central Control/Monitoring System.

c. Each transceiver shall transmits a unique identity code as part of all messages; the code is set by the user at the transceiver.

#### 2.18.1.1 Radio Frequency Communications

Use of radio frequency-type communications systems shall comply with National Telecommunications and Information Administration (NTIA) requirements.

#### 2.18.1.2 Licensed Radio Frequency Systems

An approved DD Form 1494 for the system is required prior to operation.

## 2.19 AUTOMATIC FIRE Radio Transmitter and Interface Panels

### 2.19.1 Radio Transmitter and Interface Panels

Transmitters shall be compatible with proprietary supervising station receiving equipment. Each radio alarm transmitter shall be the manufacturer's recognized commercial product, completely assembled, wired, factory tested, and delivered ready for installation and operation. Transmitters shall be provided in accordance with applicable portions of NFPA 72, Federal Communications Commission (FCC) 47 CFR 90 and Federal Communications Commission (FCC) 47 CFR 15. Transmitter electronics module shall be contained within the physical housing as an integral, removable assembly. The Base Fire Department receiving equipment is manufactured by Monaco and the transceiver shall be fully compatible with this equipment. At the contractors option, and if UL or FM listed, the transmitter may be housed in the same panel as the fire alarm control panel. The transmitter shall be Narrowband radio, with FCC certification for narrowband operation and meets the requirements of the NTIA (National Telecommunications and Information Administration) Manual of Regulations and Procedures for Federal Frequency Management.

a. Operation: Each transmitter shall operate from 120-volt ac power.

In the event of 120-volt ac power loss, the transmitter shall automatically switch to battery operation. Switchover shall be accomplished with no interruption of protective service, and shall automatically transmit a trouble message. Upon restoration of ac power, transfer back to normal ac power supply shall also be automatic.

b. Battery Power: Transmitter standby battery capacity shall provide sufficient power to operate the transmitter in a normal standby status for a minimum of 72 hours and be capable of transmitting alarms during that period.

c. Transmitter housing shall be NEMA Type 1. The housing shall contain a lock that is keyed identical to the fire alarm system for the building. Radio alarm transmitter housing shall be factory painted with a suitable priming coat and not less than two coats of a hard, durable weatherproof enamel.

d. Antenna shall be omnidirectional, coaxial, halfwave dipole antennas for radio alarm transmitters with a driving point impedance to match transmitter output. Use of omnidirectional antenna shall be reviewed and approved by the Base Fire Department. The antenna and antenna mounts shall be corrosion resistant and designed to withstand wind velocities of 161 km/h. 100 mph. Antennas shall not be mounted to any portion of the building roofing system. Protect the antenna from physical damage.

2.19.2 Signals to Be Transmitted to the Base Receiving Station

The following signals shall be sent to the base receiving station:

a. Sprinkler water flow

b. Manual pull stations

c. Smoke detectors

d. Duct smoke detectors

h. Sprinkler valve supervision

2.20 WIRING

Provide wiring materials under this section as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM with the additions and modifications specified herein.

2.20.1 Alarm Wiring

The SLC wiring shall be copper cable in accordance with the manufacturers requirements. Copper signaling line circuits and initiating device circuit field wiring shall be No. 16 AWG size conductors at a minimum. Notification appliance circuit conductors, that contain audible alarm devices, other than speakers, shall be solid copper No. 14 AWG size conductors at a minimum. Speaker circuits shall be copper No. 16 AWG size conductors at a minimum. Wire size shall be sufficient to prevent voltage drop problems. Circuits operating at 24 VDC shall not operate at less than 21.6 volts. Circuits operating at any other voltage shall not have a voltage drop exceeding 10 percent of nominal voltage. Power wiring, operating at 120 VAC minimum, shall be a minimum No. 12 AWG solid copper

having similar insulation.

PART 3 EXECUTION

3.1 INSTALLATION OF FIRE ALARM INITIATING AND INDICATING DEVICES

a. FACP/FMCP: Locate the FACP/FMCP where indicated on the drawings. Surface mount the enclosure with the top of the cabinet 6 feet above the finished floor or center the cabinet at 5 feet, whichever is lower. Conductor terminations shall be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection shall be permanently mounted in the FACP.

b. Manual Stations: Locate manual stations where shown on the drawings. Mount stations so that their operating handles are 4 feet above the finished floor. Mount stations so they are located no farther than 5 feet from the exit door they serve, measured horizontally.

c. Notification Appliance Devices: Locate notification appliance devices where shown on the drawings. Mount assemblies on walls 90 inches above the finished floor or 6 inches below the ceiling whichever is lower. Ceiling mounted speakers shall conform to NFPA 72.

d. Smoke and Heat Sensors: Locate sensors as shown on the drawings on a 4 inch mounting box. Sensors located on the ceiling shall be installed not less than 4 inches from a side wall to the near edge. Those located on the wall shall have the top of the sensor at least 4 inches below the ceiling, but not more than 12 inches below the ceiling. In raised floor spaces, the smoke sensors shall be installed to protect 225 square feet per sensor. Install smoke sensors no closer than 5 feet from air handling supply outlets.

e. Remote Annunciator: Locate the remote annunciator as shown on the drawings. Surface mount the panel, centered at 5 feet.

f. Water Flow Detectors and Tamper Switches: Locate water flow detectors and tamper switches at each supervised sprinkler valve station.

g. The modification of any fire alarm system and the procedures shall comply with the requirements of NFPA 241.

3.2 SYSTEM FIELD WIRING

3.2.1 Wiring within Cabinets, Enclosures, and Boxes

Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure, or cabinet. Conductors that are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting, or junction box shall be connected to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. Make connections with approved pressure type terminal blocks, that are securely mounted. The use of wire nuts or similar devices shall be prohibited. Wiring shall conform to NFPA 70.

### 3.2.2 Terminal Cabinets

Provide a terminal cabinet at the base of any circuit riser, on each floor at each riser, and where indicated on the drawings. Terminal size shall be appropriate for the size of the wiring to be connected. Conductor terminations shall be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection shall be permanently mounted in the terminal cabinet. Minimum size is 8 inches by 8 inches.

### 3.2.3 Alarm Wiring

Provide all wiring in rigid metal conduit or intermediate metal conduit. Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Electrical metallic tubing conduit is acceptable in dry locations not enclosed in concrete or where not subject to mechanical damage. Conceal conduit in finished areas of new construction and wherever practicable in existing construction. The use of flexible conduit not exceeding a 6 foot length shall be permitted in initiating device circuits. Run conduit or tubing concealed unless specifically shown otherwise on the drawings. Shielded wiring shall be utilized where recommended by the manufacturer. For shielded wiring, the shield shall be grounded at only one point, that shall be in or adjacent to the FACP. Pigtail or T-tap connections to signal line circuits, initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited. T-tapping using screw terminal blocks is allowed for Style 5 addressable systems. Color coding is required for circuits and shall be maintained throughout the circuit. Conductors used for the same functions shall be similarly color coded. Wiring shall conform to NFPA 70.

### 3.2.4 Conductor Terminations

Labeling of conductors at terminal blocks in terminal cabinets, FACP, and remote fire alarm control units shall be provided at each conductor connection. Each conductor or cable shall have a shrink-wrap label to provide a unique and specific designation. Each terminal cabinet, FACP, and fire alarm control unit shall contain a laminated drawing that indicates each conductor, its label, circuit, and terminal. The laminated drawing shall be neat, using 12 point lettering minimum size, and mounted within each cabinet, panel, or unit so that it does not interfere with the wiring or terminals. Maintain existing color code scheme where connecting to existing equipment.

## 3.3 FIRESTOPPING

Provide firestopping for holes at conduit penetrations through floor slabs, fire rated walls, partitions with fire rated doors, corridor walls, and vertical service shafts in accordance with Section 07 84 00 FIRESTOPPING.

## 3.4 PAINTING

Paint exposed electrical, fire alarm conduit, and surface metal raceway to match adjacent finishes in exposed areas. Paint junction boxes red in unfinished areas. Painting shall comply with Section 09 90 00 PAINTS AND COATINGS.

## 3.5 FIELD QUALITY CONTROL

### 3.5.1 Testing Procedures

Detailed test procedures, prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician, and signed by representative of the installing company, for the fire detection and alarm system 30 days prior to performing system tests. Detailed test procedures shall list all components of the installed system such as initiating devices and circuits, notification appliances and circuits, signaling line devices and circuits, control devices/equipment, batteries, transmitting and receiving equipment, power sources/supply, annunciators, special hazard equipment, emergency communication equipment, interface equipment, Guard's Tour equipment, and transient (surge) suppressors. Test procedures shall include sequence of testing, time estimate for each test, and sample test data forms. The test data forms shall be in a check-off format (pass/fail with space to add applicable test data) and shall be used for the preliminary testing and the acceptance testing. The test data forms shall record the test results and shall:

a. Identify the NFPA Class and Style of all Initiating Device Circuits (IDC), Notification Appliance Circuits (NAC), Voice Notification System, and Signaling Line Circuits (SLC).

b. Identify each test required by NFPA 72 Test Methods and required test herein to be performed on each component, and describe how this test shall be performed.

c. Identify each component and circuit as to type, location within the facility, and unique identity within the installed system. Provide necessary floor plan sheets showing each component location, test location, and alphanumeric identity.

d. Identify all test equipment and personnel required to perform each test (including equipment necessary for testing smoke detectors using real smoke).

e. Provide space to identify the date and time of each test. Provide space to identify the names and signatures of the individuals conducting and witnessing each test.

### 3.5.2 Tests Stages

a. Preliminary Testing: Conduct preliminary tests to ensure that devices and circuits are functioning properly. Tests shall meet the requirements of paragraph entitled "Minimum System Tests." After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that panel functions were tested and operated properly. The letter shall include the names and titles of the witnesses to the preliminary tests. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.

b. Request for Formal Inspection and Tests: When tests have been completed and corrections made, submit a signed, dated certificate with a request for formal inspection and tests to the Naval Facilities

Engineering Command.

c. Final Testing: Notify the Contracting Officer in writing when the system is ready for final acceptance testing. Submit request for test at least 15 calendar days prior to the test date. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. Furnish instruments and personnel required for the tests. A final acceptance test will not be scheduled until the operation and maintenance (O&M) manuals are furnished to the Contracting Officer and the following are provided at the job site:

(1) The systems manufacturer's technical representative

(2) Marked-up red line drawings of the system as actually installed

(3) Megger test results

(4) Loop resistance test results

(5) Complete program printout including input/output addresses

The final tests shall be witnessed by the Naval Facilities Engineering Command. At this time, any and all required tests shall be repeated at their discretion. Following acceptance of the system, as-built drawings and O&M manuals shall be delivered to the Contracting Officer for review and acceptance.

3.5.3 Minimum System Tests

Test the system in accordance with the procedures outlined in NFPA 72, ISO 7240-16, IEC 60268-16. The required tests are as follows:

a. Megger Tests: After wiring has been installed, and prior to making any connections to panels or devices, wiring shall be megger tested for insulation resistance, grounds, and/or shorts. Conductors with 300 volt rated insulation shall be tested at a minimum of 250 VDC. Conductors with 600 volt rated insulation shall be tested at a minimum of 500 VDC. The tests shall be witnessed by the Contracting Officer and test results recorded for use at the final acceptance test.

b. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the Contracting Officer and test results recorded for use at the final acceptance test.

c. Verify the absence of unwanted voltages between circuit conductors and ground. The tests shall be accomplished at the preliminary test with results available at the final system test.

d. Verify that the control unit is in the normal condition as detailed in the manufacturer's O&M manual.

e. Test each initiating and indicating device and circuit for proper operation and response at the control unit. Smoke sensors shall be tested in accordance with manufacturer's recommended calibrated test method. Use of magnets is prohibited. Testing of duct smoke detectors shall comply with the requirements of NFPA 72.

f. Test the system for specified functions in accordance with the contract drawings and specifications and the manufacturer's O&M manual.

g. Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the time period and in the manner specified.

h. Determine that the system is operable under trouble conditions as specified.

i. Visually inspect wiring.

j. Test the battery charger and batteries.

k. Verify that software control and data files have been entered or programmed into the FACP. Hard copy records of the software shall be provided to the Contracting Officer.

l. Verify that red-line drawings are accurate.

m. Measure the current in circuits to ensure there is the calculated spare capacity for the circuits.

n. Measure voltage readings for circuits to ensure that voltage drop is not excessive.

o. Disconnect the verification feature for smoke sensors during tests to minimize the amount of smoke needed to activate the sensor. Testing of smoke sensors shall be conducted using real smoke. The use of canned smoke is prohibited.

p. Measure the voltage drop at the most remote appliance (based on wire length) on each notification appliance circuit.

q. Audibility Intelligibility testing of the Voice Evacuation Notification System shall be accomplished iaw NFPA 72 for Voice Evacuation Systems, IEC 60268-16, and ASA S3.2.

r. Opening the circuit at not less than 10% of alarm initiating devices and notification appliances to test the wiring supervisory feature.

s. Demonstrate modem communications with remote sites as specified by the COR. Dial in capability shall also, be demonstrated, using specified security.

t. Demonstrate fiber optic communications with remote sites as specified by the COR. Dial in capability shall also, be demonstrated, using specified security.

## 3.6 INSTRUCTION OF GOVERNMENT EMPLOYEES

Equipment manufacturer shall provide 1 day on site. Training shall allow for classroom instruction as well as individual hands on programming, troubleshooting and diagnostics exercises.

3.6.1 Instructor

Include in the project the services of an instructor, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided. The instructor shall train the Government employees designated by the Contracting Officer, in the care, adjustment, maintenance, and operation of the fire alarm system. Each instructor shall be thoroughly familiar with all parts of this installation. The instructor shall be trained in operating theory as well as in practical O&M work.

3.6.2 Required Instruction Time

Provide 8 hours of instruction after final acceptance of the system. The instruction shall be given during regular working hours on such dates and times as are selected by the Contracting Officer. The instruction may be divided into two or more periods at the discretion of the Contracting Officer. The training shall allow for rescheduling for unforeseen maintenance and/or fire department responses.

3.6.3 Technical Data and Computer Software

Provide, in manual format, lesson plans, operating instructions, maintenance procedures, and training data for the training courses. The operations training shall familiarize designated government personnel with proper operation of the installed system. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

-- End of Section --

**SOF RIVERINE AND COMBATANT CRAFT OPERATIONS FACILITY**
**STENNIS SPACE CENTER, MS**

**FIRE ALARM / VOICE EVACUATION SYSTEM** - NOTIFIER FIRE SYSTEMS

**OPERATIONS BUILDING 2440 / MAINTENANCE BUILDING 2441**

| | | | |
|---|---|---|---|
| 1 | NFS2-640 | | Intelligent Addressable Voice Evacuation Fire Alarm Control Panel |
| | 1 | CPU2-640 | Central Processing Unit, Power Supply, & Chassis |
| | 2 | BMP-1 | Blank Module Panel |
| | 1 | DP-DISP2 | Dress Plate for CPU2-640 |
| | 1 | CA-1 | Chassis, DVC |
| | 1 | DVC-EM | Digital Voice Command |
| | 1 | DVC-KD | Digital Voice Command, Keypad |
| | 1 | DVC-AO | Digital Voice Analog Output |
| | 1 | DPA-1 | Dress Plate, DVC |
| | 1 | AA-120 | 120 Watt Amplifier |
| | 1 | CHS-6 | Chassis |
| | 1 | XP6-C | Control Transponder, 6 Output |
| | 2 | ACM-8R | Annunciator Relay Module, 8 Relays |
| | 2 | DP-1B | Blank Plate, Row |
| | 1 | ADDR-D4 | Audio Command Door for CAB-D |
| | 1 | SBB-D4 | Back Box, 4 Chassis, Black |
| 1 | NFS-LBB | | Large Battery Box |
| 2 | PS-12550 | | Battery, 12 Volt DC, 55 Amp Hour |
| 1 | HSP-121BT1RU | | 120 Vac Surge Suppression |

| | | | |
|---|---|---|---|
| 1 | Remote Annunciator / Microphone Station | | |
| | 1 | LCD-80 | Remote LCD Annunciator |
| | 1 | RM-1 | Remote Microphone Station |
| | 1 | ACM-24AT | Annunciator Control Module |
| | 1 | BMP-1 | Blank Annunciator Module |
| | 1 | ADP-4 | Annunciator Dress Plate |
| | 1 | DR-A4 | A Size Door with Plexi Window |
| | 1 | SBB-A4 | A Size Back Box |

| | | |
|---|---|---|
| 8 | NBG-12LX | Addressable Pull Station |
| 7 | FSP-851 / B710LP | Intelligent Addressable Photo Detector / Base |
| 2 | FSD-751P / ST-5 | Intelligent Addressable Duct Photo Detector / Sample Tube |
| 2 | FRM-1 | Addressable Relay Module |
| 1 | FMM-1 | Monitor Module |
| 2 | FDM-1 | Dual Monitor Module |
| 14 | SPSW-Alert | Speaker Strobe, Wall Mount, White, Clear Strobe, “Alert” Letters |
| 18 | SPSCW-Alert | Speaker Strobe, Ceiling Mount, White, Clear Strobe, “Alert” |
| 2 | SPSWK-Alert | WP Speaker Strobe, Wall Mount, White, Clear Strobe, “Alert” |

| | | |
|---|---|---|
| 4 | SW-Alert | Clear Strobe, Wall Mount, White, “Alert” |
| 4 | SCW-Alert | Clear Strobe, Ceiling Mount, White, “Alert” |
| 9 | STH-15S / WBB | Weatherproof 15 Watt Horn |
| 1 | Monaco BT | Sixteen Zone Transceiver & Antennae Package |

**BOAT STORAGE BUILDING 2442**

| | | |
|---|---|---|
| 1 | SFP-5UD | Five Zone Control Panel |
| 2 | PS-12120 | 12 Volt 12 Amp Hour Battery |
| 1 | FAS120AC | 120 Vac Surge Suppressor |
| 1 | STI-7551 | Poly Carbonate Weatherproof Enclosure |
| 6 | NBG-12LOB | Weatherproof Manual Station / Back Box |
| 11 | P2RK | Weatherproof Horn Strobe / Back Box |
| 1 | DECT3020 | Fiber Transmitter, 8 Contact Closure |
| 1 | DECR3020 | Fiber Receiver, 8 Contact Closure |
| 1 lot | Fiber Optic Cable | 2 Strand Multi-mode Fiber Optic Cable |

**Notes**:

1. It is our intent to use the Fire Alarm Voice Evacuation System as a Mass Notification System as well. Thus the “ALERT” markings indicated on the speakers and strobes. There are some contradictions within the RFP as to wether the Mass Notification should be a part of the fire alarm system or the public address system.
   There is an indications in the RFP that the Mass Notification System should be a part of a Bogen Telephone Paging System. If that is the preferred method to provide Mass Notification, then we will change the lettering on the speakers & strobes to “FIRE”.

2. The fire alarm system for Building 2440/2441 will be a Notifier Fire Systems (Honeywell) NFS2-640 Intelligent Addressable Fire Alarm System with Digital Voice Control. The batteries will be sized to provide a minimum of 60 hours of standby & 15 minutes of alarm. There will be a remote local operator control that will include a remote LCD 80 character display, remote microphone, and control buttons for activation of additional messages. Location to be determined.
   The system will include addressable pull stations at all exits from the building; smoke detector at the FACP, and in all Electrical, Mechanical, and Communication Rooms; duct detectors on the supply side of air handling units over 2000cfm, as well as addressable monitor modules for all fire protection flow and tamper switches.
   Occupant notification will be provided by speaker strobes, strobes, and speakers. The interior of the building will be covered utilizing speaker strobes and strobes per NFPA 72 and UFC requirements. Speaker horns will be included on the exterior walls in areas that may be occupied.
   Transmission of signals to the Fire Department will be via Monaco Transceiver.

3. In Boat Storage Building 2442 we propose to provide a Notifier Five Zone Conventional Panel, with 60 hours of standby battery. This system will monitor the dry pipe sprinkler system, including the alarm pressure switch, valve tamper switch, and the Hi-Low air pressure supervisory switch. There will be manual pull stations at all exits and horn strobes to provide notification. All fire alarm devices will be provided as weatherproof type devices. We will provide a weather proof enclosure for the FACP as well, if need be. It is our intent to use a fiber optic transmitter & receiver and fiber optic cable to interface the FACP in Building 2442 with the Monaco Transceiver in Building 2440; for transmission of signals to the fire department.

# NFS2-640

## Intelligent Addressable Fire Alarm System

NOTIFIER® by Honeywell

**Intelligent Fire Alarm Control Panels**

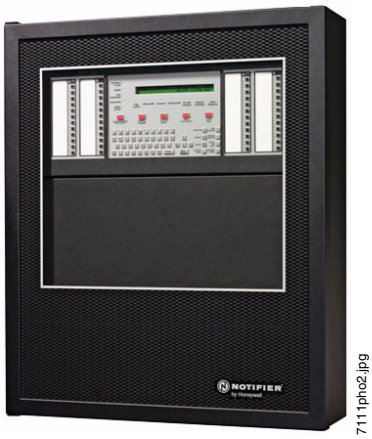
## General

The NFS2-640 intelligent Fire Alarm Control Panel is part of the ONYX® Series of Fire Alarm Controls from NOTIFIER.

As a stand-alone small-to-large system, or as a large network, the ONYX Series of products meets virtually every application requirement.

Designed with modularity and for ease of system planning, the NFS2-640 can be configured with just a few devices for small building applications, or for a large campus or high-rise application. Simply add additional peripheral equipment to suit the application.

***NOTE:*** *Unless called out with a version-specific "E" at the end of the part number, "NFS2-640" refers to models NFS2-640 and NFS2-640E; similarly, "CPU2-640" refers to models CPU2-640 and CPU2-640E.*

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**NFS2-640**

## Features

- **Listed to UL Standard 864, 9th edition.**
- One, expandable to two, isolated intelligent Signaling Line Circuit (SLC) Style 4, 6 or 7.
- Up to 159 detectors (any mix of ion, photo, thermal, or multi-sensor) and 159 modules (Addressable pull stations, normally open contact devices, two-wire smoke, notification, or relay) per SLC. 318 devices per loop/636 per FACP or network node.
- Standard 80-character display, 640-character large display, or display-less (a node on a network).
- Network option — 103 nodes supported (AFP-200, AFP-300/400, NFS-320, NFS-640, NFS2-640, AFP1010, AM2020, NFS-3030, NFS2-3030, NCA/NCA-2 Network Annunciator, DVC-EM, NCS Network Control Station, or ONYXWorks™ Network Control Station) using wire or fiber-optic connections.
- 6.0 amp switch mode power supply with four Class A/B built-in Notification Appliance Circuits (NAC). Selectable System Sensor, Wheelock, or Gentex strobe synchronization.
- Built-in Alarm, Trouble, Security, and Supervisory relays.
- VeriFire® Tools online or offline programming utility. Upload/Download, save, store, check, compare, and simulate panel databases. Upgrade panel firmware.
- Autoprogramming and Walk Test reports.
- Optional universal 636-point DACT.
- 80-character remote annunciators (up to 32).
- EIA-485 annunciators, including custom graphics.
- Printer interface (80-column and 40-column printers).
- History file with 800-event capacity in nonvolatile memory, plus separate 200-event alarm-only file.
- Alarm Verification selection per point, with tally.
- Autoprogramming and Walk Test reports.
- Presignal/Positive Alarm Sequence (PAS).
- Silence inhibit and Auto Silence timer options.
- March time/temporal/California two-stage coding/strobe synchronization.
- Field-programmable on panel or on PC, with VeriFire Tools program check, compare, simulate.
- Full QWERTY keypad.
- Battery charger supports 18 – 200 amp hour batteries.
- Non-alarm points for lower priority functions.
- Remote ACK/Signal Silence/System Reset/Drill via monitor modules.
- Automatic time control functions, with holiday exceptions.
- Surface Mount Technology (SMT) electronics.
- Extensive, built-in transient protection.
- Powerful Boolean logic equations.

### *NCA-2 640-CHARACTER DISPLAY FEATURES:*

- Backlit, 640-character display.
- Supports SCS Series smoke control system in both HVAC or FSCS modes (not UL-Listed for FSCS).
- Printer and CRT EIA-232 ports.
- EIA-485 annunciator and terminal mode ports.
- Alarm, Trouble, Supervisory, and Security relays.

### *FLASHSCAN® INTELLIGENT FEATURES:*

- Poll 318 devices in less than two seconds.
- Activate up to 159 outputs in less than five seconds.
- Multicolor LEDs blink device address during Walk Test.
- Fully digital, high-precision protocol (U.S. Patent 5,539,389).
- Manual sensitivity adjustment — nine levels.
- Pre-alarm ONYX intelligent sensing — nine levels.
- Day/Night automatic sensitivity adjustment.
- Sensitivity windows:
  - **Ion –** 0.5 to 2.5%/foot obscuration.
  - **Photo –** 0.5 to 2.35%/foot obscuration.
  - **Laser (VIEW®) –** 0.02 to 2.0%/foot obscuration.
  - **Acclimate Plus™ –** 0.5 to 4.0%/foot obscuration.
  - **HARSH™ –** 0.5 to 2.35%/foot obscuration.
  - **IntelliQuad™** – 1.0 to 4.0%/foot obscuration.
- Drift compensation (U.S. Patent 5,764,142).
- Degraded mode — in the unlikely event that the CPU2-640 microprocessor fails, FlashScan detectors revert to degraded operation and can activate the CPU2-640 NAC circuits and alarm relay. Each of the four built-in panel circuits includes a Disable/Enable switch for this feature.
- Multi-detector algorithm involves nearby detectors in alarm decision (U.S. Patent 5,627,515).

- Automatic detector sensitivity testing (NFPA-72 compliant).
- Maintenance alert (two levels).
- Self-optimizing pre-alarm.

### *FSC-851 INTELLIQUAD ADVANCED MULTI-CRITERIA DETECTOR*

- Detects all four major elements of a fire (smoke, heat, CO, and flame)
- Automatic drift compensation of smoke sensor and CO cell
- High nuisance-alarm immunity
- Six sensitivity levels

### *VIEW (VERY INTELLIGENT EARLY WARNING) SMOKE DETECTION TECHNOLOGY:*

- Revolutionary spot laser design.
- Advanced ONYX intelligent sensing algorithms differentiate between smoke and non-smoke signals (U.S. Patent 5,831,524).
- Addressable operation pinpoints the fire location.
- No moving parts to fail or filters to change.
- Early warning performance comparable to the best aspiration systems at a fraction of the lifetime cost.

### *ACCLIMATE PLUS LOW-PROFILE INTELLIGENT MULTI-SENSOR:*

- Detector automatically adjusts sensitivity levels without operator intervention or programming. Sensitivity increases with heat.
- Microprocessor-based technology; combination photo and thermal technology.
- FlashScan or classic mode compatible.
- Low-temperature warning signal at 40°F ± 5°F (4.44°C ± 2.77°C).

### *HARSH HOSTILE-AREA SMOKE HEAD:*

- Provides early warning of smoke detection in environment where traditional smoke detectors are not practical.
- The detector's filters remove particulates down to 30 microns in size.
- Intake fan draws air into photo chamber, while airborne particles and water mist are removed.
- Requires auxiliary 24 VDC from system or remote power supply.

### *RELEASING FEATURES:*

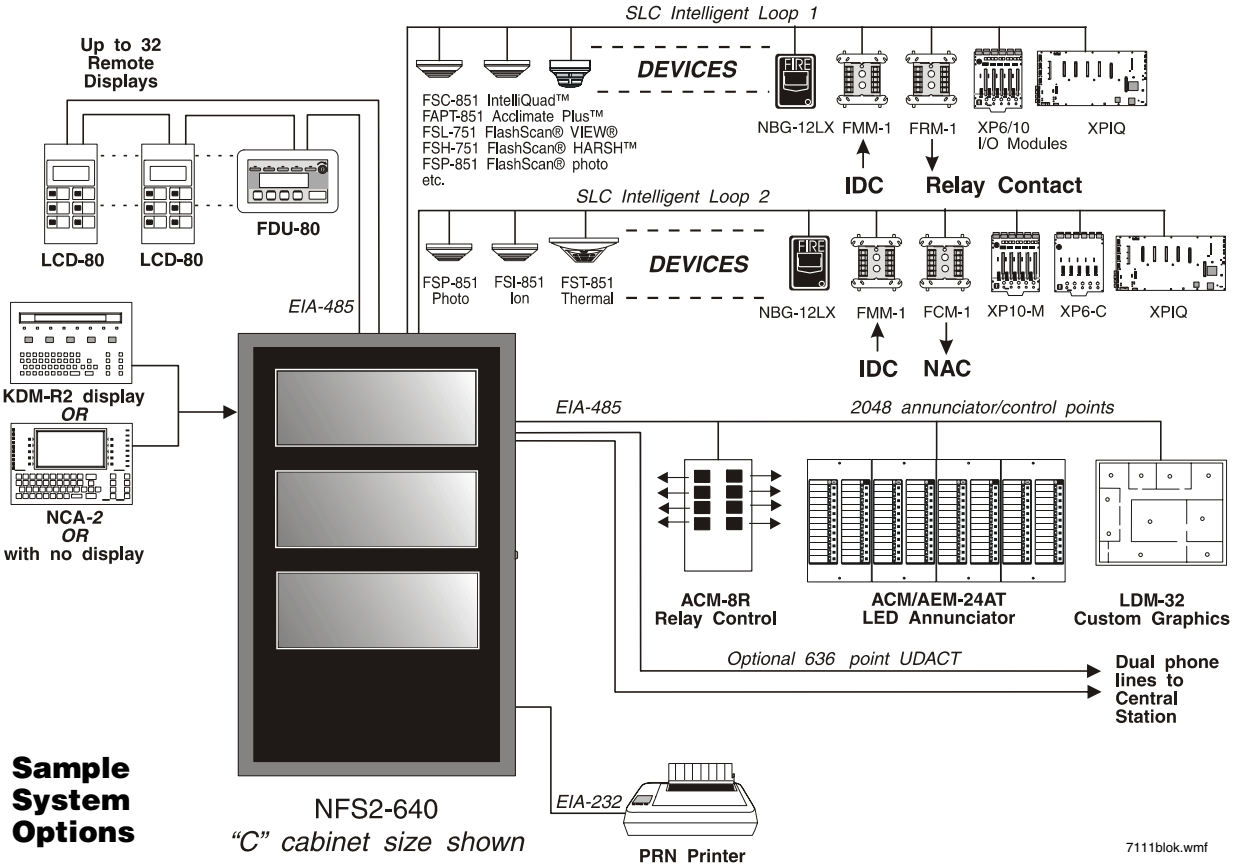
- Ten independent hazards.
- Sophisticated cross-zone (three options).
- Delay timer and Discharge timers (adjustable).
- Abort (four options).
- Low-pressure $CO_2$ listed.

### *VOICE AND TELEPHONE FEATURES:*

- Up to eight channels of digital audio.
- 50 and 75 watt digital amplifiers (DAA series).
- Solid-state digital message generation.
- Firefighter telephone option.
- 30- to 120-watt high-efficiency amplifiers (AA Series).
- Backup tone generator and amplifier option.
- Multichannel voice transponder (XPIQ).

### *HIGH-EFFICIENCY OFFLINE SWITCHING 3.0 AMP POWER SUPPLY (6.0 A IN ALARM):*

- 120 VAC (NFS2-640); 240 VAC (NFS2-640E).
- Displays battery current/voltage on panel (with display).




**Sample System Options**

## FlashScan, Exclusive New World-Leading Detector Protocol

At the heart of the NFS2-640 is a set of detection devices and device protocol — FlashScan (U.S. Patent 5,539,389). FlashScan is an all-digital protocol that gives superior precision and high noise immunity.

In addition to providing quick identification of an active input device, this new protocol can also activate many output devices in a fraction of the time required by competitive protocols. This high speed also allows the NFS2-640 to have the largest device per loop capacity in the industry — 318 points — yet every input and output device is sampled in less than two seconds. The microprocessor-based FlashScan detectors have bicolor LEDs that can be coded to provide diagnostic information, such as device address during Walk Test.

## ONYX Intelligent Sensing

Intelligent sensing is a set of software algorithms that provides the NFS2-640 with industry-leading smoke detection capability. These complex algorithms require many calculations on each reading of each detector, and are made possible by the high-speed microcomputer used by the NFS2-640.

**Drift Compensation and Smoothing:** Drift compensation allows the detector to retain its original ability to detect actual smoke, and resist false alarms, even as dirt accumulates. It reduces maintenance requirements by allowing the system to automatically perform the periodic sensitivity measurements required by NFPA 72. Smoothing filters are also provided by software to remove transient noise signals, such as those caused by electrical interference.

**Maintenance Warnings:** When the drift compensation performed for a detector reaches a certain level, the performance of the detector may be compromised, and special warnings are given. There are three warning levels: (1) Low Chamber value; (2) Maintenance Alert, indicative of dust accumulation that is near but below the allowed limit; (3) Maintenance Urgent, indicative of dust accumulation above the allowed limit.

**Sensitivity Adjust:** Nine sensitivity levels are provided for alarm detection. These levels can be set manually, or can change automatically between day and night. Nine levels of pre-alarm sensitivity can also be selected, based on predetermined levels of alarm. Pre-alarm operation can be latching or self-restoring, and can be used to activate special control functions.

**Self-Optimizing Pre-Alarm:** Each detector may be set for "Self-Optimizing" pre-alarm. In this special mode, the detector "learns" its normal environment, measuring the peak analog readings over a long period of time, and setting the pre-alarm level just above these normal peaks.

**Cooperating Multi-Detector Sensing:** A patented feature of ONYX intelligent sensing is the ability of a smoke sensor to consider readings from nearby sensors in making alarm or pre-alarm decisions. Without statistical sacrifice in the ability to resist false alarms, it allows a sensor to increase its sensitivity to actual smoke by a factor of almost two to one.

## Field Programming Options

**Autoprogram** is a timesaving feature of the NFS2-640. It is a special software routine that allows the NFS2-640 to "learn" what devices are physically connected and automatically load them in the program with default values for all parameters. Requiring less than one minute to run, this routine allows the user to have almost immediate fire protection in a new installation, even if only a portion of the detectors are installed.

**Keypad Program Edit (with KDM-R2)** The NFS2-640, like all NOTIFIER intelligent panels, has the exclusive feature of program creation and editing capability from the front panel keypad, ***while continuing to provide fire protection***. The architecture of the NFS2-640 software is such that each point entry carries its own program, including control-by-event links to other points. This allows the program to be entered with independent per-point segments, while the NFS2-640 simultaneously monitors other (already installed) points for alarm conditions.

**VeriFire Tools** is an offline programming and test utility that can greatly reduce installation programming time, and increase confidence in the site-specific software. It is Windows®-based and provides technologically advanced capabilities to aid the installer. The installer may create the entire program for the NFS2-640 in the comfort of the office, test it, store a backup file, then bring it to the site and download from a laptop into the panel.

ENTER PROG OR STAT PASSWORD, THEN ENTER
<ESCAPE TO ABORT> *****

0=CLR 1= AUTO 2=POINT 3=PASSWORD 4=MESSAGE

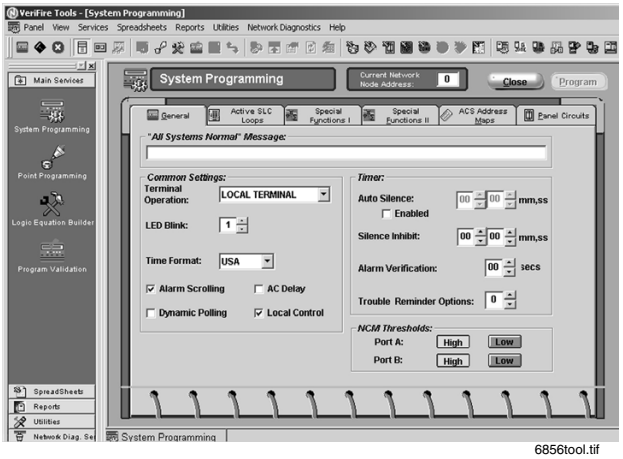
5=ZONES 6=SPL FUNCT 7=SYSTEM 8=CHECK PRG

**Above: Keypad program editing**

**Below: Autoprogram function**

AUTOPROGRAM PLEASE WAIT

L1:80 DETS, 15 MODS L2:93 DETS, 35 MODS
BELLS: 04



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**VeriFire Tools System Programming screen**

# CPU2-640 Board Diagram

All NAC circuits are power-limited, supervised.

**TB10**: DC Power (24 VDC, power-limited); Non-Resettable, Resettable.

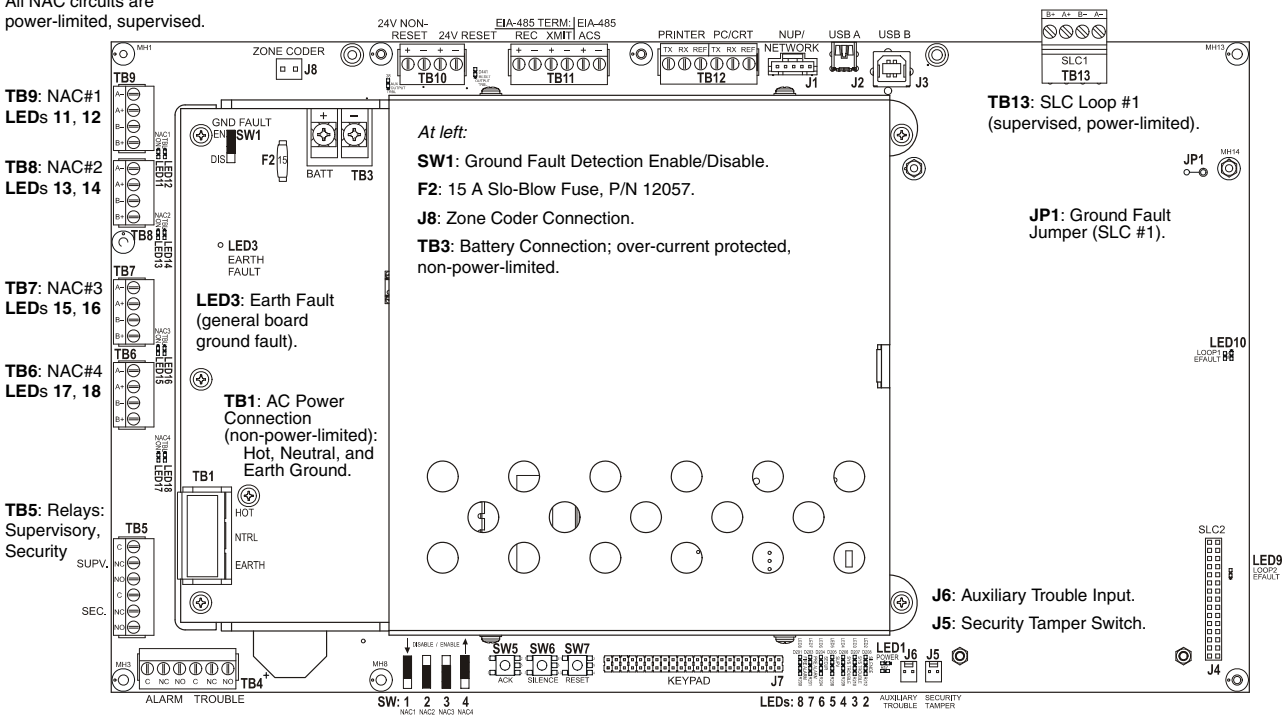
**TB11**: EIA-485 Connection (supervised); Terminal Mode, ACS Mode.

**TB12**: EIA-232 Connection; Printer, PC/Terminal (CRT).

**J1**: Network/Service Connection (NUP), power-limited, supervised.

**J2**: USB A **VeriFire Tools** Connection.

**J3**: USB B **VeriFire Tools** Connection.




*At left:*

**SW1**: Ground Fault Detection Enable/Disable.

**F2**: 15 A Slo-Blow Fuse, P/N 12057.

**J8**: Zone Coder Connection.

**TB3**: Battery Connection; over-current protected, non-power-limited.

**TB9**: NAC#1 **LED**s **11**, **12**

**TB8**: NAC#2 **LED**s **13**, **14**

**TB7**: NAC#3 **LED**s **15**, **16**

**TB6**: NAC#4 **LED**s **17**, **18**

**TB5**: Relays: Supervisory, Security

**LED3**: Earth Fault (general board ground fault).

**TB1**: AC Power Connection (non-power-limited): Hot, Neutral, and Earth Ground.

**TB13**: SLC Loop #1 (supervised, power-limited).

**JP1**: Ground Fault Jumper (SLC #1).

**J6**: Auxiliary Trouble Input.

**J5**: Security Tamper Switch.

**TB4**: Alarm Relay, Trouble Relay. Output relays; power-limited only if connected to a power-limited source.

7111bord.wmf

**SW1**, **SW2**, **SW3, SW4**: Disable-Enable switches for Backup Alarm, NACs 1 – 4 respectively.

System switches, "No Keyboard Operation":

**SW5** Acknowledge

**SW6** Silence

**SW7** Reset

**J7**: KDM-R2 Connection

**LED1**: Power On (AC or battery)

**LED2**: Signals Silenced

**LED3**: Point Disabled

**LED4**: System Trouble

**LED5**: Supervisory

**LED6**: Security

**LED7**: Pre-Alarm

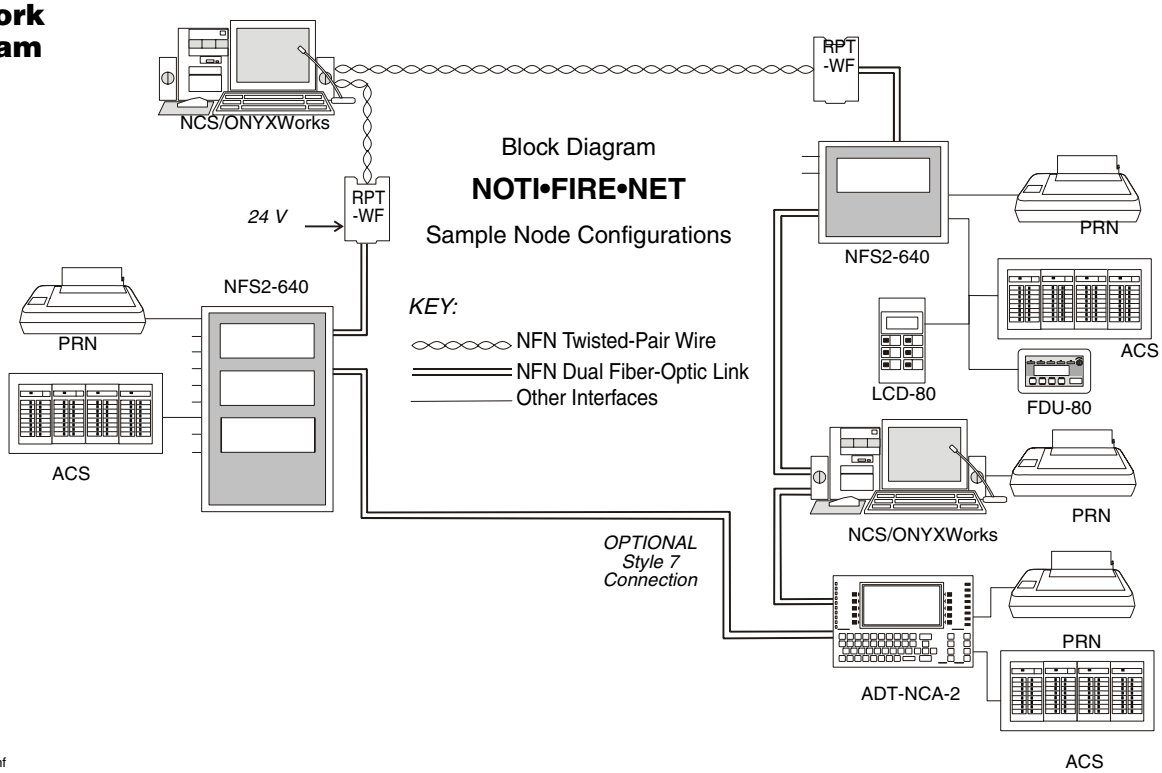
**LED8**: Fire Alarm

**LED10**: SLC Loop #1 Ground Fault.

**LED9**: SLC Loop #2 Ground Fault.

**J4**: LEM-320 Connector for SLC Loop #2.

# Network Diagram

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## Placement of Equipment in Chassis and Cabinet

The following guidelines outline the NFS2-640's flexible system design.

**Rows:** The first row of equipment in the cabinet mounts in chassis **CHS2-M2** (ships with the CPU). Mount the second, third, or fourth rows of equipment in a CHS4 series chassis or, for Digital Voice Command products, in **CA-1** or **CA-2**. (For DVC and DAA components see DVC Manual; for DVC-AO applications, see AA Series Installation Manual).

**Wiring:** When designing the cabinet layout, consider separation of power-limited and non-power-limited wiring as discussed in the NFS2-640 Installation Manual.

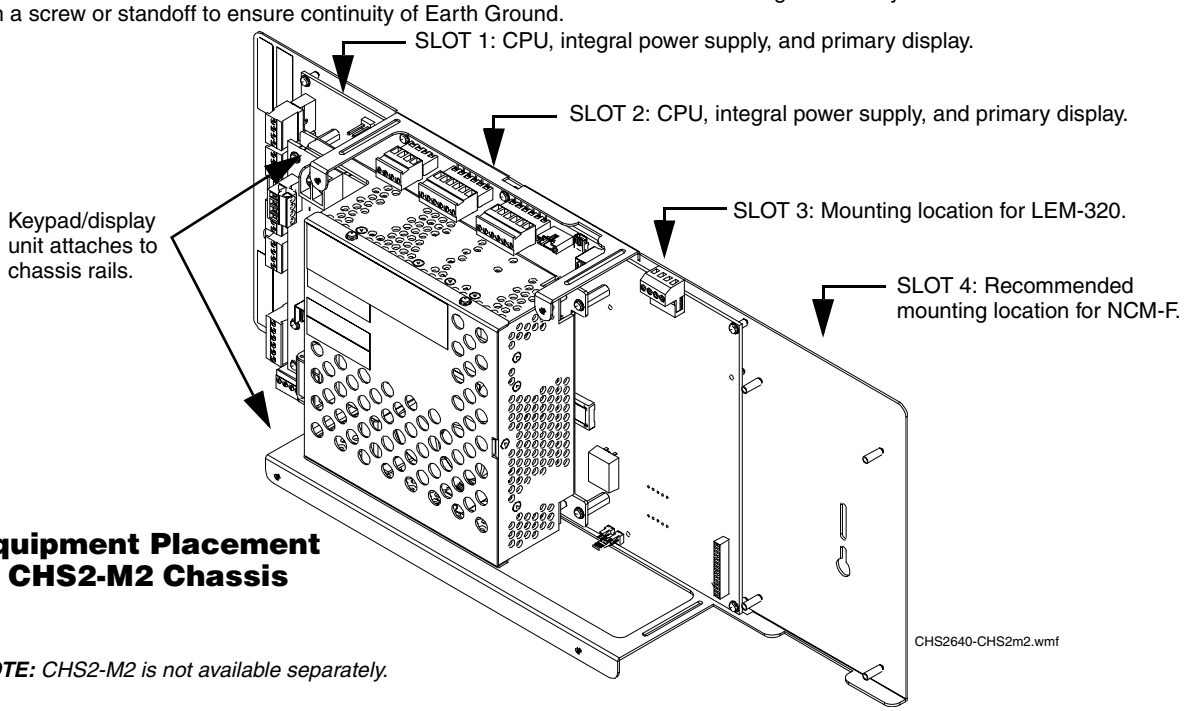
**Positions:** A chassis offers four basic side-by-side positions for components; the number of modules that can be mounted in each position depends on the chassis model and the size of the individual module. There are a variety of standoffs and hardware items available for different combinations and configurations of components.

It is critical that all mounting holes of the NFS2-640 are secured with a screw or standoff to ensure continuity of Earth Ground.

**Layers:** The CHS2-M2 accepts four layers of equipment, including the control panel. The **CPU2-640** fills three positions (left to right) in the first-installed layer (the back of the chassis); its integral power supply occupies the center two positions in the next two layers; the optional display occupies (the left) two positions at the front, flush with the door. Some equipment, such as the **NCA-2**, may be mounted in the dress panel directly in front of the control panel. The NCA-2 can be used as a primary display for the NFS2-640 (use NCA/640-2-KIT) by directly connecting their network ports (required in Canadian stand-alone applications); see NCA-2 data sheet for mounting options *(DN-7047)*.

**Expansion:** Installing an **LEM-320** Loop Expander Module adds a second SLC loop to the control panel. The LEM-320 is mounted onto the CPU2-640, occupying the middle-right, second (back) slot on the chassis. If networking two or more control panels, each unit requires a **NCM-W** (wire) or **NCM-F** (fiber) Network Control Module. The NCM-W/-F can be installed in any panel output module position (see manual); the default position is at the back of the chassis next to the control panel. **Option boards** can be mounted in front of the LEM-320 or NCM modules; for ease of access, complete installation of those devices before mounting another layer.

## Equipment Placement in CHS2-M2 Chassis




***NOTE:*** *CHS2-M2 is not available separately.*

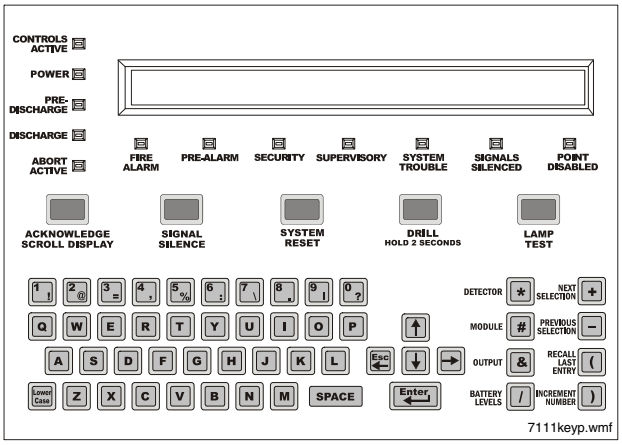
## KDM-R2 Controls and Indicators

**Program Keypad:** QWERTY type *(keyboard layout, at right)*.

**12 LED indicators:** Power; Fire Alarm; Pre-Alarm; Security; Supervisory; System Trouble; Signals Silenced; Points Disabled; Control Active; Abort; Pre-Discharge; Discharge.

**Keypad Switch Controls:** Acknowledge/Scroll Display; Signal Silence; Drill; System Reset; Lamp Test.

**LCD Display:** 80 characters (2 x 40) with long-life LED backlight *(see illustration below)*.



## Configuration Guidelines

*Stand-alone and network systems require a main display. On single-CPU systems (one CPU2-640/-640E), display options are the KDM-R2 or the NCA-2. On network systems (two or more CPU2-640/640E panels), at least one NCA-2 or NCS/ONYX-Works annunciation device is required. Other options listed as follows:*

**KDM-R2:** 80-character backlit LCD display with QWERTY programming and control keypad. Order two BMP-1 blank modules and DP-DISP2 mounting plate separately. *Requires top row of a cabinet. Required for each stand-alone 80-character display system. The KDM-R2 may mount in network nodes to display "local" node information as long as at least one NCA-2 or NCS/ONYXWorks network display is on the system to display network information.*

**NCA-2:** Network Control Annunciator, 640 characters. On single *CPU2-640/-640E* systems, the optional NCA-2 can be used as the Primary Display for the panel and connects directly to the *CPU2-640/-640E*. On network systems (two or more *CPU2-640/-640E*'s), one network display (either NCA-2 or NCS*/ONYX-Works*) is required for every system. On network systems, the NCA connects (and requires) an NCM network communications module. Mounts in a row of FACP node or in two annunciator positions. Mounting options include the DP-DISP2, ADP-4B, or in an annunciator box, such as the ABS-2D. In CAB-4 top-row applications, a DP-DISP2 and two BMP-1 blank modules are required for mounting. Required for *NFS2-640* applications employing the DVC-EM and DAA series amplifiers. *See DN-7047.*

**CPU2-640:** Central processing unit with integral 3.0 amp (6.0 A in alarm) power supply for an NFS2-640 system. Includes CPU factory-mounted to chassis **CHS2-M2**; one Signaling Line Circuit expandable to two; installation, programming and operating manuals. *Order one per system or as necessary (up to 103 network nodes) on a network system.*

**CPU2-640E:** Same as CPU2-640 but requires 240 VAC, 1.5 amp, (3.0 A in alarm).

**NCA/640-2-KIT:** Bracket installation kit required to mount NCA-2 to CHS2-M2 chassis with CPU2-640/-640E.

**DP-DISP2:** Dress panel for top row in cabinet with CPU2-640/640E installed.

**ADP2-640:** Dress panel for middle rows with CPU2-640/640E.

**BMP-1:** Blank module for unused module positions.

**BP2-4:** Battery plate, required.

### *AUDIO OPTIONS*

**DVC-EM:** Digital Voice Command, digital audio processor with message storage for up to 32 minutes of standard quality (4 minutes at high quality) digital audio. Capable of playing up to eight simultaneous messages when used with DAA Series amplifiers. *See DN-7045.*

**DVC-KD:** Keypad for local annunciation and controls; status LEDs and 24 user-programmable buttons. *See DN-7045.*

**DVC-AO:** DVC Analog Output board provides four analog output circuits for use with AA or XPIQ Series amplifiers. Four-channel operation supported. *See DN-7045.*

**DAA-5025:** 25 Vrms Digital Audio Amplifier assembly with DAA-PS power supply board, shipped mounted to its chassis. See DN-7046.

**DAA-5070:** 70.7 Vrms Digital Audio Amplifier assembly with DAA-PS power supply board, shipped mounted to its chassis. See DN-7046.

**DAA-7525:** 25 Vrms Digital Audio Amplifier assembly with DAA-PS power supply board. Shipped mounted to its chassis (no battery charger on DAA-7525 power supply board). *See DN-60257.*

**CHS-BH1:** Battery chassis; holds two 12.0 AH batteries. Mounts one the left side of DAA chassis. See DN-7046.

**CA-1:** Chassis, occupies one tier of a CAB-4 Series enclosure. The left side accommodates one DVC and a DVC-KD (optional); and the right side houses a CMIC-1 microphone and its well (optional). *See DN-7045.*

**CA-2:** Chassis assembly, occupies two tiers of a CAB-4 Series enclosure. The left side accommodates one DVC mounted on a half-chassis and one NCA-2 or BP-CA2 mounted on a half-chassis. The right side houses a microphone/handset well. The CA-2 assembly includes CMIC-1 microphone. ADDR Series doors with two-tier visibility are available for use with the CA-2 configuration: ADDR-B4, ADDR-C4, ADDR-D4 (below).

**TELH-1:** Firefighter's Telephone Handset for use with the DVC-EM when mounted in the CA-2 chassis. *See DN-7045.*

**ADDR-B4NOTE::** Two-tier-sized door designed for use with the CA-2 chassis configuration. ADDR Series doors are similar to CAB-4 Series "DR" doors, but a clear window space exposes the top two tiers of the CAB-4 enclosure. Use an SBB-B4 backbox with the ADDR-B4. *See DN-7045, DN-6857.*

**ADDR-C4NOTE::** Three-tier-sized door, designed for use with the CA-2 chassis configuration. ADDR Series doors are similar to CAB-4 Series "DR" doors, but a clear window space exposes the top two tiers of the CAB-4 enclosure. Use an SBB-C4 backbox with the ADDR-C4. *See DN-7045, DN-6857.*

**ADDR-D4NOTE::** Four-tier-sized door designed for use with the CA-2 chassis configuration. ADDR Series doors are similar to CAB-4 Series "DR" doors, but a clear window space exposes the top two tiers of the CAB-4 enclosure. Use an SBB-D4 backbox with the ADDR-D4. *See DN-7045, DN-6857.*

***NOTE:** Use ADDR-B4/C4/D4 when CA-2 chassis is installed in top two rows with NCA-2 or BP-CA2. Use standard door when CA-2 is not installed in top two rows. Please see the DVC application guide for additional configuration information.*

**DPA-1:** Dress panel, used with the CA-1 chassis when configured with a DVC, DVC-KD, and CMIC-1. *See DN-7045.*

**DPA-2B:** Dress panel used with CA-2 chassis assembly.

**VP-2B:** Dress panel, required when CA-2 chassis is installed in one of the top two cabinet rows.

**DPA-1A4:** Dress panel, used with the CA-1 chassis when the CMIC-1 is not used. Provides mounting options on right two bays for two ACS annunciators, or for blank plates. *See DN-7045.*

**BP-CA2:** Blank plate for CA-2 chassis, used for NFS2-640 Firefighters Telephone Applications with no NCA-2.

**CMIC-1:** Optional microphone and microphone well assembly used with the CA-1 chassis.

**RM-1/RM-1SA:** Remote microphone assemblies, mount on ADP-4 (RM-1) dress panel or CAB-RM/-RMR (RM-1SA) stand-alone cabinets. *See DN-6728.*

**FTM-1:** Firephone Control Module connects a remote firefighter telephone to a centralized telephone console. Reports status to panel. Wiring to jacks and handsets is supervised.

**AA-30:** Audio Amplifier, 30 watts. Switch-mode power. Includes amplifier and audio input supervision, backup input, and automatic switchover, power supply, cables. *See AA Series data sheet, DN-3224.*

**AA-120/AA-100:** Audio Amplifier provides up to 120 watts of 25 VRMS audio power for the NFS-640. The amplifier contains an integral chassis for mounting to a CAB-B4, -C4, or -D4 backbox (consumes one row). Switch-mode power. Includes audio input and amplified output supervision, backup input, and automatic switchover to backup tone. Order the AA-100 for 70.7 VRMS systems and 100 watts of power. *See AA Series data sheet, DN-3224.*

**XPIQ:** The XPIQ quad intelligent voice transponder for distributed multichannel voice evacuation systems, an integrated

audio amplification and distribution subsystem controlled by FACP. Capable of playing up to four simultaneous messages. Accepts up to four 25-watt amplifiers. *See XPIQ data sheet, DN-6823.*

### *POWER SUPPLIES, STANDARD CABINETS*

**ACPS-610:** 6.0 or 10 Amp addressable charging power supply. See DN-60244.

**FCPS-24S6/S8:** Remote six-amp and eight-amp power supplies with battery charger. *See FCPS-24S6/-24S8 data sheet, DN-6927.*

**CHS-4:** Chassis for mounting up to four APS-6Rs.

**CHS-4L:** Low-profile four-position Chassis. Mounts two AA-30 amplifiers or one AMG-E and one AA-30.

**DP-1B:** Blank Dress panel. Provides dead-front panel for unused tiers or to cover AA-30, AA-120, or one AMG-E and one AA-30.

**CAB-4 Series:** The CAB-4 Series cabinets are fabricated from 16-gauge steel with unique full-front LEXAN®, reverse-silk-screened for durability. The cabinet assembly consists of two basic parts: a Backbox (SBB-_4), and a Locking Door (DR-_4) that may hinge right or left. Cabinets are available in four sizes, "A" through "D", with one to four tiers. A trim ring option is available for semi-flush mounting. *See CAB-4 Series data sheet, DN-6857.*

### *COMPATIBLE DEVICES, EIA-232 PORTS*

**PRN-6:** 80-column printer. *See DN-6956.*

**VS4095/S2:** Printer, 40-column, 24V. Mounted in external backbox. *See DN-3260.*

### *COMPATIBLE DEVICES, EIA-485 PORTS*

**ACS:** Annunciator Control Modules ACM/AEM-24AT and ACM/AEM-48A; remote serial annunciator/control systems. *See data sheets, DN-0524 and DN-6862.*

**ACM-24AT:** ONYX Series ACS annunciator – up to 96 points of annunciation with Alarm or Active LED, Trouble LED, and switch per circuit. Active/Alarm LEDs can be programmed (by powered-up switch selection) by point to be red, green, or yellow; the Trouble LED is always yellow. *See DN-6862.*

**AEM-24AT:** Same LED and switch capabilities as ACM-24AT, expands the ACM-24AT to 48, 72, or 96 points. *See DN-6862.*

**ACM-48A:** ONYX Series ACS annunciator – up to 96 points of annunciation with Alarm or Active LED per circuit. Active/Alarm LEDs can be programmed (by powered-up switch selection) in groups of 24 to be red, green, or yellow. Expandable to 96 points with one AEM-48A. *See DN-6862.*

**AEM-48A:** Same LED capabilities as ACM-48A, expands the ACM-48A to 96 points. *See DN-6862.*

**LCD-80/FDU-80:** 80-character, backlit LCD display. Mounts up to 6,000 ft. (1828.8 m) from panel. Up to 32 per FACP. *See LCD-80/-80TM (DN-3198) and FDU-80 (DN-6820).*

**LDM:** Lamp Driver Modules LDM-32, LDM-E32, and LDM-R32; remote custom graphic driver modules. *See LDM data sheet DN-0551.*

**ACM-8R:** Remote Relay Module with eight Form-C contacts. Can be located up to 6,000 ft. (1828.8 m) from panel on four wires. *See ACM-8R data sheet DN-3558.*

**SCS:** Smoke control stations SCS-8, SCE-8, with lamp drivers SCS-8L, SCE-8L; eight (expandable to 16) circuits. *See SCS data sheet DN-4818.*

**TM-4:** Transmitter Module. Includes three reverse-polarity circuits and one municipal box circuit. Mounts in panel module position (single-address-style) or in CHS2-M2 position. *See DN-6860.*

**UDACT:** Universal Digital Alarm Communicator Transmitter, 636 channel. *See DN-4867.*

**UZC-256:** Programmable Universal Zone Coder provides positive non-interfering successive zone coding. Microprocessor-controlled, field-programmable from IBM®-compatible PCs (requires optional programming kit). Up to 256 programmable codes. *See UZC-256 data sheet, DN-3404.*

### *COMPATIBLE INTELLIGENT DEVICES*

**BEAMHK:** Heating kit for transmitter/receiver unit of FSB-200(S) below. *See DN-6985.*

**BEAMHKR:** Heating kit for use with the reflector of FSB-200(S) below. *See DN-6985*

**BEAMLRK:** Long-range accessory kit, FSB-200(S) below.

**BEAMMKR:** Multi-mount kit, FSB-200(S) below.

**BEAMSMK:** Surface-mount kit, FSB-200(S) below.

**FSB-200:** Intelligent beam smoke detector. *See DN-6985.*

**FSB-200S:** Intelligent beam smoke detector with integral sensitivity test. *See DN-6985.*

**FSC-851:** FlashScan IntelliQuad Advanced Multi-Criteria Detector. *See DN-60412.*

**FSP-851:** Low-profile FlashScan photoelectric detector, will replace FSP-751. *See DN-6935.*

**FST-851:** FlashScan thermal detector 135°F (57°C), will replace FST-751. *See DN-6936.*

**FST-851R:** FlashScan thermal detector 135°F (57°C) with rate-of-rise, will replace FST-751R. *See DN-6936.*

**FST-851H:** FlashScan 190°F (88°C) high-temperature thermal detector. *See DN-6936.*

**FSD-751PL:** Low-flow FlashScan photo duct detector with housing, will replace FSD-751P. *See DN-6955.*

**FSD-751RPL:** Low-flow FlashScan photo duct detector with relay and housing, will replace FSD-751RPL. *See DN-6955.*

**FAPT-851:** FlashScan Acclimate Plus low-profile multi-sensor detector, will replace FAPT-751. *See DN-6937.*

**FSH-751:** FlashScan HARSH Hostile Area Smoke Head. *See DN-6875.*

**FSL-751:** FlashScan VIEW laser photo detector, will replace LPX-751. *See DN-6886.*

**B224RB:** Low-profile relay base. *See DN-60054.*

**B224BI:** Isolator base for low-profile detectors. *See DN-60054.*

**B710LP:** Low-profile base. Standard U.S. style. *See DN-60054.*

**B501:** European-style, 4" (10.16 cm) base. *See DN-60054.*

**B501BH-2:** Standard sounder base. Replaces B501BH. *See DN-60054.*

**B501BHT-2:** Temporal tone sounder base. Replaces B501BHT. *See DN-60054.*

**FMM-1:** FlashScan monitor module. *See DN-6720.*

**FDM-1:** FlashScan dual monitor module. *See DN-6720.*

**FZM-1:** FlashScan two-wire detector monitor module. *See DN-6720.*

**FMM-101:** FlashScan miniature monitor module. *See DN-6720.*

**FCM-1-REL:** FlashScan releasing control module. *See DN-60390.*

**FCM-1:** FlashScan NAC control module. *See DN-6724.*

**FRM-1:** FlashScan relay module. *See DN-6724.*

**NBG-12LX:** Manual fire alarm station, addressable. *See DN-6726.*

**ISO-X:** Isolator module. *See DN-2243.*

**XP6-C:** FlashScan six-circuit supervised control module. *See DN-6924.*

**XP6-MA:** FlashScan six-zone interface module; connects intelligent alarm system to two-wire conventional detection zone. *See DN-6925.*

**XP6-R:** FlashScan six-relay (Form-C) control module. *See DN-6926.*

**XP10-M:** FlashScan ten-input monitor module. *See DN-6923.*

## Other Options

**DPI-232:** Direct Panel Interface, specialized modem for extending serial data links to remotely located FACPs and/or peripherals. *See DN-6870.*

**LEM-320:** Loop Expander Module. Expands each NFS2-640 to two Signaling Line Circuits. *See DN-6881.*

**NCM-W:** Network Communications Module, Wire. Order one NCM per network node (CPU-640, CPU2-640,NCA, NCA-2). *See DN-6861.*

**NCM-F:** Network Communications Module, Fiber. Order one NCM per network node (CPU-640, CPU2-640,NCA, NCA-2). *See DN-6861.*

**RPT-W, RPT-F, RPT-WF:** Repeater board with wire connection (RPT-W), fiber connection (RPT-F), or allowing a change in media type between wire and fiber (RPT-WF). *See DN-6971.*

**NCS5-W-ONYX:** Network Control Station, Wire. UL-Listed graphics PC with mouse, 19" color flat-screen LCD monitor. Order as necessary for network systems. Each NCS consumes one of 103 network addresses. *See DN-6868 (previous NCS-W), ONYX DN-6869.*

**NCS5-F-ONYX:** Network Control Station, Fiber. UL-Listed graphics PC with mouse, 19" color flat-screen LCD monitor. Order as necessary for network systems. Each NCS consumes one of 103 network addresses. *See DN-6868 (previous NCS-F), ONYX DN-6869.*

**ONYXWORKS-NW:** Workstation with NFN **wire** PC card. ONYXWorks workstation GUI software and hardware package for NOTI•FIRE•NET. Includes NFN Gateway (NFNGW-PC-W) wire version. Each ONYXWorks consumes one of 103 network addresses. *See DN-7048.*

**ONYXWORKS-NF:** Workstation with NFN **fiber** PC cardONYX-Works workstation GUI software and hardware package for NOTI•FIRE•NET. Includes NFN Gateway (NFNGW-PC-F) fiber version. Each ONYXWorks consumes one of 103 network addresses. *See DN-7048.*

**NFN-GW-EM:** NFN Gateway, embedded.

**VeriFire-TCD:** VeriFire Tools CD-ROM. Contains programming software for the ONYX Series. Includes local panel connection cable. *See DN-6871.*

**VeriFireUG-TCD:** VeriFire Tools CD-ROM. Upgrade.

**BAT Series:** Batteries. NFS2-640 utilizes two 12 volt, 18 to 200 AH batteries. This series of products replaces the previous PS Series. *See DN-6933.*

**NFS-LBB:** Battery Box (required for batteries larger than 25 AH).

**NFS-LBBR:** Same as above but red.

**411:** Slave digital alarm communicator. See DN-6619.

**411UDAC:** Digital alarm communicator. See DN-6746.

# SYSTEM SPECIFICATIONS

## System Capacity

- Intelligent Signaling Line Circuits ..... 1 expandable to 2
- Intelligent detectors ..... 159 per loop
- Addressable monitor/control modules ..... 159 per loop
- Programmable software zones ..... 99
- Special programming zones ..... 14
- LCD annunciators per CPU2-640/-640E and NCA-2 *(observe power)* ..... 32
- ACS annunciators per CPU2-640/-640E ..... 32 addresses x 64 points
- ACS annunciators per NCA-2 ..... 32 addresses x 64 or 96 points

***NOTE:*** *The* NCA-2 *supports up to 96 annunciator address points per ACM-24/48.*

## Specifications

- Primary input power, **CPU2-640 board:** 120 VAC, 50/60 Hz, 3.0 A. **CPU2-640E board:** 220/240 VAC, 50/60 Hz, 1.5 A.
- Total output 24 V power: 6.0 A in alarm.

***NOTE:*** *The power supply has a total of 6.0 Amps of available power. This is shared by all internal circuits.*

- Standard notification circuits (4): 1.5 A each.
- Four-wire detector power: 1.25 A.
- Non-resettable regulated power outputs: 1.25 A each.
- Battery charger range: 18 AH – 200 AH. Use separate cabinet for batteries over 25 AH.
- Float rate: 27.6 V.

## Cabinet Specifications

Systems can be installed in CAB-4 Series cabinets *(four sizes with various door options, see DN-6857)*. Requires BP2-4 Battery Plate.

## Temperature and Humidity Ranges

This system meets NFPA requirements for operation at 0 – 49°C/32 – 120°F and at a relative humidity 93% ± 2% RH (noncondensing) at 32°C ± 2°C (90°F ± 3°F). However, the useful life of the system's standby batteries and the electronic components may be adversely affected by extreme temperature ranges and humidity. Therefore, it is recommended that this system and its peripherals be installed in an environment with a normal room temperature of 15 – 27°C/60 – 80°F.

## Agency Listings and Approvals

The listings and approvals below apply to the basic NFS2-640 control panel. In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL Listed:** S635
- **ULC Listed:** S635
- **FM Approved**
- **MEA:** 128-07-E, **NYFD:** Certificate #6007
- **CSFM:** 7170-0028:244; 7165-0028:243
- **City of Chicago**
- **City and County of Denver**

## Standards

The NFS2-640 complies with the following UL Standards and NFPA 72 Fire Alarm Systems requirements:

– **UL 864, 9th Edition** (Fire).
– **UL 1076** (Burglary).
– **LOCAL** (Automatic, Manual, Waterflow and Sprinkler Supervisory).
– **AUXILIARY** (Automatic, Manual and Waterflow) (requires TM-4).
– **REMOTE STATION** (Automatic, Manual, Waterflow and Sprinkler Supervisory) (requires TM-4).
– **PROPRIETARY** (Automatic, Manual and Waterflow). *Not applicable for FM.*
– **EMERGENCY VOICE/ALARM**.

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# DVC Series

## Digital Voice Command
## DVC-EM, DVC-EMF, DVC-EMSF

NOTIFIER® by Honeywell

**Voice Control Systems**

## General

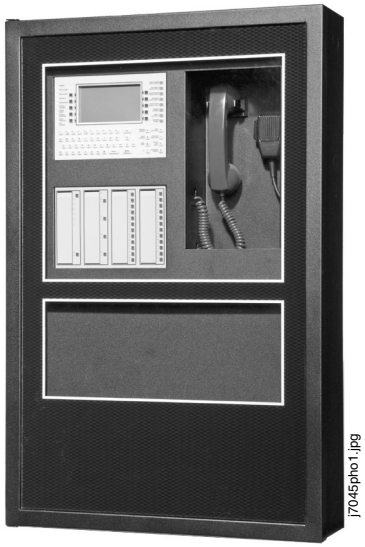
The **DVC** is the heart of an integrated, full-featured Audio Command Center. The DVC Digital Voice Command combines the capabilities of a powerful digital audio processor, an event-driven audio message generator, and a router. Designed for use with **DAA** series Digital Audio Amplifiers, each DVC supports a dedicated audio network with up to eight channels of audio, five channels of firefighters' telephone, and control and supervision for up to 32 DAA series amplifiers. Twisted-pair wire, multi-mode fiber, or single-mode fiber media options are supported. Larger audio systems incorporating hundreds of amplifiers can be created by networking additional DVC units via **NOTI•FIRE•NET**™.

The DVC may be networked with ONYX® Series panels via **NOTI•FIRE•NET** with an **NCA-2**, or used in a stand-alone panel configuration with an **NFS2-640 or NFS2-3030** Fire Alarm Control Panel (FACP). When used as an Audio Command Center with Emergency Paging capability, the optional **DVC-KD** Keypad Display is required.

***NOTE:*** *Unless otherwise noted, the term "DVC" refers to the DVC-EM, DVC-EMF, and DVC-EMSF models.*

## Features

- **Listed to UL Standard 864, 9th edition.**
- Programmable from NUP port using ***VeriFire® Tools*** with:
  - **DVC-EM**: up to 32 minutes of standard quality or 4 minutes of high quality digital audio storage of user-selected/created messages and tones.
  - **DVC-EMF**: EM features; supports multi-mode fiber-optic media.
  - **DVC-EMSF**: EM features; supports single-mode fiber-optic media.
- Up to 1000 audio sequences.
- Message prioritization.
- Equations support flexible programming for distribution of messages.
- Electrically isolated digital audio ports for direct connection with up to 32 DAA amplifiers. Style 4 or 7 configurations supported.
- DCC (Display and Control Center) capabilities when used with optional DVC-KD.
- FireFighters' Telephone Communications to local FFT riser on DVC, 32 local DAA FFT risers, and FFT communication to additional command stations via **NOTI•FIRE•NET**™.
- Local paging microphone option.
- Remote microphone option.
- Broad All-Call functionality when used with DVC-KD (DVC-Keyboard Display): All Call, Page Active Evac Areas, Page Active Alert Areas, Page Inactive Areas.
- Auxiliary input for 12 $V_{p-p}$ analog low-level audio sources. Includes user audio level adjustment feature.
- Auxilary input accepts external audio sources such as telephone paging or background msuic. Hi impedance input accepts 600 ohm, line level, 1.41 VRMS, or 1 Vp~p low level audio. Selectable AGC, user control of audio level, and audio supervision are supported.
- Associated NCA-2 supports **NOTI•FIRE•NET** applications.




**DVC**
**Shown using CA-2 mounting option, CAB-C4, and ADDR-C4 door.**

- Multiple audio command centers supported via **NOTI•FIRE•NET**.
- Distribution of one channel of standard-level paging audio on **NOTI•FIRE•NET**.
- Three stand-alone, non network mode options:
  - NFS2-3030 (NUP to NUP) digital and analog.
  - NFS2-640 (NUP to NUP) analog.
  - NFS2-640 with NCA-2 (NUP to NUP to NUP) digital and analog.
- Push-to-talk relay.
- Isolated alarm bus input, to be used for backup activation of alarm messages when normal digital communication is lost.

## Installation Options

The DVC provides flexible installation options based on two chassis options: the **CA-1** or the **CA-2** (one-row or two-row audio chassis). Both these chassis mount into size "B", "C", or "D" CAB-4 Series cabinets. The CA-2 must be installed in the top two rows of the cabinet. The **DPA-1** dress panel is used with chassis CA-1. The **DPA-2** dress panel is required for the CA-2 chassis.

## Specifications

- **24 VDC power (TB1)**: 24 VDC, 1.0 A, non-resettable, power-limited by the source. Recommended wiring: 14 to 18 AWG (2.08 to 0.821 $mm^2$) twisted-pair.
- **Digital audio ports, wire media, A and B (TB2, TB3)**: Maximum distance per segment is 1900 feet (579.12 m) on Belden 5320UJ (18 AWG, TP) FPL cable: 18 AWG (0.821 $mm^2$) twisted-pair, foil-shielded, power-limited. Consult wiring documentation provided in document P/N 52916ADD:C *Addendum to DVC and DAA Manuals*.

- **Digital audio ports, single- and multi-mode fiber-optic RXA, TXA, RXB, and TXB (J100, J101, J102, and J103)**: ST® style, supervised. Multi-mode fiber-optic cable: 50/125 or 62.5125 micrometers. Single-mode fiber-optic cable: 9/125 micrometers. Attenuation of cabling between two nodes (fiber-optic circuits are point-to-point) must not exceed the following maximum attenuations: 4.2 dB for multi-mode with 50/125 micrometer cable @ 850 nm. 8.0 dB for multi-mode with 62.5/125 micrometer cable @ 850 nm. 5.0 dB for single-mode with 9/125 micrometer cable @ 1300 nm.
- **Auxiliary input A (AUX A, TB4)**: Signal strength from low-level analog audio input: 1 VRMS maximum. Optional supervision is selectable through programming. Recommended wiring: 18 AWG (0.821 mm²) twisted-pair; max. 14 AWG (2.08 mm²). Auxiliary input must be in the same room as the DVC.
- **Remote microphone interface (TB9)**: Recommended wiring: 14 to 18 AWG (2.08 to 0.821 mm²) twisted-pair. Power-limited. Maximum distance between remote microphone and DVC: 1000 feet (300 m).
- **Push-to-talk interface (TB10)**: Dry contact. Recommended wiring: 14 to 18 AWG (2.08 to 0.821 mm²) twisted-pair.
- **Alarm bus (TB12)**: Power-limited by source. Recommended wiring: 14 to 18 AWG (2.08 to 0.821 mm²) twisted-pair.
- **FFT riser (TB13)**: Power-limited output. Class A (Style Z) or Class B (Style Y) operation. Style Y two-wire connections require a 3.9K ohm, 1/2 watt resistor (P/N K-3.9K). Maximum wiring resistance (including individual telephone zone to last handset) permitted is 50 ohms, 10,000 feet (3048 m) maximum wiring distance at 12 AWG (3.31 mm²) to last handset.
- **Auxiliary input B (AUX B, TB14)**: Signal strength from low-level analog audio input: 12 $V_{p-p}$ nominal, 15 $V_{p-p}$ maximum. Optional supervision is selected through programming. Recommended wiring: 14 to 18 AWG (2.08 to 0.821 mm²) twisted-pair.
- **Optional DVC-AO analog audio output circuits (TB5, TB6, TB7, and TB8)**: Supervised, power-limited outputs. Signal strength: +12 V nominal, +15 V maximum. Recommended wiring: 18 AWG (0.821 mm²) twisted-pair; max. 14 AWG (2.08 mm²). Maximum impedance: 66 ohms.

## Standards and Codes

The Digital Voice Command DVC, DVC-EM, DVC-EMF, and DVC-EMSF comply with the following standards:

- NFPA 72 2002 National Fire Alarm Code.
- Underwriters Laboratories Standard UL 864, 9th edition.
- Underwriters Laboratories of Canada (ULC) ULC-S527-99 Standard of Control Units for Fire Alarm Systems.

## Listings and Approvals

The listings and approvals below apply to the DVC, DVC-EM, DVC-EMF, and DVC-EMSF Digital Voice Command. In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL** Listed: file S635.
- **ULC** Listed: file S635.
- FM Approved.
- **CSFM** approved: file 7170-0028:223, 7170-0028:244.
- **MEA** approved: file 232-06-E., 128-07-E (wire only).
- **City of Chicago** approved: High Rise, Class 1, Class 2 (NFS2-3030, NFS2-640, NCA-2).
- **City of Denver** approved (NFS2-3030).
- **PSB Corporation** approved *(Singapore) (NFS2-3030)*.

## Product Line Information

**DVC-EM**: Digital Voice Command, digital audio processor with message storage for up to 32 minutes of standard quality (4 minutes at high quality) digital audio.

**DVC-EMF**: Digital Voice Command, digital audio processor with message storage for up to 32 minutes of standard quality (4 minutes at high quality) digital audio. *Supports multi-mode fiber-optic ports, requires DAA-5025F, DAA-5070F, or DAA-7525F.*

**DVC-EMSF**: Digital Voice Command, digital audio processor with message storage for up to 32 minutes of standard quality (4 minutes at high quality) digital audio. *Supports single-mode fiber-optic ports, requires DAA-5025SF, DAA-5070SF, or DAA-7525SF.*

**DVC-KD**: Keypad for local annunciation and controls; status LEDs and 24 user-programmable buttons.

**DVC-AO**: Optional DVC Analog Output board provides four analog output circuits for use with AA or XPIQ Series amplifiers. Four-channel operation supported.

**CA-1**: Chassis, occupies one tier of a CAB-4 Series enclosure. The left side accommodates one DVC and a DVC-KD *(optional)*; and the right side houses a CMIC-1 microphone and its well *(optional)*.

**CMIC-1**: Optional microphone and microphone well assembly used with the CA-1 chassis.

**CA-2**: Chassis assembly, occupies two tiers of a CAB-4 Series enclosure. The left side accommodates one DVC mounted on a half-chassis and one NFS2-3030 or NCA-2 mounted on a half-chassis. The right side houses a microphone/handset well. The CA-2 assembly includes a microphone. **DPA-2** dress plate is required *(below)*. ADDR Series doors with two-tier visibility are available for use with the CA-2 configuration: ADDR-B4, ADDR-C4, ADDR-D4 *(below)*.

**DPA-2**: Dress plate required for CA-2 chassis assembly.

**TELH-1**: Firefighter's Telephone Handset for use with the DVC when mounted in the CA-2 chassis. Order separately.

**ADDR-B4**: Two-tier-sized door designed for use with the CA-2 chassis configuration. ADDR Series doors are similar to CAB-4 Series "DR" doors, but a clear window space exposes the top two tiers of the CAB-4 enclosure. Use an SBB-B4 backbox with the ADDR-B4 *(see data sheet DN-6857)*.

**ADDR-C4**: Three-tier-sized door designed for use with the CA-2 chassis configuration. ADDR Series doors are similar to CAB-4 Series "DR" doors, but a clear window space exposes the top two tiers of the CAB-4 enclosure. Use an SBB-C4 backbox with the ADDR-C4 *(see data sheet DN-6857)*.

**ADDR-D4**: Four-tier-sized door designed for use with the CA-2 chassis configuration. ADDR Series doors are similar to CAB-4 Series "DR" doors, but a clear window space exposes the top two tiers of the CAB-4 enclosure. Use an SBB-D4 backbox with the ADDR-D4 *(see data sheet DN-6857)*.

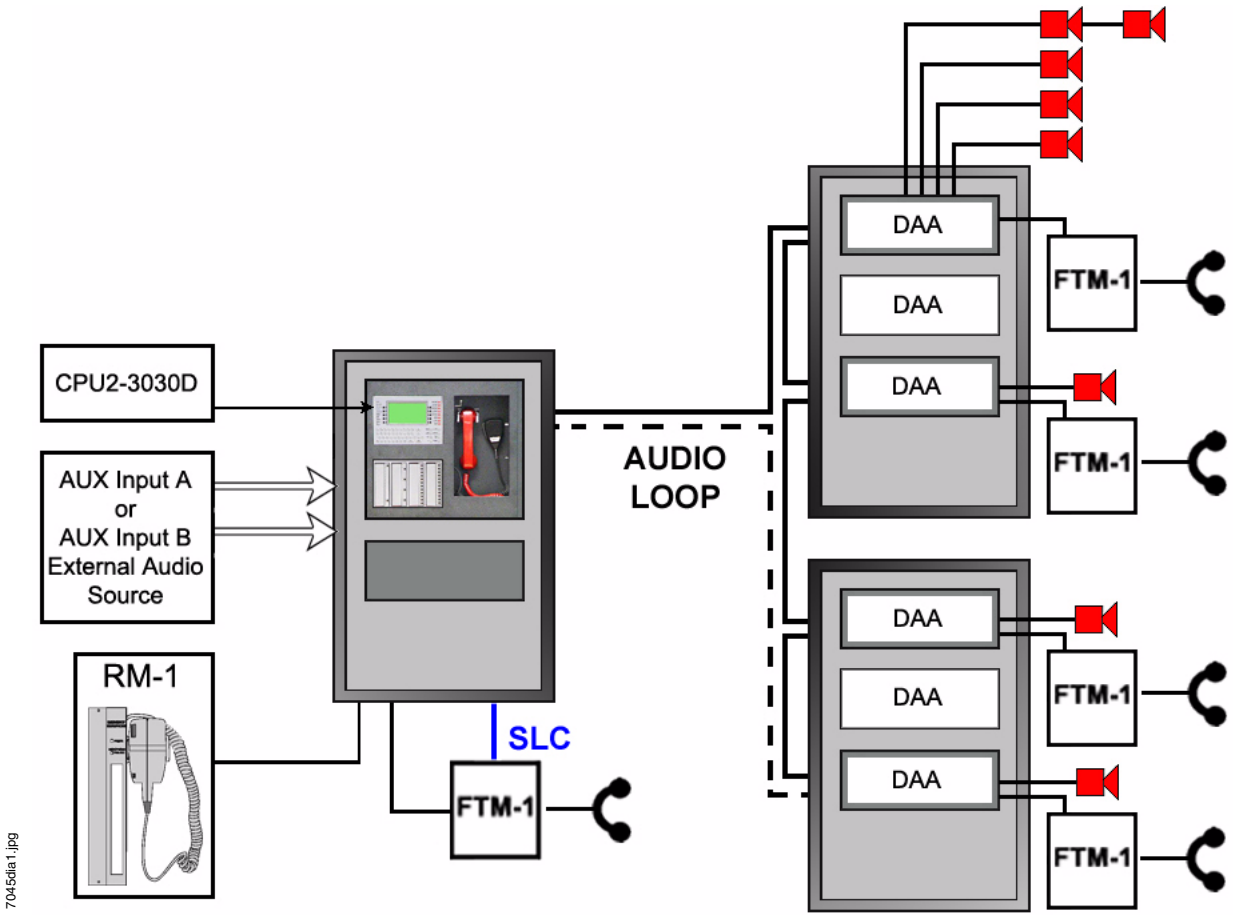
**DPA-1**: Dress panel, can be used with the CA-1 chassis when configured with a DVC, DVC-KD, and CMIC-1.

**DPA-1A4**: Dress panel, used with the CA-1 chassis when the CMIC-1 is not used. Provides mounting options on right two bays for two ACS annunciators, or for blank plates.

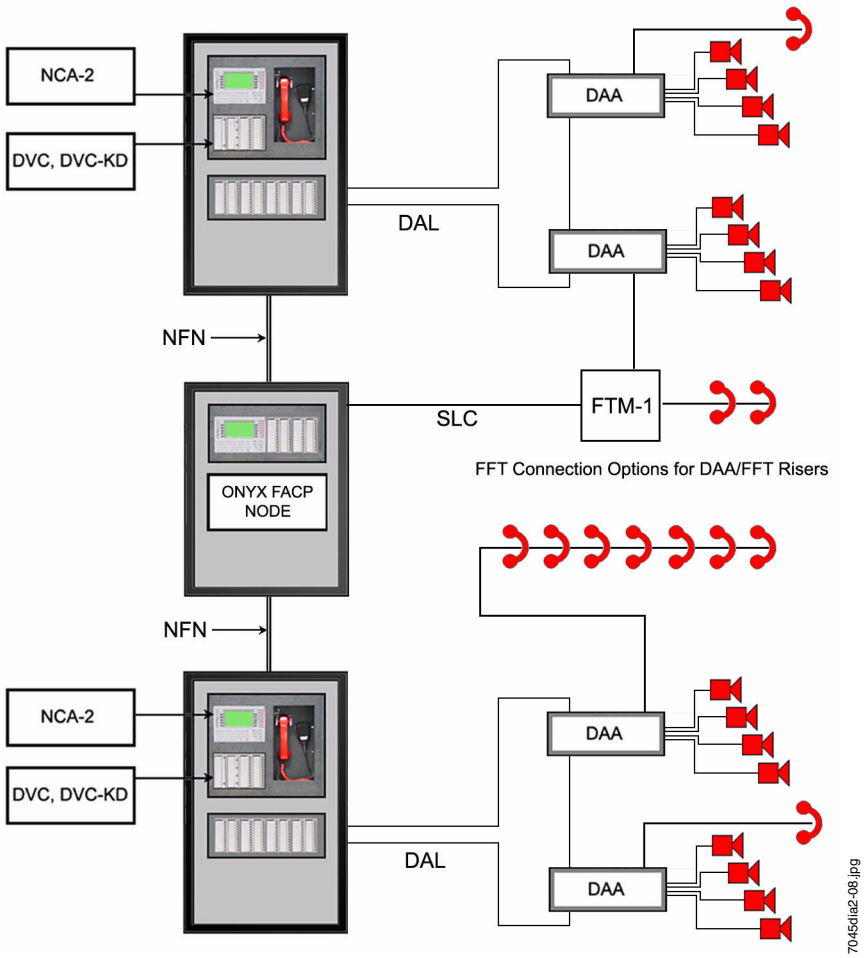
**ACT-4**: Audio-coupling transformer. Used to electronically isolate DVC-AO analog risers.

**ACT-25, ACT-70**: Audio-coupling transformers. Used with AA-30 or DAA-series amplifiers to drive thousands of amplifiers in large system applications.

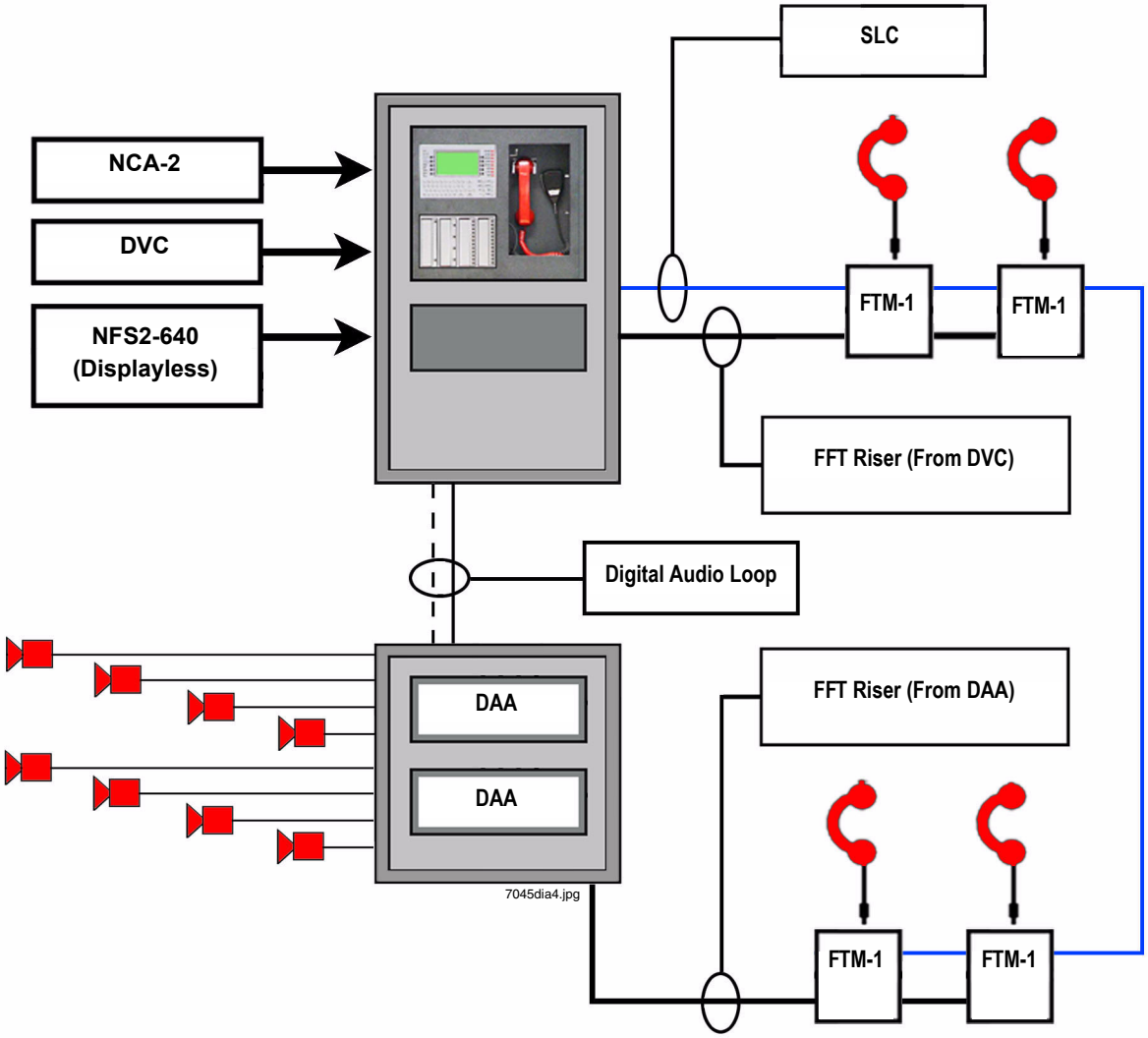
## Stand-Alone NFS2-3030 with DVC



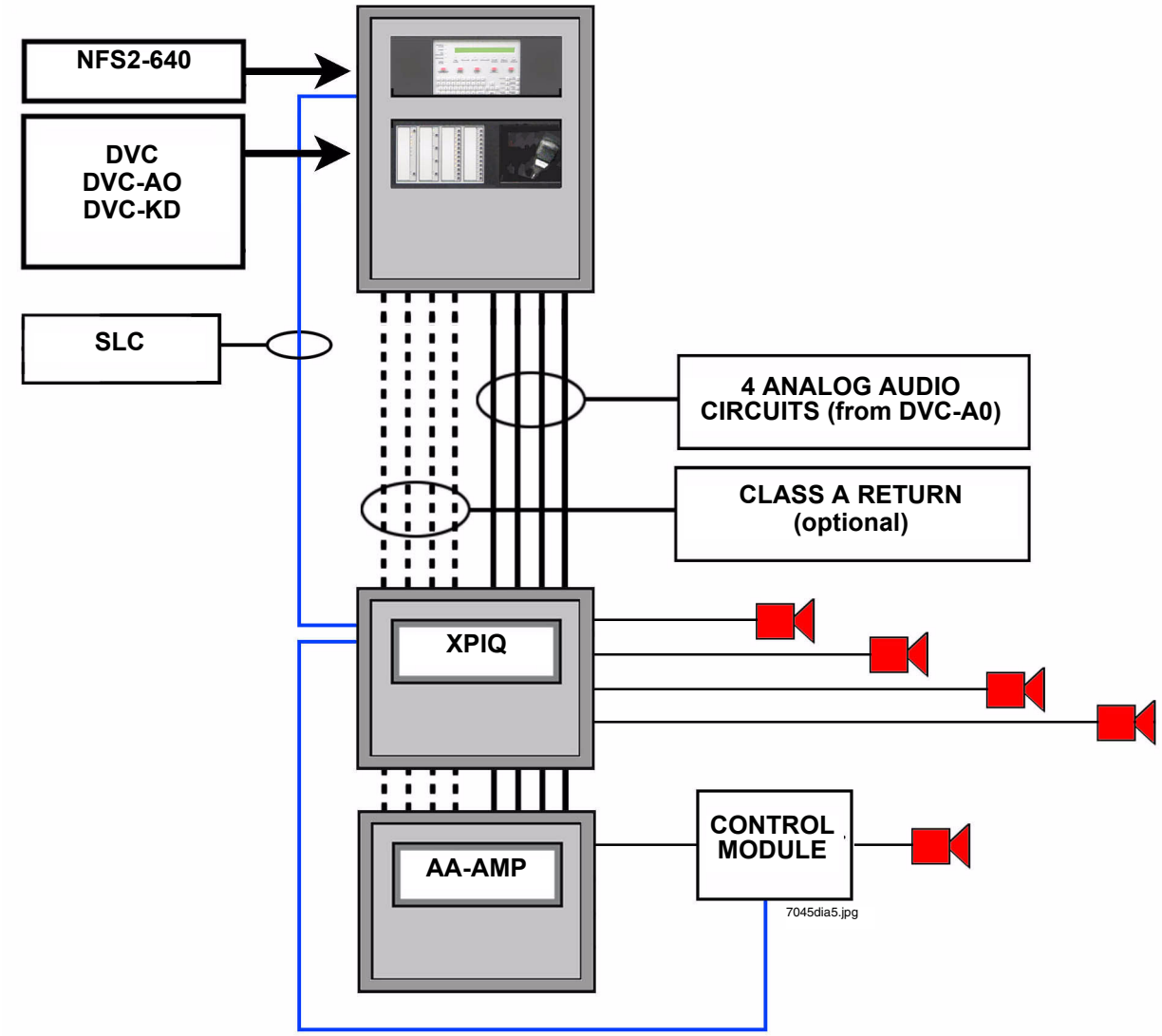
## Networked DVC with NCA-2



## Stand-Alone NFS2-640 with DVC



## Standalone NFS2-640 with DVC-AO

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# AA Series

## Audio Amplifiers

NOTIFIER® by Honeywell

Voice Control Systems

## Description

The AA series audio amplifiers provide traditional high level audio technology for use with Notifier's integrated voice evacuation systems. The AA Series is compatible with classic audio systems such as the AMG-1 as well as the DVC (Digital Voice Command Series) when used with the DVC-AO analog audio option.

Three models are available: the AA-30 (30 watts @ 25 Vrms), the AA-120 (120 watts @ 25 Vrms) and the AA-100 (100 watts @ 70.7 Vrms). All use power-switching technology to reduce production of heat and permit mounting in either 19" (48.26 cm) racks or in standard Notifier cabinets (wall mount). All include power supply, battery switch-over control, amplifier supervision, and backup amplifier switch-over control.

## Features of the AA-30

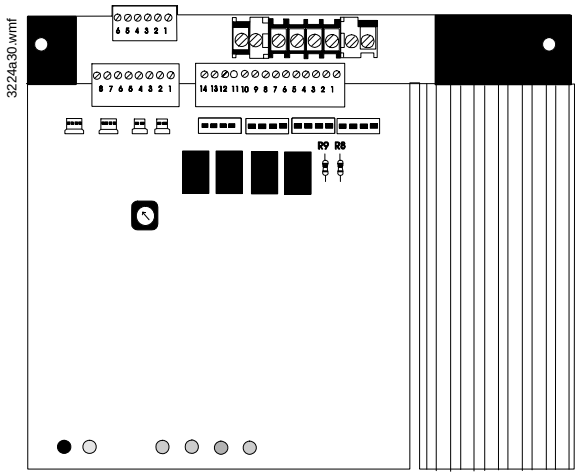
- Provides up to 30 watts of 25 Vrms audio power.
- Low-power standby mode for low battery drain.
- Includes grouped or one-to-one backup amplifier switching bus.
- Battery input and brownout switch-over control.
- High-efficiency switched regulation.
- Plug-in terminal strips and cable connectors for ease of installation.
- 10-position level adjustment and indicator LEDs.
- High-fidelity sound quality.
- Class A output wire supervision option.
- Power-limited per UL requirements and NFPA as dictated by NEC Article 760.
- Mounts in a standard CAB-3/CAB-4, or EQ Cabinet Series enclosure.
- 240 VAC version option (AA-30E).

## Features of the AA-120/AA-100

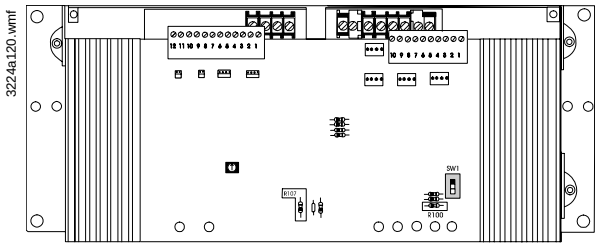
- AA-120 provides up to 120 watts of 25 Vrms audio power.
- AA-100 provides dual outputs of up to 100 watts of 70.7 Vrms audio power (combined outputs not to exceed 100 watts).
- Low-power standby mode for low battery drain.
- Includes grouped or one-to-one backup amplifier switching bus.
- Battery input and brownout switch-over control.
- High-efficiency switched regulation.
- Plug-in terminal strips and cable connectors for ease of installation.
- 10-position level adjust and indicator LEDs.
- Separate mounting chassis is not required (integral chassis for mounting in a CAB-3/CAB-4 Series or EQ Cabinet Series enclosure).
- Includes a built-in automatic backup tone generator (slow whoop or high/low).
- Power-limited per UL requirements and NFPA as dictated by NEC Article 760.
- 240 VAC option (AA-100E/AA-120E)

## Indicators and Controls

- Level Adjustment ..... 10 position switch.
- Normal Level ..... Green LED.
- Incorrect Level ..... Yellow LED.




**AA-30 Audio Amplifier**




**AA-100/AA-120 Audio Amplifier**

- Amplifier Trouble ..... Yellow LED.
- Speaker Trouble ..... Yellow LED.
- Brown Out/AC Failure ..... Yellow LED.
- Battery Supervision ..... Yellow LED.
- AC Overload Protection ..... Circuit Breaker.
- Battery Overload Protection ..... Fuse.

## Agency Listings and Approvals

In some cases, certain modules or applications may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL Listed:** S624
- **ULC Listed:** CS118/CS733/CBP696 Vol. VII
- **MEA:** 17-96-E; 289-91-E; 290-91-E (AA-120); 317-01-E 232-06-E; 317-01-E; 345-02-E
- **CSFM:** 7170-0028:153; 7170-0028:154;7170-0028:216; 7170-0028:223; 7170-0028:182
- **BSA:** 578-81-SA (AA-30)
- **FM Approved**

- **City of Chicago**
- **City of Denver**

## Wiring Connections

| Signal | Wires | In/Out | Terminals | Connector |
|---|---|---|---|---|
| AC Power | 3 | In + Out | Yes (Fixed) | No |
| Battery | 2 | In = Out | Yes (Fixed) | No |
| Audio Input | 2 + Shield | In + Out | Yes (Plug) | Yes (Dual) |
| Audio Output | 2 + Shield | Out | Yes (Plug) | Yes |
| Audio Return (for integral supervision) | 2 + Shield | In | Yes (Plug) | Yes |
| Backup Amp | 2 + Shield | In + Out | Yes (Plug) | Yes (Dual) |
| Trouble Bus | 2 | In + Out | Yes (Plug) Output Only | Yes (Dual) |

## Specifications

| | AA-30 | AA-120/AA-100 |
|---|---|---|
| **Rated Output** | 30 watts RMS | 120 watts RMS (AA-120)<br>100 watts RMS (AA-100) |
| **Output Voltage** | 25 VRMS | 25 VRMS (AA-120)<br>70.7 VRMS (AA-100) |
| **Total Harmonic Distortion at 1 KHz** | 0.5% | 4.0% |
| **Frequency Response (+3, -1 dB)** | 220 - 22,000 Hz | 170 - 7,500 Hz |
| **Supply Voltage** | 120 V, 60 Hz<br>(AA-30E: 220/240 V, 50Hz) | 120 V, 60 Hz<br>(AA-100E/AA-120E: 220/240 V, 50 Hz) |
| **120 VAC Power Consumption** | Standby: 208 mA<br>Alarm: 0.9 A | Standby: 306 mA<br>Alarm: 1.85 A |
| **220/240 V Power Consumption** | Standby: 120 mA<br>Alarm: 0.5 A | Standby: 160 mA<br>Alarm: 0.925 A |
| **24 VDC (Battery) Power Consumption** | Standby: 21 mA<br>Alarm: 3.4 A | Standby: 51 mA<br>Alarm: 7.3 A (AA-120); 6.5 A (AA-100) |
| **Dimensions** | | |
| **Height** | 7.0 in. (17.78 cm) | 7.0 in (17.78 cm) |
| **Width** | 8.5 in (21.59 cm) | 19.0 in. (48.26 cm) |
| **Depth** | 4.3 in. (10.92 cm) | 4.5 in. (11.43 cm) |
| **Weight** | 6.0 lbs. (13.22 kg) | 16.0 lbs. (35.27 kg) |

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# CAB-4 Series Cabinets

## ONYX® Series Backboxes with Locking Doors

NOTIFIER® by Honeywell

**Peripheral Devices**

## General

All cabinets for NOTIFIER fire alarm control panels are fabricated from 16-gauge steel. The cabinet assembly consists of two basic parts: a backbox and a locking door. Cabinets are available in either black or red, with or without LEXAN® windows. The LEXAN model provides a tasteful combination to accent the decor of the finest lobby setting.

- The ***key-locked door*** is provided with a pin-type hinge, two keys and the necessary hardware to mount the door to the backbox.
- The ***backbox*** has been engineered to provide ease-of-entry for the installer. ***Knockouts*** are positioned at numerous points to aid the installer in bringing a conduit into the enclosure with a minimum of hardship.
- ***Right- or left-hand hinges***, selectable in the field. Door opens 180°.
- Cabinets are arranged in ***four standard sizes***, A (one tier) through D (four tiers), plus a ***mini cabinet*** (AA, one tier without a battery compartment). See *Ordering Information*.
- A ***trim ring option*** is available for semi-flush mounting.
- ***Chassis bridge*** available for assembling multiple CHS-4 chassis external to the backbox.

***NFS-640 in "B" sized CAB-4 cabinet***

## Ordering Information

A complete cabinet assembly consists of: a door, a backbox, an optional battery plate, and an optional semi-flush trim ring. For each cabinet required, order one "DR" door and one "SBB" backbox. The BP-4 or BP2-4 battery plate is required for each cabinet assembly that mounts batteries and/or a power supply in the lower position of the cabinet. The optional trim ring is an attractive "picture frame"-style black metal ring.

### *MINI "AA" SIZE, ONE TIER:*

**DR-AA4:** Door assembly, LEXAN window, one tier (no battery compartment), BLACK.

**DR-AA4R:** Door assembly, LEXAN window, one tier (no battery compartment), RED.

**DR-AA4B:** Door assembly, solid door, one tier (no battery compartment), BLACK.

**DR-AA4BR:** Door assembly, solid door, one tier (no battery compartment), RED.

**SBB-AA4:** Backbox assembly, one tier (no battery compartment), BLACK.

**SBB-AA4R:** Backbox assembly, one tier (no battery compartment), RED.

**TR-AA4:** Accessory semi-flush-mount trim ring, one tier (no battery compartment).

***NOTE:*** *Black trim rings are used with red or black cabinets.*

### *ONE TIER, "A" SIZE:*

**DR-A4:** Door assembly, LEXAN window, one tier, BLACK.

**DR-A4R:** Door assembly, LEXAN window, one tier, RED.

**DR-A4B:** Door assembly, solid door, one tier, BLACK.

**DR-A4BR:** Door assembly, solid door, one tier, RED.

**SBB-A4:** Backbox assembly, one tier, BLACK.

**SBB-A4R:** Backbox assembly, one tier, RED.

**TR-A4:** Accessory semi-flush-mount trim ring, one tier (opening 24.062" [61.118 cm] W x 20.062" [50.958 cm] H), BLACK.

***NOTE:*** *Black trim rings are used with red or black cabinets.*

**BP-4:** Battery panel for NFS-640 and NFS-3030. Used to cover battery and power supply when lower position is used in backbox.

**BP2-4:** Battery panel for NFS2-3030. Used to cover battery and power supply when lower position is used in backbox.

### *TWO TIERS, "B" SIZE:*

**DR-B4:** Door assembly, LEXAN window, two tiers, BLACK.

**DR-B4R:** Door assembly, LEXAN window, two tiers, RED.

**DR-B4B:** Door assembly, solid door, two tiers, BLACK.

**DR-B4BR:** Door assembly, solid door, two tiers, RED.

**SBB-B4:** Backbox assembly, two tiers, BLACK.

**SBB-B4R:** Backbox assembly, two tiers, RED.

**TR-B4:** Accessory semi-flush-mount trim ring, two tiers (opening 24.062" [61.118 cm] W x 28.562" [72.548 cm] H), BLACK.

***NOTE:*** *Black trim rings are used with red or black cabinets.*

**BP-4:** Battery panel for NFS-640 and NFS-3030. Used to cover battery and power supply when lower position is used in backbox.

**BP2-4:** Battery panel for NFS2-3030. Used to cover battery and power supply when lower position is used in backbox.

### *THREE TIERS, "C" SIZE:*

**DR-C4:** Door assembly, LEXAN window, three tiers, BLACK.

**DR-C4R:** Door assembly, LEXAN window, three tiers, RED.

**DR-C4B:** Door assembly, solid door, three tiers, BLACK.

**DR-C4BR:** Door assembly, solid door, three tiers, RED.

**SBB-C4:** Backbox assembly, three tiers, BLACK.

**SBB-C4R:** Backbox assembly, three tiers, RED.

**TR-C4:** Accessory semi-flush-mount trim ring, three tiers (opening 24.062" [61.118 cm] W x 37.187" [94.455 cm] H), BLACK.

***NOTE:** Black trim rings are used with red or black cabinets.*

**BP-4:** Battery panel for NFS-640 and NFS-3030. Used to cover battery and power supply when lower position is used in backbox.

**BP2-4:** Battery panel for NFS2-3030. Used to cover battery and power supply when lower position is used in backbox.

### *FOUR TIERS, "D" SIZE:*

**DR-D4:** Door assembly, LEXAN window, four tiers, BLACK.

**DR-D4R:** Door assembly, LEXAN window, four tiers, RED.

**DR-D4B:** Door assembly, solid door, four tiers, BLACK.

**DR-D4BR:** Door assembly, solid door, four tiers, RED.

**SBB-D4:** Backbox assembly, four tiers, BLACK.

**SBB-D4R:** Backbox assembly, four tiers, RED.

**TR-D4:** Accessory semi-flush-mount trim ring, four tiers (opening 24.062" [61.118 cm] W x 45.812" [116.363 cm] H), BLACK.

***Note:** Black trim rings are used with red or black cabinets.*

**BP-4:** Battery panel for NFS-640 and NFS-3030. Used to cover battery and power supply when lower position is used in backbox.

**BP2-4:** Battery panel for NFS2-3030. Used to cover battery and power supply when lower position is used in backbox.

### *ACCESSORIES:*

**WC-2:** Wire channel. Provides a pair of wire trays to neatly route wiring between CHS chassis.

**CB-1:** Chassis bridge. Provides a bridge between CHS Series chassis.

**DP-1B:** Blank dress panel, covers one CAB-4 tier, BLACK.

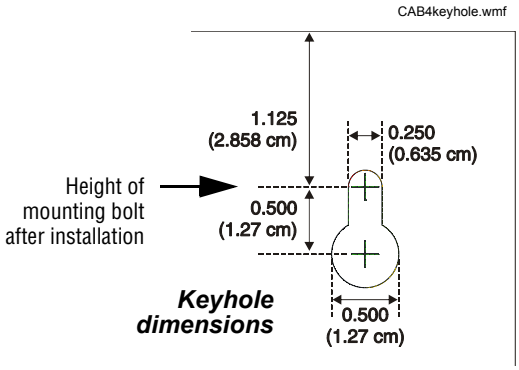
**ADP-4B:** Annunciator dress panel.

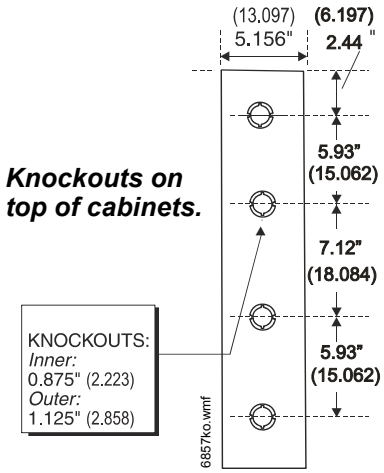
## Agency Listings and Approvals

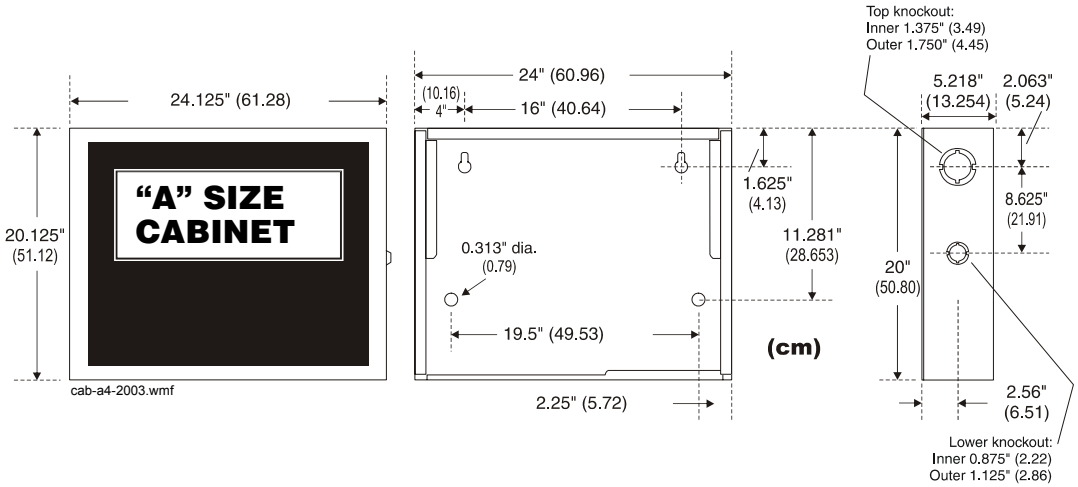
These listings and approvals below apply to the CAB-4 Series Cabinets. In some cases, certain modules or applications may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

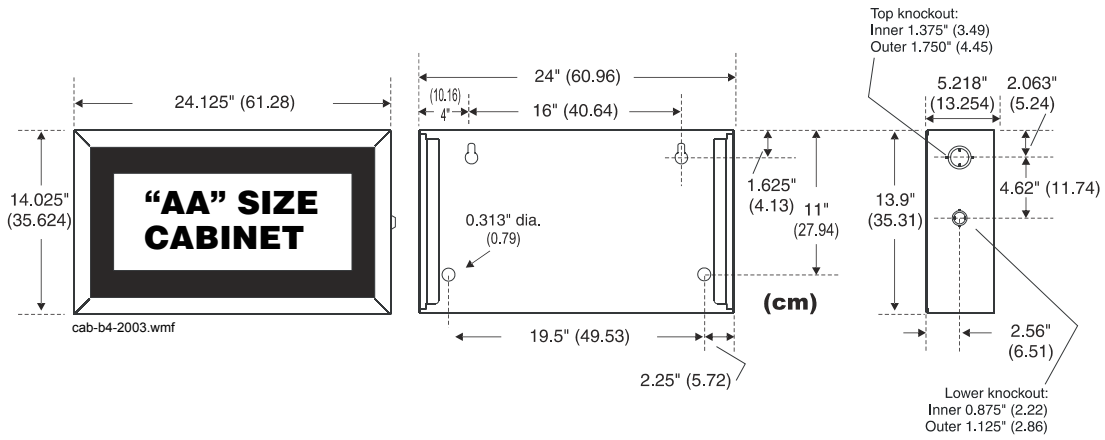
- **UL** Listed: file S635 *(except AA size)*.
- **ULC** Listed: file CS118 *(except AA size)*.
- **MEA** approved: files 317-01-E, 345-02-E *(except AA size)*.
- **CSFM** approved *(except AA size)*: files 7165-0028:214 *(NFS-640)*, 7170-0028:216 *(NFS-640)*, 7165-0028:224 *(NFS-3030)*, 7170-0028:223 *(NFS-3030)*.
- **FM** approved *(except AA size)*.
- **U.S. Coast Guard** approved: 161.002/42/1 *(NFS-640)*.

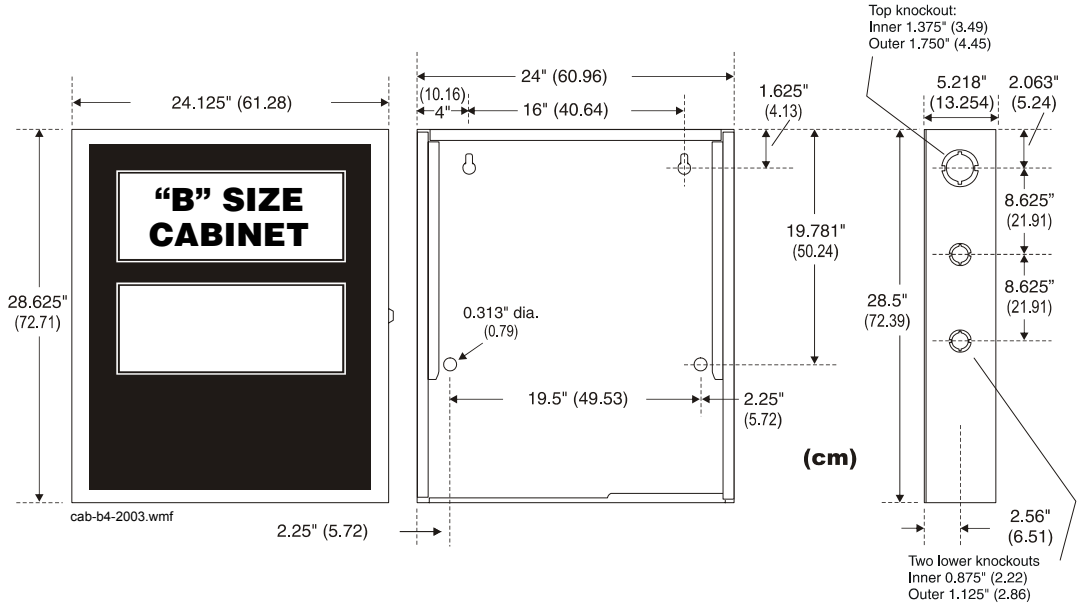
## Cabinet Dimensions and Features

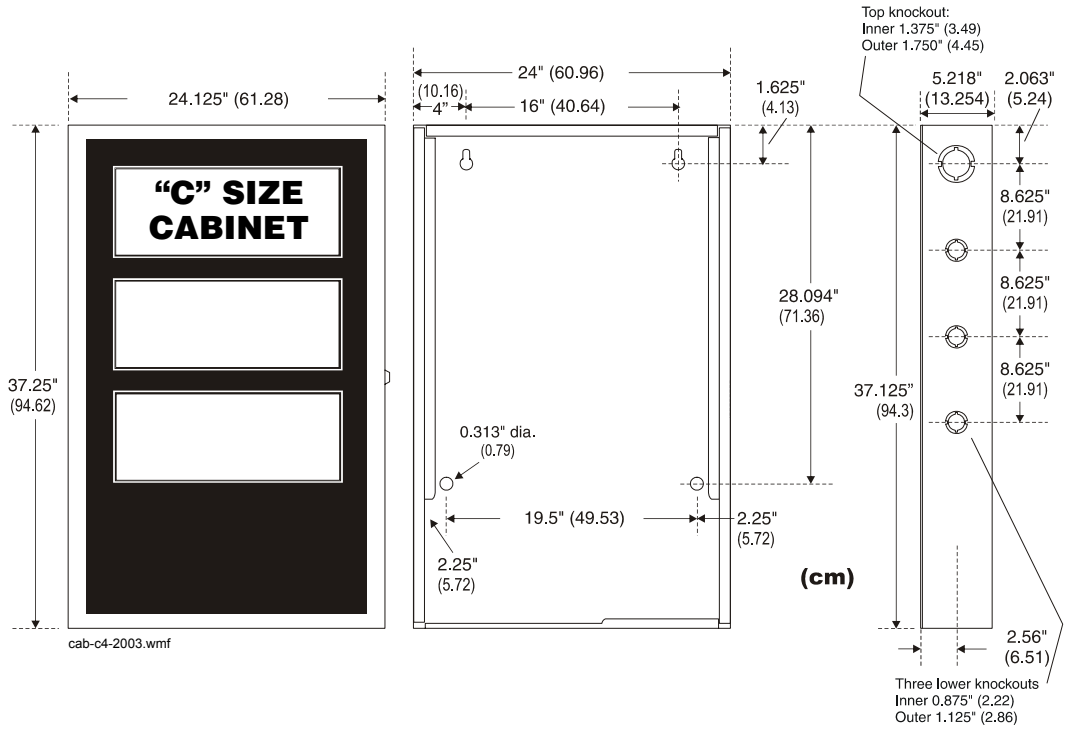


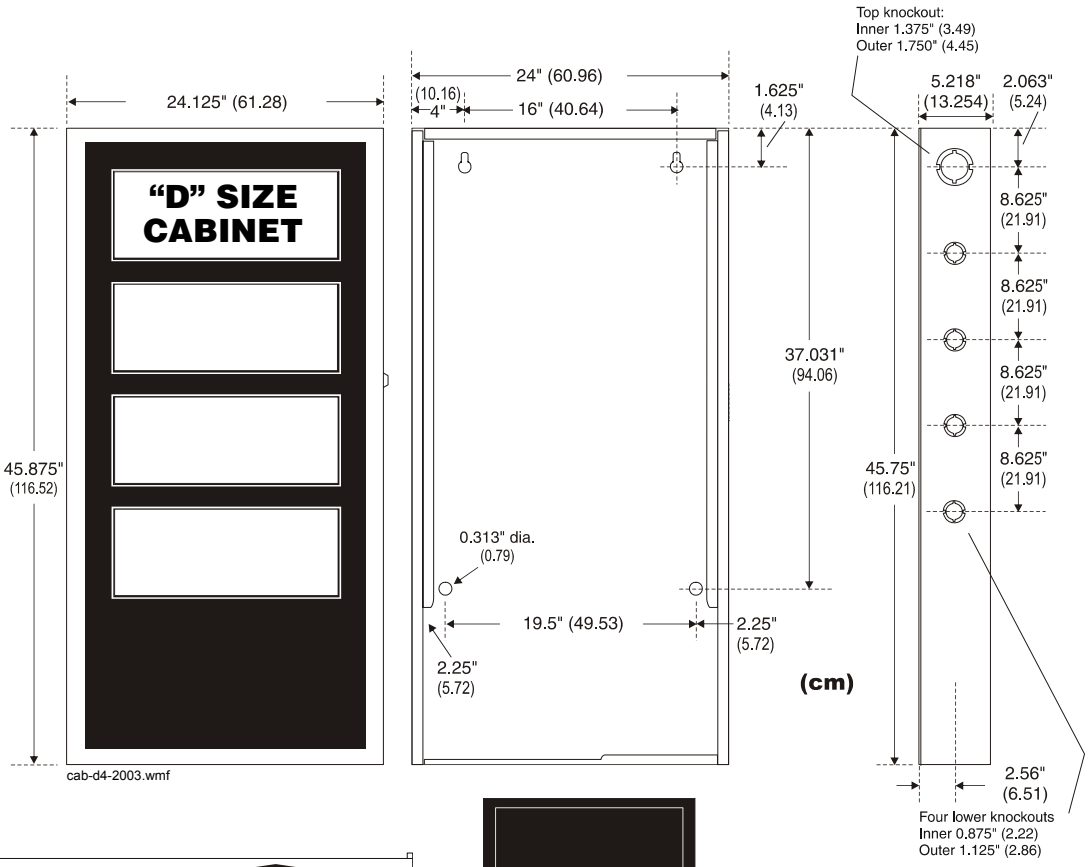



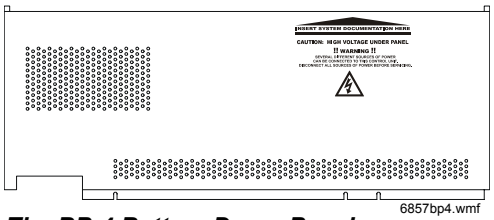




24.125" (61.28)
14.025"
(35.624)
"AA" SIZE
CABINET
cab-b4-2003.wmf
24" (60.96)
(10.16)
4"
16" (40.64)
0.313" dia.
(0.79)
1.625"
(4.13)
11"
(27.94)
19.5" (49.53)
2.25" (5.72)
(cm)
Top knockout:
Inner 1.375" (3.49)
Outer 1.750" (4.45)
5.218"
(13.254)
2.063"
(5.24)
4.62" (11.74)
13.9"
(35.31)
2.56"
(6.51)
Lower knockout:
Inner 0.875" (2.22)
Outer 1.125" (2.86)


24.125" (61.28)
28.625"
(72.71)
"B" SIZE
CABINET
cab-b4-2003.wmf
24" (60.96)
(10.16)
4"
16" (40.64)
1.625"
(4.13)
19.781"
(50.24)
0.313" dia.
(0.79)
19.5" (49.53)
2.25"
(5.72)
2.25" (5.72)
(cm)
Top knockout:
Inner 1.375" (3.49)
Outer 1.750" (4.45)
5.218"
(13.254)
2.063"
(5.24)
8.625"
(21.91)
8.625"
(21.91)
28.5"
(72.39)
2.56"
(6.51)
Two lower knockouts
Inner 0.875" (2.22)
Outer 1.125" (2.86)


24.125" (61.28)
37.25"
(94.62)
"C" SIZE
CABINET
cab-c4-2003.wmf
24" (60.96)
(10.16)
4"
16" (40.64)
1.625"
(4.13)
28.094"
(71.36)
0.313" dia.
(0.79)
19.5" (49.53)
2.25"
(5.72)
2.25"
(5.72)
(cm)
Top knockout:
Inner 1.375" (3.49)
Outer 1.750" (4.45)
5.218"
(13.254)
2.063"
(5.24)
8.625"
(21.91)
8.625"
(21.91)
8.625"
(21.91)
37.125"
(94.3)
2.56"
(6.51)
Three lower knockouts
Inner 0.875" (2.22)
Outer 1.125" (2.86)




***The BP-4 Battery Dress Panel covers the Main Power Supply and the batteries in the cabinet. Only one BP-4 or BP2-4 is required per cabinet unless an AA cabinet is used (no battery compartment).***

***"D" sized cabinet with solid door. Solid door option available on all sizes in black or red.***

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# RM-1 Series

## Remote Microphone and Cabinets
## RM-1, RM-1SA, CAB-RM, CAB-RMR

NOTIFIER® by Honeywell

**Emergency Voice Evacuation**

## GENERAL

The **RM-1 Series Remote Microphone** provides a cost-effective microphone interface for paging to selected speaker zones. The Power and Trouble LEDs provide easy-to-understand visual indications of its status. Various mounting options are available. The microphone assembly can be mounted in a small, compact enclosure or located in a comprehensive paging command center.

The RM-1 Series remote microphone can be utilized with the **NFS-3030/NFS2-3030, NFS-640, AM2020, AFP1010, AFP-400, AFP-300,** and **System 5000** Fire Alarm Control Panels (FACPs).

## FEATURES

- Automatic gain control circuit.
- Supervised microphone.
- Form-C trouble contacts.
- Form-C contacts activated when microphone is in use.
- Power On LED.
- Trouble LED.
- Pluggable terminal blocks.
- Low-level audio (LLA) IN and THRU screws.

## CAB-3/CAB-4 SERIES INSTALLATION

The RM-1 can mount to the back of an ADP-4 dress panel inside a CAB-3 or CAB-4 Series cabinet. It can be mounted in any of the four positions on the dress panel, with the following exceptions:

- ***Do NOT mount*** the RM-1 in front of an AA-100/AA-100E or AA-120/AA-120E; there is not enough room to shut the door of the cabinet if it is placed in front of one of these audio amplifiers.
- ***Do NOT mount*** the RM-1 in the first position to the right of an AA-30/AA-30E; there is not enough room for the RM-1 wiring in this position. An RM-1 can fit only in the far-right position of a row if an AA-30/AA-30E is in the far-left position of the same row. However, an RM-1 can fit into either of the two left positions of the row if the AA-30/AA-30E is in the far-right position of that row.

See page 2 for illustrations of mounted units.

## SPECIFICATIONS

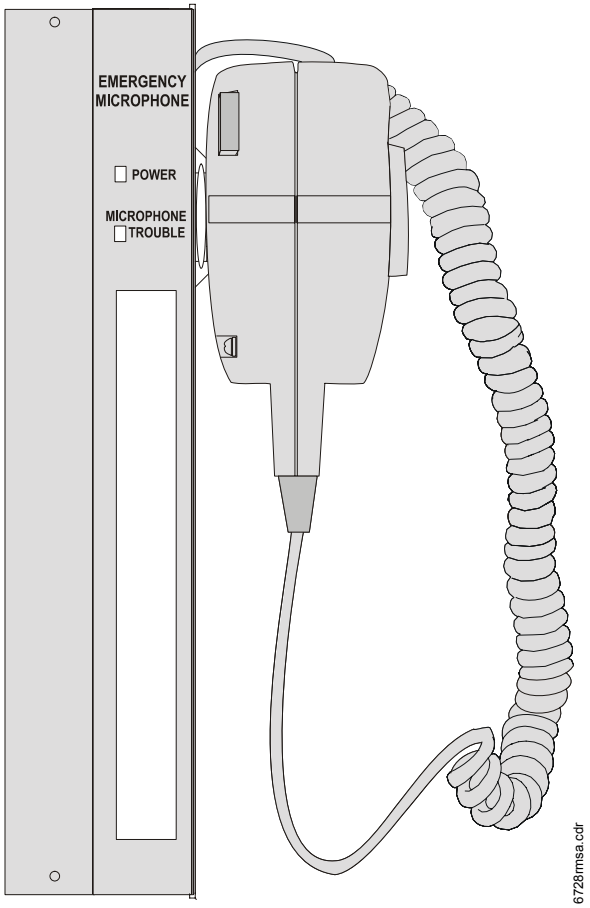
**Power requirements:** 20 mA primary, non-fire alarm current; 66 mA when microphone is activated; 20 mA secondary, non-fire alarm current.

**Operating voltage:** 17 to 26.4 volts.

## PRODUCT LINE INFORMATION

**RM-1:** Remote microphone assembly for mounting on an ADP-4 dress panel.

**RM-1SA:** Remote microphone assembly for mounting in a CAB-RM(R), for remote applications.




**CAB-RM:** Stand-alone cabinet, gray.

**CAB-RMR:** Stand-alone cabinet, red.

## AGENCY LISTINGS AND APPROVALS

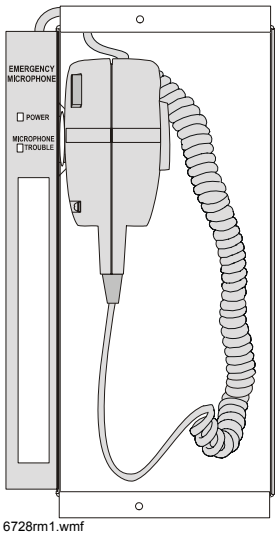
These listings and approvals apply to the RM-1 Series Remote Microphone. In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL:** S635
- **ULC:** CS118/CS733 Vol. 12
- **MEA:** 327-94-E Vol.III
- **CSFM:** 7170-0028:223 and 7165-0028:224 (NFS-3030/NFS2-3030)
- **FM:** Approved (RM-1, RM-1SA)

# RM-1 MOUNTING & CABINET DIMENSIONS

*AT RIGHT: RM-1SA (right) and in CAB-RM or CAB-RMR.*

*BELOW: RM-1 (left) and on ADP-4 dress panel.*



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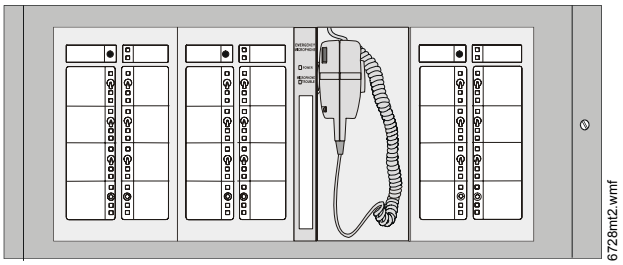
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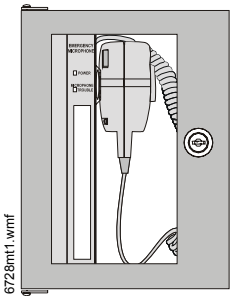
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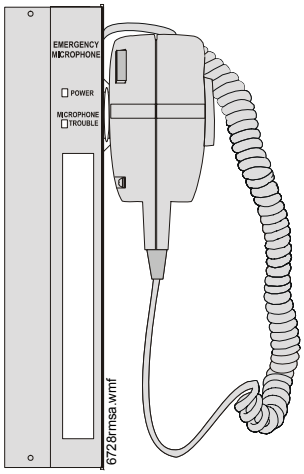

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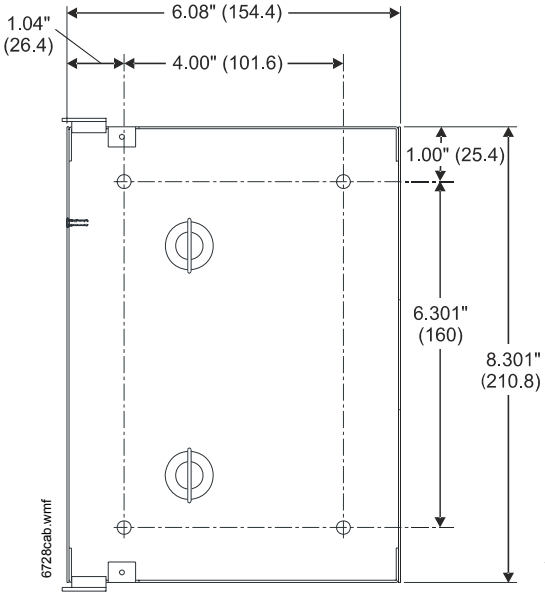
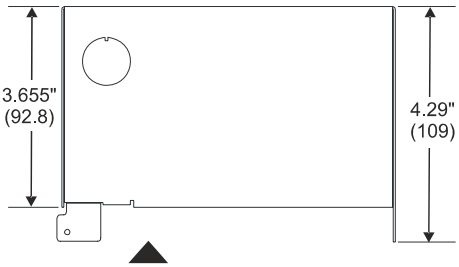


6728cab.wmf

## CAB-RM/CAB-RMR

DIMENSIONS inches (mm)




**DEPTH WITHOUT DOOR**

**HEIGHT/WIDTH WITHOUT DOOR**

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# ACS Series Annunciators

## ONYX® Series
## ACM/AEM-24AT, ACM/AEM-48A

NOTIFIER® by Honeywell

**Annunciator Control Systems**

## General

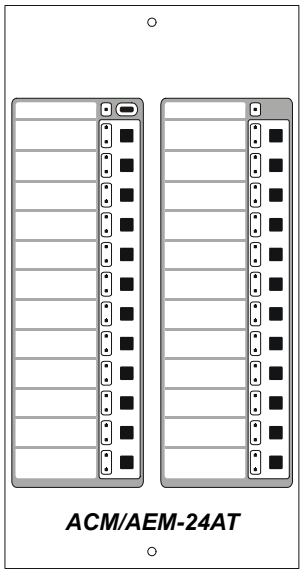
The ONYX® Series ACS Annunciators provide a modular line of products for annunciation and control of the NOTIFIER ONYX® Series NFS-640, NFS-3030, and NFS2-3030 Intelligent Fire Alarm Control Panels, and NCA and NCA-2 Network Control Annunciators, as well as NOTIFIER's AM2020, AFP1010, AFP-400, AFP-300, AFP-200, and AFP-100 fire control panels. The ACS line provides arrays of LEDs to indicate point status and, in some versions, switches to control the state of output circuits. These ACS units use a serial interface and may be located at distances of up to 6,000 feet (1,828.8 meters) from the panel.

## Features

- Speaker control mode for use with XPIQ and the following panels: NFS-3030, NFS2-3030, NFS-640, AM2020, AFP1010, AFP-400, AFP-300. Enables the ACS to control operation of groups of multi-channels mapped to groups of multi-speakers.
- Compatible with existing annunciators.
- Color-programmable LEDs.
- On-board end-of-line resistors can be enabled/disabled by setting a switch.
- Alarm/Circuit On and Trouble LED per-point option or more dense Alarm-only option.
- Touch-pad control switch option for remote control of system relays; or silence, reset, and evacuate.
- LEDs may be programmed to display status of indicating circuits or control relays as well as system status conditions.
- Fan Control (manual/automatic) option for the AM2020 and AFP1010.
- System Trouble LED indicator.
- On-Line/Power LED indicator.
- Alarm and trouble resound with flash of new conditions.
- Local sounder for both alarm and trouble conditions with silence/acknowledge button (program options).
- Serial EIA-485 interface for reduced installation cost.
- May be powered by 24 VDC from the panel or by remote power supplies.
- Microprocessor-controlled electronics, fully supervised.
- Slip-in custom labels, lettered with standard typewriter or LabelEase program.
- Plug-in terminal blocks for ease of installation and service.
- Trouble monitor option for remote power supplies.

## Construction

The ACS modules are provided in two basic controller modules, each with its expander module. The ACM-24AT provides 24 annunciation and control points per module, each with a red, green, or yellow Alarm/Circuit On LED, a yellow Trouble LED, and a touch-key switch. The ACM-48A provides 48 annunciation points per module, each with a red, green, or yellow Alarm/Circuit On LED (for annunciating control relays, the LED indicates ON/OFF).

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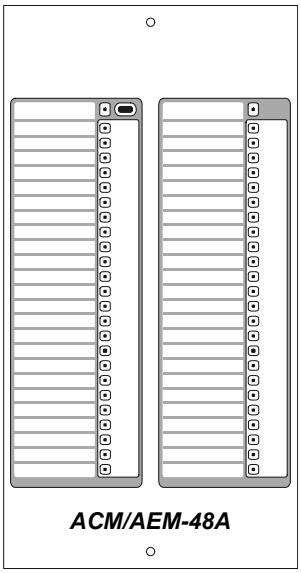



6862a48.wmf

On the ACM-24AT, each LED point is individually color-programmable. On ACM-48A, each column of 24 LED points can be color-configured using a DIP switch.

**Temperature and humidity ranges:** This system meets NFPA requirements for operation at 0°C to 49°C (32°F to 120°F); and at a relative humidity (noncondensing) of 85% at 30°C (86°F) per NFPA, and 93% ± 2% at 32°C ± 2°C (89.6°F ± 1.1°F) per ULC. However, the useful life of the system's standby batteries and the electronic components may be adversely affected by extreme temperature ranges and humidity. Therefore, it is recommended that this system and all peripherals be installed in an environment with a nominal room temperature of 15°C to 27°C (60°F to 80°F).

## Installation

The ACS Series annunciator and control subsystems use modular hardware assemblies which allow the custom configuration of the annunciator panel to fit the individual job requirements.

Standard backboxes and mounting hardware schemes, including special remote cabinets, allow the annunciators to be constructed and configured with other system components.

When used with the NFS(2)-3030, NFS-640, AM2020, AFP1010, AFP-400, or AFP-300, the ACS modules can be used for manual selection of speaker and telephone circuits. In this application, they are typically mounted in the main control near the microphone and telephone handset.

For remote annunciation applications, the modules are typically mounted in special ABF or ABS boxes. Control switch key locks (AKS-1/-1B) and phone jacks (APJ-1/-1B) are available.

Communication between the ACS Series annunciators and the host Fire Alarm Control Panel is made through an EIA-485 multi-drop loop, eliminating the need for costly wiring schemes. Four wires are required, two for the EIA-485 communications (twisted pair), and two for 24 VDC regulated power.

Retrofit of ACS Series annunciators into existing systems is easily accomplished. Software may require upgrading, and the AM2020 or AFP1010 must include a SIB-2048(A)/SIB-NET Serial Interface Board.

All field-wiring terminations use removable, compression-type terminal blocks for ease of installation, wiring, and circuit testing.

## Operation

The ACS Series annunciator and control system provides the NOTIFIER system with up to 32 remote serially connected annunciators, each with a capacity of 96 points, for a total capacity of ***3072 points*** (subject to the capability of the FACP). The NCA(-2) is capable of using the full 96 points.

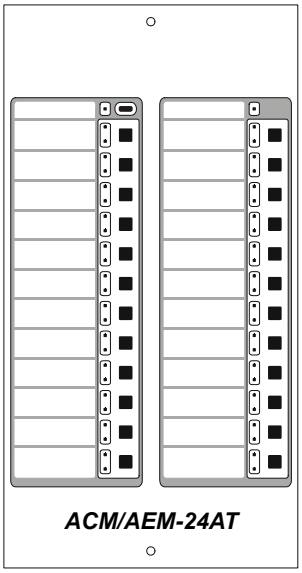
Local or remote power supplies and serial communications allow the ACS to be located virtually anywhere in the protected premises.

AM2020, AFP1010, NFS-640, NFS(2)-3030 and NCA(-2) system alarm and/or trouble conditions may be annunciated on a per-point basis, or in a grouped or zone configuration.

Control of system operational controls, such as Signal Silence, System Reset, and local annunciation controls (such as Local Acknowledge and Lamp Test) may be accomplished through the module's rubber keypad.

## Product Line Information

**ACM-24AT:** *(shown below)* The Annunciator Control Module-24AT contains 24 color-programmable (red/green/yellow) Active and 24 yellow Trouble LEDs, 24 momentary touch-pad switches, a System Trouble LED, an On-Line/Power LED, and a local piezo sounder with a silence/acknowledge switch for audible indication of alarm and trouble conditions. Includes instructions. 8.375" (21.27 cm) high; 4.375" (11.11 cm) wide.



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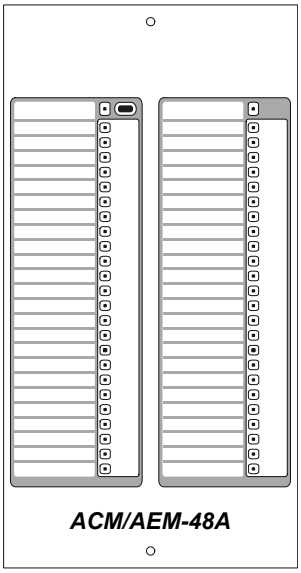

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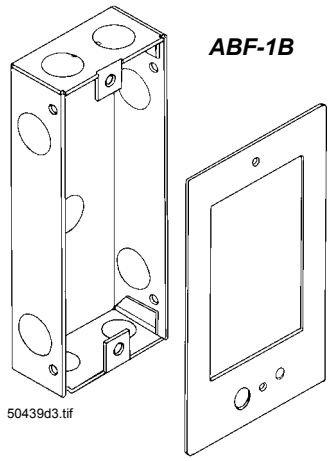
**AEM-24AT:** The Annunciator Expander Module-24AT expands the ACM-24AT by 24 system points. The AEM-24AT is identical in size and in frontal appearance to the ACM-24AT. Up to three of these expander modules can be supported by an ACM-24AT, for a maximum of 96 system points. 8.375" (21.27 cm) high; 4.375" (11.11 cm) wide. ***NOTE:*** *The AEM-24AT* ***cannot*** *be used to expand the ACM-48A.*

**ACM-48A:** *(shown above)* The Annunciator Control Module-48A contains 48 color-programmable (red/green/yellow) Active LEDs, a System Trouble LED, an On-Line/Power LED, and a local piezo sounder with a Silence/Acknowledge switch for audible indication of alarm and trouble conditions. Includes instructions. 8.375" (21.27 cm) high; 4.375" (11.11 cm) wide.

**AEM-48A:** The Annunciator Expander Module-48A expands the ACM-48A by 48 system points. The AEM-48A is identical in frontal appearance to the ACM-48A. One expander module can be supported by an ACM-48A, providing a maximum of 96 points (subject to the capability of the FACP). 8.375" (21.27 cm) high; 4.375" (11.11 cm) wide. ***NOTE:*** *The AEM-48A* ***cannot*** *be used to expand the ACM-24AT.*

**ABS-1B:** *(shown below)* The Annunciator Surface Box-1B (black) provides for the remote mounting of one annunciator module in a surface-mount enclosure. Knockouts are provided for use with 1/2" (1.27 cm) conduit. The annunciator mounts directly to the ABS-1B without a dress plate. 8.5" (21.59 cm) high x 4.5" (11.43 cm) wide x 2" (5.08 cm) deep. ***NOTE:*** *The ABS-1B will not support the installation of the AKS-1B Annunciator Key Switch.*



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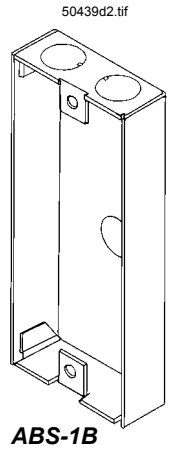
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ABS-1B

**ABS-1TB:** The ABS-1TB is an attractive surface-mount backbox for mounting one ACS Series Annunciator. Unlike the ABS-1B, the ABS-1TB has an increased depth that allows mounting of the APJ-1B Annunciator Phone Jack and AKS-1B Annunciator Key Switch. Black, 9.938" (25.24 cm) high x 4.625" (11.75 cm) wide x 2.5" (6.35 cm) deep. ***NOTE:*** *An earlier gray model, ABS-1T, will not accommodate the ACM/AEM-24AT or ACM/AEM-48A. The slightly deeper ABS-1TB will accommodate both the ACM/AEM-24AT or ACM/AEM-48A models and the ACM-16AT/ACM-32A Series (see DN-0524).*

**ABS-2B:** The Annunciator Surface Box-2B (black) provides for the surface mounting of one ACM-24AT/AEM-24AT combination or one ACM-48A/AEM-48A combination. Knockouts are provided for use with 1/2" (1.27 cm) conduit. The annunciators mount directly to the ABS-2B without a dress plate. 8.5" (21.59 cm) high x 8.92" (22.66 cm) wide x 2" (5.08 cm) deep. ***NOTE:*** *The ABS-2B will not support the installation of the AKS-1B Annunciator Key Switch.*

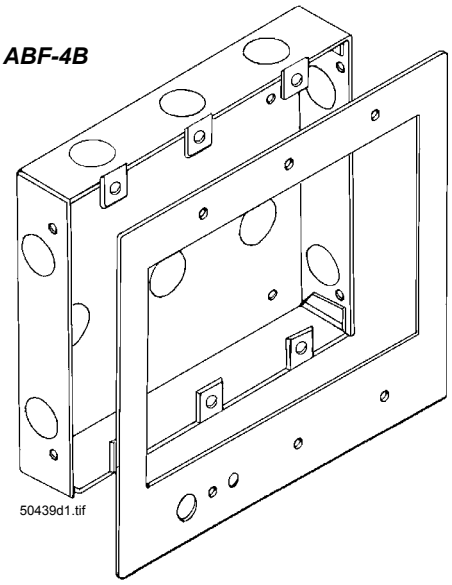
**ABF-1B:** *(shown above)* The Annunciator Flush Box-1B (black) provides for the remote mounting of a single annunciator module in a flush-mount enclosure. Knockouts are provided for use with 1/2" (1.27 cm) conduit. The ABF-1B includes a painted black metal trim plate [11" (27.94 cm) high x 6.25" (15.875 cm) wide], mounting hardware, and an adhesive-backed annunciator label for the dress plate. 9.938"

(25.24 cm) high x 4.625" (11.75 cm) wide x 2.5" (6.35 cm) deep.

**ABF-2B:** The Annunciator Flush Box-2B (black) provides for the flush mounting of two annunciator modules. Includes a painted black metal trim plate [11" (27.94 cm) high x 10.625" (26.99 cm) wide] and adhesive-backed annunciator label. 9.938" (25.24 cm) high x 9.188" (23.34 cm) wide x 3.75" (9.525 cm) deep.

**ABF-4B:** *(shown below)* The Annunciator Flush Box-4B (black) provides for the remote mounting of one to four annunciator modules. Knockouts are provided for use with 1/2" (1.27 cm) conduit. The flush-mounted ABF-4B includes a painted black metal trim plate [11" (27.94 cm) high x 19.375" (49.21 cm) wide] and an annunciator label. 9.938" (25.24 cm) high x 17.75" (45.09 cm) wide x 2.5" (6.35 cm) deep.

***ABF-4B***



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**ABF-1DB, ABF-2DB, ABS-4D:** The ABF-1DB, ABF-2DB and ABS-4D are semi-flush-mount backboxes for ACS Series Annunciators. The ABF-1DB mounts one annunciator module and the ABF-2DB mounts two modules or one NCA(-2). The ABS-4D mounts up to four annunciators ***or*** two annunciators with an NCA. Black with an attractive smoked glass door with a keylock. The ABS-4D is hinged on the bottom for stability.

**DIMENSIONS, ABF-1DB:** ***Box only:*** 9.938" (25.24 cm) high x 4.625" (11.75 cm) wide x 2.5" (6.35 cm) deep.
***Door:*** 11" (27.94 cm) high x 6" (15.24 cm) wide x 0.75" (1.9 cm) deep.

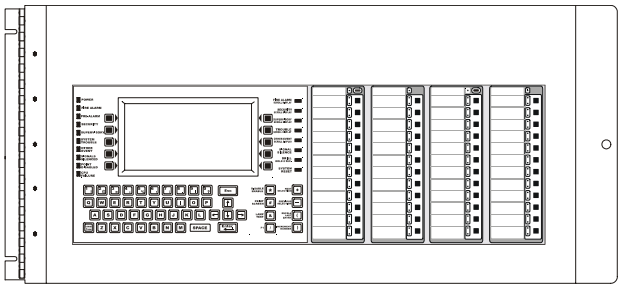
**DIMENSIONS, ABF-2DB:** ***Box only:*** 9.938" (25.24 cm) high x 9.188" (23.34 cm) wide x 3.75" (9.525 cm) deep. ***Door:*** 11" (27.94 cm) high x 10.375" (26.35 cm) wide x 0.75" (1.9 cm) deep.

**DIMENSIONS, ABS-4D:** ***Box only:*** 11.97" (30.40 cm) high x 19.87" (50.47cm) wide x 3.50" (8.89 cm) deep.
***Door:*** 11.97" (30.40 cm) high x 19.87" (50.47 cm) wide x 1.25" (3.18 cm) deep.

**ADP-4B:** The Annunciator Dress Panel-4B (black) provides for the cabinet mounting of one to four modules. The ADP-4B hinge-mounts to a CAB-4 Series cabinet. Modules mount directly to threaded studs on the ADP-4B.

**DP-DISP:** The Dress Panel-Display provides for the cabinet mounting of one to four modules in the ***top row*** of a CAB-4 Series backbox. Modules mount directly to threaded studs on the DP-DISP *(see illustration below)*.

6858disp.wmf



***DP-DISP Dress Panel with NCA Network Control Annunciator in left two positions, and two ACM-24AT Annunciators at right.***

**BMP-1:** Annunciator Blank Module is a flat black dress plate that covers unused module positions in the annunciator backbox or in the ADP-4B. 8.375" (21.27 cm) high x 4.375" (11.11 cm) wide. Studs for a variety of module mounting options are available.

**AKS-1B:** The Annunciator Key Switch-1B (black) provides access security for the control switches on the ACM/AEM-24AT. The key switch kit includes a key and hardware for mounting to the ABF-1B. Also included is an adhesive-backed annunciator label for use with the key switch/dress plate assembly. ***NOTE:*** *The* ***AKS-1B*** *can* ***only*** *be employed with the ABS-1TB.*

**APJ-1B:** Annunciator Phone Jack-1B (black) for Fire Fighters Telephone (**FFT-7**). Includes mounting hardware and adhesive-backed label.

## Agency Listings and Approvals

The listings and approvals below apply to the ACM/AEM-24AT and the ACM/AEM-48A. In some cases, certain modules or applications may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

*Additional listings relating to recent product or applications to be released shortly.*

- **UL** Listed: file S635.
- **ULC** Listed: file CS118.
- **MEA** approved: files 317-01-E *(NFS-640)*, 345-02-E *(NFS-3030)*.
- **CSFM** approved: file 7120-0028:156.
- **FM** approved.
- **Lloyd's Register**: type approved 02/60007 *(NFS-640)*.
- **U.S. Coast Guard**: file 161.002/42/1 *(NFS-640)*.

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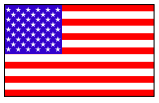
We cannot cover all specific applications or anticipate all requirements.
All specifications are subject to change without notice.



Made in the U.S. A.

For more information, contact Notifier. Phone: (203) 484-7161, FAX: (203) 484-7118.
www.notifier.com

# NBG-12LX

## Addressable Manual Pull Station

NOTIFIER® by Honeywell

**Intelligent/Addressable Devices**

## General

The Notifier NBG-12LX is a state-of-the-art, dual-action (i.e., requires two motions to activate the station) pull station that includes an addressable interface for any Notifier intelligent control panel except FireWarden series panels. Because the NBG-12LX is addressable, the control panel can display the exact location of the activated manual station. This leads fire personnel quickly to the location of the alarm.

## Features

- Maintenance personnel can open station for inspection and address setting without causing an alarm condition.
- Built-in bicolor LED, which is visible through the handle of the station, flashes in normal operation and latches steady red when in alarm.
- Handle latches in down position and the word “ACTIVATED” appears to clearly indicate the station has been operated.
- Captive screw terminals wire-ready for easy connection to SLC loop (accepts up to 12 AWG/3.25 mm² wire).
- Can be surface mounted (with SB-10 or SB-I/O) or semi-flush mounted. Semi-flush mount to a standard single-gang, double-gang, or 4" (10.16 cm) square electrical box.
- Smooth dual-action design.
- Meets ADAAG controls and operating mechanicsms guidelines (Section 4.1.3[13]); meets ADA requirement for 5 lb. maximum activation force.
- Highly visible.
- Attractive shape and textured finish.
- Key reset.
- Includes Braille text on station handle.
- Optional trim ring (BG12TR).
- Meets UL 38, Standard for Manually Actuated Signaling Boxes.
- Up to 99 NBG-12LX stations per loop on CLIP protocol systems.
- Up to 159 NBG-12LX stations per loop on FlashScan® protocol systems.
- Dual-color LED blinks green to indicate normal on FlashScan® systems.

## Construction

Shell, door, and handle are molded of durable LEXAN® (or polycarbonate equivalent) with a textured finish.

## Specifications

- Normal operating voltage: 24 VDC.
- Maximum SLC loop voltage: 28.0 VDC.
- Maximum SLC loop current: 375 µA.
- Ambient Temperature: 32°F to 120°F (0°C to 49°C)
- Relative Humidity: 93% ± 2% RH (noncondensing) at 32°C ± 2°C (90°F ± 3°F)
- For use indoors in a dry location

**The NBG-12LX**
**Addressable Manual Pull Station**

## Installation

The NBG-12LX will mount semi-flush into a single-gang, double-gang, or standard 4" (10.16 cm) square electrical outlet box, or will surface mount to the model SB-10 or SB-I/O surface backbox. If the NBG-12LX is being semi-flush mounted, then the optional trim ring (BG12TR) may be used. The BG12TR is usually needed for semi-flush mounting with 4" (10.16 cm) or double-gang boxes (not with single-gang boxes).

## Operation

Pushing in, then pulling down on the handle causes it to latch in the down/activated position. Once latched, the word “ACTIVATED” (in bright yellow) appears at the top of the handle, while a portion of the handle protrudes from the bottom of the station. To reset the station, simply unlock the station with the key and pull the door open. This action resets the handle; closing the door automatically resets the switch.

Each manual station, on command from the control panel, sends data to the panel representing the state of the manual switch. Two rotary decimal switches allow address settings (1 – 159 on FlashScan® systems, 1 – 99 on CLIP systems ).

## Architectural/Engineering Specifications

Manual Fire Alarm Stations shall be non-coded, with a key-operated reset lock in order that they may be tested, and so designed that after actual Emergency Operation, they cannot be restored to normal except by use of a key. An operated station shall automatically condition itself so as to be visually detected as activated. Manual stations shall be constructed of red-colored LEXAN (or polycarbonate equivalent) with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in white letters, 1.00 inches (2.54 cm) or larger. Stations shall be suitable for surface mounting on matching backbox SB-10 or SB-I/O; or semi-flush mounting on a standard single-gang, double-gang,

or 4" (10.16 cm) square electrical box, and shall be installed within the limits defined by the Americans with Disabilities Act (ADA) or per national/local requirements. Manual Stations shall be Underwriters Laboratories listed.

Manual stations shall connect with two wires to one of the control panel SLC loops. The manual station shall, on command from the control panel, send data to the panel representing the state of the manual switch. Manual stations shall provide address setting by use of rotary decimal switches.

The loop poll LED shall be clearly visible through the front of the station. The LED shall flash while in the normal condition, and stay steadily illuminated when in alarm.

## Product Line Information

**NBG-12LX:** Dual-action addressable pull station. Includes key locking feature.

**SB-10:** Surface backbox; metal.

**SB-I/O:** Surface backbox; plastic.

**BG12TR:** Optional trim ring.

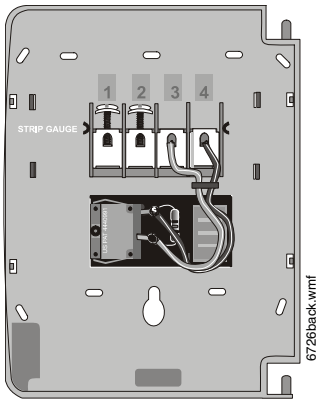
**17021:** Keys, set of two.

**NY-Plate:** New York City trim plate

## Agency Listings and Approvals

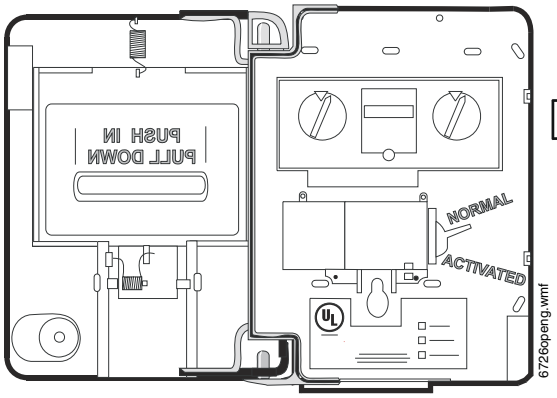
In some cases, certain modules or applications may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL Listed:** S692 (listed for Canadian and non-Canadian applications)
- **MEA:** 67-02-E
- **CSFM:** 7150-0028:199
- **BSMI:** CI313066760047
- **U.S.** Coast Guard: 161.002/23/3 (AFP-200); 161.002/27/3 (AM-2020/AFP-1010); 161.002/42/1 (NFS-640)
- **Lloyd's Register:** 02/6007 (NFS-640); 94/60004 (E2) (AFP-200); 03/60011 (E1); 07/60007 (NFS2-3030)
- **FM Approved**

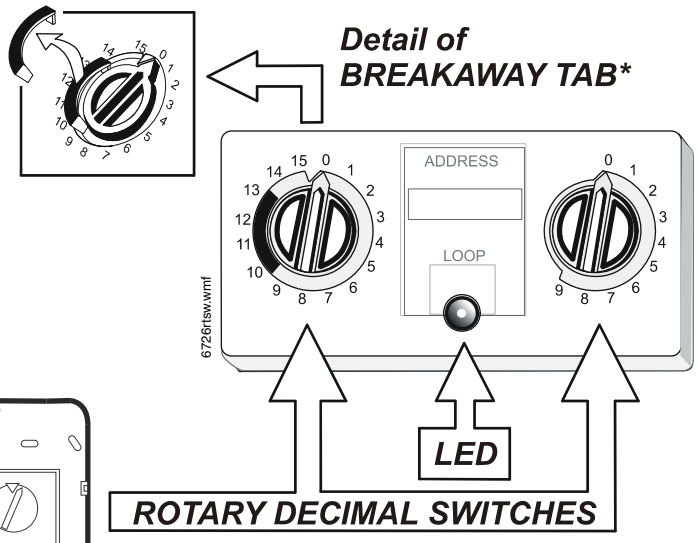



**Back of station without door**

Terminal Connections:
1 SLC (-); 2 SLC (+)




**Cover open to show easy access to miniature monitor module, rotary switch, and UL label.**




* Remove tab to select addresses above 99 (FlashScan systems only).

**Patented:**
U.S. Patent No. D428,351; 6,380,846; 6,314,772; 6,632,108.

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Made in the U.S. A.

# FSP-851 and FSP-851T

## Intelligent Plug-In Photoelectric Smoke Detectors with FlashScan®

NOTIFIER® by Honeywell

**Intelligent/Addressable Devices**

## General

Notifier 851 Series intelligent plug-in smoke detectors with integral communication provide features that surpass conventional detectors. Detector sensitivity can be programmed in the control panel software. Sensitivity is continuously monitored and reported to the panel. Point ID capability allows each detector's address to be set with decade address switches, providing exact detector location for selective maintenance when chamber contamination reaches an unacceptable level. The FSP-851 photoelectric detector's unique optical sensing chamber is engineered to sense smoke produced by a wide range of combustion sources. Dual electronic thermistors add 135°F (57°C) fixed-temperature thermal sensing on the FSP-851T. FSP-851 and FSP-851T detectors are compatible with all Notifier intelligent Fire Alarm Control Panels (FACP).

**FlashScan®** (U.S. Patent 5,539,389) is a communication protocol developed by Notifier engineering that greatly enhances the speed of communication between analog intelligent devices. Intelligent devices communicate in a grouped fashion. If one of the devices in the group has new information, the panel's CPU stops the group poll and concentrates on single points. The net effect is response speed **greater than five times** that of earlier designs.

**FSP-851 with B710LP base**

**FSP-851T with B710LP base**

## Features

- Sleek, low-profile design.
- Addressable-analog communication.
- Stable communication technique with noise immunity.
- Low standby current.
- Two-wire SLC connection.
- FlashScan (NFS-640, NFS-3030) and classic CLIP systems (AFP-100, AFP-200, AFP-300, AFP-400, NFS-640, AM2020/AFP1010, NFS-3030) compatible.
- Rotary, decimal addressing (1-99 on current classic systems, 1-159 on FlashScan systems).
- Optional remote, single-gang LED accessory (RA400Z).
- Dual LED design provides 360° viewing angle.
- Visible bi-color LEDs blink green every time the detector is addressed, and illuminate steady red on alarm.
- Remote test feature from the panel.
- Walk test with address display (an address on 121 will blink the detector LED: 12-[pause]-1*(FlashScan systems only)*.
- Built-in functional test switch activated by external magnet.
- Built-in tamper-resistant feature.
- Sealed against back pressure.
- Constructed of off-white Bayblend®, designed to commercial standards, and offers an attractive appearance.
- 94-5V plastic flammability rating.
- SEMS screws for wiring of the separate base.
- Optional relay, isolator, and sounder bases.
- Backward compatible.

## Specification

**Size:** 2.1" (5.3cm) high x 4.1" (10.4cm) diameter installed in B501 base, 6.1" (15.5cm) diameter installed in B710LP base.

**Shipping Weight:** 5.2oz. (147g).

**Operating Temperature:** FSP-851, 0°C to 49°C (32°F to 120°F); FSP-851T, 0°C to 38°C (32°F to 100°F). Low temperature signal for FSP-851T at 45°F +/- 10°F (7.22°C +/- 5.54°C).

**UL Listed Velocity Range:** 0-4000 ft/min. (1219.2 m/min.), suitable for installation in ducts.

**Relative Humidity:** 10%-93% noncondensing.

**Thermal Ratings:** Fixed-temperature setpoint 135°F (57°C).

### *DETECTOR SPACING AND APPLICATIONS*

Notifier recommends spacing detectors in compliance with NFPA 72. In low airflow applications with smooth ceiling, space detectors 30 feet (9.144m) for ceiling heights 10 feet (3.148m) and higher. For specific information regarding detector spacing, placement, and special applications refer to NFPA 72. *System Smoke Detector Application Guide*, document A05-1003, is available at **systemsensor.com**

FSP-851 and FSP-851T are listed for use in ducts, but they are *NOT* listed for use inside duct smoke detector housings. See Duct Application Smoke Detectors Guide, document A05-1004, available at **systemsensor.com**, for details on pendant-mount applications.

### *ELECTRICAL SPECIFICATIONS*

**Voltage Range:** 15-32 volts DC peak.

**Standby Current (max. avg.):** 250µA @ 24VDC (with no communication enabled); 360µA @ 24VDC (one communication every five minutes with LED enabled).

**LED Current (max.):** 6.5mA @ 24VDC ('ON').

### *BASES AVAILABLE*

**B710LP:** 6.1" (15.5cm) diameter.

**B501:** 4.1" (10.4cm) diameter.

**B501BH or B501BHT**: Sounder base assembly. Includes B501 base.

**B224RB Relay Base:** *Screw Terminals*, up to 14AWG (2.0mm$^2$); *Relay Type*, Form-C; *Rating*, 2.0A @ 30VDC resistive, 0.3A @ 110VDC inductive, 1.0A @ 30VDC inductive; *Dimensions*, 6.2" (15.748cm) x 1.2" (3.048cm) x 1.2" (3.048cm).

**B224BI Isolator Base:** *Dimensions*, 6.2" (15.748cm) x 1.2" (3.048cm) x 1.2" (3.048cm); *Maximum*, 25 devices between isolator bases.

## Installation

FSP-851 plug-in detectors use a separate base to simplify installation, service, and maintenance. A special tool allows maintenance personnel to plug in and remove detectors without using a ladder.

Mount base on an electrical backbox which is at least 1.5" (3.81cm) deep. Suitable mounting base boxes include:

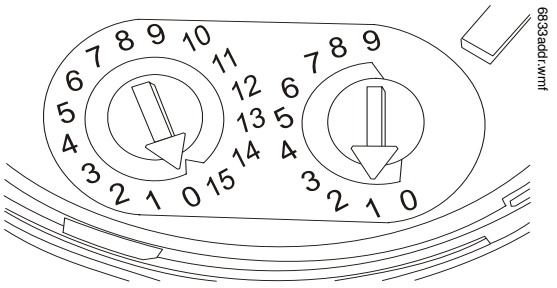
- 4.0" (10.16cm) square box.
- 3.5" (8.89cm) or 4.0" (10.16cm) octagonal box.
- Single-gang box (except relay or isolator base).
- With B501BH or B501BHT base, use a 4.0" (10.16cm) square box.
- With B224RB or B224BI base, use a 3.5" (8.89cm) octagonal box, or a 4.0" (10.16cm) octagonal or square box.

***NOTE:*** *1) Because of inherent supervision provided by the SLC loop, end-of-line resistors are not required. Wiring "T-taps" or branches are permitted for style 4 (Class "B") wiring. 2) When using relay or sounder bases, consult data sheet DN-2243 (ISO-X) for device limitations between isolator modules and isolator bases.*

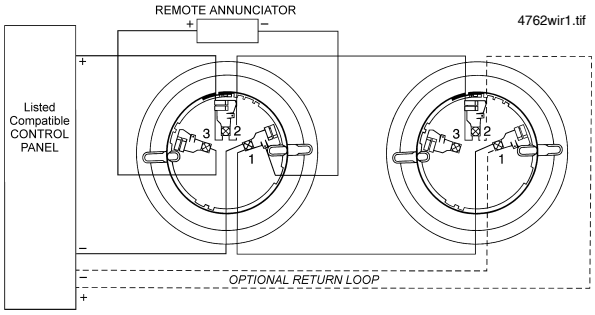
## Agency Listings and Approvals

These listings and approvals apply to the modules specified in this document. In some cases, certain modules or applications may not be listed by certain approval agencies, or listing may be in process. *Consult factory for latest listing status.*

- **UL Listed:** S1115
- **ULC Listed:** CS915 (FSP-962A, FSP-851TA)
- **MEA Listed:** 225-02-E
- **FM Approved**
- **CSFM:** 7272-0028:206
- **Maryland State Fire Marshal:** Permit # 2122
- **BSMI:** CI313066760036
- **CCCF:** Certif. # 2004081801000017 (FSP-851T)
  Certif. # 2004081801000016 (FSP-851)
- **Lloyd's Register:** 03/60011




**Address Dial on back of Detector**




**Wiring Diagram**

## Product Line Information

***NOTE:*** *"A" suffix indicates ULC listed model.*

**FSP-851:**Low-profile intelligent photoelectric sensor. Must be mounted to one of the bases listed below.

**FSP-851A:**Same as FSP-851 but with ULC listing.

**FSP-851T:**Same as FSP-851 but includes a built-in 135°F (57°C) fixed-temperature thermal device.

**FSP-851TA:**Same as FSP-851T but with ULC listing.

### *BASES*

**B710LPBP:**Standard U.S. low-profile base, pkg. of 10.

**B710LPA:**Standard U.S. low-profile base, ULC listing.

**B501BP:**Standard European flangeless base, pkg. of 10.

**B501A:**Standard European flangeless base, ULC listing.

**B501BH(A):**Sounder base, includes B501**(A)** base.

**B501BHT(A):**Same as B501BH**(A)**, but includes temporal sounder.

**B224RB(A):**Intelligent relay base.

**B224BI(A):**Intelligent isolator base. Isolates SLC from loop shorts.

### *ACCESSORIES*

**F110:**Retrofit replacement flange for older style bases. Converts old high profile base for use with FlashScan detectors.

**RA400Z(A):**Remote LED annunciator. 3-32VDC. Fits U.S. single-gang electrical box. *Supported by* B710LP(A) *and* B501(A) *bases only.*

**SMK400:**Surface mounting kit provides for entry of surface wiring conduit. *For use with* B501(A) *base only.*

**RMK400:**Recessed mounting kit. *For use with* B501(A) *base only.*

**SMB600:**Surface mounting kit for use with B710LP(A).

**BCK-200B:**Black detector covers, box of 10. For use with FSP-851 only.

**M02-04-01:**Test magnet.

**M02-09-00:**Test magnet with telescope stick.

**XR2B:**Detector removal tool. Allows installation and/or removal of FlashScan Series detector heads from base in high ceiling installations.

**T55-127-000:**Detector removal tool without pole.

**XP-4:**Extension pole for XR2B. Comes in three 5-ft. sections.

### *DETECTOR GUARDS*

***NOTE:*** *Some guards listed below may not be applicable to FPS models.*

**SDG-773:**Smoke detector guard; cover is 7.0" (17.78cm) square x 3.0" (7.62cm) deep. This guard is mechanically compatible with FSP-751. It is UL-compatibility listed with the FSP-851 (file UL S5515).

**STI 9601:**Low-profile , flush-mount smoke detector guard, wire.*

**STI 9602:**Low-profile, surface-mount, smoke detector guard, wire.*

**STI 9609:**High-profile, flush-mount, smoke detector guard, wire.*

**STI 9605:**High Profile, surface-mount, smoke detector guard, wire.*

**STI 9604:**Flush-mount, heat detector guard, wire.*

**STI 9610:**Surface-mount, heat detector guard, wire.*

**STI-8200-SS:**Flush-mount stainless steel smoke detector guard (compatibility pending).

**STI-8230-SS:**Surface mount stainless steel smoke detector guard (compatibility pending).

** For dimensions and additional information on STI Steel Web Stoppers, see data sheet DN-4936.*

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We try to keep our product information up-to-date and accurate.
We cannot cover all specific applications or anticipate all requirements.
All specifications are subject to change without notice.

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www.notifier.com

# FSD-751PL(A), FSD-751RPL(A)

## Intelligent Low-Flow Photoelectric Duct Smoke Detectors with FlashScan®

NOTIFIER® by Honeywell

**Intelligent Addressable Devices**

## General

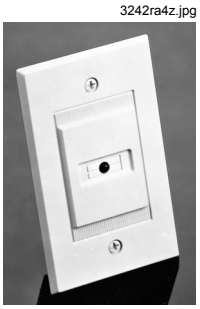
NOTIFIER FSD-751PL(A) and FSD-751RPL(A) Intelligent Photoelectric Smoke Duct Detectors provide ***low-flow*** technology that enables duct smoke detection throughout a broad range of airflow environments in HVAC applications. The low-flow technology can detect smoke at air speed velocities of 100 feet per minute (0.5 m/sec) or greater, while continuing the same reliable performance to 4,000 feet per minute (20.32 m/sec). The intelligent low-flow duct detectors sample air currents passing through a duct and gives dependable performance for shutdown of fans, blowers, and air conditioning systems, preventing the spread of toxic smoke an fire gases through the protected area.

FSD-751PL(A) and FSD-751RPL(A) are compatible with all NOTIFIER addressable panels. FSD-751PL(A) and FSD-751RPL(A) provide a remote alarm output for use with auxiliary devices, such as the RA400Z(A) remote LED annunciator, as well as remote test capability with the RTS451(A) or RTS451KEY(A) Remote Test Stations.

Traditional panels support addresses of 0 – 99. The FlashScan® protocol supports addresses of 0 – 159. The patented FlashScan communication protocol was developed by NOTIFIER Engineering, it greatly enhances the speed of communication between analog intelligent devices and the Notifier control panel. Intelligent devices communicate in a grouped fashion. If one of the devices within the group has new information, the panel stops the group poll and concentrates on single points. The net effect is response speed greater than five times that of earlier designs.

***FSD-751PL***

***FSD-751RPL***




***RA400Z***

***RTS451***

***RTS451KEY***

## Applications

Duct smoke detectors have specific limitations, they are:

- ***NOT*** a substitute for open area smoke detectors.
- ***NOT*** a substitute for early warning detection.
- ***NOT*** a replacement for a building's regular fire detection system.

Please call NOTIFIER for a copy of System Sensor's application guide, *Proper Use of Smoke Detectors in Duct Applications*, (A05-1004-00).

## Features

- Air velocity rating from 100 to 4,000 feet per minute (0.5 to 20.32 m/sec).
- Patented telescopic sampling tube.
- Easily accessible code wheels for addressing detector.
- Outside mounting tabs.
- Mounts to round or rectangular ducts from 1' to 12' (0.3 to 3.7 meters) wide.
- Transparent cover for convenient visual inspection.

## Installation

Refer to installation manuals for control panel and duct detector for detailed information or to install equipment. Installation manuals for detectors: I561978-003R for FSD-751PL(A), 156-1979-004R for FSD-751RPL(A).

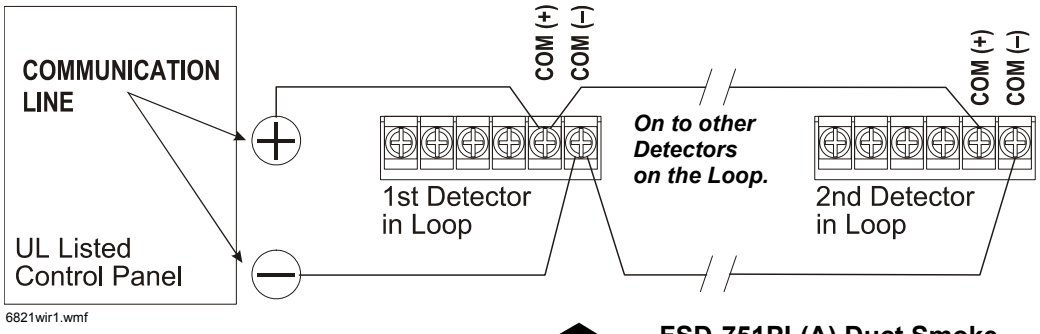
**Wiring:** For signal wiring (the wiring between detectors or from detectors to auxiliary devices), it is recommended that single conductor wire be no smaller than 18 AWG (0.821 mm²). The duct smoke detector terminals accommodate wire sizes up to 12 AWG (3.31 mm²). Flexible conduit is recommended for the last foot (30.48 cm) of conduit; solid conduit connections may be used if desired.

Smoke detectors and alarm system control panels have specifications for Signaling Line Circuit (SLC) wiring. Consult the control panel specifications for wiring requirements before wiring the detector loop. The FSD-751PL(A) and FSD-751RPL(A) detectors are designed for ease of wiring; their housing provides a terminal strip with clamping plates.

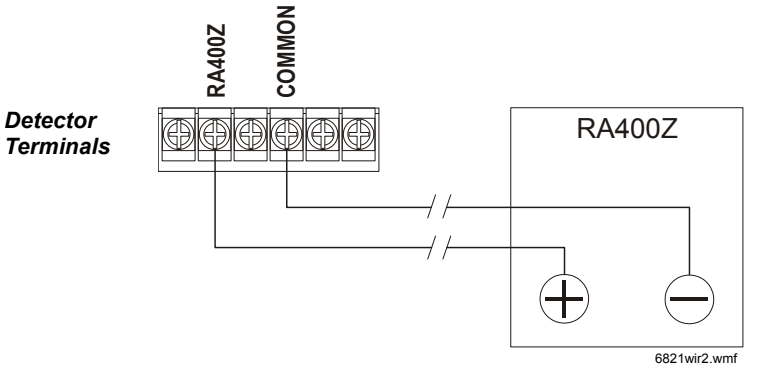
**LED Features:** If programmed with the system control panel, two LEDs on each duct smoke detector light to provide local visible indication.

**Programming specifications/requirements for intelligent system control panels:** The number of devices that can have their LEDs programmed to illuminate is limited by the features of the panel and the individual devices. The actual number of devices is determined by the control panel and its ability to supply LED current. Refer to the control panel installation manual for details.

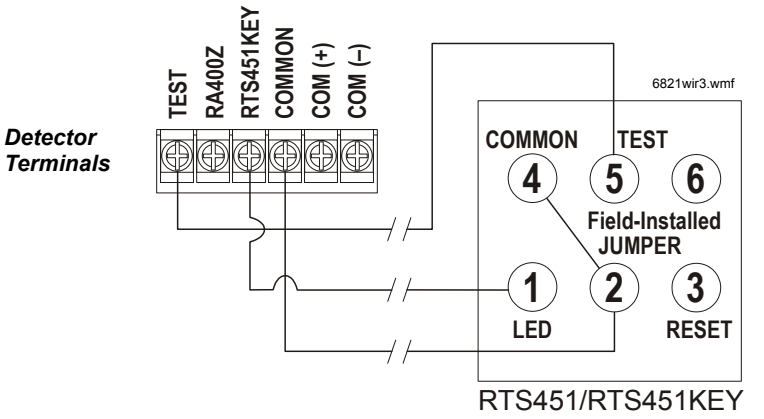
## Wiring Diagrams for FSD-751PL(A)




**FSD-751PL(A) Duct Smoke Detector using a UL or ULC Listed control panel.**




**FSD-751PL(A) Duct Smoke Detector with an optional RA400Z(A).**




**FSD-751PL(A) Duct Smoke Detector with RTS451(A)/ RTS451KEY(A).**

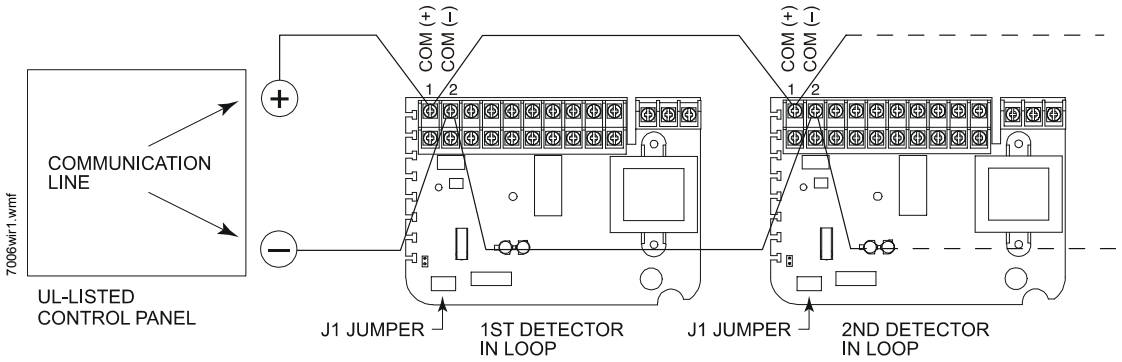
***NOTE:*** *For **RTS451(A)**, Terminal 3 is not used. RTS451(A) does not have a Terminal 6. For **RTS451KEY(A)**, Terminals 3 and 6 are not used.*

## Inlet Tube Selection

| Outside Duct Width | Inlet Tube* |
|---|---|
| Up to 2 feet (0.6096 m) | ST-1.5(A) |
| 2 to 4 feet (0.6096 to 1.2192 m) | ST-3(A) |
| 4 to 8 feet (1.2192 to 2.4384 m) | ST-5(A) |
| 8 to 12 feet (2.4384 to 3.6576 m) | ST-10(A) |
| **Inlet tube is required and must be purchased separately. Order One inlet tube for each duct smoke detector ordered.* | |

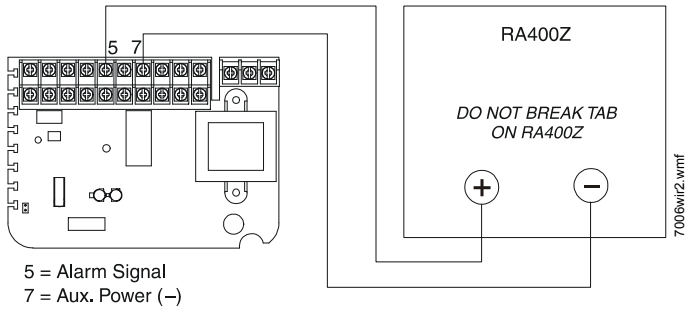
## Wiring Diagrams for FSD-751RPL(A)

### FSD-751RPL(A) Duct Smoke Detector using a UL-Listed control panel:

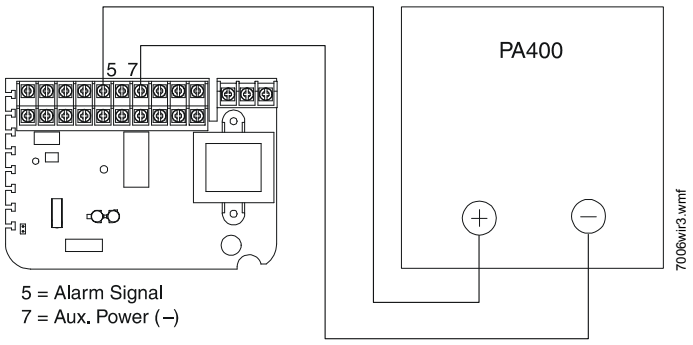



***NOTE: 1) Jumper J1 shunt** must be installed for 2-W applications. J1 shunt must be removed for power PCB supervision. Note that removal of shunt without adding external power will prevent communications to the panel over the SLC. **2)** External power of 24 V AC/DC or 120/220 VAC must be connected in order to **power all remote horn or strobe accessories.***

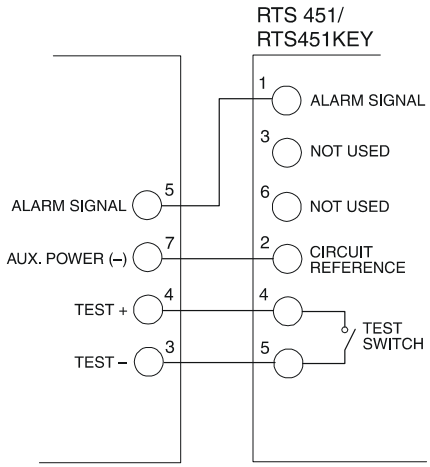
### FSD-751RPL(A) Duct Smoke Detector with an optional RA400Z(A):




### FSD-751RPL(A) Duct Smoke Detector with an optional PA400:




### FSD-751RPL(A) Duct Smoke Detector with RTS451(A)/RTS451KEY(A):




*FOR RTS451, TERMINAL 3 IS NOT USED. (RTS451 DOES NOT HAVE A TERMINAL 6.) FOR RTS451KEY, TERMINALS 3 AND 6 ARE NOT USED.*

7006wir4.wmf

## Product Line Information

***NOTE:** "A" model suffix is for Canadian models.*

**FSD-751PL:** Addressable low-flow duct detector housing with photoelectric smoke detector.

**FSD-751PLA:** Same as above with ULC listing.

**FSD-751RPL:** Addressable low-flow duct detector housing with photoelectric smoke detector with DPDT relay.

**FSD-751RPLA:** Same as above with ULC listing.

**A5053FS:** Replacement photoelectric sensor board.

**A5067:** Replacement power board (without relay).

**A5060:** Replacement power board (with relay).

**ST-1.5(A):** Metal sampling tube, duct widths 1' to 2' *(see Inlet Tube Selection table on page 2 for metric lengths)*.

**ST-3(A):** Metal sampling tube, duct widths 2' to 4'.

**ST-5(A):** Metal sampling tube, duct widths 4' to 8'.

**ST-10(A):** Metal sampling tube, duct widths 8' to 12'.

**RA400Z(A):** Remote annunciator alarm LED.

**RTS451(A):** Remote test station. Mounts in single-gang box. Includes red alarm LED and magnet test switch.

**RTS451KEY(A):** Key-activated remote test station.

**F36-09-11:** Replacement filters.

**M02-04-00:** Test magnet.

**M02-09-00:** Test magnet with telescoping handle.

**S08-39-01:** Replacement photo insect screen.

**P48-61-00:** Replacement end cap for plastic sampling tube.

**P48-21-00:** Replacement end cap for metal sampling tube.

**T80-71-00:** Replacement plastic sampling tube.

## Specifications

### *FOR FSD-751PL(A)*

**Operating voltage range:** 15 to 30 VDC.

**Standby current:** 300 µA @ 24 VDC (one communication every 5 seconds with LED blink enabled).

**Operating temperature range:** 32° to 131°F (0° to 55°C).

**Operating humidity range:** 10% to 93% relative humidity (non-condensing).

**Storage temperature range:** –22°F to +158°F (–30°C to +70°C).

**Duct air velocity:** 100 to 4,000 feet/min (0.5 to 20.32 m/s).

**Shipping weight:** 3.35 lbs. (1.5 kg).

**Dimensions:** 14.75" (37 cm) length x 5.50" (14 cm) width x 2.75" (7 cm) deep.

**FSD-751PL(A) accessory current loads @ 24 VDC:**
***RA400Z(A):*** 0 mA standby, 10 mA maximum in alarm. ***RTS451(A) and RTS451KEY(A):*** 0 mA standby, 7.5 mA maximum in alarm.

### *FOR FSD-751RPL(A)*

**Operating voltage range:** 20 to 30 VDC, 24 VAC/VDC, 120/240 VAC auxiliary power (requires a separate auxiliary source).

**Standby current:** 300 µA @ 24 VDC (one communication every 5 seconds with LED blink enabled).

**Operating temperature range:** 32° to 131°F (0° to 55°C).

**Operating humidity range:** 10% to 93% relative humidity (non-condensing).

**Storage temperature range:** –22°F to +158°F (–30°C to +70°C).

**Duct air velocity:** 100 to 4,000 feet/min (0.5 to 20.32 m/s).

**Shipping weight:** 3.90 lbs. (1.8 kg).

**Dimensions:** 14.75" (37 cm) length x 5.50" (14 cm) width x 2.75" (7 cm) deep.

### *FSD-751RPL(A) CONTACT RATINGS*

**Alarm auxiliary contacts (DPDT):** 10 A @ 30 VDC; 10 A @ 277 VAC (0.75 power factor); 240 VA @ 249 VAC (0.4 power factor); 1/8 HP @ 120 VAC; 1/4 HP @ 240 VAC.

**Minimum switching current for auxiliary contact** must be 100 mA DC minimum @ 5 VDC.

**Supervisory contact (SPST):** 2.0 A @ 30 VDC (resistive).

**FSD-751RPL(A) accessory current loads @ 24 VDC:** ***PA400:*** refer to PA400 data sheet DN-2405. ***RA400Z(A):*** 0 mA standby, 12 mA maximum in alarm. ***RTS451(A) and RTS451KEY(A):*** 0 mA standby, 10 mA maximum in alarm.

### *FSD-751RPL(A) CURRENT REQUIREMENTS (USING NO ACCESSORIES)*

**20 – 30 VDC power supply voltage:** 26 mA maximum standby current; 87 mA maximum alarm current; 3 to 10 second alarm response time; 2 second power-up time.

**24 VAC, 50/60 Hz power supply voltage:** 65 mA RMS maximum standby current; 182 mA RMS maximum alarm current; 3 to 10 second alarm response time; 2 second power-up time.

**120 VAC, 50/60 Hz power supply voltage:** 44 mA RMS maximum standby current; 52 mA RMS maximum alarm current; 3 to 10 second alarm response time; 2 second power-up time.

**220/240 VAC, 50/60 Hz power supply voltage:** 25 mA RMS maximum standby current; 30 mA RMS maximum alarm current; 3 to 10 second alarm response time; 2 second power-up time.

## Agency Listings and Approvals

The listings and approvals below apply to FSD-751PL(A) and FSD-751RPL(A) Intelligent Low-Flow Photoelectric Smoke Duct Detectors. In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL** Listed: file S1115 *(FSD-751PL, FSD-751RPL)*.
- **ULC** Listed: file S115 *(FSD-751PLA, FSD-751RPLA)*.
- **CSFM** approved: file 3240-0028:205.
- **FM** approved.
- **MEA** approved: file 384-02-E.
- **Maryland State Fire Marshal** approved: Permit #2127.

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# FCM & FRM Series

## Control and Relay Modules with FlashScan®

NOTIFIER® by Honeywell

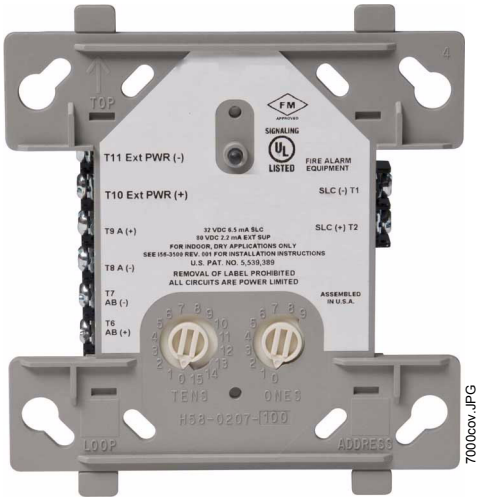
**Intelligent/Addressable Devices**

## General

**FCM-1 Control Module:** The FCM-1 Addressable Control Module provides Notifier intelligent control panels a circuit for Notification Appliances (horns, strobes, speakers, etc.) or to monitor a telephone circuit. Addressability allows the FCM-1 to be activated, either manually or through panel programming, on a select (zone or area of coverage) basis.

**FRM-1 Relay Module:** The FRM-1 Addressable Relay Module provides the system with a dry-contact output for activating a variety of auxiliary devices, such as fans, dampers, control equipment, etc. Addressability allows the dry contact to be activated, either manually or through panel programming, on a select basis.

FlashScan® (U.S. Patent 5,539,389) is a communication protocol developed by NOTIFIER Engineering that greatly enhances the speed of communication between analog intelligent devices. Intelligent devices communicate in a grouped fashion. If one of the devices within the group has new information, the panel CPU stops the group poll and concentrates on single points. The net effect is response speed greater than five times that of other designs.




**FCM-1**

## Features

- Built-in type identification automatically identifies these devices to the control panel.
- Internal circuitry and relay powered directly by two-wire SLC loop. The FCM-1 module requires power (for horns, strobes, etc.), audio (for speakers), or a telephone riser (for handsets).
- Integral LED “blinks” green each time a communication is received from the control panel and turns on in steady red when activated.
- LED blink may be deselected globally (affects all devices).
- High noise immunity (EMF/RFI).
- The FCM-1 may be used to switch 24-volt NAC power, audio (up to 70.7 Vrms) or telephone.
- Wide viewing angle of LED.
- SEMS screws with clamping plates for wiring ease.
- Direct-dial entry of address 01– 159 for FlashScan loops, 01 – 99 for CLIP mode loops.
- Speaker, audible/visual, and telephone applications may be wired for Class B or A (Style Y or Z).

## Applications

The FCM-1 is used to switch 24 VDC audible/visual power, high-level audio (speakers), or control telephone devices. The FRM-1 may be programmed to operate dry contacts for applications such as door holders or Air Handling Unit shutdown, and to reset four-wire smoke detector power.

***NOTE:*** *Refer to the SLC Manual (PN 51253) for details regarding releasing applications with the FCM-1. Refer to the FCM-1-REL datasheet (DN-60390) for more extensive releasing applications.*

## Construction

- The face plate is made of off-white heat-resistant plastic.
- Controls include two rotary switches for direct-dial entry of address (01-159).
- The FCM-1 is configured for a single Class B (Style Y) or Class A (Style Z) Notification Appliance Circuit.
- The FRM-1 provides two Form-C dry contacts that switch together.

## Operation

Each FCM-1 or FRM-1 uses one of 159 possible module addresses on a SLC loop (99 on CLIP loops). It responds to regular polls from the control panel and reports its type and status, including the open/normal/short status of its Notification Appliance Circuit (NAC). The LED blinks with each poll received. On command, it activates its internal relay. The FCM-1 supervises Class B (Style Y) or Class A (Style Z) notification or control circuits.

Upon code command from the panel, the FCM-1 will disconnect the supervision and connect the external power supply in the proper polarity across the load device. The disconnection of the supervision provides a positive indication to the panel that the control relay actually turned ON. The external power supply is always relay isolated from the communication loop so that a trouble condition on the external power supply will never interfere with the rest of the system.

Rotary switches set a unique address for each module. The address may be set before or after mounting. The built-in TYPE CODE (not settable) will identify the module to the control panel, so as to differentiate between a module and a sensor address.

## Specifications for FCM-1

**Normal operating voltage:** 15 to 32 VDC.

**Maximum current draw:** 6.5 mA (LED on).

**Average operating current:** 350 µA direct poll (CLIP mode), 375 µA group poll (FlashScan® mode) with LED flashing.

**External supply voltage (between Terminals T3 and T4):** maximum 80 volts (RMS or DC).

**Drain on external supply:** 2 mA maximum (using internal EOL relay).

**EOL resistance:** 47K ohms.

**Temperature range:** 32°F to 120°F (0°C to 49°C).

**Humidity range:** 10% to 93% non-condensing.

**Dimensions:** 4.5" (114.3 mm) high x 4" (101.6 mm) wide x 1.25" (31.75 mm) deep. Mounts to a 4" (101.6 mm) square x 2.125" (53.975 mm) deep box.

## Specifications for FRM-1

**Normal operating voltage:** 15 to 32 VDC.

**Maximum current draw:** 6.5 mA (LED on).

**Average operating current:** 230 µA direct poll (CLIP mode), 255 µA group poll (FlashScan® mode) with LED flashing.

**EOL resistance:** not used.

**Temperature range:** 32°F to 120°F (0°C to 49°C).

**Humidity range:** 10% to 93% non-condensing.

**Dimensions:** 4.5" (114.3 mm) high x 4" (101.6 mm) wide x 1.25" (31.75 mm) deep. Mounts to a 4" (101.6 mm) square x 2.125" (53.975 mm) deep box.

## Contact Ratings

***FOR BOTH FCM-1 AND FRM-1 MODELS***

| Load Description | Application | Maximum Voltage | Current Rating |
|---|---|---|---|
| Resistive | Non-Coded | 30 VDC | 3.0 A |
| Resistive | Coded | 30 VDC | 2.0 A |
| Resistive | Non-Coded | 110 VDC | 0.9 A |
| Resistive | Non-Coded | 125 VAC | 0.9 A |
| Inductive (L/R=5ms) | Coded | 30 VDC | 0.5 A |
| Inductive (L/R=2ms) | Coded | 30 VDC | 1.0 A |
| Inductive (PF=0.35) | Non-Coded | 125 VAC | 0.5 A |

***NOTE:*** *Maximum (Speakers): 70.7 V RMS, 50 W*

## Agency Listings and Approvals

In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL:** S635
- **ULC:** S7557 (A version only)
- **FM Approved**
- **CSFM:** 7300-0028:202
- **MEA:** 14-00-E

## Product Line Information

***NOTE:*** *"A" suffix indicates ULC Listed model.*

**FCM-1(A):** Intelligent Addressable Control Module.

**FRM-1(A):** Intelligent Addressable Relay Module.

**A2143-20:** Capacitor, required for Class A (Style Z) operation of speakers.

**SMB500:** Optional Surface-Mount Backbox.

**CB500:** Control Module Barrier — required by UL for separating power-limited and non-power limited wiring in the same junction box as FCM-1.

***NOTE:*** *For installation instructions, see the following documents:*

- *FCM-1 Installation document I56-1169.*
- *FRM-1 Installation document I56-3502.*
- *Notifier SLC Wiring Manual, document 51253.*

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# FMM-1, FMM-101, FZM-1 & FDM-1

## Monitor Modules with FlashScan®

NOTIFIER® by Honeywell

**Intelligent/Addressable Devices**

## General

Four different monitor modules are available for Notifier's intelligent control panels for a variety of applications. Monitor modules supervise a circuit of dry-contact input devices, such as conventional heat detectors and pull stations, or monitor and power a circuit of two-wire smoke detectors (FZM-1).

**FMM-1** is a standard-sized module (typically mounts to a 4" [10.16 cm] square box) that supervises either a Class A (Style D) or Class B (Style B) circuit of dry-contact input devices.

**FMM-101** is a miniature monitor module (a mere 1.3" (3.302 cm) H x 2.75" (6.985 cm) W x 0.5" (1.270 cm) D) that supervises a Class B (Style B) circuit of dry-contact input devices. Its compact design allows the FMM-101 to often be mounted in a single-gang box behind the device it monitors.

**FZM-1** is a standard-sized module that monitors and supervises compatible two-wire, 24 volt, smoke detectors on a Class A (Style D) or Class B (Style B) circuit.

**FDM-1** is a standard-sized dual monitor module that monitors and supervises two independent two-wire Style B (Class B) dry-contact initiating device circuits (IDCs) at two separate, consecutive addresses in intelligent, two-wire systems.

FlashScan® (U.S. Patent 5,539,389) is a communication protocol developed by NOTIFIER that greatly increases the speed of communication between analog intelligent devices. Intelligent devices communicate in a grouped fashion. If one of the devices within the group has new information, the panel CPU stops the group poll and concentrates on single points. The net effect is response speed greater than five times that of other designs. protocols.

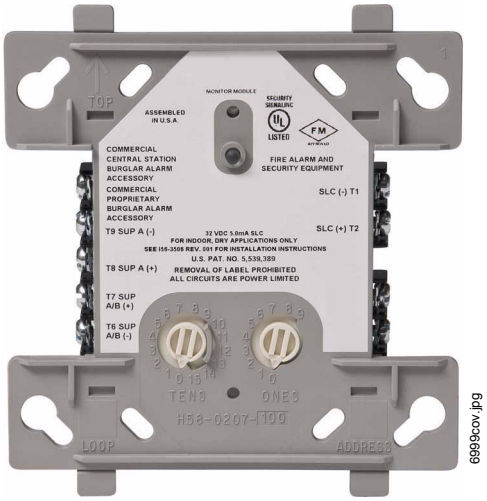
## FMM-1 Monitor Module

- Built-in type identification automatically identifies this device as a monitor module to the control panel.
- Powered directly by two-wire SLC loop. No additional power required.
- High noise (EMF/RFI) immunity.
- SEMS screws with clamping plates for ease of wiring.
- Direct-dial entry of address: 01 – 159 on FlashScan systems; 01 – 99 on CLIP systems. , 01 – 99 on .
- LED flashes green during normal operation (this is a programmable option) and latches on steady red to indicate alarm.

The FMM-1 Monitor Module is intended for use in intelligent, two-wire systems, where the individual address of each module is selected using the built-in rotary switches. It provides either a two-wire or four-wire fault-tolerant Initiating Device Circuit (IDC) for normally-open-contact fire alarm and supervisory devices. The module has a panel-controlled LED indicator. The FMM-1 can be used to replace MMX-1 modules in existing systems.

### *FMM-1 APPLICATIONS*

Use to monitor a zone of four-wire smoke detectors, manual fire alarm pull stations, waterflow devices, or other normally-open dry-contact alarm activation devices. May also be used to monitor normally-open supervisory devices with special supervisory indication at the control panel. Monitored circuit may be wired as an NFPA Style B (Class B) or Style D (Class




**FMM-1 (Type H)**

A) Initiating Device Circuit. A 47K ohm End-of-Line Resistor (provided) terminates the Style B circuit. No resistor is required for supervision of the Style D circuit.

### *FMM-1 OPERATION*

Each FMM-1 uses one of the available module addresses on an SLC loop. It responds to regular polls from the control panel and reports its type and the status (open/normal/short) of its Initiating Device Circuit (IDC). A flashing LED indicates that the module is in communication with the control panel. The LED latches steady on alarm (subject to current limitations on the loop).

### *FMM-1 SPECIFICATIONS*

**Nominal operating voltage:** 15 to 32 VDC.

**Maximum current draw:** 5.0 mA (LED on).

**Maximum operating current:** 375 µA (LED flashing).

**Maximum IDC wiring resistance:** 1,500 ohms.

**EOL resistance:** 47K ohms.

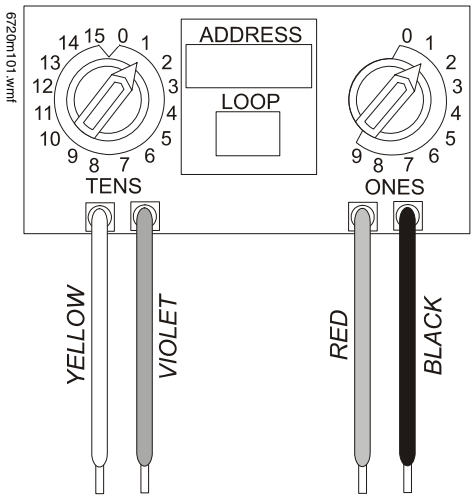
**Temperature range:** 32°F to 120°F (0°C to 49°C).

**Humidity range:** 10% to 93% noncondensing.

**Dimensions:** 4.5" (11.43 cm) high x 4" (10.16 cm) wide x 1.25" (3.175 cm) deep. Mounts to a 4" (10.16 cm) square x 2.125" (5.398 cm) deep box.

## FMM-101 Mini Monitor Module

- Built-in type identification automatically identifies this device as a monitor module to the panel.
- Powered directly by two-wire SLC loop. No additional power required.
- High noise (EMF/RFI) immunity.
- Tinned, stripped leads for ease of wiring.
- Direct-dial entry of address: 01 – 159 on FlashScan systems; 01 – 99 on CLIP systems. , 01 – 99 on .




The FMM-101 Mini Monitor Module can be installed in a single-gang junction directly behind the monitored unit. Its small size and light weight allow it to be installed without rigid mounting. The FMM-101 is intended for use in intelligent, two-wire systems where the individual address of each module is selected using rotary switches. It provides a two-wire initiating device circuit for normally-open-contact fire alarm and security devices. The FMM-101 can be used to replace MMX-101 modules in existing systems.

### *FMM-101 APPLICATIONS*

Use to monitor a single device or a zone of four-wire smoke detectors, manual fire alarm pull stations, waterflow devices, or other normally-open dry-contact devices. May also be used to monitor normally-open supervisory devices with special supervisory indication at the control panel. Monitored circuit/device is wired as an NFPA Style B (Class B) Initiating Device Circuit. A 47K ohm End-of-Line Resistor (provided) terminates the circuit.

### *FMM-101 OPERATION*

Each FMM-101 uses one of the available module addresses on an SLC loop. It responds to regular polls from the control panel and reports its type and the status (open/normal/short) of its Initiating Device Circuit (IDC).

### *FMM-101 SPECIFICATIONS*

**Nominal operating voltage:** 15 to 32 VDC.

**Maximum operating current:** 375 µA.

**Maximum IDC wiring resistance:** 1,500 ohms.

**EOL resistance:** 47K ohms.

**Temperature range:** 32°F to 120°F (0°C to 49°C).

**Humidity range:** 10% to 93% noncondensing.

**Dimensions:** 1.3" (3.302 cm) high x 2.75" (6.985 cm) wide x 0.65" (1.651 cm) deep.

**Wire length:** 6" (15.24 cm) minimum.

## FZM-1 Interface Module

- Supports compatible two-wire smoke detectors.
- Supervises IDC wiring and connection of external power source.
- High noise (EMF/RFI) immunity.
- SEMS screws with clamping plates for ease of wiring.
- Direct-dial entry of address: 01 – 159 on FlashScan systems, 01 – 99 on CLIP systems.
- LED flashes during normal operation; this is a programmable option.
- LED latches steady to indicate alarm on command from control panel.

The FZM-1 Interface Module is intended for use in intelligent, addressable systems, where the individual address of each module is selected using built-in rotary switches. This module allows intelligent panels to interface and monitor two-wire conventional smoke detectors. It transmits the status (normal, open, or alarm) of one full zone of conventional detectors back to the control panel. All two-wire detectors being monitored must be UL compatible with the module. The FZM-1 can be used to replace MMX-2 modules in existing systems.

### *FZM-1 APPLICATIONS*

Use the FZM-1 to monitor a zone of two-wire smoke detectors. The monitored circuit may be wired as an NFPA Style B (Class B) or Style D (Class A) Initiating Device Circuit. A 3.9 K ohm End-of-Line Resistor (provided) terminates the end of the Style B or D (class B or A) circuit (maximum IDC loop resistance is 25 ohms). Install ELR across terminals 8 and 9 for Style D application.

### *FZM-1 OPERATION*

Each FZM-1 uses one of the available module addresses on an SLC loop. It responds to regular polls from the control panel and reports its type and the status (open/normal/short) of its Initiating Device Circuit (IDC). A flashing LED indicates that the module is in communication with the control panel. The LED latches steady on alarm (subject to current limitations on the loop).

### *FZM-1 SPECIFICATIONS*

**Nominal operating voltage:** 15 to 32 VDC.

**Maximum current draw:** 5.1 mA (LED on).

**Maximum IDC wiring resistance:** 25 ohms.

**Maximum operating current:** 270 µA (LED flashing).

**EOL resistance:** 3.9K ohms.

**External supply voltage (between Terminals T3 and T4):** DC voltage: 24 volts power limited. Ripple voltage: 0.1 Vrms maximum. Current: 90 mA per module maximum.

**Temperature range:** 32°F to 120°F (0°C to 49°C).

**Humidity range:** 10% to 93% noncondensing.

**Dimensions:** 4.5" (11.43 cm) high x 4" (10.16 cm) wide x 1.25" (3.175 cm) deep. Mounts to a 4" (10.16 cm) square x 2.125" (5.398 cm) deep box.

## FDM-1 Dual Monitor Module

The FDM-1 Dual Monitor Module is intended for use in intelligent, two-wire systems. It provides two independent two-wire initiating device circuits (IDCs) at two separate, consecutive addresses. It is capable of monitoring normally open contact fire alarm and supervisory devices; or either normally open or normally closed security devices. The module has a single panel-controlled LED.

***NOTE:*** *The FDM-1 provides two Class B (Style B) IDC circuits ONLY. Class A (Style D) IDC circuits are NOT supported in any application.*

### *FDM-1 SPECIFICATIONS*

**Normal operating voltage range:** 15 to 32 VDC.

**Maximum current draw:** 6.4 mA (LED on).

**Maximum operating current:** 750 µA (LED flashing).

**Maximum IDC wiring resistance:** 1,500 ohms.

**EOL resistance:** 47K ohms.

**Temperature range:** 32° to 120°F (0° to 49°C).

**Humidity range:** 10% to 93% (non-condensing).

**Dimensions:** 4.5" (11.43 cm) high x 4" (10.16 cm) wide x 2.125" (5.398 cm) deep.

### *FDM-1 AUTOMATIC ADDRESSING*

The FDM-1 automatically assigns itself to two addressable points, starting with the original address. For example, if the FDM-1 is set to address “26”, then it will automatically assign itself to addresses “26” and “27”.

***NOTE:*** *“Ones” addresses on the FDM-1 are 0, 2, 4, 6, or 8 only. Terminals 6 and 7 use the first address, and terminals 8 and 9 use the second address.*

**CAUTION:**
Avoid duplicating addresses on the system.

## Installation

FMM-1, FZM-1, and FDM-1 modules mount directly to a standard 4" (10.16 cm) square, 2.125" (5.398 cm) deep, electrical box. They may also be mounted to the SMB500 surface-mount box. Mounting hardware and installation instructions are provided with each module. All wiring must conform to applicable local codes, ordinances, and regulations. These modules are intended for power-limited wiring only.

The FMM-101 module is intended to be wired and mounted without rigid connections inside a standard electrical box. All wiring must conform to applicable local codes, ordinances, and regulations.

## Agency Listings and Approvals

In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL:** S635
- **ULC:** S3705
- **FM Approved**
- **CSFM:** 7300-0028:202
- **MEA:** 457-99-E, 457-99-E Vol. 3, 143-01-E
- **U.S. Coast Guard:**
  - 161.002/23/3 *(AFP-200: FMM-1/-101, FZM-1)*
  - 161.002/42/1 *(NFS-640: FMM-1/-101)*
- **Lloyd’s Register:**
  - 03/60011/E1 *(FMM-1/-101, FZM-1)*
  - 94/60004/E2 *(AFP-200: except FDM-1)*
  - 02/60007 *(NFS-640: FDM-1)*

## Product Line Information

***NOTE:*** *“A” suffix indicates ULC-listed model.*

**FMM-1(A):** Monitor module.

**FMM-101(A):** Monitor module, miniature.

**FZM-1(A):** Monitor module, two-wire detectors.

**FDM-1(A):** Monitor module, dual, two independent Class B circuits.

**SMB500:** Optional surface-mount backbox.

***NOTE:*** *See installation instructions and refer to the SLC Wiring Manual, PN 51253.*

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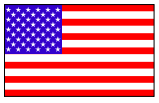
We cannot cover all specific applications or anticipate all requirements.
All specifications are subject to change without notice.



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# SpectrAlert® Advance

**Indoor Selectable Output Speaker Strobes and Dual Voltage Evacuation Speakers**

NOTIFIER® by Honeywell

**Audio/Visual Devices**

## General

The SpectrAlert Advance Series of speakers and speaker strobes is designed to reduce ground faults. The plug-in design allows the installer to pre-wire mounting plates and dress the wires before plugging in the speakers. The plastic cover prevents nicked wires by covering exposed speaker components.

This design also allows faster installations with instant feedback to ensure that wiring is properly connected, rotary switches to select voltage and power settings, and 11 field selectable candela settings for wall and ceiling speaker strobes.

The low total harmonic distortion of the SP speaker offers high fidelity sound output while the SPV speaker offers high volume sound output for use in high ambient noise applications.

*SpectrAlert Advance makes installation easy*

- Attach a universal mounting plate to a 4" x 4" x 2-1/8" back box. Flush mount applications are achievable without the need for an extension ring.
- Connect the notification appliance circuit or speaker wiring to the PEMS terminals on the mounting plate.
- Attach the speaker or speaker strobe to the mounting plate by inserting the product tabs into the mounting plate grooves. Rotate the device into position to lock the product pins into the mounting plate terminals. The device will temporarily hold in place with a catch until it is secured with a captured mounting screw.

## Features

- Plug-in design
- Protective cover isolates speaker components, reduces ground faults
- Electrical compatibility with existing SpectrAlert products
- Field selectable candela settings on wall and ceiling units:
  - Standard: 15, 15/75, 30, 75, 95, 110, 115
  - High: 135, 150, 177, 185
- Shorting spring on mounting plate tests continuity before installation
- Rotary switch simplifies field selection of speaker voltage and power settings
- Universal mounting plate for wall- and ceiling-mount units
- Compatible with System Sensor synchronization protocol
- SP speakers offer high fidelity sound output
- SPV speakers offer high volume sound output
- Automatic selection of 12 or 24 volt operation at 15 and 15/75 candela
- No extension ring required
- Ceiling and wall mount application
- Optional tamper resistant Torx head screw included

## Specifications

### *PHYSICAL SPECIFICATIONS*

**Operating Temperature:** 32°F to 120°F (0°C to 49°C)

**Humidity Range:** 10 to 93% non-condensing

**Dimensions, Wall-Mount:**

**SPS Speaker Strobe:** 6.0"L x 5.0"W x 4.7"D (includes lens and speaker)

**SPSV Speaker Strobe:** 6.0"L x 5.0"W x 4.9"D (includes lens and speaker)

**SP Speaker:** 6.0"L x 5.0"W x 2.8"D

**SPSV Speaker:** 6.0"L x 5.0"W x 2.9"D

**Dimensions, Ceiling-Mount:**

**SPS Speaker Strobe:** 6.8"Dia x 4.7"D (includes lens and speaker)

**SPSV Speaker Strobe:** 6.8"Dia x 4.8"D (includes lens and speaker)

**SP Speaker:** 6.8"Dia x 2.8"D

**SPSV Speaker:** 6.8"Dia x 2.9"D

### *ELECTRICAL/OPERATING SPECIFICATIONS*

**Nominal Voltage (speakers):** 25 Volts or 70.7 Volts (nominal)

**Maximum Supervisory Voltage (speakers):** 50VDC

**Strobe Flash Rate:** 1 flash per second

**Nominal Voltage (strobes):** Regulated 12VDC/FWR or regulated 24DC/FWR

**Operating Voltage Range (includes fire alarm panels with built-in sync):** 8 to 17.5V (12V nominal) or 16 to 33V (24V nominal)

**Operating Voltage with MDL Sync Module:** 9 to 17.5V (12V nominal) or 17 to 33V (24V nominal)

**Frequency Range:** 400 to 4000 Hz

**Power:** ¼, ½, 1, 2 watts

## Agency Listings and Approvals

In some cases, certain modules may not be listed by certain approval agencies, or listing may be in progress. *Consult factory for latest listing status.*

- **UL Listed:** S4048
- **MEA:** 10-08-E
- **CSFM:** 7320-1653:201
- **FM Approved**

| UL Maximum Strobe Current Draw (mA RMS) | | | | | |
|---|---|---|---|---|---|
| | Candela | 8 to 17.5 Volts | | 16 to 33 Volts | |
| | | DC | FWR | DC | FWR |
| Standard Candela Range | 15 | 123 | 128 | 66 | 71 |
| | 15/75 | 142 | 148 | 77 | 81 |
| | 30 | NA | NA | 94 | 96 |
| | 75 | NA | NA | 158 | 153 |
| | 95 | NA | NA | 181 | 176 |
| | 110 | NA | NA | 202 | 195 |
| | 115 | NA | NA | 210 | 205 |
| High Candela Range | 135 | NA | NA | 228 | 207 |
| | 150 | NA | NA | 246 | 220 |
| | 177 | NA | NA | 281 | 251 |
| | 185 | NA | NA | 286 | 258 |

| Sound Output | | | | |
|---|---|---|---|---|
| UL Reverberant (dBA @ 10ft) | 2W | 1W | ½W | ¼W |
| Wall Mount SP Series | 86 | 83 | 80 | 77 |
| Wall Mount SPV Series | 90 | 87 | 84 | 81 |
| Ceiling Mount SPC Series | 86 | 83 | 80 | 77 |
| Ceiling Mount SPCV Series | 90 | 87 | 84 | 81 |
| Wall Mount SPS Series | 85 | 82 | 79 | 76 |
| Wall Mount SPSV Series | 89 | 86 | 83 | 80 |
| Ceiling Mount SPSC Series | 85 | 82 | 79 | 76 |
| Ceiling Mount SPSCV Series | 89 | 86 | 83 | 80 |

# Architectural/Engineering Specifications

### *GENERAL*

SpectrAlert Advance speaker and speaker strobes shall mount to a 4" x 4" x 2-1/8" backbox. A universal mounting plate shall be used for mounting ceiling and wall products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate. Also, SpectrAlert Advance speaker strobes, when used with the Sync Circuit. Module accessory, shall be powered from a non-coded notification appliance circuit output and shall operate on a nominal 12 or 24volts. When used with the Sync.Circuit Module, 12 volt rated notification appliance circuit outputs shall operate between nine and 17.5 volts; 24 volt rated notification appliance circuit outputs shall operate between 17 and 33 volts. Indoor SpectrAlert Advance products shall operate between 32°F and 120°F from a regulated DC, or full-wave rectified, unfiltered power supply. Speaker strobes shall have field-selectable candela settings including 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, 185.

### *SPEAKER*

The speaker shall be a System Sensor SpectrAlert Advance model _____ dual-voltage transformer speaker capable of operating at 25.0 or 70.7 nominal Vrms. It should be listed to UL 1480 and shall be approved for fire protective service. The speaker shall have a frequency range of 400 to 4000Hz and shall have an operating temperature between 32°F and 120°F. Speaker shall have power taps and voltage that are selected by rotary switches.

### *SPEAKER STROBE COMBINATION*

The speaker strobe shall be a System Sensor SpectrAlert Advance model _____ listed to UL1480 and UL 1971 and be approved for fire protective signaling systems. Speaker shall be capable of operating at 25.0 or 70.7 nominal Vrms selected via rotary switch, and shall have a frequency range of 400 to 4000Hz. Speaker shall have power taps which are selected by rotary switch. The strobe shall comply with the NFPA 72 requirements for visible signaling appliances, flashing at 1Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system.

### *SYNCHRONIZATION MODULE*

The module shall be a System Sensor Sync Circuit model MDL listed to UL 464 and shall be approved for fire protective service. The module shall synchronize SpectrAlert strobes at 1Hz. The module shall mount to a 4-11/16" x 4-11/16" x 2-1/8" backbox. The module shall also control two Style Y (class B) circuits or one Style Z (class A) circuit. The module shall synchronize multiple zones. Daisy chaining two or more synchronization modules together will synchronize all the zones they control. The module shall not operate on a coded power supply.

# Ordering Information

***NOTE:*** *(W) indicates white coloring; (R), red.*

### *WALL MOUNT*

**SP(W)(R):** Speaker only.

**SP(W)(R)V:** Speaker only, high dB; white.

**SPS(W)(R)*:** Speaker strobe, selectable candela (15, 15/75, 30, 75, 95, 100, 115).

**SPS(W)(R)H*:** Speaker strobe, selectable candela, high cd (135, 150, 177, 185).

**SPS(W)(R)V*:** Speaker strobe, selectable candela, high dB.

### *CEILING MOUNT*

**SPC(W)(R):** Speaker only.

**SPC(W)(R)V:** Speaker only, high dB.

**SPSC(W*)(R):** Speaker strobe, selectable candela (15, 15/75, 30, 50, 75, 95, 110, 115)

**SPSC(W*)(R)H:** Speaker strobe, selectable candela, high cd (135, 150, 177, 185)

**SPSC(W*)(R)V:** Speaker strobe, selectable candela, high dB (15, 15/75, 30, 50, 75, 95, 110, 115).

**SPSC(W*)(R)VH:** Speaker strobe, selectable candela, high dB, high cd (135, 150, 177, 185).

### *ACCESSORIES*

**RFP:** Retrofit plate, red.

**RFPW:** Retrofit plate, white.

**SPBBSC:** Ceiling mount backbox skirt, red.

**SPBBSCW:** Ceiling mount backbox skirt, white.

**SPBBS:** Wall mount backbox skirt, red.

**SPBBSW:** Wall mount backbox skirt, white.

**TR:** Wall mount trim ring, red.

**TRW:** Wall mount trim ring, white.

**TRC:** Ceiling mount trim ring, red.

**TRCW:** Ceiling mount trim ring, white.

***NOTE:** Add -P to model number for plain housing (no 'FIRE' marking on the cover), e.g. SPSW-P*

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# SpectrAlert® Advance

**Outdoor Selectable Output Speaker Strobes and Dual Voltage Evacuation Speakers**

NOTIFIER® by Honeywell

**Audio/Visual Devices**

## General

The SpectrAlert Advance series offers the broadest line of outdoor speakers and speaker strobes in the industry. From metal and plastic outdoor back boxes, to white and red plastic housings, to wall and ceiling mounting options, virtually every application is covered. SpectrAlert Advance outdoor speakers and speaker strobes offer reliable operation over the entire temperature range of -40°F to 151°F. They may be used indoors or outdoors in wet or dry applications. In addition, these speakers provide a broad frequency response range and low harmonic distortion to provide an accurate and intelligible broadcast of evacuation messages. High sound pressure level at all tap settings ensures that messages are clearly heard.

The plug-in design allows the installer to pre-wire mounting plates and dress the wires before plugging in the speakers to help reduce ground faults. This design also allows faster installations with instant feedback to ensure that wiring is properly connected, rotary switches to select voltage and power settings, and field selectable candela settings for wall and ceiling speaker strobes.

The new weatherproof back boxes have plastic and metal versions. They are now designed to accommodate in-and-out wiring for daisy chaining outdoor devices. The plastic weatherproof back boxes shipped with the product feature removable side flanges and improved resistance to salt water corrosion. The screw hole knockouts located on the back of the weatherproof back box eliminate the need to drill holes for screw-in mounting. Both weatherproof back boxes are available with 3/4 inch top and bottom conduit entries and 3/4 inch knock-outs at the back. Included with each back box is a screw-in NPT plug with an O-ring gasket for a watertight seal. Metal back boxes are available separately.

## Features

- Plug-in design
- Electrical compatibility with existing SpectrAlert products
- Shorting spring on mounting plate tests continuity before installation
- Rotary switch simplifies field selection of speaker voltage and power settings
- Universal mounting plate for wall- and ceiling-mount units
- Weatherproof per NEMA 4x, IP56
- Compatible with System Sensor synchronization protocol
- Automatic selection of 12- or 24-volt operation at 15 and 15/75 candela
- Field selectable candela settings on wall and ceiling units
- Ceiling and wall mount application

## Specifications

### *PHYSICAL SPECIFICATIONS*

**Operating Temperature:** -40°F to 151°F (-40°C to 66°C)

**Dimensions, Wall-Mount:**

**SPS Speaker Strobe:** 6.0”L x 5.0”W x 4.9”D (including lens and speaker)

**SP Speaker:** 6.0”L x 5.0”W x 2.9”D

**Dimensions, Ceiling-Mount:**

**SPS Speaker Strobe:** 6.8”Dia x 4.8”D (including lens and speaker)

**SP Speaker:** 6.8”L x 2.9”D

**Dimensions, Wall-Mount Weatherproof Backbox:** 6.5”L x 5.5”H x 2.9”D

**Dimensions, Ceiling-Mount Weatherproof Backbox:** 7.2”Dia x 2.9”D

### *ELECTRICAL/OPERATING SPECIFICATIONS*

**Nominal Voltage (speakers):** 25 Volts or 70.7 Volts (nominal)

**Maximum Supervisory Voltage (speakers):** 50VDC

**Strobe Flash Rate:** 1 flash per second

**Nominal Voltage (Strobes):** Regulated 12VDC/FWR or 24VDC/FWR

**Operating Voltage Range (includes fire panels with built-in sync):** 8 to 17.5V (12V nominal) or 16 to 33V (24 nominal)

**Operating Voltage with MDL Sync Module:** 9 to 17.5V (12V nominal) or 17 to 33V (24V nominal)

**Frequency Range:** 400 to 4000Hz

**Power:** ¼, ½, 1, 2 watts

## Agency Listings and Approvals

In some cases, certain modules may not be listed by certain approval agencies, or listing may be in progress. *Consult factory for latest listing status.*

- **UL Listed:** S4048
- **MEA:** 10-08-E
- **CSFM:** 7320-1653:201

| Sound Output | | | | |
|---|---|---|---|---|
| UL Reverberant (dBA @ 10ft) | 2W | 1W | ½W | ¼W |
| Outdoor Speaker | 90 | 87 | 84 | 81 |
| Outdoor Speaker/Speaker Strobe | 89 | 86 | 83 | 80 |

| UL Maximum Strobe Current Draw (mA RMS) | | | | | |
|---|---|---|---|---|---|
| | Candela | 8 to 17.5 Volts | | 16 to 33 Volts | |
| | | DC | FWR | DC | FWR |
| Standard Candela Range | 15 | 123 | 128 | 66 | 71 |
| | 15/75 | 142 | 148 | 77 | 81 |
| | 30 | NA | NA | 94 | 96 |
| | 75 | NA | NA | 158 | 153 |
| | vmvm95 | NA | NA | 181 | 176 |
| | 110 | NA | NA | 202 | 195 |
| | 115 | NA | NA | 210 | 205 |
| High Candela Range | 135 | NA | NA | 228 | 207 |
| | 150 | NA | NA | 246 | 220 |
| | 177 | NA | NA | 281 | 251 |
| | 185 | NA | NA | 286 | 258 |

## Candela Derating

***NOTE:*** *For K series products used at low temperatures, listed candela ratings must be reduced in accordance with this table.*

| Strobe Output (cd) | |
|---|---|
| Listed Candela | Candela Rating at -40°F |
| 15 | Do not use below 32°F |
| 15/75 | |
| 30 | |
| 75 | 44 |
| 95 | 70 |
| 110 | 110 |
| 115 | 115 |
| 135 | 135 |
| 150 | 150 |
| 177 | 177 |
| 185 | 185 |

## Architectural/Engineering Specifications

### *GENERAL*

SpectrAlert Advance outdoor speaker and speaker strobes shall mount to a weatherproof back box. A universal mounting plate shall be used for mounting ceiling and wall products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate. Also, SpectrAlert Advance speaker strobes, when used with the Sync•Circuit™ Module accessory, shall be powered from a non-coded notification appliance circuit output and shall operate on a nominal 12 or 24 volts. When used with the Sync•Circuit Module, 12-volt rated notification appliance circuit outputs shall operate between 9 and 17.5 volts; 24-volt rated notification appliance circuit outputs shall operate between 17 and 33 volts. Outdoor SpectrAlert Advance products shall operate between –40°F and 151°F from a regulated DC, or full-wave rectified, unfiltered power supply.

### *SPEAKER*

The Speaker shall be a System Sensor SpectrAlert Advance Model _____ dual voltage transformer speaker capable of operating at 25.0 or 70.7 nominal Vrms. Speaker shall be listed to Underwriter's Laboratories Standard S4048 for outdoor fire protective signaling systems. Speaker shall have a frequency range of 400 to 4000 Hz and shall have an operating temperature from –40°F to 150.8°F. Speaker shall have power taps and wattage settings which are selected by rotary switches. The speaker must be installed with its weatherproof backbox in order to remain outdoor approved per UL listing S4048. The speaker shall be suitable for use in air handling spaces, as well as wet environments.

### *SPEAKER STROBE COMBINATION*

The Speaker Strobe shall be a System Sensor Model _____ listed to UL 1638 and UL 1480 and be approved for fire protective signaling systems. Speaker shall be capable of operating at 25.0 or 70.7 nominal Vrms, and shall have a frequency range of 400 to 4000 Hz. Speaker shall have power taps that are selected by rotary switch. The strobe shall consist of a xenon flash tube with associated lens/reflector system and operate on either 12V or 24V. The strobe shall also feature selectable candela output, providing options for 15 or 15/75 candela when operating on 12V and 15, 15/75, 30, 75, 110, 115, 135, 150, 177 or 185 when operating on 24V. The strobe shall comply with the Americans with Disabilities Act requirement for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range. The speaker strobe must be installed with its weatherproof back box in order to remain outdoor approved per UL. The speaker strobe shall be suitable for use in wet environments.

## Ordering Information

**SPWK:** Wall mount outdoor speaker; white.

**SPRK:** Wall mount outdoor speaker; red.

**SPSWK:** Wall mount outdoor speaker strobe, selectable candela (15, 15/75, 30, 75, 95, 100, 115); white.

**SPSRK:** Wall mount outdoor speaker strobe, selectable candela (15, 15/75, 30, 75, 95, 100, 115); red.

**SPCWK:** Ceiling mount outdoor speaker; white.

**SPSCWK:** Ceiling mount outdoor speaker strobe, selectable candela (15, 15/75, 30, 50, 75, 95, 110, 115); white.

**SPSCWHK:** Ceiling mount outdoor speaker strobe, selectable candela, high cd (135, 150, 177, 185); white.

### *ACCESSORIES*

**MWBB:** Wall, metal weatherproof backbox; red.

**MWBBW:** Wall, metal weatherproof backbox; white.

**MWBBCW:** Ceiling, metal weatherproof backbox; white.

**PWBB:** Wall, plastic weatherproof backbox; red.

**PWBBW:** Wall, plastic weatherproof backbox; white.

**PWBBCW:** Ceiling, plastic weatherproof backbox; white.

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ISO 9001 CERTIFIED ENGINEERING & MANUFACTURING QUALITY SYSTEMS

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# SpectrAlert® Advance

## Selectable Output Notification Appliances

NOTIFIER® by Honeywell

**Audio/Visual Devices**

## General

System Sensor® SpectrAlert® Advance selectable-output horns, strobes and horn/strobes are rich with features guaranteed to cut installation times and maximize profits. The SpectrAlert Advance series of notification appliances is designed to simplify your installations, with features such as: plug-in designs, instant feedback messages to ensure correct installation of individual devices, and eleven field-selectable candela settings for wall and ceiling strobes and horn/strobes.

More specifically, when installing Advance products, first attach a universal mounting plate to a four-inch square, four-inch octagon, or double-gang junction box. The two-wire mounting plate attaches to a single-gang junction box.

Then, connect the notification appliance circuit wiring to the SEMS terminals on the mounting plate.

Finally, attach the horn, strobe, or horn/strobe to the mounting plate by inserting the product's tabs in the mounting plate's grooves. The device will rotate into position, locking the product's pins into the mounting plate's terminals. The device will temporarily hold in place with a catch until it is secured with a captured mounting screw.

**SpectrAlert Advance products allow you to choose:**

- 12 or 24 volts.
- At 24 volts, 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, or 185 candela by way of a rear-mounted slide switch and front viewing window.
- Horn tones and volume by way of a rotary switch.
- The SpectrAlert Advance series includes outdoor notification appliances. Outdoor strobes and horn/strobes (two-wire and four-wire) are available for wall or ceiling. Outdoor horns are available for wall only. All System Sensor outdoor products are rated between –40°F and 151°F (–40°C and 66°C) in wet or dry applications.

**Models available:**

- Indoor wall-mount: horn, strobe, 2-wire horn/strobe, 4-wire horn/strobe.
- Indoor ceiling-mount: strobe, 2-wire horn/strobe, 4-wire horn/strobe.
- Outdoor wall-mount: horn, strobe, 2-wire horn/strobe, 4-wire horn/strobe.
- Outdoor ceiling-mount: strobe, 2-wire horn/strobe, 4-wire horn/strobe.

## Features

- Plug-in design.
- Same mounting plate for wall- and ceiling-mount units.
- Shorting spring on mounting plate for continuity check before installation.
- Captive mounting screw.
- Tamper-resistance capability.
- Field-selectable candela settings on wall and ceiling units: 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, 185.
- Automatic selection of 12 or 24 volt operation at 15 and 15/75 candela.
- Outdoor wall and ceiling products.
- Outdoor products rated from –40°F and 151°F (–40°C and 66°C).

7087pho1.jpg

*Indoor Ceiling Horn/Strobe*

7087pho2.jpg

*Outdoor Ceiling Strobe*

7087pho3.jpg

*Indoor Wall Horn/Strobe*

7087pho4.jpg

*Indoor Ceiling Strobe*

7087pho5.jpg

*Indoor Wall Horn*

7087pho6.jpg

*Outdoor Wall Strobe*

- Minimal intrusion into the backbox.
- Horn rated at 88+ dbA at 16 volts.
- Rotary switch for tone selection.
- Three horn volume settings.
- Electrically compatible with existing SpectrAlert products.

## Engineering Specifications

SpectrAlert Advance horns, strobes, and horn/strobes shall mount to a standard 4.0" x 4.0" x 1.5" (10.16 x 10.16 x 3.81 cm) backbox, 4.0" (10.16 cm) octagonal backbox, or a double-gang backbox. Two-wire products shall also mount to a single-gang 2.0" x 4.0" x 1.875" (5.08 x 10.16 x 4.763 cm) backbox. A universal mounting plate shall be used for mounting ceiling and wall products. The notification appliance circuit wiring shall terminate at the universal mounting plate. Also, SpectrAlert Advance products, when used with the Sync•Circuit™ Module accessory, shall be powered from a non-coded notification appliance circuit output and shall operate on a nominal 12 or 24 volts. When used with the Sync•Circuit Module, 12-volt rated notification appliance circuit outputs shall operate between 9 and 17.5 volts; 24-volt rated notification appliance circuit outputs shall operate between 17 and 33 volts. Indoor SpectrAlert Advance products shall operate between 32°F and 120°F (0°C and 49°C) from a regulated DC, or full-wave-rectified, unfiltered power supply. Strobes and horn/strobes shall have field-selectable candela settings including 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, 185.

### *STROBE*

The strobe shall be a System Sensor SpectrAlert Advance Model _____ listed to UL 1971 and shall be approved for fire protective service. The strobe shall be wired as a primary-signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system.

### *HORN/STROBE COMBINATION*

The horn/strobe shall be a System Sensor SpectrAlert Advance Model _____ listed to UL 1971 and UL 464 and shall be approved for fire protective service. The horn/strobe shall be wired as a primary-signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. The horn shall have three audibility options and an option to switch between a Temporal 3 pattern and a Non-Temporal (continuous) pattern. These options are set by a multiple position switch. On four-wire products, the strobe shall be powered independently of the sounder. The horn on horn/strobe models shall operate on a coded or non-coded power supply.

### *OUTDOOR PRODUCTS*

SpectrAlert Advance outdoor horns, strobes and horn/strobes shall be listed for outdoor use by UL and shall operate between –40°F and 151°F (–40°C and 66°C). The products shall be listed for use with a System Sensor outdoor/weatherproof backbox with half-inch and three-fourths-inch conduit entries.

### *SYNCHRONIZATION MODULE*

The module shall be a System Sensor Sync•Circuit _____ listed to UL 464 and shall be approved for fire protective service. The module shall synchronize SpectrAlert strobes at 1 Hz and horns at Temporal 3. Also, while operating the strobes, the module shall silence the horns on horn/strobe models over a single pair of wires. The module shall mount to a 4.688" x 4.688" x 2.125" (11.906 x 11.906 x 5.398 cm) backbox. The module shall also control two Style Y (class B) circuits or one Style Z (Class A) circuit. The module shall synchronize multiple zones. Daisy-chaining two or more synchronization modules together will synchronize all the zones they control. The module shall not operate on a coded power supply.

## Operating Specifications

- **Standard operating temperature:** 32°F to 120°F (0°C to 49°C).
- **K Series operating temperature:** –40°F to 151°F (–40°C to 66°C).
- **Humidity range:** 10% to 93% non-condensing (indoor products).
- **Strobe flash rate:** 1 flash per second.
- **Nominal voltage:** regulated 12 VDC/FWR or regulated 24 VDC/FWR. ***NOTE:*** *Full Wave Rectified (FWR) voltage is a non-regulated, time-varying power source that is used on some power supply and panel outputs.*
- **Operating voltage range:** 8 V to 17.5 V (12 V nominal); or 16 V to 33 V (24 V nominal). ***NOTE:*** *P, S, PC, and SC products will operate at 12 V nominal only for 15 cd and 15/75 cd.*
- **Input terminal wire gauge:** 12 to 18 AWG (3.31 to 0.821 mm²).
- **Ceiling-mount dimensions (including lens):** 6.8" diameter x 2.5" deep (17.3 cm diameter x 6.4 cm deep).
- **Wall-mount dimensions (including lens):** 5.6" H x 4.7" W x 2.5" D (14.2 cm H x 11.9 cm W x 6.4 cm D).
- **Horn dimensions:** 5.6" H x 4.7" W x 1.3" D (14.2 cm H x 11.9 cm W x 3.3 cm D).

## Agency Listings and Approvals

The listings and approvals below apply to SpectrAlert Advance Selectable Output Notification Devices. In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL** Listed: file **S4011** (HR__, HW__, P2__, P4__, PC2__, PC4__ models); file **S5512** (models SCR, SCRH, SCW, SCWH, SR, SRH, SW, SWH); file **S3593** (SCRHK, SCRK, SRHK, SRK).
- **ULC** Listed: file **CS1099** (HRA, HRKA); file **CS1089** (typically "A" models, with exception of outdoor strobes). *See Canadian data sheet for listings and specifications.*
- **FM** approved.
- **MEA** approved: file **452-05-E**.
- **CSFM** approved: file **7125-1653:186** (SCR, SCRH, SCW, SCWH, SR, SRH, SW, SWH); file **7125-1653:188** P2__, P4__, PC2__, PC4__ models); file **7135-1653:189** (HR, HRK, HW); file **7300-1653:187** (SCRHK, SCRK, SRHK, SRK).

## Strobe Current Draw, UL Maximum (mA RMS)

| Candela | | 8 – 17.5 V | | 16 – 33 V | |
|---|---|---|---|---|---|
| | | DC | FWR | DC | FWR |
| Standard Candela Range | 15 | 123 | 128 | 66 | 71 |
| | 15/75 | 142 | 148 | 77 | 81 |
| | 30 | NA | N/A | 94 | 96 |
| | 75 | NA | NA | 158 | 153 |
| | 95 | NA | NA | 181 | 176 |
| | 110 | NA | NA | 202 | 195 |
| | 115 | NA | NA | 210 | 205 |
| High Candela Range | 135 | NA | NA | 228 | 207 |
| | 150 | NA | NA | 246 | 220 |
| | 177 | NA | NA | 281 | 251 |
| | 185 | NA | NA | 286 | 258 |

## Horn Current Draw, UL Maximum (mA RMS)

| Sound Pattern | dB | 8 – 17.5 V | | 16 – 33 V | |
|---|---|---|---|---|---|
| | | DC | FWR | DC | FWR |
| Temporal | High | 57 | 55 | 69 | 75 |
| Temporal | Medium | 44 | 49 | 58 | 69 |
| Temporal | Low | 38 | 44 | 44 | 48 |
| Non-temporal | High | 57 | 56 | 69 | 75 |
| Non-temporal | Medium | 42 | 50 | 60 | 69 |
| Non-temporal | Low | 41 | 44 | 50 | 50 |
| Coded | High | 57 | 55 | 69 | 75 |
| Coded | Medium | 44 | 51 | 56 | 69 |
| Coded | Low | 40 | 46 | 52 | 50 |

## Horn and Horn/Strobe Rotary Switch Setting

| Setting | Repetition Rate | dB Level |
|---|---|---|
| 1 | Temporal horn | High |
| 2 | Temporal horn | Medium |
| 3 | Temporal horn | Low |
| 4 | Normal horn | High |
| 5 | Normal horn | Medium |
| 6 | Normal horn | Low |
| 7* | Externally coded | High |
| 8* | Externally coded | Medium |
| 9* | Externally coded | Low |

***NOTE:** Settings 7, 8, and 9 are not available on 2-wire horn/strobe.*

## Horn and Horn/Strobe Output (dBA)

| Switch Position | Sound Pattern | dB | 8 – 17.5 V | | 16 – 33 V | |
|---|---|---|---|---|---|---|
| | | | DC | FWR | DC | FWR |
| 1 | Temporal | High | 78 | 78 | 84 | 84 |
| 2 | Temporal | Medium | 74 | 74 | 80 | 80 |
| 3 | Temporal | Low | 71 | 73 | 76 | 76 |
| 4 | Non-temporal | High | 82 | 82 | 88 | 88 |
| 5 | Non-temporal | Medium | 78 | 78 | 85 | 85 |
| 6 | Non-temporal | Low | 75 | 75 | 81 | 81 |
| 7* | Coded | High | 82 | 82 | 88 | 88 |
| 8* | Coded | Medium | 78 | 78 | 85 | 85 |
| 9* | Coded | Low | 75 | 75 | 81 | 81 |

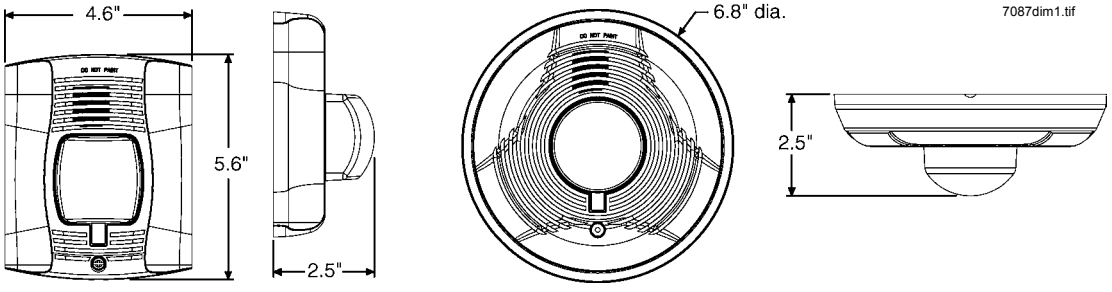
***NOTE:** Settings 7, 8, and 9 are not available on 2-wire horn/strobe.*

## Two-Wire Horn/Strobe, *STANDARD* Candela Range (15 – 115 cd), UL Maximum Current Draw (mA RMS)

| Input, Sound Pattern, dB Level | 8 – 17.5 V | | 16 – 33 V | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 15 | 15/75 | 15 | 15/75 | 30 | 75 | 95 | 110 | 115 |
| DC Input, Temporal, High | 137 | 147 | 79 | 90 | 107 | 176 | 194 | 212 | 218 |
| DC Input, Temporal, Medium | 132 | 144 | 69 | 80 | 97 | 157 | 182 | 201 | 210 |
| DC Input, Temporal, Low | 132 | 143 | 66 | 77 | 93 | 154 | 179 | 198 | 207 |
| DC Input, Non-temporal, High | 141 | 152 | 91 | 100 | 116 | 176 | 201 | 221 | 229 |
| DC Input, Non-temporal, Medium | 133 | 145 | 75 | 85 | 102 | 163 | 187 | 207 | 216 |
| DC Input, Non-temporal, Low | 131 | 144 | 68 | 79 | 96 | 156 | 182 | 201 | 210 |
| FWR Input, Temporal, High | 136 | 155 | 88 | 97 | 112 | 168 | 190 | 210 | 218 |
| FWR Input, Temporal, Medium | 129 | 152 | 78 | 88 | 103 | 160 | 184 | 202 | 206 |
| FWR Input, Temporal, Low | 129 | 151 | 76 | 86 | 101 | 160 | 184 | 194 | 201 |
| FWR Input, Non-temporal, High | 142 | 161 | 103 | 112 | 126 | 181 | 203 | 221 | 229 |
| FWR Input, Non-temporal, Medium | 134 | 155 | 85 | 95 | 110 | 166 | 189 | 208 | 216 |
| FWR Input, Non-temporal, Low | 132 | 154 | 80 | 90 | 105 | 161 | 184 | 202 | 211 |

## Two-Wire Horn/Strobe, *HIGH* Candela Range (135 – 185 cd), UL Maximum Current Draw (mA RMS)

| DC Input | 16 – 33 V | | | | FWR Input | 16 – 33 V | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 135 | 150 | 177 | 185 | | 135 | 150 | 177 | 185 |
| DC, Temporal, High | 245 | 259 | 290 | 297 | FWR, Temporal, High | 215 | 231 | 258 | 265 |
| DC, Temporal, Medium | 235 | 253 | 288 | 297 | FWR, Temporal, Medium | 209 | 224 | 250 | 258 |
| DC, Temporal, Low | 232 | 251 | 282 | 292 | FWR, Temporal, Low | 207 | 221 | 248 | 256 |
| DC, Non-temporal, High | 255 | 270 | 303 | 309 | FWR, Non-temporal, High | 233 | 248 | 275 | 281 |
| DC, Non-temporal, Medium | 242 | 259 | 293 | 299 | FWR, Non-temporal, Medium | 219 | 232 | 262 | 267 |
| DC, Non-temporal, Low | 238 | 254 | 291 | 295 | FWR, Non-temporal, Low | 214 | 229 | 256 | 262 |



## Ordering Information

| Model | Description* | Model | Description |
|---|---|---|---|
| ***WALL HORN/STROBES*** | | ***CEILING HORN/STROBES*** | |
| **P2R** | 2-wire horn/strobe, standard cd, red. | **PC2R** | 2-wire horn/strobe, standard cd, red. |
| **P2RH** | 2-wire horn/strobe, high cd, red. | **PC2RH** | 2-wire horn/strobe, high cd, red. |
| **P2RK** | 2-wire horn/strobe, standard cd, red, outdoor.** | **PC2RK** | 2-wire horn/strobe, standard cd, red, outdoor. |
| **P2RHK** | 2-wire horn/strobe, high cd, red, outdoor. | **PC2RHK** | 2-wire horn/strobe, high cd, red, outdoor. |
| **P2W** | 2-wire horn/strobe, standard cd, white. | **PC2W** | 2-wire horn/strobe, standard cd, white. |
| **P2WH** | 2-wire horn/strobe, high cd, white. | **PC2WH** | 2-wire horn/strobe, high cd, white. |
| **P4R** | 4-wire horn/strobe, standard cd, red. | **PC4R** | 4-wire horn/strobe, standard cd, red. |
| **P4RH** | 4-wire horn/strobe, high cd, red. | **PC4RH** | 4-wire horn/strobe, high cd, red. |
| **P4RK** | 4-wire horn/strobe, standard cd, red, outdoor. | **PC4RK** | 4-wire horn/strobe, standard cd, red, outdoor. |
| **P4RHK** | 4-wire horn/strobe, high cd, red, outdoor. | **PC4RHK** | 4-wire horn/strobe, high cd, red, outdoor. |
| **P4W** | 4-wire horn/strobe, standard cd, white. | **PC4W** | 4-wire horn/strobe, standard cd, white. |
| **P4WH** | 4-wire horn/strobe, high cd, white. | **PC4WH** | 4-wire horn/strobe, high cd, white. |
| ***WALL STROBES*** | | ***CEILING STROBES*** | |
| **SR** | Strobe, standard cd, red. | **SCR** | Strobe, standard cd, red. |
| **SRH** | Strobe, high cd, red. | **SCRH** | Strobe, high cd, red. |
| **SRK** | Strobe, standard cd, red, outdoor. | **SCRK** | Strobe, standard cd, red, outdoor. |
| **SRHK** | Strobe, high cd, red, outdoor. | **SCRHK** | Strobe, high cd, red, outdoor. |
| **SW** | Strobe, standard cd, white. | **SCW** | Strobe, standard cd, white. |
| **SWH** | Strobe, high cd, white. | **SCWH** | Strobe, high cd, white. |
| ***ACCESSORIES*** | | ***HORNS*** | |
| **BBS-2** | Backbox skirt, wall, red. | **HR** | Horn, red. |
| **BBSW-2** | Backbox skirt, wall, white. | **HRK** | Horn, red, outdoor. |
| **BBSC-2** | Backbox skirt, ceiling, red. | **HW** | Horn, white. |
| **BBSCW-2** | Backbox skirt, ceiling, white. | ***ACCESSORIES, continued*** | |
| **SA-WBB** | Weatherproof backbox, wall. | **MP-2W-20BP** | 2-wire indoor mounting plates, pkg of 20. |
| **SA-WBBC** | Weatherproof backbox, ceiling. ***cont'd at right*** | **MPK-2W-20BP** | 2-wire outdoor mounting plates, pkg of 20. |

***NOTE:** *"High cd" refers to strobes that include 135, 150, 177, and 185 candela settings. "Standard cd" refers to strobes that include 15, 15/75, 30, 75, 95, 110, and 115 candela settings. **All outdoor models ("K" suffix) include weatherproof backbox.*

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COOPER Notification

# Series STH-15S Supervised Horn Loudspeaker

STH-15S (Gray)
STH-15SR (Red)

SHMP-R Adapter Plate

## *Description*

The Wheelock Series STH-15S supervised horn loudspeakers are equipped with a compression driver providing up to 15 watts RMS power handling capability, superior intelligibility and dispersion to achieve maximum sound projection and penetration.

Weather-resistant metal construction and reentrant acoustic path assure protection against water, humidity, vermin and corrosion. The mounting bracket allows directional sound dispersion via vertical and horizontal positioning. Provisions are also included for surface or strap mounting to pillars and I-beams.

All models include a built-in 25/70/100 V transformer featuring a screwdriver adjustable, 7-position watt/impedance selection switch. Wiring terminals are protected with a vandal-resistant adapter cover for control equipment utilizing cable or conduit.

A built-in, 5 mfd capacitor is provided on both models for line supervision.

All models meet or exceed the UL Listed standards for audible signal appliances and are capable of operating within an ambient temperature range of 66°C (150°F) to -35°C (-30°F). Models comply with UL Standard 1480 — Speakers for Fire Protective Signaling Systems and California State Fire Marshal (Title 19).

## *Features*

- Approvals include: UL Standard 1480 – (Speakers for Fire Protective Signaling Systems), California State Fire Marshal (CSFM) Title 19
- Meets or exceeds UL Listed standards for audible signal appliances
- 15-Watt High Efficiency Compression Driver
- Weather-resistant, vandal-resistant aluminum construction assures protection against water, humidity, vermin, and corrosion
- Reentrant acoustic path
- 25/70/100 V transformer featuring a screwdriver adjustable, 7-position watt/impedance selection switch
- 5 mfd Capacitor for Line Supervision
- STH-15S Gray baked epoxy finish
- STH-15SR Red baked epoxy finish
- Simplified, universal-mounting bracket adjustable in horizontal and vertical planes with banding slots for beam or pillar mounting
- Installation terminals and power selector are recessed mounted, and protected by the metal interface adapter, or clear plastic shield

## *Applications*

The Wheelock Series STH-15S supervised horn loudspeakers are surface-mounting, high-efficiency units for life safety and communication system applications. When used with compatible control equipment, they provide high-intelligibility voice reproduction and signal transmission for indoor or outdoor emergency alarm and protective signaling.

## *Specifications and Ordering Information*

| Model Number | Order Code | Product Description | Weight |
|---|---|---|---|
| STH-15S | 7937 | 9” Dia. Supervised, Weatherproof, 15 Watt Horn, Loudspeaker with Transformer, Aluminum, Gray | 4.5 lbs. (2.0 kgs.) |
| STH-15SR | 7938 | 9” Dia. Supervised, Weatherproof, 15 Watt Horn, Loudspeaker with Transformer, Aluminum, Red | 4.5 lbs. (2.0 kgs.) |
| SHMP-R | 8154 | UL Listed Adapter Plate, Designed to mount the STH-15SR Horn Speaker (7938) to a Series RSSP Strobe Mounting Plate. For Surface Mount Applications, the SBL-2 (6988) Surface mount backbox is required. | |
| STH-RSSP-KIT | 6096 | Weatherproof 15 watt supervised 25/70 horn loudspeaker and 15/30/75/110cd strobe with mounting plate, adjustable mounting base for horn and backbox. Red color. This kit includes STH-15SR, SHMP-R, RSSP-24MCW-FR, & SBL-2. | |

S2652 151-92-E 7320-0785:144

### *Architects and Engineers Specifications*

The supervised horn loudspeaker shall be a STH-15S/STH-15SR or approved equal. The horn shall be weather resistant and constructed of heavy gauge, treated aluminum. The horn shall be able to operate within any ambient temperature environment ranging from 66 degrees C (150°F) to -35 degrees C (-30°F). The horn shall be a double reentrant type with a 15 watt RMS audio power rated compression driver producing a UL rated 102 dB measured at 15 watts at 10 feet. The horn shall have an impedance selection via a 7 position switch of 5000, 2500, 1300, 666, 333, 89 & 45. Power taps shall be available at 2.0, 4.0, 7.5 & 15 watts for the 100 volt line, .9, 1.8, 3.8, 7.5 & 15 watts for the 70 volt line and .48, .94, 1.8, 7.5 & 15 watts for the 25 volt line. Each power tap shall have a 3dB incremental rating. The frequency response range shall be 400 - 14000 Hz. The horn shall have a dispersion of 70 degrees. The horn assembly shall be furnished with a mounting bracket that allows adjustment on either a vertical or horizontal plane with a single locking pin and include provisions for mounting, banding or strapping. Wiring terminals shall be fully enclosed and a vandal-resistant adapter cover shall provide connection protection for cable or conduit. The horn shall be 7.875" W x 8.75" H x 9.313" D (200 x 222 x 237 mm). The horn shall be finished in gray (STH-15S) or red (STH-15SR) baked epoxy.

⚠ WARNING: PLEASE READ THESE SPECIFICATIONS AND INSTALLATION INSTRUCTIONS CAREFULLY BEFORE USING, SPECIFYING OR APPLYING THIS PRODUCT. FAILURE TO COMPLY WITH ANY OF THESE INSTRUCTIONS, CAUTIONS AND WARNINGS COULD RESULT IN IMPROPER APPLICATION, INSTALLATION AND/OR OPERATION OF THESE PRODUCTS IN AN EMERGENCY SITUATION, WHICH COULD RESULT IN PROPERTY DAMAGE, AND SERIOUS INJURY OR DEATH TO YOU AND/OR OTHERS.

### *STH-15S & STH-15SR Power Switch Selections*

| Setting | Impedance (Ohms) | 70.7 Volts | | 25 Volts | | 100 Volts | |
|---|---|---|---|---|---|---|---|
| | | Watts | dB @ 10 Feet | Watts | dB @ 10 Feet | Watts | dB @ 10 Feet |
| 1 | 5,000 | 0.9W | 90 | Not Used | Not Used | 2.0W | 93 |
| 2 | 2,500 | 1.8W | 93 | Not Used | Not Used | 4.0W | 96 |
| 3 | 1,300 | 3.8W | 96 | 0.48W | 87 | 7.5W | 99 |
| 4 | 666 | 7.5W | 99 | 0.94W | 90 | 15.0W | 102 |
| 5 | 333 | 15.0W | 102 | 1.8W | 93 | Not Used | Not Used |
| 6 | 89 | Not Used | Not Used | 7.5W | 99 | Not Used | Not Used |
| 7 | 45 | Not Used | Not Used | 15.0W | 102 | Not Used | Not Used |

### *Specifications (UL RATING)*

POWER RATING: 15 Watt Continuous
FREQUENCY RESPONSE: 400-14,000 Hz (Nominal)
SENSITIVITY: 102 dB @ 15 Watts @ 10'

SPECIFICATIONS GENERAL
DISPERSION ANGLE: 70 Degrees (-6 dB @ 2,000 Hz Octave Band)

### *Anechoic Measurements:*

15 watt tap @ 10 feet

| | |
|---|---|
| Code-3 Tone | 107.2 dBA |
| Slow Whoop | 108.5 dBA |
| Siren | 107.8 dBA |

NOTE: Due to continuous development of our products, specifications and offerings are subject to change without notice in accordance with Wheelock Inc. standard terms and conditions.

NEMA Member

WE ENCOURAGE AND SUPPORT NICET CERTIFICATION
3 YEAR WARRANTY
Made in USA

**S0100 STH 02/08**


**NJ Location**
273 Branchport Ave.
Long Branch, NJ 07740
P: 800-631-2148
F: 732-222-8707
www.coopernotification.com

**FL Location**
7565 Commerce Ct.
Sarasota, FL 34243
P: 941-487-2300
F: 941-487-2389

**VA Location**
P: 877-459-7726
F: 703-294-6560



Cooper Notification is Wheelock® MEDC SAFEPATH WAVES Roam Secure

COOPER Notification

# SFP-5UD/SFP-10UD(E)

## Five Zone Fire Alarm Control Panel
## Ten Zone Fire Alarm Control Panel

NOTIFIER® by Honeywell

**Conventional Fire Alarm Control Panels**

## General

The **SFP-5UD** is a five-zone FACP (Fire Alarm Control Panel) and the **SFP-10UD(E)** is a ten-zone FACP. These control panels provide reliable fire signaling protection for small to medium-sized commercial, industrial, and institutional buildings. Both panels include built-in communicators for Central Station Service and remote upload/download.

Each of these FACPs is compatible with System Sensor's microprocessor-based $i^3$ series detectors. These conventional smoke detectors can transmit a maintenance trouble signal to the FACP indicating the need for cleaning and a supervisory "freeze" signal when the ambient temperature falls below the detector rating. Additionally, both the SFP-5UD and SFP-10UD are compatible with conventional input devices such as two- and four-wire smoke detectors, pull stations, waterflow devices, tamper switches, and other normally-open contact devices. Refer to the *Notifier Device Compatibility Document* for a complete listing of compatible devices.

Outputs include four NACs (Notification Appliance Circuits), three programmable Form-C relays (factory programmed for Alarm, Trouble, and Supervisory) and 24 VDC special application resettable and nonresettable power outputs. The FACPs supervise all wiring, AC voltage, battery level and telephone line integrity.

Activation of a compatible smoke detector or any normally-open fire alarm initiating device will activate audible and visual signaling devices, illuminate an indicating LED, sound the piezo sounder at the FACP, activate the communicator and FACP alarm relay, and operate an optional module used to notify a remote station or initiate an auxiliary control function.

***NOTE:*** *The SFP-10UDE offers the same features as the SFP-10UD but allows connection to 240 VAC. Unless otherwise specified, the information in this data sheet applies to both the 120 VAC and the 240 VAC versions of these panels.*

## Features

- Listed to UL Standard 864, 9th edition.
- Built-in DACT (Digital Alarm Communicator/Transmitter).
- Style B (Class B) IDC (Initiating Device Circuit)
  - SFP-5UD - five IDCs.
  - SFP-10UD - ten IDCs.
- Style Y (Class B) NAC (Notification Appliance Circuit) - special application power
  - SFP-5UD - four NACs.
  - SFP-10UD - four NACs.
- Notification Appliances may be programmed as
  - Silence Inhibit.
  - Auto-Silence.
  - Strobe Synchronization for System Sensor, Wheelock, Gentex, Faraday, or Amseco devices.
  - Selective Silence (horn-strobe mute).
  - Temporal or Steady Signal.
  - Silenceable or Nonsilenceable.
- Optional N-CAC-5X Style Z (Class A) Converter Module for NACs and IDCs (2 required for SFP-10UD).

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- Form-C Relays for Alarm, Trouble and Supervisory - Contact Ratings 2.0 A@ 30 VDC or 30 VAC (resistive).
- 3.0 A total system current for SFP-5UD.
- 7.0 A total system current for SFP-10UD.
- Optional Dress Panel DP-51050 (red)
- Optional Dress Panel DP-51050B (black).
- Optional Trim Ring TR-CE/-B for semi-flush mounting.
- 24 volt operation.
- Low AC voltage sense.
- Alarm Verification.
- PAS (Positive Alarm Sequence).
- Automatic battery trickle charger.
- Up to eight ANN-BUS annunciators:
  - Optional 8 zone Relay Module N-ANN-RLY.
  - Optional LED Annunciator Module N-ANN-LED,
  - Optional Remote Annunciator N-ANN-80.
  - Optional Remote Printer Gateway N-ANN-S/PG.
  - Optional LED Annunciator Driver N-ANN-I/O.
- Optional 4XTM module (conventional reverse polarity/city box transmitter).

***PROGRAMMING AND SOFTWARE:***

- Can be programmed at the panel with no special software or additional equipment.
- Programmable Make/Break Ratio.
- Upload/Download (local or remote) of program and data via integral DACT.

***USER INTERFACE:***

- Built-in DACT (Digital Alarm Communicator/Transmitter).
- Integral 80-character LCD display with backlighting and keypad.
- Real-time clock/calendar with automatic daylight savings adjustments.
- ANN-BUS for connection to remote annunciators.

- Audible or silent walk test capabilities.
- Piezo sounder for alarm, trouble, and supervisory.

## Controls and Indicators

***LED INDICATORS***

- FIRE ALARM (red)
- SUPERVISORY (yellow)
- TROUBLE (yellow)
- AC POWER (green)
- ALARM SILENCED (yellow)

***CONTROL BUTTONS***

- ACKNOWLEDGE
- ALARM SILENCE
- SYSTEM RESET (lamp test)
- DRILL

## Terminal Blocks

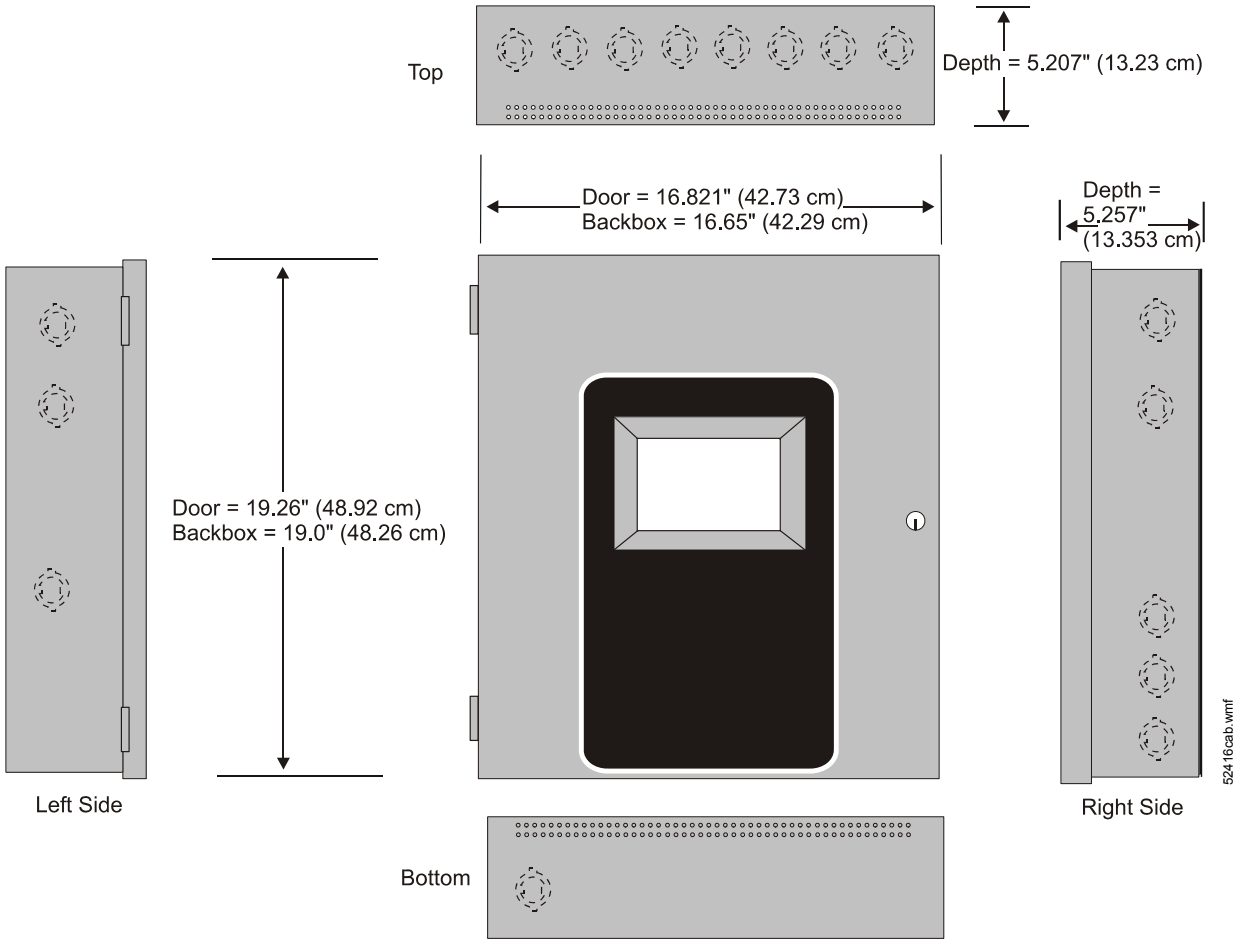
**AC Power – TB1:**

- *SFP-5UD* (FLPS-3 Power Supply): 120 VAC, 50/60 HZ, 1.00 A.
- SFP-10UD (FLPS-7 Power Supply): 120 VAC, 50/60 Hz, 3.8 A.
- SFP-10UDE (FLPS-7 Power Supply): 240 VAC, 50 HZ, 2.20 A.

Wire size: minimum 14 AWG (2.00 mm²) with 600 V insulation. Supervised, nonpower-limited.

**Battery (sealed lead acid only) – J12:**

- Maximum Charging Circuit - Normal Flat Charge: 27.6 VDC @ 1.4 A. Supervised, nonpower-limited.
- Maximum Charger Capacity: 18 AH battery for SFP-5UD, and 26 AH battery for SFP-10UD(E). [Two 18 Ah batteries can be housed in the FACP cabinet. Larger batteries require separate battery box such as the BB-26 or NFS-LBB.]
- Minimum Battery Size: 7 AH.




**Cabinet Measurements**

**Initiating Device Circuits – TB4 (and TB 6 on SFP-10UD only):**

- Alarm Zones 1 - 5 on TB 4 (SFP-5UD and SFP-10UD).
- Alarm Zones 6 - 10 on TB6 (SFP-10UD only).
- Supervised and power-limited circuitry.
- Operation: All zones Style B (Class B).
- Normal Operating Voltage: Nominal 20 VDC.
- Alarm Current: 15 mA minimum.
- Short Circuit Current: 40 mA max.
- Maximum Loop Resistance: 100 ohms.
- End-of-Line Resistor: 4.7K ohm, 1/2 watt (P/N 71252 UL-listed).
- Standby Current: 2 mA.

Refer to the *Notifier Device Compatibility Document* for listed compatible devices.

**Notification Appliance Circuits – TB5 (and TB 7 on SFP-10UD only):**

- Four NACs
- Operation: Style Y (Class B)
- Special Application power
- Supervised and power-limited circuitry
- Normal Operating Voltage: Nominal 24 VDC
- Maximum Signaling Current: 3.0 A for SFP-5UD, 2.5 A maximum per NAC; 7.0 A for SFP-10UD(E), 3.0 A maximum per NAC.
- End-of-Line Resistor: 4.7K ohm, 1/2 watt (Part #71252)
- Max. Wiring Voltage Drop: 2 VDC

Refer to the *Notifier Device Compatibility Document* for compatible listed devices

**Form C Relays – TB8:**

- *Relay 1* (factory default programmed as Alarm Relay)
- *Relay 2* (factory default programmed as fail-safe Trouble Relay)
- *Relay 3* (factory default programmed as Supervisory Relay)

**Special Application Resettable Power – TB9:**

- Jumper selectable by JP31 for resettable or nonresettable power.
- Operating voltage: 24 VDC nominal.
- Maximum available current: 500 mA - appropriate for powering four-wire smoke detectors.
- Power-limited circuit.

Refer to the *Notifier Device Compatibility Document* for listed compatible devices.

**Remote Sync Output - TB2:** Remote power supply synchronization output, only required for the SFP-5UD. 24 VDC nominal special application power. Maximum current is 40 mA. End-of-Line Resistor: 4.7K ohm. Supervised and power-limited circuit.

## Ordering Information

**SFP-5UD:** Five-zone, 24-volt Fire Alarm Control Panel (includes black backbox, FLPS-3 power supply, technical manual, and a frame & post operating instruction sheet).

**SFP-5UDR:** Same as above in a red backbox.

**SFP-10UD:** Ten-zone, 24-volt Fire Alarm Control Panel (includes black backbox, FLPS-7 power supply, technical manual, and a frame & post operating instruction sheet).

**SFP-10UDE:** Same as above with 220 VAC FLPS-7.

**SFP-10UDR:** Same as SFP-10UD in a red backbox.

### *OPTIONAL MODULES*

**N-CAC-5X:** Optional (Class A) Converter Module. Converts Style B (Class B) Initiating Device Circuits to Style D (Class A); and Style Y (Class B) Notification Appliance Circuits to Style Z (Class A). Connects to J2 on the SFP-5UD and SFP-10UD main circuit board and to J7 on the SFP-10UD.

***NOTE:*** *Two Class A Converter Modules are required for the ten-zone panel.*

**4XTM:** Transmitter module. Provides a supervised output for local energy municipal box transmitter and alarm and trouble reverse polarity. Includes a disable switch and disable trouble LED. A module jumper option allows the reverse polarity circuit to open with a system trouble condition if no alarm conditions exists. Mounts to the main circuit board connectors J4 and J5.

### *COMPATIBLE ANNUNCIATORS*

**N-ANN-80:** Remote LCD Annunciator. Mimics the information displayed on the FACP's LCD. Red. (A white version is also available: **N-ANN-80-W**.)

**N-ANN-LED:** Mounts in the DP-51050(B) dress panel and provides three LEDs for each zone: Alarm, Trouble, and Supervisory.

**N-ANN-RLY:** Relay module. Mounts inside the cabinet. Provides ten Form C relays.

**N-ANN-S/PG:** Serial/parallel printer gateway. Provides a connection for a serial or parallel printer.

**N-ANN-I/O:** Driver module. Provides connections to a user-supplied graphic annunciator.

### *ACCESSORIES*

**DP-51050:** Optional dress panel. Restricts access to the system wiring while allowing access to the membrane switch panel. Red.

**DP-51050B:** Same as DP-51050 except black.

**BB-26:** Battery backbox, holds up to two 25 AH batteries and CHG-75.

**NFS-LBB:** Battery backbox, holds up to two 55 AH batteries. Black.

**NFS-LBBR:** Same as above in red.

**TR-CE-B:** Optional black trim-ring for semi-flush mounted cabinets.

**TR-CE:** Same as above in red.

**PRN-6:** UL listed printer.

# SYSTEM SPECIFICATIONS

## System Capacity

- Annunciators ..... 8

## Electrical Specifications

- **SFP-5UD (FLPS-3 Power Supply):** 120 VAC, 50/60 HZ, 1.0 A
- **SFP-10UD (FLPS-7 Power Supply):** 120 VAC, 50/60 HZ, 3.8 A
- **SFP-10UDE (FLPS-7 Power Supply):** 240 VAC, 50/60 HZ, 2.2 A
- **Wire size:** minimum 14 AWG (2.0 $mm^2$) with 600 V insulation, supervised, nonpower-limited

## Cabinet Specifications

**Door:** 19.26" (48.92 cm.) high x 16.82" (42.73 cm.) wide x 0.72" (1.82 cm.) deep. **Backbox:** 19.00" (48.26 cm.) high x 16.65" (42.29 cm.) wide x 5.25" (13.34 cm.) deep. **Trim Ring (TR-CE):** 22.00" (55.88 cm.) high x 19.65" (49.91 cm.) wide.

## Shipping Specifications

**Dimensions:**

- 20.00" (50.80 cm.) high
- 22.5" (57.15 cm.) wide
- 8.5" (21.59 cm.) deep.

## Temperature and Humidity Ranges

This system meets NFPA requirements for operation at 0 – 49°C/32 – 120°F and at a relative humidity 93% ± 2% RH (noncondensing) at 32°C ± 2°C (90°F ± 3°F). However, the useful life of the system's standby batteries and the electronic components may be adversely affected by extreme temperature ranges and humidity. Therefore, it is recommended that this system and its peripherals be installed in an environment with a normal room temperature of 15 – 27°C/60 – 80°F.

## Agency Listings and Approvals

The listings and approvals below apply to the basic SFP-5UD and SFP-10UD control panels. In some cases, certain modules or applications may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL Listed:** File S635
- **FM Approved**
- **CSFM:** 7165-0028:246
- **MEA:** MEA: 333-07-E

## NFPA Standards

The SFP-5UD/SFP-10UD(E) complies with the following NFPA 72 Fire Alarm Systems requirements:

- **LOCAL** (Automatic, Manual, Waterflow and Sprinkler Supervisory).
- **AUXILIARY** (Automatic, Manual and Waterflow) (requires 4XTM).
- **REMOTE STATION** (Automatic, Manual and Waterflow) (Where a DACT is not accepted, the alarm, trouble and supervisory relays may be connected to UL 864 listed transmitters. For reverse polarity signaling of alarm and trouble, 4XTM is required.)
- **PROPRIETARY** (Automatic, Manual and Waterflow).
- **CENTRAL STATION** (Automatic, Manual and Waterflow, and Sprinkler Supervised).

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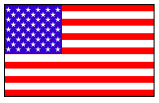
ISO 9001 CERTIFIED
ENGINEERING & MANUFACTURING
QUALITY SYSTEMS

This document is not intended to be used for installation purposes.
We try to keep our product information up-to-date and accurate.
We cannot cover all specific applications or anticipate all requirements.
All specifications are subject to change without notice.



Made in the U.S. A.

For more information, contact Notifier. Phone: (203) 484-7161, FAX: (203) 484-7118.
www.notifier.com

# STI PROTECTIVE CABINETS

## Clear Polycarbonate Cabinets Help Protect Against Vandalism and Accidental Damage

Multipurpose lockable cabinets for remote annunciators, fire alarm control panels, or other electronic products which require physical or environmental protection. Helps guard against vandalism (accidental or intentional), as well as dirt, dust and grime (models without alarm). Covers mount on the wall enabling the unit to be stored in a central location. The cabinets are available with a key or thumb lock, with or without siren alarm or siren/strobe alarm. They also have an additional eyelet for a secondary lock or safety seal.

STI-7520 with Key Lock

c UL us
NEMA 4X
See reverse for details

## How It Works

Cabinets are constructed of a clear polycarbonate that allows the unit within to be highly visible and accessible. When cabinet with siren alarm is opened, the alarm emits an ear piercing siren (model with siren/strobe alarm also flashes), drawing immediate attention to the area. Operator has to unlock the unit and open the lid for access.

STI-7533 with Thumb Lock

STI-7554 with Key Lock

## Features

- Clear UV-stabilized polycarbonate cover.
- Polycarbonate rated -40°F to 120°F (-40°C to 49°C).
- Includes thumb lock or key lock.
- Steel internal mounting plate provided.
- Design allows visibility at any angle.
- External mounting tabs.
- Complete with mounting hardware and gasket.
- Additional eyelet can be used for secondary padlock or safety seal.
- Models available with or without siren alarm or siren/strobe alarm (see separate spec sheets for specific details. For siren alarm only, see STI-6400. For siren/strobe alarm see SA5000).
- Tamperproof mounting screws available.
- Lifetime guarantee against breakage of polycarbonate in normal use (one year on electronics).

**STI-7520 Cabinet Series**

- Frosted polycarbonate backbox.
- STI-7520 and STI-7521 NEMA 4X Approved, UL Listed.

**STI-7530 Cabinet Series**

- Internal drill dimples.
- Optional adjustable wire shelf available.

**STI-7550 Cabinet Series**

- Two rotary action latches.
- Optional wire shelf available.
- STI-7550 and STI-7551 NEMA 4X Approved, UL Listed.

**Safety Technology International, Inc.**
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# STI PROTECTIVE CABINETS
## Dimensions and Technical Information

## Models Available

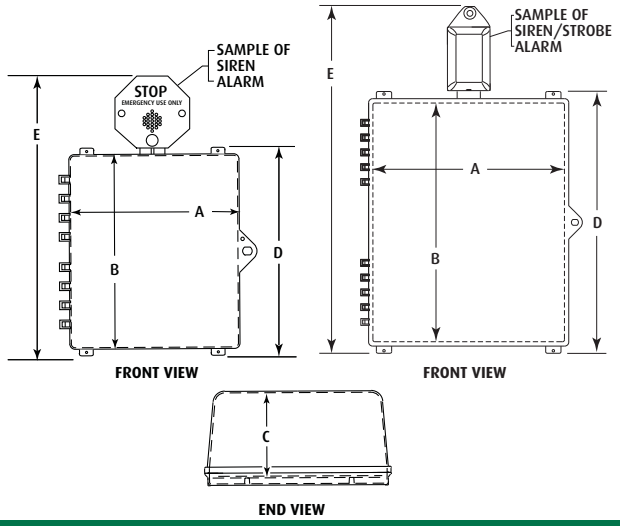
| | |
|---|---|
| **STI-7520** | NEMA 4X Cabinet with key lock - clear |
| **STI-7521** | NEMA 4X Cabinet with thumb lock - clear |
| **STI-7522** | Cabinet with key lock and siren alarm - clear |
| **STI-7523** | Cabinet with thumb lock and siren alarm - clear |
| **STI-7524** | Cabinet with key lock and siren/strobe alarm - clear |
| **STI-7525** | Cabinet with thumb lock and siren/strobe alarm - clear |
| **STI-7530** | Cabinet with key lock - clear |
| **STI-7531** | Cabinet with thumb lock - clear |
| **STI-7532** | Cabinet with key lock and siren alarm - clear |
| **STI-7533** | Cabinet with thumb lock and siren alarm - clear |
| **STI-7534** | Cabinet with key lock and siren/strobe alarm - clear |
| **STI-7535** | Cabinet with thumb lock and siren/strobe alarm - clear |
| **STI-7550** | Cabinet with key lock - clear |
| **STI-7551** | Cabinet with thumb lock - clear |
| **STI-7552** | Cabinet with key lock and siren alarm - clear |
| **STI-7553** | Cabinet with thumb lock and siren alarm - clear |
| **STI-7554** | Cabinet with key lock and siren/strobe alarm - clear |
| **STI-7555** | Cabinet with thumb lock and siren/strobe alarm - clear |
| **STI-6453** | Replacement siren alarm |
| **05000** | Replacement siren/strobe alarm |
| **07530WR** | Wire shelf for STI-7530 series |
| **07550WR** | Wire shelf for STI-7550 series |
| **18021** | NEMA 4X 3/4" rigid conduit hub |
| **18051** | Additional key (J236) |
| **18075** | Replacement key for siren/strobe alarm |
| **19032** | Replacement key #2341 for siren alarm |
| **SUB-82** | #8 x 1.5" snake eye tamper resistant stainless steel screw (qty. 4) |
| **19038** | Snake eye bit |

**NOTE:** End user must verify the alarm and battery every six months and replace battery annually or as required.

## Testing Approvals

STI-7520 and STI-7521 have been tested and approved or listed by:
- UL and cUL S7255
- NEMA 4X Certified
- Tested to UL38, UL50 and UL2017

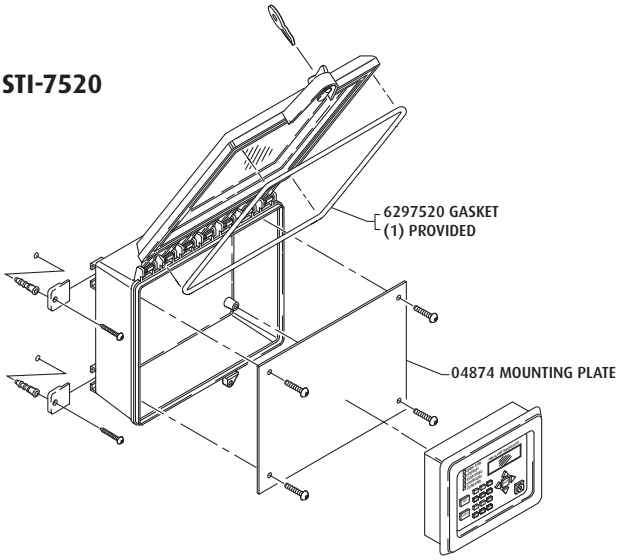
STI-7550 and STI-7551 have been tested and approved or listed by:
- UL S7255
- NEMA 4X Certified



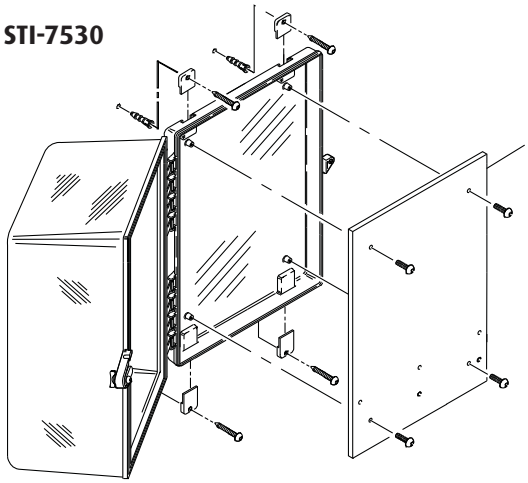

| | A | B | C | D | E |
|---|---|---|---|---|---|
| STI-7520/7521 | 8.875 in. (225mm) | 10.875 in. (276mm) | 3.625 in. (92mm) | 12 in. (305mm) | * |
| STI-7522/7523 | | | | | 19 in. (483mm) |
| STI-7524/7525 | | | | | 19.46 in.(494.34mm) |
| STI-7530/7531 | 12.2 in. (310mm) | 14.2 in. (361mm) | 6.44 in. (164mm) | 16.5 in. (419mm) | * |
| STI-7532/7533 | | | | | 23 in.(584mm) |
| STI-7534/7535 | | | | | 23.5 in.(597mm) |
| STI-7550/7551 | 19.75 in. (502mm) | 24.75 in. (629mm) | 7.31 in. (186mm) | 27.5 in. (699mm) | * |
| STI-7552/7553 | | | | | 34.7 in.(881mm) |
| STI-7554/7555 | | | | | 35 in.(889mm) |

* Models with no alarm

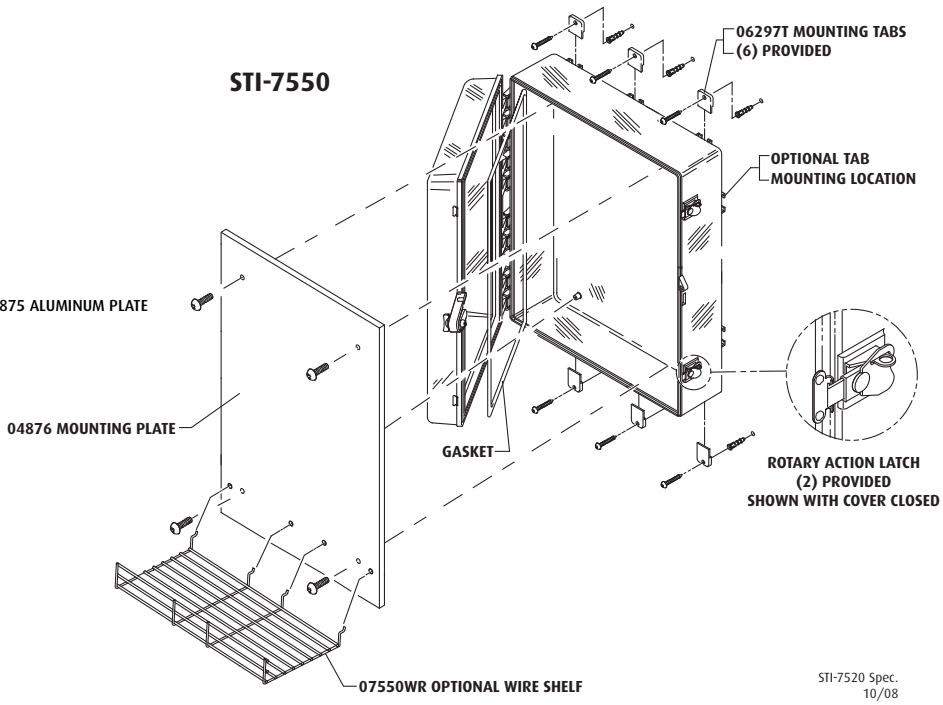
### STI-7520




### STI-7530




### STI-7550

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# NBG-12 Series

## Non-Coded Conventional Manual Fire Alarm Pull Stations

NOTIFIER® by Honeywell

**Conventional Initiating Devices**

## General

The NOTIFIER **NBG-12 Series** is a cost-effective, feature-packed series of non-coded manual fire alarm pull stations. It was designed to meet multiple applications with the installer and end-user in mind. The NBG-12 Series features a variety of models including single- and dual-action versions.

The NBG-12 Series provides an alarm initiating input signal to conventional fire alarm control panels (FACPs) such as the SFP Series, and to XP Transponders. Its innovative design, durable construction, and multiple mounting options make the NBG-12 Series simple to install, maintain, and operate.

## Features

- Aesthetically pleasing, highly visible design and color.
- Attractive contoured shape and light textured finish.
- Meets ADA 5 lb. maximum pull-force.
- Meets UL 38, Standard for Manually Actuated Signaling Boxes.
- Easily operated (single- or dual-action, model dependent), yet designed to prevent false alarms when bumped, shaken, or jarred.
- PUSH IN/PULL DOWN handle latches in the down position to clearly indicate the station has been operated.
- The word “ACTIVATED” appears on top of the handle in bright yellow, further indicating operation of the station.
- Operation handle features white arrows showing basic operation direction for non-English-speaking persons.
- Braille text included on finger-hold area of operation handle and across top of handle.
- Multiple hex- and key-lock models available.
- U.S. patented hex-lock needs only a quarter-turn to lock/unlock.
- Station can be opened for inspection and maintenance without initiating an alarm.
- Product ID label viewable by simply opening the cover; label is made of a durable long-life material.
- The words “NORMAL” and “ACTIVATED” are molded into the plastic adjacent to the alarm switch (located inside).
- Four-position terminal strip molded into backplate.
- Terminal strip includes Phillips combination-head captive 8/32 screws for easy connection to Initiating Device Circuit (IDC).
- Terminal screws backed-out at factory and shipped ready to accept field wiring (up to 12 AWG/3.1 mm²).
- Terminal numbers are molded into the backplate, eliminating the need for labels.
- Switch contacts are normally open.
- Can be surface-mounted (with **SB-10** or **SB-I/O**) or semi-flush mounted. Semi-flush mount to a standard single-gang, double-gang, or 4" (10.16 cm) square electrical box.
- Backplate is large enough to overlap a single-gang backbox cutout by 1/2" (1.27 cm).
- Optional trim ring (**BG12TR**).
- Spanish versions *(FUEGO)* available (**NBG-12LSP**, **NBG-12LPSP**).
- Designed to replace the legacy **NBG-10** Series.
- Models packaged in attractive, clear plastic (PVC), clam-shell-style, Point-of-Purchase packages. Packaging includes a cutaway dust/paint cover in shape of pull station.

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## Construction

- Cover, backplate and operation handle are all molded of durable polycarbonate material.
- Cover features white lettering and trim.
- Red color matches System Sensor’s popular SpectrAlert® Advance horn/strobe series.

## Operation

The NBG-12 manual pull stations provide a textured finger-hold area that includes Braille text. In addition to PUSH IN and PULL DOWN text, there are arrows indicating how to operate the station, provided for non-English-speaking people.

Pushing in and then pulling down on the handle activates the normally-open alarm switch. Once latched in the down position, the word “ACTIVATED” appears at the top in bright yellow, with a portion of the handle protruding at the bottom as a visible flag. Resetting the station is simple: insert the key or hex (model dependent), twist one quarter-turn, then open the station’s front cover, causing the spring-loaded operation handle to return to its original position. The alarm switch can then be reset to its normal (non-alarm) position manually (by hand) or by closing the station’s front cover, which automatically resets the switch.

## Specifications

### *PHYSICAL SPECIFICATIONS:*

| pull station | | SB-10 | SB-I/O | WBB | WP-10 |
|---|---|---|---|---|---|
| H | 5.500 in. (13.97 cm) | 5.500 in. (13.97 cm) | 5.601 in. (14.23 cm) | 4.25 in. (10.79 cm) | 6.000 in. (15.24 cm) |
| W | 4.121 in. (10.467 cm) | 4.125 in. (10.478 cm) | 4.222 in. (10.72 cm) | 4.25 in. (10.79 cm) | 4.690 in. (11.913 cm) |
| D | 1.390 in. (3.531 cm) | 1.375 in. (3.493 cm) | 1.439 in. (3.66 cm) | 1.75 in. (4.445 cm) | 2.000 in. (5.08 cm) |

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### *ELECTRICAL SPECIFICATIONS:*

**Switch contact ratings:** gold-plated; rating 0.25 A @ 30 VAC or VDC. **Auxiliary contact circuit** (Terminals 3 & 4, NBG-12LA): rated to 3.0 A @ 30 VAC or VDC.

### *ENGINEERING/ARCHITECTURAL SPECIFICATIONS*

Manual Fire Alarm Stations shall be non-code, with a key- or hex-operated reset lock in order that they may be tested, and so designed that after actual Emergency Operation, they cannot be restored to normal except by use of a key or hex. An operated station shall automatically condition itself so as to be visually detected as activated. Manual stations shall be constructed of red colored LEXAN (or polycarbonate equivalent) with clearly visible operating instructions provided on the cover. The word **FIRE** shall appear on the front of the stations in white letters, 1.00 inches (2.54 cm) or larger.* Stations shall be suitable for surface mounting on matching backbox SB-10 or SB-I/O; or semi-flush mounting on a standard single-gang, double-gang, or 4" (10.16 cm) square electrical box, and shall be installed within the limits defined by the Americans with Disabilities Act (ADA) or per national/local requirements. Manual Stations shall be Underwriters Laboratories listed.

***NOTE:*** **The words "FIRE/FUEGO" on the NBG-12LSP and NBG-12LPSP shall appear on the front of the station in white letters, approximately 3/4" (1.905 cm) high.*

## Pre-Signal Models

The **NBG-12LPS** and **NBG-12LPSP** pull stations are non-coded manual pull stations which provide a FACP with two normally open alarm initiating input signals. "Pre-signal" input is activated by pushing in, then pulling down, the dual-action handle. A "general" alarm input signal can be manually activated via a momentary rocker switch mounted inside the unit. This general alarm switch can only be accessed by opening the cover with the supplied key/lock. *See diagram at right.*

## Agency Listings and Approvals

The listings and approvals below apply to the NBG-12 Series pull stations. In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **C(UL)US** Listed: file S692.
- **CSFM** approved: file 7150-0028:199.
- **FM** approved *(except NBG-12LPS, NBG-12LPSP).*
- **MEA** approved: file 67-02-E *(NBG-12, NBG-12L, NBG-12LOB, NBG-12LA).*
- **Lloyd's Register** type approved: file 93/60141 (E3) *(NBG-12, NBG-12L, NBG-12LA, NBG-12LOB, NBG-12S).*
- **U.S. Coast Guard** approved: files 161.002/23/3 *(AFP-200 with NBG-12, NBG-12L, NBG-12S)*; 161.002/42/1 *(NFS-640 with NBG-12, NBG-12L, NBG-12S)*; 161.002/27/3 *(AFP1010/AM2020 with NBG-12, NBG-12L, NBG-12S).*
- **Patented:** U.S. Patent No. D428,351; 6,380,846; 6,314,772; 6,632,108.

## Product Line Information

**NBG-12S:** Single-action pull station with pigtail connections, hex lock.

**NBG-12:** Dual-action pull station with SPST N/O switch, screw terminal connections, ***hex lock***.

**NBG-12L:** Dual-action pull station with SPST N/O switch, screw terminal connections, ***key lock***.

**NBG-12LSP:** Same as NBG-12L with English/Spanish *(FIRE/FUEGO)* labeling.

**NBG-12LPS:** Dual-action pull station with pre-signal option.

**NBG-12LPSP:** Same as NBG-12LPS with English/Spanish *(FIRE/FUEGO)* labeling.

**NBG-12LOB:** Dual-action pull station with key lock, outdoor applications listings (**NBG-12LO**), and backbox. Includes **SB-I/O** indoor/outdoor backbox, and sealing gasket. Model will also mount to **WP-10** weatherproof backbox in retrofit applications.

***NOTE:*** *NBG-12LO not available separately;*
*NBG-12LO + approved backbox = NBG-12LOB.*
*Outdoor applications listings apply to NBG-12LOB combination.*

**NBG-12LA:** Dual-action pull station with key lock and annunciator contacts.

**SB-10:** Surface-mount backbox, metal.

**SB-I/O:** Surface-mount backbox, plastic. *(Included with NBG-12LOB.)*

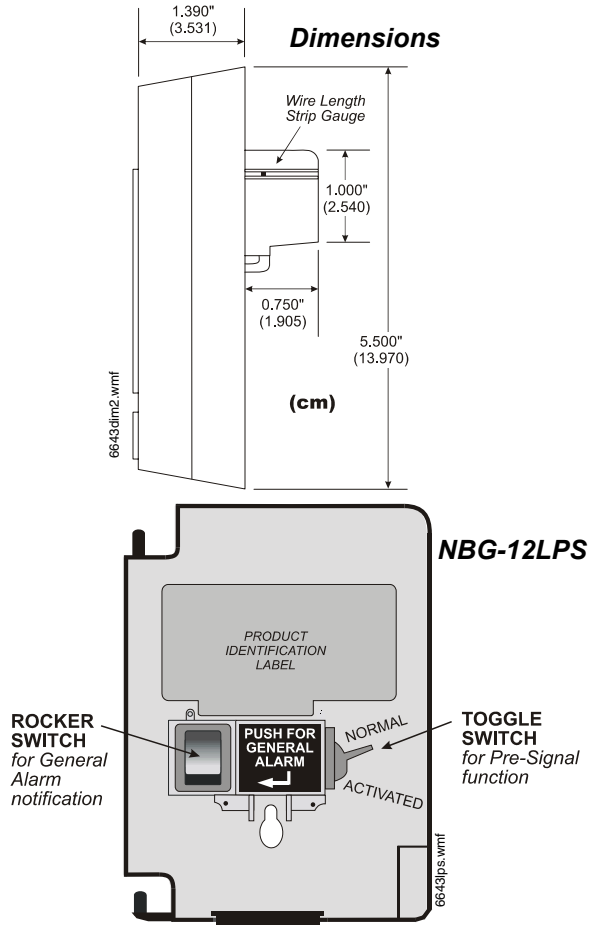
**BG12TR:** Optional trim ring for semi-flush mounting.

**WP-10:** Outdoor use backbox.

**17021:** Keys, set of two. (Included with key-lock pull stations.)

**17007:** Hex key, 9/64". (Included with hex-lock pull stations.)

***NOTE:*** *For addressable NBG-12LX models, see data sheet DN-6726.*

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www.notifier.com

# SpectrAlert® Advance

## Selectable Output Notification Appliances

NOTIFIER® by Honeywell

**Audio/Visual Devices**

## General

System Sensor® SpectrAlert® Advance selectable-output horns, strobes and horn/strobes are rich with features guaranteed to cut installation times and maximize profits. The SpectrAlert Advance series of notification appliances is designed to simplify your installations, with features such as: plug-in designs, instant feedback messages to ensure correct installation of individual devices, and eleven field-selectable candela settings for wall and ceiling strobes and horn/strobes.

More specifically, when installing Advance products, first attach a universal mounting plate to a four-inch square, four-inch octagon, or double-gang junction box. The two-wire mounting plate attaches to a single-gang junction box.

Then, connect the notification appliance circuit wiring to the SEMS terminals on the mounting plate.

Finally, attach the horn, strobe, or horn/strobe to the mounting plate by inserting the product's tabs in the mounting plate's grooves. The device will rotate into position, locking the product's pins into the mounting plate's terminals. The device will temporarily hold in place with a catch until it is secured with a captured mounting screw.

**SpectrAlert Advance products allow you to choose:**

- 12 or 24 volts.
- At 24 volts, 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, or 185 candela by way of a rear-mounted slide switch and front viewing window.
- Horn tones and volume by way of a rotary switch.
- The SpectrAlert Advance series includes outdoor notification appliances. Outdoor strobes and horn/strobes (two-wire and four-wire) are available for wall or ceiling. Outdoor horns are available for wall only. All System Sensor outdoor products are rated between –40°F and 151°F (–40°C and 66°C) in wet or dry applications.

**Models available:**

- Indoor wall-mount: horn, strobe, 2-wire horn/strobe, 4-wire horn/strobe.
- Indoor ceiling-mount: strobe, 2-wire horn/strobe, 4-wire horn/strobe.
- Outdoor wall-mount: horn, strobe, 2-wire horn/strobe, 4-wire horn/strobe.
- Outdoor ceiling-mount: strobe, 2-wire horn/strobe, 4-wire horn/strobe.

## Features

- Plug-in design.
- Same mounting plate for wall- and ceiling-mount units.
- Shorting spring on mounting plate for continuity check before installation.
- Captive mounting screw.
- Tamper-resistance capability.
- Field-selectable candela settings on wall and ceiling units: 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, 185.
- Automatic selection of 12 or 24 volt operation at 15 and 15/75 candela.
- Outdoor wall and ceiling products.
- Outdoor products rated from –40°F and 151°F (–40°C and 66°C).

7087pho1.jpg

*Indoor Ceiling Horn/Strobe*

7087pho2.jpg

*Outdoor Ceiling Strobe*

7087pho3.jpg

*Indoor Wall Horn/Strobe*

7087pho4.jpg

*Indoor Ceiling Strobe*

7087pho5.jpg

*Indoor Wall Horn*

7087pho6.jpg

*Outdoor Wall Strobe*

- Minimal intrusion into the backbox.
- Horn rated at 88+ dbA at 16 volts.
- Rotary switch for tone selection.
- Three horn volume settings.
- Electrically compatible with existing SpectrAlert products.

## Engineering Specifications

SpectrAlert Advance horns, strobes, and horn/strobes shall mount to a standard 4.0" x 4.0" x 1.5" (10.16 x 10.16 x 3.81 cm) backbox, 4.0" (10.16 cm) octagonal backbox, or a double-gang backbox. Two-wire products shall also mount to a single-gang 2.0" x 4.0" x 1.875" (5.08 x 10.16 x 4.763 cm) backbox. A universal mounting plate shall be used for mounting ceiling and wall products. The notification appliance circuit wiring shall terminate at the universal mounting plate. Also, SpectrAlert Advance products, when used with the Sync•Circuit™ Module accessory, shall be powered from a non-coded notification appliance circuit output and shall operate on a nominal 12 or 24 volts. When used with the Sync•Circuit Module, 12-volt rated notification appliance circuit outputs shall operate between 9 and 17.5 volts; 24-volt rated notification appliance circuit outputs shall operate between 17 and 33 volts. Indoor SpectrAlert Advance products shall operate between 32°F and 120°F (0°C and 49°C) from a regulated DC, or full-wave-rectified, unfiltered power supply. Strobes and horn/strobes shall have field-selectable candela settings including 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, 185.

### *STROBE*

The strobe shall be a System Sensor SpectrAlert Advance Model _____ listed to UL 1971 and shall be approved for fire protective service. The strobe shall be wired as a primary-signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system.

### *HORN/STROBE COMBINATION*

The horn/strobe shall be a System Sensor SpectrAlert Advance Model _____ listed to UL 1971 and UL 464 and shall be approved for fire protective service. The horn/strobe shall be wired as a primary-signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. The horn shall have three audibility options and an option to switch between a Temporal 3 pattern and a Non-Temporal (continuous) pattern. These options are set by a multiple position switch. On four-wire products, the strobe shall be powered independently of the sounder. The horn on horn/strobe models shall operate on a coded or non-coded power supply.

### *OUTDOOR PRODUCTS*

SpectrAlert Advance outdoor horns, strobes and horn/strobes shall be listed for outdoor use by UL and shall operate between –40°F and 151°F (–40°C and 66°C). The products shall be listed for use with a System Sensor outdoor/weatherproof backbox with half-inch and three-fourths-inch conduit entries.

### *SYNCHRONIZATION MODULE*

The module shall be a System Sensor Sync•Circuit _____ listed to UL 464 and shall be approved for fire protective service. The module shall synchronize SpectrAlert strobes at 1 Hz and horns at Temporal 3. Also, while operating the strobes, the module shall silence the horns on horn/strobe models over a single pair of wires. The module shall mount to a 4.688" x 4.688" x 2.125" (11.906 x 11.906 x 5.398 cm) backbox. The module shall also control two Style Y (class B) circuits or one Style Z (Class A) circuit. The module shall synchronize multiple zones. Daisy-chaining two or more synchronization modules together will synchronize all the zones they control. The module shall not operate on a coded power supply.

## Operating Specifications

- **Standard operating temperature:** 32°F to 120°F (0°C to 49°C).
- **K Series operating temperature:** –40°F to 151°F (–40°C to 66°C).
- **Humidity range:** 10% to 93% non-condensing (indoor products).
- **Strobe flash rate:** 1 flash per second.
- **Nominal voltage:** regulated 12 VDC/FWR or regulated 24 VDC/FWR. ***NOTE:*** *Full Wave Rectified (FWR) voltage is a non-regulated, time-varying power source that is used on some power supply and panel outputs.*
- **Operating voltage range:** 8 V to 17.5 V (12 V nominal); or 16 V to 33 V (24 V nominal). ***NOTE:*** *P, S, PC, and SC products will operate at 12 V nominal only for 15 cd and 15/75 cd.*
- **Input terminal wire gauge:** 12 to 18 AWG (3.31 to 0.821 mm²).
- **Ceiling-mount dimensions (including lens):** 6.8" diameter x 2.5" deep (17.3 cm diameter x 6.4 cm deep).
- **Wall-mount dimensions (including lens):** 5.6" H x 4.7" W x 2.5" D (14.2 cm H x 11.9 cm W x 6.4 cm D).
- **Horn dimensions:** 5.6" H x 4.7" W x 1.3" D (14.2 cm H x 11.9 cm W x 3.3 cm D).

## Agency Listings and Approvals

The listings and approvals below apply to SpectrAlert Advance Selectable Output Notification Devices. In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL** Listed: file **S4011** (HR__, HW__, P2__, P4__, PC2__, PC4__ models); file **S5512** (models SCR, SCRH, SCW, SCWH, SR, SRH, SW, SWH); file **S3593** (SCRHK, SCRK, SRHK, SRK).
- **ULC** Listed: file **CS1099** (HRA, HRKA); file **CS1089** (typically "A" models, with exception of outdoor strobes). *See Canadian data sheet for listings and specifications.*
- **FM** approved.
- **MEA** approved: file **452-05-E**.
- **CSFM** approved: file **7125-1653:186** (SCR, SCRH, SCW, SCWH, SR, SRH, SW, SWH); file **7125-1653:188** P2__, P4__, PC2__, PC4__ models); file **7135-1653:189** (HR, HRK, HW); file **7300-1653:187** (SCRHK, SCRK, SRHK, SRK).

## Strobe Current Draw, UL Maximum (mA RMS)

| Candela | | 8 – 17.5 V | | 16 – 33 V | |
|---|---|---|---|---|---|
| | | DC | FWR | DC | FWR |
| Standard Candela Range | 15 | 123 | 128 | 66 | 71 |
| | 15/75 | 142 | 148 | 77 | 81 |
| | 30 | NA | N/A | 94 | 96 |
| | 75 | NA | NA | 158 | 153 |
| | 95 | NA | NA | 181 | 176 |
| | 110 | NA | NA | 202 | 195 |
| | 115 | NA | NA | 210 | 205 |
| High Candela Range | 135 | NA | NA | 228 | 207 |
| | 150 | NA | NA | 246 | 220 |
| | 177 | NA | NA | 281 | 251 |
| | 185 | NA | NA | 286 | 258 |

## Horn Current Draw, UL Maximum (mA RMS)

| Sound Pattern | dB | 8 – 17.5 V | | 16 – 33 V | |
|---|---|---|---|---|---|
| | | DC | FWR | DC | FWR |
| Temporal | High | 57 | 55 | 69 | 75 |
| Temporal | Medium | 44 | 49 | 58 | 69 |
| Temporal | Low | 38 | 44 | 44 | 48 |
| Non-temporal | High | 57 | 56 | 69 | 75 |
| Non-temporal | Medium | 42 | 50 | 60 | 69 |
| Non-temporal | Low | 41 | 44 | 50 | 50 |
| Coded | High | 57 | 55 | 69 | 75 |
| Coded | Medium | 44 | 51 | 56 | 69 |
| Coded | Low | 40 | 46 | 52 | 50 |

## Horn and Horn/Strobe Rotary Switch Setting

| Setting | Repetition Rate | dB Level |
|---|---|---|
| 1 | Temporal horn | High |
| 2 | Temporal horn | Medium |
| 3 | Temporal horn | Low |
| 4 | Normal horn | High |
| 5 | Normal horn | Medium |
| 6 | Normal horn | Low |
| 7* | Externally coded | High |
| 8* | Externally coded | Medium |
| 9* | Externally coded | Low |

***NOTE:** Settings 7, 8, and 9 are not available on 2-wire horn/strobe.*

## Horn and Horn/Strobe Output (dBA)

| Switch Position | Sound Pattern | dB | 8 – 17.5 V | | 16 – 33 V | |
|---|---|---|---|---|---|---|
| | | | DC | FWR | DC | FWR |
| 1 | Temporal | High | 78 | 78 | 84 | 84 |
| 2 | Temporal | Medium | 74 | 74 | 80 | 80 |
| 3 | Temporal | Low | 71 | 73 | 76 | 76 |
| 4 | Non-temporal | High | 82 | 82 | 88 | 88 |
| 5 | Non-temporal | Medium | 78 | 78 | 85 | 85 |
| 6 | Non-temporal | Low | 75 | 75 | 81 | 81 |
| 7* | Coded | High | 82 | 82 | 88 | 88 |
| 8* | Coded | Medium | 78 | 78 | 85 | 85 |
| 9* | Coded | Low | 75 | 75 | 81 | 81 |

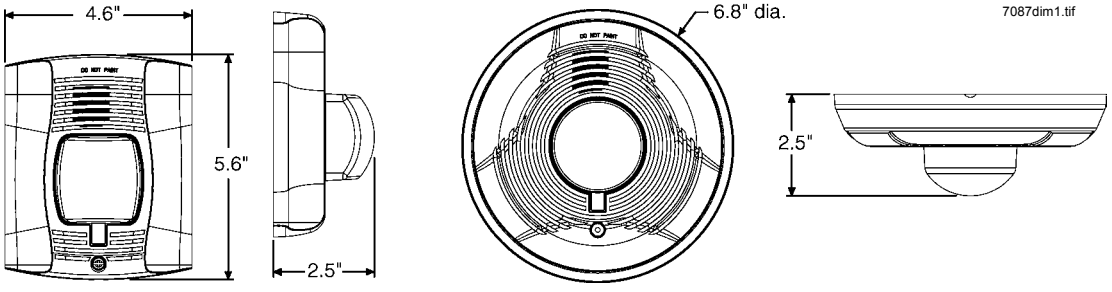
***NOTE:** Settings 7, 8, and 9 are not available on 2-wire horn/strobe.*

## Two-Wire Horn/Strobe, *STANDARD* Candela Range (15 – 115 cd), UL Maximum Current Draw (mA RMS)

| Input, Sound Pattern, dB Level | 8 – 17.5 V | | 16 – 33 V | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 15 | 15/75 | 15 | 15/75 | 30 | 75 | 95 | 110 | 115 |
| DC Input, Temporal, High | 137 | 147 | 79 | 90 | 107 | 176 | 194 | 212 | 218 |
| DC Input, Temporal, Medium | 132 | 144 | 69 | 80 | 97 | 157 | 182 | 201 | 210 |
| DC Input, Temporal, Low | 132 | 143 | 66 | 77 | 93 | 154 | 179 | 198 | 207 |
| DC Input, Non-temporal, High | 141 | 152 | 91 | 100 | 116 | 176 | 201 | 221 | 229 |
| DC Input, Non-temporal, Medium | 133 | 145 | 75 | 85 | 102 | 163 | 187 | 207 | 216 |
| DC Input, Non-temporal, Low | 131 | 144 | 68 | 79 | 96 | 156 | 182 | 201 | 210 |
| FWR Input, Temporal, High | 136 | 155 | 88 | 97 | 112 | 168 | 190 | 210 | 218 |
| FWR Input, Temporal, Medium | 129 | 152 | 78 | 88 | 103 | 160 | 184 | 202 | 206 |
| FWR Input, Temporal, Low | 129 | 151 | 76 | 86 | 101 | 160 | 184 | 194 | 201 |
| FWR Input, Non-temporal, High | 142 | 161 | 103 | 112 | 126 | 181 | 203 | 221 | 229 |
| FWR Input, Non-temporal, Medium | 134 | 155 | 85 | 95 | 110 | 166 | 189 | 208 | 216 |
| FWR Input, Non-temporal, Low | 132 | 154 | 80 | 90 | 105 | 161 | 184 | 202 | 211 |

## Two-Wire Horn/Strobe, *HIGH* Candela Range (135 – 185 cd), UL Maximum Current Draw (mA RMS)

| DC Input | 16 – 33 V | | | | FWR Input | 16 – 33 V | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 135 | 150 | 177 | 185 | | 135 | 150 | 177 | 185 |
| DC, Temporal, High | 245 | 259 | 290 | 297 | FWR, Temporal, High | 215 | 231 | 258 | 265 |
| DC, Temporal, Medium | 235 | 253 | 288 | 297 | FWR, Temporal, Medium | 209 | 224 | 250 | 258 |
| DC, Temporal, Low | 232 | 251 | 282 | 292 | FWR, Temporal, Low | 207 | 221 | 248 | 256 |
| DC, Non-temporal, High | 255 | 270 | 303 | 309 | FWR, Non-temporal, High | 233 | 248 | 275 | 281 |
| DC, Non-temporal, Medium | 242 | 259 | 293 | 299 | FWR, Non-temporal, Medium | 219 | 232 | 262 | 267 |
| DC, Non-temporal, Low | 238 | 254 | 291 | 295 | FWR, Non-temporal, Low | 214 | 229 | 256 | 262 |



## Ordering Information

| Model | Description* | Model | Description |
|---|---|---|---|
| ***WALL HORN/STROBES*** | | ***CEILING HORN/STROBES*** | |
| **P2R** | 2-wire horn/strobe, standard cd, red. | **PC2R** | 2-wire horn/strobe, standard cd, red. |
| **P2RH** | 2-wire horn/strobe, high cd, red. | **PC2RH** | 2-wire horn/strobe, high cd, red. |
| **P2RK** | 2-wire horn/strobe, standard cd, red, outdoor.** | **PC2RK** | 2-wire horn/strobe, standard cd, red, outdoor. |
| **P2RHK** | 2-wire horn/strobe, high cd, red, outdoor. | **PC2RHK** | 2-wire horn/strobe, high cd, red, outdoor. |
| **P2W** | 2-wire horn/strobe, standard cd, white. | **PC2W** | 2-wire horn/strobe, standard cd, white. |
| **P2WH** | 2-wire horn/strobe, high cd, white. | **PC2WH** | 2-wire horn/strobe, high cd, white. |
| **P4R** | 4-wire horn/strobe, standard cd, red. | **PC4R** | 4-wire horn/strobe, standard cd, red. |
| **P4RH** | 4-wire horn/strobe, high cd, red. | **PC4RH** | 4-wire horn/strobe, high cd, red. |
| **P4RK** | 4-wire horn/strobe, standard cd, red, outdoor. | **PC4RK** | 4-wire horn/strobe, standard cd, red, outdoor. |
| **P4RHK** | 4-wire horn/strobe, high cd, red, outdoor. | **PC4RHK** | 4-wire horn/strobe, high cd, red, outdoor. |
| **P4W** | 4-wire horn/strobe, standard cd, white. | **PC4W** | 4-wire horn/strobe, standard cd, white. |
| **P4WH** | 4-wire horn/strobe, high cd, white. | **PC4WH** | 4-wire horn/strobe, high cd, white. |
| ***WALL STROBES*** | | ***CEILING STROBES*** | |
| **SR** | Strobe, standard cd, red. | **SCR** | Strobe, standard cd, red. |
| **SRH** | Strobe, high cd, red. | **SCRH** | Strobe, high cd, red. |
| **SRK** | Strobe, standard cd, red, outdoor. | **SCRK** | Strobe, standard cd, red, outdoor. |
| **SRHK** | Strobe, high cd, red, outdoor. | **SCRHK** | Strobe, high cd, red, outdoor. |
| **SW** | Strobe, standard cd, white. | **SCW** | Strobe, standard cd, white. |
| **SWH** | Strobe, high cd, white. | **SCWH** | Strobe, high cd, white. |
| ***ACCESSORIES*** | | ***HORNS*** | |
| **BBS-2** | Backbox skirt, wall, red. | **HR** | Horn, red. |
| **BBSW-2** | Backbox skirt, wall, white. | **HRK** | Horn, red, outdoor. |
| **BBSC-2** | Backbox skirt, ceiling, red. | **HW** | Horn, white. |
| **BBSCW-2** | Backbox skirt, ceiling, white. | ***ACCESSORIES, continued*** | |
| **SA-WBB** | Weatherproof backbox, wall. | **MP-2W-20BP** | 2-wire indoor mounting plates, pkg of 20. |
| **SA-WBBC** | Weatherproof backbox, ceiling. ***cont'd at right*** | **MPK-2W-20BP** | 2-wire outdoor mounting plates, pkg of 20. |

***NOTE:** *"High cd" refers to strobes that include 135, 150, 177, and 185 candela settings. "Standard cd" refers to strobes that include 15, 15/75, 30, 75, 95, 110, and 115 candela settings. **All outdoor models ("K" suffix) include weatherproof backbox.*

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EtherNAV

# PRODUCT SPECIFICATION DECT/DECR3000 SERIES

## 8-CHANNEL CONTACT MAPPING ETHERNET TRANSMITTERS AND RECEIVERS

## DESCRIPTION

The IFS DECT/DECR3000 series contact mapping transmitter and receiver provides transmission of up to eight independent contact closures over Ethernet electrical 10/100 TX or 100 FX optical fiber. The DECT/DECR3000 utilizes microprocessor-based logic for exceptionally robust communications channel redundancy. Models within this series are available for use with electrical RJ45, multimode or singlemode optical fiber. Plug-and-play design ensures ease of installation requiring no electrical or optical adjustments. Each module incorporates power and individual status indicating LED's for monitoring confirmation of contact closure of each of the eight channels. The modules are available in stand-alone only.

## APPLICATION EXAMPLES

- Alarm Event Triggering
- Building Automation and Environmental Control Systems
- Fire & Alarm Systems
- Lane/Gate Control
- PIR Signal Transmission

## FEATURES

- Transmits Up to Eight Contact Closures Over Fiber or CAT 5.
- Web Based Configuration
- Eight Channel Point-to-Point Transmission Architecture
- Power and Eight Individual Channel Status LED Indicators
- Eight SPST Reed Relays (with individual indicators)
- Designed to Meet the Requirements of NEMA TS-1/TS-2 & Caltrans Specifications (Temperature/Humidity, Shock/Vibration, and Voltage Transient Protection) for Traffic Control Equipment.
- Loss of Carrier Relay for Alarm Notifications
- Relay Contact Rating: 200 VDC, 0.5 Amps, Normally Open
- No In-field Electrical or Optical Adjustments Required
- Automatic Resettable Solid-State Current Limiters
- Hot-Swappable Rack Modules
- Distances up to 28 Miles (45 km)
- Comprehensive Lifetime Warranty

8 CC

Available at: www.ifs.com

- A & E Specifications, (CSI)
- AutoCAD Drawings
- Operation Manuals
- Technical Bulletins

## ORDERING INFORMATION

| | PART NUMBER | DESCRIPTION | FIBERS REQUIRED | OPTICAL PWR BUDGET | MAX. DISTANCE* |
|---|---|---|---|---|---|
| **ELECTRICAL** | DECT3000<br>DECR3000 | 10/100 electrical Tx<br>10/100 electrical Rx | NA | NA | 300 ft. (100 m) |
| **MULTIMODE 62.5/125µm**** | DECT3020<br>DECR3020 | Contact Mapping Transmitter (1310 nm)<br>Contact Mapping Receiver (1310 nm) | 2 | 10 dB | 1.2 miles (2 km) |
| **SINGLEMODE 9/125µm** | DECT3030<br>DECR3030 | Contact Mapping Transmitter (1310 nm)<br>Contact Mapping Receiver (1310 nm) | 2 | 15 dB | 28 miles (45 km) |
| **ACCESSORIES♦** | PS-12VDC 12 Volt DC Plug-in Power Supply (Included)<br>PS-12VDC-230 12 Volt DC Plug-in Power Supply, 230 VAC Input (Included if specified at time of order) | | | | |
| **OPTIONS** | Add '-R3' to Model Number for R3 Rack Mount (Requires R3 Rack purchased separately)<br>Add '-C' for Conformally Coated Printed Circuit Boards (Extra charge, consult factory) | | | | |

*** Optical transmission distance is limited to optical loss of the fiber and any additional loss introduced by connectors, splices and patch panels. Distance can also be limited by fiber bandwidth. ** For 50/125 Fiber, subtract 4 dB from Optical Power Budget. ♦ All accessories are third party manufactured.**

EtherNAV

# TECHNICAL SPECIFICATION DECT/DECR3000 SERIES

## 8-CHANNEL CONTACT MAPPING ETHERNET TRANSMITTERS AND RECEIVERS

## SPECIFICATIONS

### DATA

| | |
|---|---|
| Input/Output Channels | 8 |
| Contacts: | 200 VDC, 0.5 amp, 12 watts. Normally open/closed |
| Response Time: | 25 msec maximum, typical |

### WAVELENGTH

| | |
|---|---|
| DECT3010, DECR3010: | 850 nm, Multimode |
| DECT3020, DECR3020: | 1310 nm, Multimode |
| DECT3030, DECR3030: | 1310 nm, Singlemode |

### NUMBER OF FIBERS

2

### CONNECTORS

| | |
|---|---|
| Optical: | SC |
| Data: | RJ45 |
| Power: | Terminal Plug with Screw Clamps |

### ELECTRICAL & MECHANICAL

| | |
|---|---|
| Power: | |
| Surface Mount: | 11 - 31 VDC @ 350 mA |
| Rack: | From Rack |
| Number of Rack Slots: | 2 |
| Current Protection: | Automatic Resettable Solid-State Current Limiters |
| Circuit Board: | Meets IPC Standard |
| Size (in./ cm.) (LxWxH): | |
| Surface Mount: | 7.0 x 4.9 x 2.0 in., 17.8 x 12.5 x 5.0 cm. |
| Rack Mount: | 7.7 x 5.0 x 2.0 in., 17.8 x 12.5 x 5.0 cm. |
| Shipping Weight: | < 2 lbs./0.9 kg |

### ENVIRONMENTAL

| | |
|---|---|
| MTBF: | >100,000 hours |
| Operating Temp: | -40° C to +74° C* |
| Storage Temp: | -40° C to +85° C* |
| Relative Humidity: | 0% to 95% (non-condensing)† |

**† May be extended to condensation conditions by adding suffix '–C' to model number for conformal coating.**

### AGENCY COMPLIANCE

FCC PART 15 COMPLIANT CE c UL us GSA

*Federal Supply Schedule Contract No. GS-07F-0049M*

### MADE IN THE USA

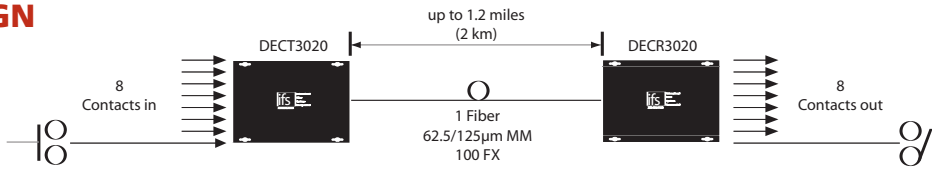
**Complies with FDA Performance Standard for Laser Products, Title 21, Code of Federal Regulations, Subchapter J**

## OPTICAL POWER BUDGET

| FIBER | WAVELENGTH | TRANSMITTER | | RECEIVER | | OPTICAL PWR BUDGET | MAX. DISTANCE* |
|---|---|---|---|---|---|---|---|
| | | MODEL | OUTPUT | MODEL | SENSITIVITY | | |
| Electrical | NA | DECT3000 | NA | DECR3000 | NA | NA | 300 ft. (100 m) |
| Multimode 62.5/125µm** | 1310 nm | DECT3020 | 20 µw (-17 dBm) | DECR3020 | 1 µw (-30 dBm) | 10 dB | 1.2 miles (2 km) |
| Singlemode 9/125µm | | DECT3030 | 25 µw (-16 dBm) | DECR3030 | | 15 dB | 28 miles (45 km) |

*** Optical transmission distance is limited to optical loss of the fiber and any additional loss introduced by connectors, splices and patch panels. Distance can also be limited by fiber bandwidth. ** For 50/125 Fiber, subtract 4 dB from Optical Power Budget.**

## SYSTEM DESIGN





International Fiber Systems Incorporated

TEL (203)426-1180 ■ FAX (203)426-3326 ■ www.ifs.com ■ sales@ifs.com
16 Commerce Road ■ Newtown, CT 06470



**Due to our continued effort to advance technology, product specifications are subject to change without notice.**

# PS Series Batteries

Section: Power Supplies

## GENERAL

Power-Sonic PS Series batteries provide secondary power for the whole series of NOTIFIER fire alarm control panels.

UL® LISTED
MH14328 (S)

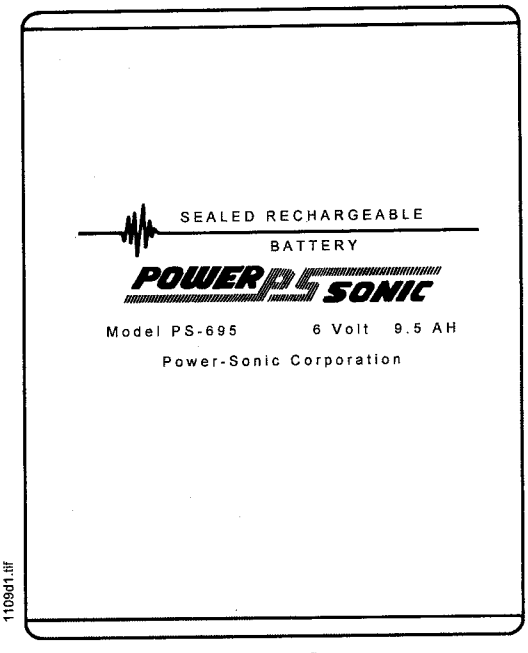
## FEATURES

- Provide secondary power for control panels.
- Gelled electrolyte.
- Sealed and maintenance-free.
- Overcharge protected.
- Extended shelf life.
- Easy handling with leakproof construction.
- Ruggedly constructed, high-impact case (ABS, polystyrene, or polypropylene depending on model).
- Long service life.
- Compact design.

## CAPACITY

Battery capacity, expressed in ampere-hours (AH), is the product of a discharge current and the length of time that the current is discharged. Batteries are rated according to their performance during 20 hours of discharge at a constant current.

The rated capacity of a battery is determined by subjecting it to a constant discharge current for 20 hours at 68°F (20°C). After 20 hours the voltage across the terminals is measured. The discharge current which causes a reading of 1.72 volts per cell (5.16 V on a 6 V battery and 10.32 V on a 12 V battery) is called the rated current. This current multiplied by 20 is the rated capacity of the battery.




*The PS-695 Battery*

## APPLICATIONS

Use the PS Series batteries to provide backup power for control panels. Select batteries based on current requirements for your system and the capacity of its charger. These batteries can be used over a temperature range of -76°F to +140°F (-60°C to +60°C).

## CONSTRUCTION

The sealed construction of the Power-Sonic battery allows trouble-free, safe operation in any position. There is no need to add electrolyte, as gases generated during overcharge are recombined in a unique "Oxygen Cycle." The battery is sealed, leakproof, and maintenance-free. The case is of high-impact materials with high resistance to chemicals and flammability.

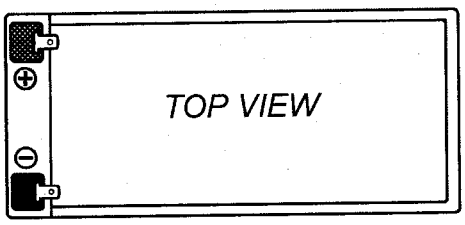
## INSTALLATION

All panels have space reserved for batteries. See the appropriate panel installation manual for battery size restrictions. Typical interconnection diagrams are shown in the literature accompanying each control panel.

This document is not intended to be used for installation purposes. We try to keep our product information up-to-date and accurate. We cannot cover all specific applications or anticipate all requirements. All specifications are subject to change without notice. For more information, contact **NOTIFIER**. Phone: (203) 484-7161 FAX: (203) 484-7118

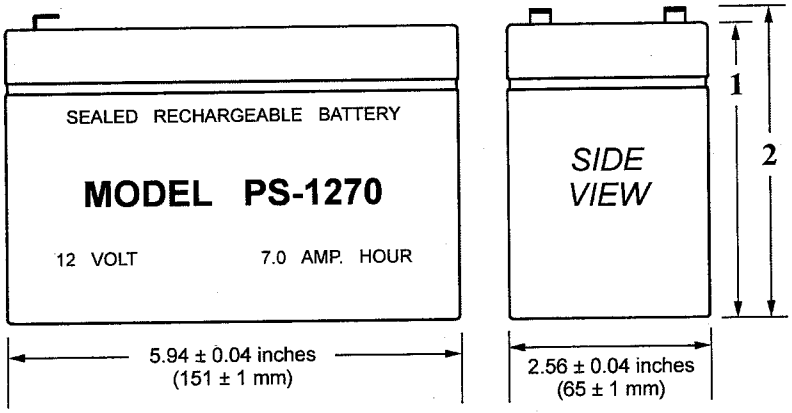
NOTIFIER® One Fire-Lite Place, Northford, Connecticut 06472

ISO 9001 CERTIFIED ENGINEERING & MANUFACTURING

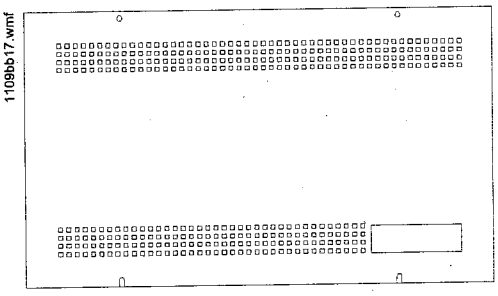



HEIGHT 1 BELOW
3.70 ± 0.08 inches
(94 ± 2 mm)

HEIGHT 2 BELOW
3.86 ± 0.08 inches
(96 ± 2 mm)

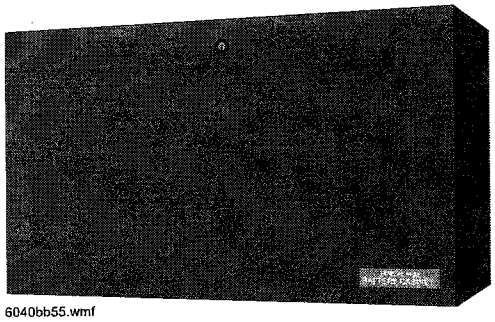



1109dim1.tif



1109bb17.wmf

***BB-17: Optional Battery Backbox***
14-1/2" W x 8-1/4" H x 4-3/4" D
(mm: 368.3 W x 209.55 H x 120.65 D)
For remote mounting of two 12-volt PS-12180 batteries.



6040bb55.wmf

***BB-55: Optional Battery Backbox***
See CHG-120 data sheet for details.

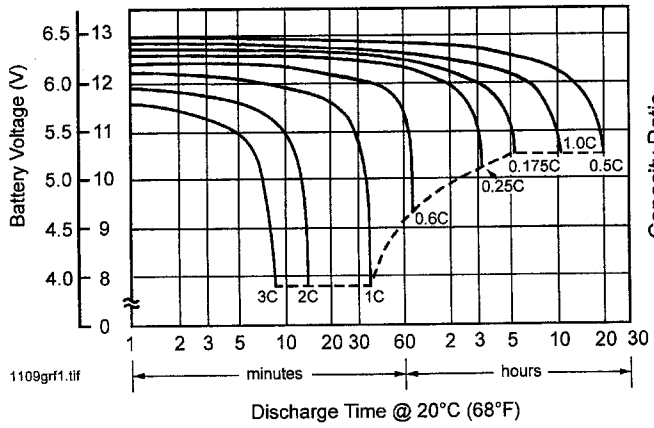
## ENGINEERING SPECIFICATIONS

The fire control panel shall be equipped with secondary power provided by gelled-electrolyte batteries. The batteries shall be maintenance-free and shall be capable of powering the system in a manner and for a length of time determined by the governing regulations and the authority having jurisdiction.

| MODEL | Nominal Voltage V | Nominal Capacity @ 20 hr. rate A.H. | Discharge Current @ 20 hr. rate mA | DIMENSIONS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Width | | Depth | | Height | | Height over terminal | | Weight | |
| | | | | in. | mm. | in. | mm. | in. | mm. | in. | mm. | lbs. | kg. |
| **PS-695** | 6 | 9.5 | 475 | 4.26 | 108 | 2.75 | 70 | 5.54 | 141 | 5.54 | 141 | 4.9 | 2.2 |
| **PS-1250** | 12 | 5.0 | 250 | 3.54 | 90 | 2.76 | 70 | 4.02 | 102 | 4.21 | 107 | 4.1 | 1.9 |
| **PS-1270** | 12 | 7.0 | 325 | 5.94 | 151 | 2.56 | 65 | 3.70 | 94 | 3.86 | 98 | 5.7 | 2.6 |
| **PS-12120** | 12 | 12 | 600 | 5.94 | 151 | 3.86 | 98 | 3.70 | 94 | 3.86 | 98 | 8.8 | 4.0 |
| **PS-12180** | 12 | 18 | 875 | 7.13 | 181 | 2.99 | 76 | 6.57 | 167 | 6.57 | 167 | 12.8 | 5.8 |
| **PS-12250** | 12 | 25 | 1300 | 6.89 | 175 | 6.54 | 166 | 4.92 | 125 | 4.92 | 125 | 18.7 | 8.5 |
| **PS-12550** | 12 | 55 | 3000 | 10.25 | 260 | 6.60 | 168 | 8.20 | 208 | 9.45 | 240 | 39.7 | 18.0 |
| **PS-121000** | 12 | 100 | 5000 | 12.00 | 305 | 6.60 | 168 | 8.20 | 208 | 9.45 | 240 | 65.7 | 29.8 |

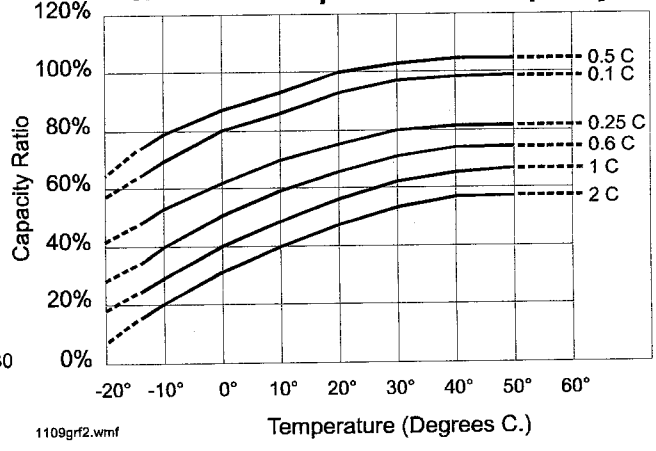
1109t1.tbl

### *Characteristic Discharge Curves*




1109grf1.tif

### *Effect of Temperature on Capacity*



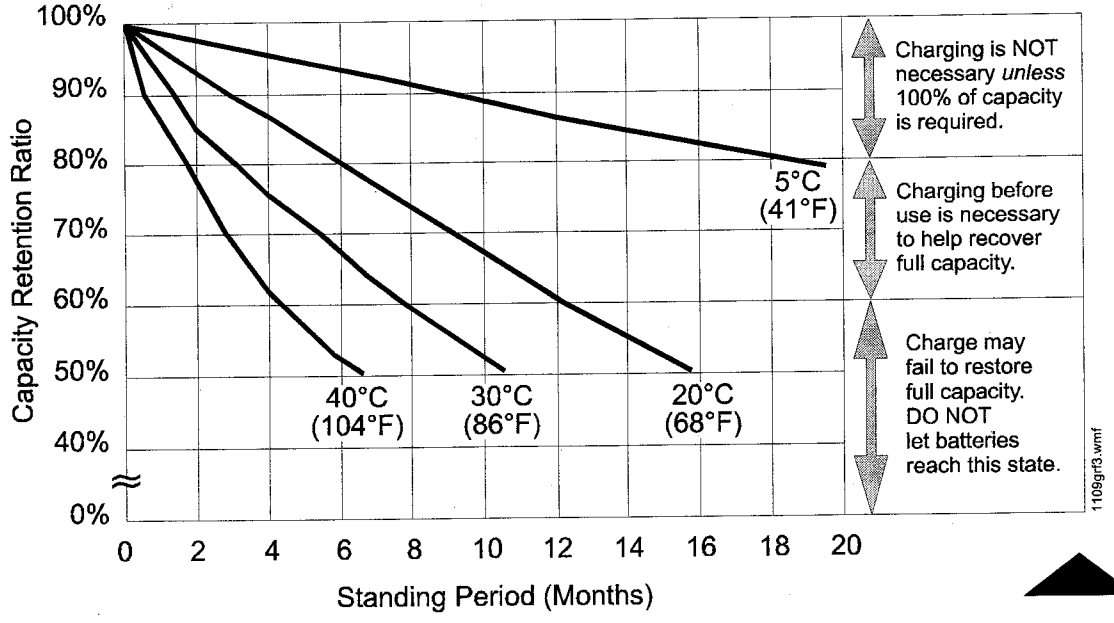

1109grf2.wmf

## PS-121000 RECHARGEABLE BATTERY: APPLICATIONS AND CHARGING

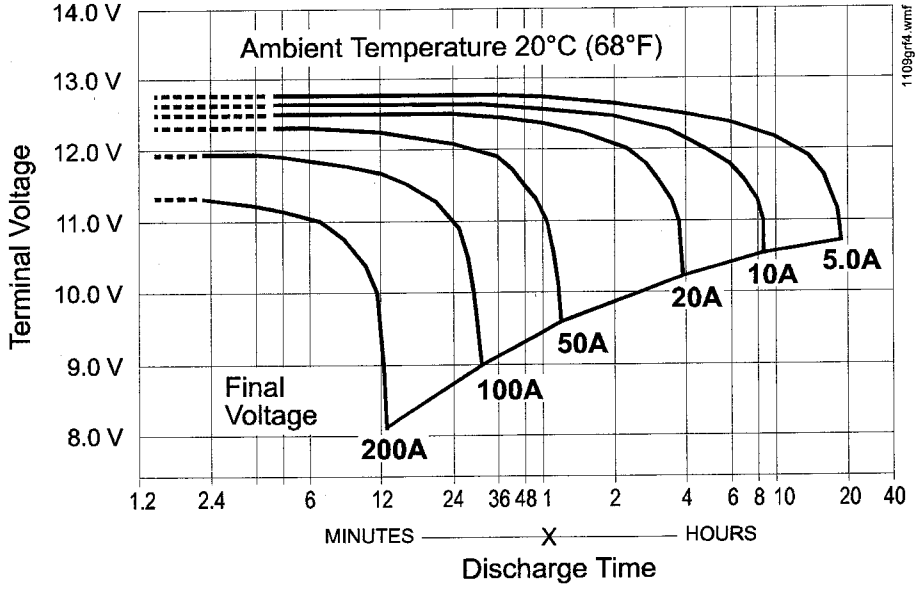
**CYCLE APPLICATIONS:** Limit initial current to 20A. Charge until battery voltage (under charge) reaches 14.40 to 14.70 volts at 68°F (20°C). Hold at 14.40 to 14.70 volts until current drops to approximately 1000 mA. Battery is fully charged under these conditions, and charger should either be disconnected or switched to "float" voltage.

**"FLOAT" OR "STAND-BY" SERVICE:** Hold battery across constant voltage source or 13.50 to 13.80 volts continuously. When held at this voltage, the battery will seek its own current level and maintain itself in a fully charged position.

***NOTE:*** *Due to the self-discharge characteristics of this type of battery, it is imperative that the battery be charged after six to nine months of storage, otherwise permanent loss of capacity might result from sulfation.*




***PS-121000 Shelf-Life and Storage***




***PS-121000 Discharge Characteristics***

# NOTIFIER®

# LCD-80 and LCD-80TM
## Liquid Crystal Displays

Section: Annunciator Control Systems

## GENERAL

The **LCD-80** is an 80-character, backlit LCD display annunciator for the NOTIFIER NFS-640, NFS-3030 (ACS mode only), AM2020, AFP1010, AFC-600, AFP-400, AFP-300, AFP-200, System 5000, and System 500 fire alarm control panels, or the NCA network control annunciator. Up to 32 LCD-80s may be connected onto the two-wire EIA-485 port. The LCD-80 has two basic modes of operation, "Terminal" and "ACS" mode.

The **LCD-80TM** shares all the features of the LCD-80, but only utilizes "Terminal" mode, where it mimics the panel display.

UL LISTED S635

ULC CS100

FM APPROVED *(LCD-80)*

Lloyd's Register TYPE APPROVED

**MEA**
290-91-E *(LCD-80)*
289-91-E *(LCD-80)*
104-93-E Vol. III *(LCD-80TM)*
317-01-E *(NFS-640)*
345-02-E *(LCD-80)*

**U.S. Coast Guard**
161.002/23/2 *(AFP-200)*
161.002/27/3 *(AFP1010, AM2020)*

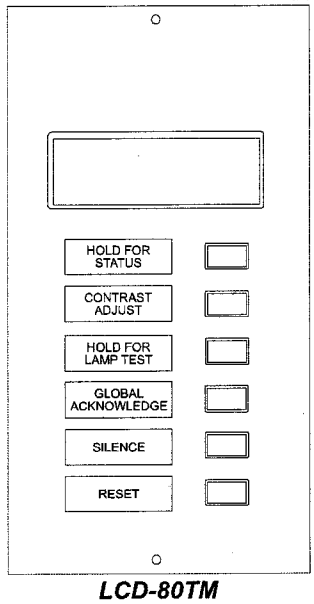
94/60004 (E2) *(AFP-200)*
93/60140 (E2) *(AFP1010, AM2020)*

California State Fire Marshal
7120-0028:156

## COMMON FEATURES

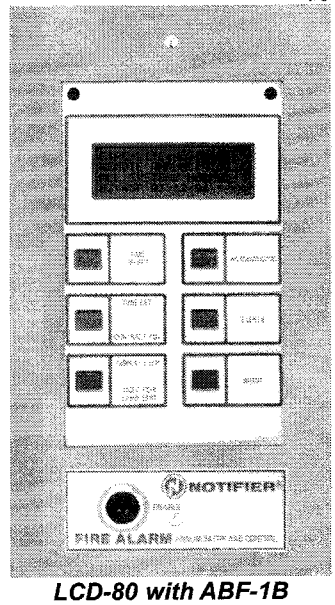
- 80-character backlit Liquid Crystal Display (20 characters x 4 lines).
- Control switches for System Acknowledge, Signal Silence and System Reset.
- Time and date display field.
- Enable Key switch and phone jack options.
- Can be remotely located up to 6,000 ft. (1828.8 m) from the control panel.
- Local piezo sounder with alarm/trouble resound.
- Flush/surface/panel mount option.
- Optional RPT-485 repeater increases the distance and number of LCD-80s in a system *(see RPT-485 data sheet)*.
- Optional transmission over fiber optics *(see RPT-485 data sheet)*.

3198lcd8.jpg




***LCD-80TM***

3198lcd8.jpg




***LCD-80 with ABF-1B***

## ACS MODE

When operated in "ACS" mode, the LCD-80 provides a remote or local digital display and printer interface for the System 5000 and System 500. For the NFS-640, NFS-3030, NCA, AM2020, AFP1010, AFC-600, AFP-400, AFP-300, and AFP-200, the LCD-80 provides a vectored annunciation capability. Individual devices/zones can be installer-defined to only display and print at specific locations (*EXAMPLE:* A maintenance office receives only non-alarm point activations. These inputs could be sump pump on, high water, backup AHU on, low temperature in freezer, etc.).

- Alarm/trouble count.
- Custom "normal" message.
- European option: first alarm/last alarm/alarm count.
- Field-programmable messages from CRT or PC-compatible computer (PK-LCD-80 Programming Kit required).
- EIA-485 interface: up to 32 per system.
- Printer output port: EIA-232, compatible with PRN Series printers.
- Field-programmable messages in nonvolatile memory in two options: 128 points, 40 character labels; or 256 points, 20 character labels.
- Internal nonvolatile clock for time and date in ACS mode.
- NFS-640, NFS-3030, AM2020, AFP1010, AFC-600, AFP-400, and AFP-300 "vectored" printer capability.
- Can be mounted in a System 5000 cabinet module position.

***NOTE:*** *The NFS-3030 operates with the LCD-80 in ACS mode only.*

## TERMINAL MODE

In "Terminal" mode, the LCD-80 mimics the NFS-640, NCA, AM2020, AFP1010, AFC-600, AFP-400, AFP-300 and AFP-200 displays. Up to 32 LCD-80s can annunciate and provide remote reset, acknowledge, and silence of the control panel from remote locations. The DIA-1010 and DIA-2020 (Display Interface) include a Terminal mode driver port for LCD-80s in Terminal mode. The Terminal mode port is standard on the NFS-640, AFC-600, AFP-400, AFP-300, and AFP-200 main PC/CPU boards.

- Displays device type identifiers.
- Device and zone custom alpha labels.
- Time/date and Device address.
- May operate in addition to CRT.
- No programming necessary. LCD-80 displays time, date, and custom messages received from NFS-640, AM2020, AFP1010, AFC-600, AFP-400, AFP-300, or AFP-200.

***NOTE:*** *The NFS-3030 does NOT use LCD-80 in terminal mode, or the LCD-80TM.*

**NOTIFIER®** is a Honeywell company.
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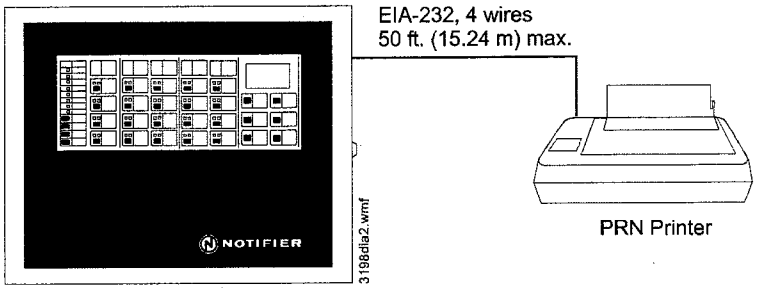
For more information, contact **NOTIFIER.** Phone: (203) 484-7161 FAX: (203) 484-7118
NOTIFIER® 12 Clintonville Road, Northford, Connecticut 06472

ISO 9001 CERTIFIED ENGINEERING & MANUFACTURING QUALITY SYSTEMS

Made in the U.S.A.

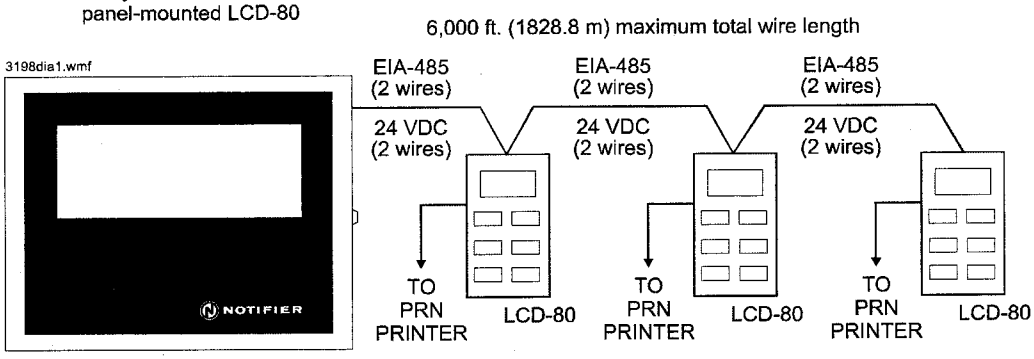
## The LCD-80 in ACS Mode

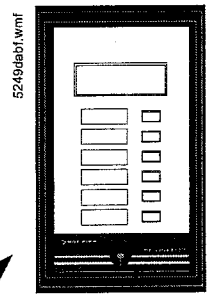



- LCD-80 is 8.25" (20.96 cm) high, 4.375" (11.11 cm) wide, and 1.75" (4.45 cm) deep.
- Up to 32 LCD-80s may be used on one EIA-485 circuit.

***NOTE:*** *Must have sufficient regulated 24 volt power. Certain NOTIFIER systems may have limits to the amount of LCD-80s with ACK/STEP, Signal Silence, and Reset switches.*

- LCD-80 mounts with any CHS-4 chassis slot.
- The LCD-80 may display all System 5000 circuits. Alternately, it may display up to 192 AIM-200 points and two rows of modules.



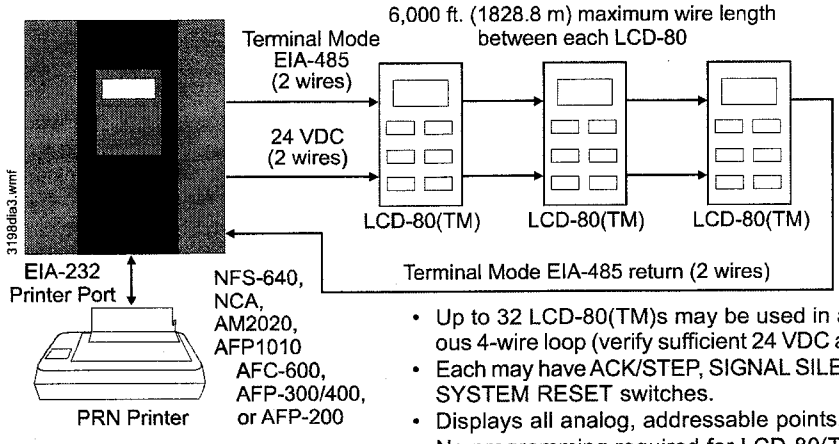




**ABF-1DB** — The ABF-1DB is a semi-flush-mount backbox for the NOTIFIER LCD-80 Series Annunciator. The ABF-1DB mounts one LCD-80(TM). It includes an attractive smoked-glass door with NOTIFIER keylock.

***Dimensions, BOX only:*** 9.938" (25.24 cm) high, 4.625" (11.75 cm) wide, 2.5" (6.35 cm) deep.

***Dimensions, DOOR only:*** 10.713" (27.21 cm) high, 6.0" (15.24 cm) wide, 0.75" (1.9 cm) deep.

## The LCD-80 or LCD-80TM in Terminal Mode




- Up to 32 LCD-80(TM)s may be used in a continuous 4-wire loop (verify sufficient 24 VDC available).
- Each may have ACK/STEP, SIGNAL SILENCE, and SYSTEM RESET switches.
- Displays all analog, addressable points.
- No programming required for LCD-80(TM)s.

## RELATED OPTIONS

**PK-LCD-80** ***(order VERIFIRE-CD)***: Off-Line Programming Kit for LCD-80. Allows PC programming messages when LCD-80 is used in the ACS mode.

**CCM-1**: Converter Module. Required for terminal mode operation on older AM2020s or AFP1010s that do not include the DIA-2020 or DIA-1010 Display Interfaces. Also required for AM2020 and AFP1010 systems which require a CRT with keyboard. Uses one ICA-4L chassis slot or two CHS-4 chassis slots.

*See ACS Series (DN-524) or ONYX™ ACS Series (DN-6862) data sheets for additional information on items below.*

**ABF-1DB**: Semi-flush box with alternative smoked-glass door, any keylock.

**ADP-4**: Annunciator Dress Plate, gray. Allows panel mounting of up to four LCD-80(TM) modules in a CAB-3 Series cabinet.

**ADP-4B**: Annunciator Dress Plate, black. Allows panel mounting of up to four LCD-80(TM) modules in a CAB-4 Series cabinet.

**ABF-1B**: Annunciator Flush Box, 9.938" (25.24 cm) high, 4.625" (11.75 cm) wide, and 2.5" (6.35 cm) deep. Order AKS-1B key switch and APJ-1B phone jack if desired. Can also be mounted in **ABF-2B** or **ABF-4B** annunciator backboxes.

**ABS-1TB**: Deep Surface Backbox (mounts one LCD-80/-80TM).

**AKS-1B**: Key Switch (black) to enable/disable controls when mounted in ABF or ABS-1TB.

**APJ-1B**: Annunciator Phone Jack, black. Mounts to ABF flush box or ABS-1TB.

**PRN Series**: 80-Column Serial Printer *(see PRN data sheet)*.

**RPT-485W**: EIA-485 Wire Repeater. Increases wire distance between LCD-80s in ACS mode *(see RPT-485 data sheet)*.

**RPT-485F**: EIA-485 Fiber-Optics Repeater. Increases distance and converts EIA-485 wire to fiber-optics in ACS mode *(see RPT-485 data sheet)*.

SECTION 31 23 00.00 20

EXCAVATION AND FILL
**04/06**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|---|---|
| AWWA C600 | (2005) Installation of Ductile-Iron Water Mains and Their Appurtenances |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.1/D1.1M | (2008) Structural Welding Code - Steel |

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

| | |
|---|---|
| AWPA C2 | (2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes |
| AWPA P5 | (2005) Standard for Waterborne Preservatives |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 139/A 139M | (2004) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over) |
| ASTM A 252 | (1998; R 2007) Standard Specification for Welded and Seamless Steel Pipe Piles |
| ASTM C 136 | (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM C 33 | (2007) Standard Specification for Concrete Aggregates |
| ASTM D 1140 | (2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve |
| ASTM D 1556 | (2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method |
| ASTM D 1557 | (2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3) |

| | |
|---|---|
| ASTM D 1883 | (2007) CBR (California Bearing Ratio) of Laboratory-Compacted Soils |
| ASTM D 2321 | (2005) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications |
| ASTM D 2487 | (2006e1) Soils for Engineering Purposes (Unified Soil Classification System) |
| ASTM D 2922 | (2005) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth) |
| ASTM D 3017 | (2005) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth) |
| ASTM D 4318 | (2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils |
| ASTM D 698 | (2007e1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.)) |

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

| | |
|---|---|
| EPA 530/F-93/004 | (1993; Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846) |
| EPA 600/4-79/020 | (1983) Methods for Chemical Analysis of Water and Wastes |

## 1.2 DEFINITIONS

### 1.2.1 Capillary Water Barrier

A layer of clean, poorly graded crushed rock, stone, or natural sand or gravel having a high porosity which is placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below a slab.

### 1.2.2 Degree of Compaction

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 698, for general soil types, abbreviated as percent laboratory maximum density.

### 1.2.3 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control

approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring and Sheeting Plan

Submit 15 days prior to starting work.

SD-06 Test Reports

Borrow Site Testing; G

Fill and backfill test

Select material test

Porous fill test for capillary water barrier

Density tests

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

## 1.4 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

## 1.5 REQUIREMENTS FOR OFF SITE SOIL

Soils brought in from off site for use as backfill shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100 ppm of total petroleum hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCPL test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA 530/F-93/004 Method 5030/8020. TCLP shall be performed in accordance with EPA 530/F-93/004 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Material shall not be brought on site until tests have been approved by the Contracting Officer.

## 1.6 QUALITY ASSURANCE

### 1.6.1 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected

by the contract excavation until approval for backfill is granted by the Contracting Officer.] Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

## PART 2 PRODUCTS

### 2.1 SOIL MATERIALS

#### 2.1.1 Satisfactory Materials

Any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

#### 2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3 inches. The Contracting Officer shall be notified of any contaminated materials.

#### 2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic (plasticity index equals zero). Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

#### 2.1.4 Expansive Soils

Soils that have a plasticity index equal to or greater than 30 when tested in accordance with ASTM D 4318.

#### 2.1.5 Common Fill

Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

#### 2.1.6 Backfill and Fill Material

ASTM D 2487, classification GW, GP, GM, SW, SP, SM, with a maximum ASTM D 4318 liquid limit of 35, maximum ASTM D 4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D 1140, No. 200 sieve.

#### 2.1.7 Select Material

Provide materials classified as SW, SP, or SP-SM by ASTM D 2487 where indicated. The liquid limit of such material shall not exceed 35 percent when tested in accordance with ASTM D 4318.

Bearing Ratio: At 0.1 inch penetration, the bearing ratio shall be 98 percent at 95 percent ASTM D 1557 maximum density as determined in

accordance with ASTM D 1883 for a laboratory soaking period of not less than 4 days. The combined material shall conform to the following sieve analysis:

| Sieve Size | Percent Passing by Weight |
|---|---|
| 2 1/2 inches | 100 |
| No. 4 | 40 - 85 |
| No. 10 | 20 - 80 |
| No. 40 | 10 - 60 |
| No. 200 | 20 max. |

2.1.8 Topsoil

Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

2.2 POROUS FILL FOR CAPILLARY WATER BARRIER

ASTM C 33 fine aggregate grading with a maximum of 3 percent by weight passing ASTM D 1140, No. 200 sieve, or 1-1/2 inches and no more than 2 percent by weight passing the No. 4 size sieve or coarse aggregate Size 57 and conforming to the general soil material requirements specified in paragraph entitled "Satisfactory Materials."

2.3 UTILITY BEDDING MATERIAL

Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide ASTM D 2321 materials as follows:

a. Class I: Angular, 0.25 to 1.5 inches, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inches, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.

2.4 BORROW

Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property.

2.5 FILTER FABRIC

Provide a pervious sheet of polyester, nylon, glass or polypropylene , ultraviolet resistant filaments woven, spun bonded, fused, or otherwise manufactured into a nonraveling fabric with uniform thickness and strength. Fabric shall have manufacturer certified minimum average roll properties as determined by ASTM D 4759.

## 2.6 MATERIAL FOR PIPE CASING

### 2.6.1 Casing Pipe

ASTM A 139/A 139M, Grade B, or ASTM A 252, Grade 2, smooth wall pipe. Casing size shall be of the outside diameter and wall thickness as indicated. Protective coating is not required on casing pipe.

### 2.6.2 Wood Supports

Treated Yellow Pine or Douglas Fir, rough, structural grade. Provide wood with nonleaching water-borne pressure preservative (ACA or CCA) and treatment conforming to AWPA P5 and AWPA C2, respectively. Secure wood supports to carrier pipe with stainless steel or zinc-coated steel bands.

## 2.7 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

| | |
|---|---|
| Yellow: | Electric |
| Yellow: | Gas, Oil; Dangerous Materials |
| Orange: | Telephone and Other Communications |
| Blue: | Water Systems |
| Green: | Sewer Systems |

### 2.7.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

### 2.7.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

## 2.8 DETECTION WIRE FOR NON-METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Shoring and Sheeting

Provide shoring, bracing, trench boxes, and sheeting where indicated. Include provisions in the shoring and sheeting plan that will accomplish the following:

a. Prevent undermining of pavements, foundations and slabs.

b. Prevent slippage or movement in banks or slopes adjacent to the excavation.

3.1.2 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.1.2.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils, prevent erosion and undermining of foundations. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.1.2.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 3 feet below the working level.

Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly.

### 3.1.3 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction.

### 3.1.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

## 3.2 SURFACE PREPARATION

### 3.2.1 Clearing and Grubbing

Unless indicated otherwise, remove trees, stumps, logs, shrubs, brush and vegetation and other items that would interfere with construction operations within the clearing limits. Remove stumps entirely. Grub out matted roots and roots over 2 inches in diameter to at least 18 inches below existing surface.

### 3.2.2 Stripping

Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be stockpiled and used for backfilling. Locate topsoil so that the material can be used readily for the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable for use as topsoil. Protect topsoil and keep in segregated piles until needed.

### 3.2.3 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

## 3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Refill with backfill and fill material and compact to 95 percent of ASTM D 1557 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with satisfactory material and compact to 95 percent of ASTM D 1557 maximum density. Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced with satisfactory materials to the indicated excavation grade; except as specified for spread footings. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.3.1 Structures With Spread Footings

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Fill over excavations with concrete during foundation placement.

3.3.2 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement. Tamp if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 6 inches below the bottom of the pipe.

3.3.3 Excavated Materials

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Paragraph "DISPOSITION OF SURPLUS MATERIAL."

3.3.4 Final Grade of Surfaces to Support Concrete

Excavation to final grade shall not be made until just before concrete is to be placed. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. All surfaces shall be protected from erosion resulting from ponding or flow of water.

3.4 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified herein.

3.4.1 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing

subgrade with six passes of a 15 ton, pneumatic-tired roller. Operate the roller in a systematic manner to ensure the number of passes over all areas, and at speeds between 2 1/2 to 3 1/2 miles per hour. When proof rolling under buildings, the building subgrade shall be considered to extend 5 feet beyond the building lines, and one-half of the passes made with the roller shall be in a direction perpendicular to the other passes. Notify the Geotechnical Engineer a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Geotechnical Engineer. Rutting or pumping of material shall be undercut as directed by the Geotechnical Engineer and replaced with select material.

## 3.5 SUBGRADE FILTER FABRIC

Place synthetic fiber filter fabric as indicated directly on prepared subgrade free of vegetation, stumps, rocks larger than 2 inches diameter and other debris which may puncture or otherwise damage the fabric. Repair damaged fabric by placing an additional layer of fabric to cover the damaged area a minimum of 3 feet overlap in all directions. Overlap fabric at joints a minimum of 3 feet. Obtain approval of filter fabric installation before placing fill or backfill. Place fill or backfill on fabric in the direction of overlaps and compact as specified herein. Follow manufacturer's recommended installation procedures.

## 3.6 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

### 3.6.1 Common Fill Placement

Provide for general site structures. Use satisfactory materials. Place in 8 to 10 inch loose lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Finish to a smooth surface by blading, rolling with a smooth roller, or both.

### 3.6.2 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where select material is provided. Place in 8 to 10 inch loose lifts. Do not place over wet or frozen areas. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

### 3.6.3 Select Material Placement

Provide under structures not pile supported. Place in 8 to 10 inch loose lifts. Do not place over wet or frozen areas. Backfill adjacent to structures shall be placed as structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structure.

### 3.6.4 Backfill and Fill Material Placement Over Pipes and at Walls

Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Where pipe is coated

or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

3.6.5 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in 6 inch lifts to top of trench and in 6 inch lifts to one foot over pipe outside structures and paved areas.

3.7 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved borrow materials shall be obtained as specified herein.

3.8 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.9 BURIED DETECTION WIRE

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

3.10 COMPACTION

Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required. Density requirements specified herein are for cohesionless materials. When cohesive materials are encountered or used, density requirements may be reduced by 5 percent.

3.10.1 General Site

Compact underneath areas designated for vegetation and areas outside the 5 foot line of the paved area or structure to 90 percent of ASTM D 1557.

3.10.2 Structures, Spread Footings, and Concrete Slabs

Compact top 12 inches of subgrades to 95 percent of ASTM D 1557. Compact select material to 95 percent of ASTM D 1557.

3.10.3 Adjacent Area

Compact areas within 5 feet of structures to 95 percent of ASTM D 1557.

3.10.4 Paved Areas

Compact top 12 inches of subgrades to 95 percent of ASTM D 1557. Compact fill and backfill materials to 95 percent of ASTM D 1557.

3.11 PIPELINE CASING UNDER PAVEMENT

Provide new smooth wall steel pipeline casing under existing pavement by the boring and jacking method of installation. Provide each new pipeline casing, where indicated and to the lengths and dimensions shown, complete and suitable for use with the new piped utility as indicated.

3.11.1 Earthwork for Pipeline Casings

Provide excavation, sheet piling, shoring, dewatering, and backfilling for pipeline casings under this section.

3.11.2 Steel Cased Pipelines

Install pipeline casing by dry boring and jacking method as follows:

3.11.2.1 Hole for Pipeline Casing

Mechanically bore holes and case through the soil with a cutting head on a continuous auger mounted inside the casing pipe. Weld lengths of pipe together in accordance with AWS D1.1/D1.1M. Do not use water or other fluids in connection with the boring operation.

3.11.2.2 Cleaning

Clean inside of the pipeline casing of dirt, weld splatters, and other foreign matter which would interfere with insertion of the piped utilities by attaching a pipe cleaning plug to the boring rig and passing it through the pipe.

3.11.2.3 Piped Utilities

Provide in casing using wood supports adjusted to obtained grades and elevations indicated.

3.11.2.4 End Seals

After installation of piped utilities in pipeline casing, provide watertight end seals at each end of pipeline casing between pipeline casing and piping utilities. Provide watertight segmented elastomeric end seals.

## 3.12 FINISH OPERATIONS

### 3.12.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. Maintain areas free of trash and debris. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

### 3.12.2 Protection of Surfaces

Protect newly backfilled, graded, and topsoiled areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

## 3.13 DISPOSITION OF SURPLUS MATERIAL

Remove from Government property surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber.

## 3.14 FIELD QUALITY CONTROL

### 3.14.1 Sampling

Take the number and size of samples required to perform the following tests.

### 3.14.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

#### 3.14.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 4318 for liquid limit and for plastic limit; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

#### 3.14.2.2 Select Material Testing

Test select material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

#### 3.14.2.3 Density Tests

Test density in accordance with ASTM D 1556, or ASTM D 2922 and ASTM D 3017. When ASTM D 2922 and ASTM D 3017 density tests are used, verify density test results by performing an ASTM D 1556 density test at a location already ASTM D 2922 and ASTM D 3017 tested as specified herein. Perform an ASTM D 1556 density test at the start of the job, and for every 10 ASTM D 2922 and ASTM D 3017 density tests thereafter. Test each lift at randomly selected locations every 2000 square feet of existing grade in fills for structures and concrete slabs, and every 2500 square feet for other fill areas and every 2000 square feet of subgrade in cut. Include density test results in daily report.

a. Bedding and backfill in trenches: One test per 50 linear feet in each lift.

-- End of Section --

SECTION 31 31 16

SOIL TREATMENT FOR SUBTERRANEAN TERMITE CONTROL
**04/06**

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Termiticide Application Plan; G

Termiticide application plan with proposed sequence of treatment work with dates and times. Include the termiticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area/volume treated, amount applied; and the name and state license number of the state certified applicator shall be included.

Termiticides

Manufacturer's label and Material Safety Data Sheet (MSDS) for termiticides proposed for use.

Foundation Exterior

Written verification that other site work will not disturb the treatment.

Utilities and Vents

Written verification that utilities and vents have been located.

Crawl and Plenum Air Spaces

Written verification that crawl spaces and plenum air spaces have been located.

Verification of Measurement

Written verification that the volume of termiticide used meets the application rate.

Application Equipment

A listing of equipment to be used.

Warranty

Copy of Contractor's warrany.

SD-04 Samples

Termiticides

Submit on request samples of the pesticides used in this work or the Contracting Officer may draw, at any time and without prior notice, from stocks at the job site; should analysis, performed by the Government, indicate such samples to contain less than the amount of active ingredient specified on the label, work performed with such products shall be repeated, with pesticides conforming to this specification, at no additional cost to the Government.

SD-06 Test Reports

Equipment Calibration and Tank Measurement

Certification of calibration tests conducted on the equipment used in the termiticide application.

Soil Moisture

Soil moisture test result.

Quality Assurance

Pest Management Report and copies of daily records signed by an officer of the Contractor.

SD-07 Certificates

Qualifications

Qualifications and state license number of the termiticide applicator.

1.2 [Enter Appropriate Subpart Title Here]1.2.1 Qualifications

For the application of pesticides, the Contractor shall use the services of a subcontractor whose principal business is pest control. The subcontractor shall be licensed and certified in the state where the work is to be performed. Termiticide applicators shall also be certified in the U.S. Environmental Protection Agency (EPA) pesticide applicator category which includes structural pest control.

The subcontractor shall:

a. Have personnel with a current State of Mississippi license/certification as required by the State of Mississippi Pesticide Laws, for transportation, handling and application of termiticide.

b. Provide a submittal with the following information to the Contracting Officer:

(1) Quantity of pesticide used.

(2) Rate of dispersion.

(3) Percent of use.

(4) Total amount used.

(5) Map of application area indicating treated areas.

(6) A certificate from the Subcontractor that the treatment shall be in accordance with the rules and laws of the State of Mississippi.

1.2.2 Safety Requirements

Formulate, treat, and dispose of termiticides and their containers in accordance with label directions. Draw water for formulating only from sites designated by the Contracting Officer, and fit the filling hose with a backflow preventer meeting local plumbing codes or standards. The filling operation shall be under the direct and continuous observation of a contractor's representative to prevent overflow. Secure pesticides and related materials under lock and key when unattended. Ensure that proper protective clothing and equipment are worn and used during all phases of termiticide application. Dispose of used pesticide containers off Government property.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver termiticide material to the site in the original unopened containers bearing legible labels indicating the EPA registration number and manufacturer's registered uses. All other materials, to be used on site for the purpose of termite control, shall be delivered in new or otherwise good condition as supplied by the manufacturer or formulator.

1.3.2 Storage

Store materials in designated areas and in accordance with manufacturer's labels. Termiticides and related materials shall be kept under lock and key when unattended.

1.3.3 Handling

Termiticides shall be handled in accordance with manufacturer's labels. Manufacturer's warning and precautions shall be observed. Materials shall be handled preventing contamination by dirt, water, and organic material. Protect termiticides from sunlight as recommended by the manufacturer.

1.4 INSPECTION

Termiticides shall be inspected upon arrival at the job site for conformity to type and quality in accordance with paragraph TERMITICIDES. Each label shall bear evidence of registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended or under appropriate regulatiosn of the host county. Other materials shall be inspected for conformance with specified requirements. Unacceptable materials shall be removed from the job site.

1.5 WARRANTY

The Contractor shall provide a 5-year written warranty against infestations or reinfestations by subterranean termites of the buildings or building

additions constructed under this contract. Warranty shall include annual inspections of the buildings or building additions. If live subterranean termite infestation or subterranean termite damage is discovered during the warranty period, and the soil and building conditions have not been altered in the interim, the Contractor shall:

a. Retreat the soil and perform other treatment as may be necessary for elimination of subterranean termite infestation;

b. Repair damage caused by termite infestation; and

c. Reinspect the building approximately 180 days after the retreatment.

1.8 QUALITY ASSURANCE

The Contactor shall comply with 7 USC Section 136 for requirements on contractor's licensing, certification, and record keeping. The Contractor shall maintain daily records using Pest Management Maintenance Record, DD Form 1532-1 and submit copies of records when requested by the Contracting Officer. These forms may be obtained from the main web site:

http://www.dtic.mil/whs/directives/infomgt/forms/ddforms1500-1999.htm

Upon completion of this work, submit Pest Management Report. DD Form 1532 identifying target pest, type of peration, brand name and manufacturer of pesticide, formulation, concentration or rate of application used.

PART 2 PRODUCTS

2.1 TERMITICIDES

Provide termiticides currently registered by the EPA or approved for such use by the appropriate agency of the State of Mississippi. Non-repellant termiticide shall be selected for maximum effectiveness and duration after application. The selected termiticide shall be suitable for the soil and climatic conditions at the project site.

PART 3 EXECUTION

3.1 TECHNICAL REPRESENTATIVE

The certified installation pest management coordinator shall be the technical representative, shall be present at all meetings concerning treatment measures for subterranean termites, and may be present during treatment application. The command Pest Control Coordinator shall be contacted prior to starting work.

3.2 SITE PREPARATION

Site preparation shall be in accordance with Sections 31 11 00 CLEARING AND GRUBBING, 31 00 00 EARTHWORK, 32 92 19 SEEDING, 32 92 23 SODDING, 32 92 26 SPRIGGING, and 32 93 00 EXTERIOR PLANTS. Work related to final grades, landscape plantings, foundations, or any other alterations to finished construction which might alter the condition of treated soils, shall be coordinated with this specification.

3.2.1 Ground Preparation

Food sources shall be eliminated by removing debris from clearing and

grubbing and post construction wood scraps such as ground stakes, form boards, and scrap lumber from the site, before termiticide application begins.

3.2.2 Verification

Before work starts, verify that final grades are as indicated and smooth grading has been completed in accordance with Section 31 00 00 EARTHWORK. Soil particles shall be finely graded with particles no larger than 1 inch and compacted to eliminate soil movement to the greatest degree.

3.2.3 Foundation Exterior

Provide written verification that final grading and landscape planting operations will not disturb treatment of the soil on the exterior sides of foundation walls, grade beams, and similar structures.

3.2.4 Utilities and Vents

Provide written verification that the location and identity of HVAC ducts and vents, water and sewer lines, and plumbing have been accomplished prior to the termiticide application.

3.2.5 Crawl and Plenum Air Spaces

Provide written verification that the location and identity of crawl and plenum air spaces have been accomplished prior to the termiticide application.

3.3 SITE CONDITIONS

The following conditions shall determine the time of application.

3.3.1 Soil Moisture

Soils to be treated shall be tested immediately before application. Soil moisture content shall be tested to a minimum depth of 3 inches. The soil moisture shall be as recommended by the termiticide manufacturer. The termiticide will not be applied when soil moisture exceeds manufacturer's recommendations because termiticides do not adhere to the soil particles in saturated soils.

3.3.2 Runoff and Wind Drift

Termiticide shall not be applied during or immediately following heavy rains. Applications shall not be performed when conditions may cause runoff or create an environmental hazard. Applications shall not be performed when average wind speeds exceeds 10 miles per hour. There termiticide shall not be allowed to enter water systems, aquifers, or endanger humans or animals.

3.3.2.1 Vapor Barriers and Waterproof Membranes.

Termiticide shall be applied prior to placement of vapor barrier or waterproof membrane.

3.3.2.2 Utilities and Vents.

Prior to applications, HVAC ducts and vants located in treatment area shall be turned off and blocked to protect people and animals from

termiticide.

3.3.3 Placement of Concrete

Concrete covering treated soils shall be placed as soon as the termiticide has reached maximum penetration into the soil. Time for maximum penetration shall be as recommended by the manufacturer.

3.3 TERMITICIDE TREATMENT

3.3.1 The Contractor shall submit a Termiticide Application Plan for approval before starting the specified treatment.

3.4.1 Equipment Calibration and Tank Measurement

Immediately prior to commencement of termiticide application, calibration tests shall be conducted on the application equipment to be used and the application tank shall be measured to determine the volume and contents. These tests shall confirm that the application equipment is operating within the manufacturer's specifications and will meet the specified requirements. The Contractor shall provide written certification of the equipment calibration test results within 1 week of testing.

3.3.2 Mixing and Application

Formulating, mixing, and application shall be performed in the presence of the Contracting Officer or the technical representative. A closed system is recommended as it prevents the termiticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying termiticides shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately.

3.3.3 Treatment Method

For areas to be treated, the Contractor shall establish complete and unbroken vertical and/or horizontal soil poison barriers between the soil and all portions of the intended structure which may allow termite access to wood and wood related products. Application shall not be made to areas which serve as crawl spaces or for use as a plenum air space.

3.3.3.1 Surface Application

Use surface application for establishing horizontal barriers. Surface applicants shall be applied as a coarse spray and provide uniform distribution over the soil surface. Termiticide shall penetrate a minimum of 1 inch into the soil, or as recommended by the manufacturer.

3.3.3.2 Rodding and Trenching

Use rodding and trenching for establishing vertical soil barriers. Trenching shall be to the depth of the foundation footing. Width of trench shall be as recommended by the manufacturer, or as indicated. Rodding or other approved method may be implemented for saturating the base of the trench with termiticide. Immediately after termiticide has reached maximum penetration as recommended by the manufacturer, backfilling of the trench shall commence. Backfilling shall be in 6 inch rises or layers. Each rise

shall be treated with termiticide.

3.3.4 Sampling

The Contracting Officer may draw from stocks at the job site, at any time and without prior notice, samples of the termiticides used to determine if the amount of active ingredient specified on the label is being applied.

3.4 [Enter Appropriate Subpart Title Here]3.5 VERIFICATION OF MEASUREMENT

Once termiticide application has been completed, tank contents shall be measured to determine the remaining volume. The total volume measurement of used contents for the application shall equal the established application rate for the project sire conditions. The Contractor shall provide written verification of the measurements.

3.6 CLEAN UP, DISPOSAL, AND PROTECTION

Once application has been completed, the Contractor shall proceed with clean up and protection of the site without delay.

3.4.1 Clean Up

The site shall be cleaned of all material associated with the treatment measures, according to label instructions, and as indicated. Excess and waste material shall be removed and disposed off site.

3.4.2 Disposal of Termiticide

The Contractor shall dispose of residual termiticides and containers off Government property, and in accordance with label instructions and EPA criteria.

3.4.3 Protection of Treated Area

Immediately after the application, the area shall be protected from other use by erecting barricades and providing signage as required or directed. Signage shall be in accordance with Section 10 14 01 EXTERIOR SIGNAGE. Signage shall be placed inside the entrances to crawl spaces and shall identify the space as treated with termiticide and not safe for children and animals.

3.5 CONDITIONS FOR SATISFACTORY TREATMENT

3.5.1 Equipment Calibrations and Measurements

Where results from the equipment calibration and tank measurements tests are unsatisfactory, re-treatment will be required.

3.5.2 Testing

Should an analysis, performed by a third party, indicate that the samples of the applied termiticide contain less than the amount of active ingredient specified on the label, and/or if soils are treated to a depth less than specified or approved, re-treatment will be required.

3.5.3 Disturbance of Treated Soils

Soil and fill material disturbed after treatment shall be re-treated before

placement of slabs or other covering structures.

3.5.4 Termites Found Within the Warranty Period

If live subterranean termite infestation or termite damage is discovered during the warranty period, the Contractor shall re-treat the site.

3.6 RE-TREATMENT

Where re-treatment is required, the Contractor shall comply with the requirements specified in paragraph WARRANTY.

-- End of Section --

**Termiticide Submittal** **#25**

DA Exterminating Co., Inc.

- Provide detailed termiticide application plan & map.
- Provide MSDS sheets.
- Provide all written verifications specified.
- Provide equipment list.
- Provide warranty for review.
- Provide required test reports & certifications.
- Provide Pest Management Report.
- Review Project Specifications Section 02360 & comply with all requirements.

**DAMMON ENGINEERING INC**

**Date:** 3.17.09 **Project:** Stennis ROF

**Reviewed:** _____

**Reviewed as Noted:** X

**Revise and Resubmit:** _____

**Rejected:** _____

**Other:** _____

**Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. This contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his or her work with that at all other trades and performing all in a safe and satisfactory manner.**

**Submittal Item:** Termiticide Submittal

**Comments**

Dammon # 25

Project Name: Stennis Riverine
Contract: N69450-05-D-0096
Brm Proj.: 3013-70
Submittal: 002360-01
Reviewed
Reviewed by: J. Collins
Date: 2/27/09

D A EXTERMINATING CO., INC.

Since 1959

# TERMITICIDE APPLICATION PLAN

Location: Riverine and Combatant Craft Operations Facility, Stennis Space Center, MS

Application Date(s): 48 hours after readiness notification(s)

Termiticide: Dominion 2L

EPA Reg. No.: 81959-28-53883

Active Ingredient: Imidacloprid

% Active Ingredient of concentrate: 21.4

% Active Ingredient of end-use solution: 0.05

Pre-treatment application rate: 1 gal./10 sq. ft. of soil surface

Post-treatment application rate: 4 gal./10 linear ft. of foundation wall

Application Methods:

Pre-treatment: All soil surfaces under concrete footings/on-grade slabs will be treated manually with a truck mounted motor, pump, tank, hose, spray gun assembly.

Post-treatment: Soil adjacent to all footings and/or on-grade slabs will be trenched. Any adjacent on-grade slabs that are not part of the foundation footings/slabs will be drilled. Application to both the trenched and drilled areas will be performed manually with a truck mounted motor, pump, tank, hose, spray gun assembly.

Total area to be treated: per drawing.

Amount of end-use solution to be applied: length (ft.) X width (ft.) of all footings/on grade slabs divided by 10 plus length of all trenched/drilled areas X 0.4 = Total gallons

Licensee: Jed D'Arensbourg

License #: 2391

4440 Wabash Street Metairie, Louisiana 70001 (504) 888-4941

RESIDENTIAL COMMERCIAL INDUSTRIAL MARINE LICENSED & BONDED

FEB/26/2009/THU 03:02 PM D A EXTERMINATING FAX No. 504 888 8120 P. 003

**BROADMOOR, L.L.C.**

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

3.17.09

DQC Manager Date

3/17/09

QC Officer Date

Since 1959

# TERMITICIDE APPLICATION PLAN

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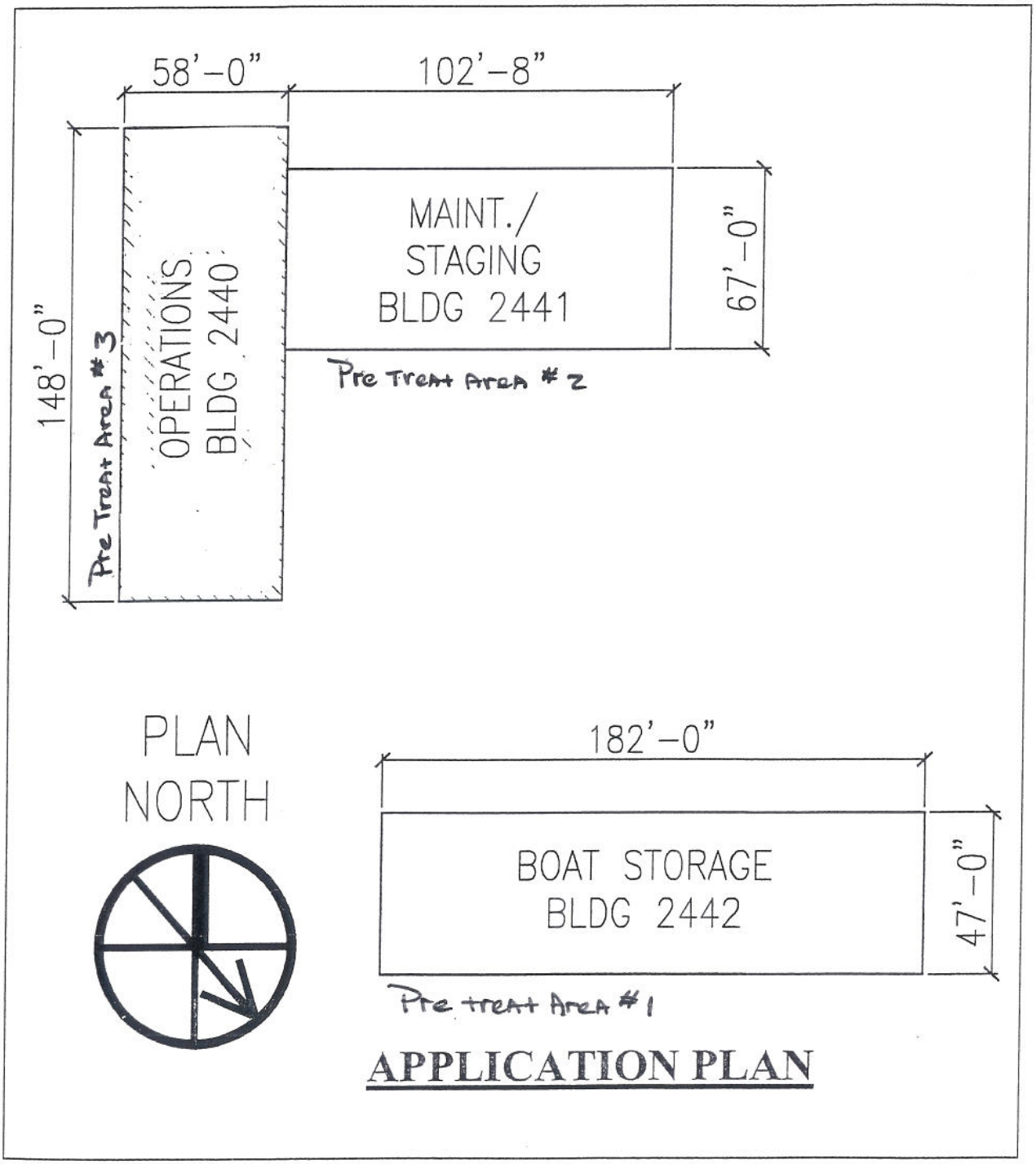
Licensee: Jed D'Arensbourg

License #: 2391




**APPLICATION PLAN**

# Dominion 2L Termiticide/Insecticide

***For use by professional personnel licensed or registered by the state to apply termiticide, turf maintenance, nursery/greenhouse, and/or landscaping/ornamental products. States may have more restrictive requirements regarding qualifications of persons using this product. Consult the structural pest control regulatory agency of your state prior to use of this product.***

*PREVENTS AND CONTROLS SUBTERRANEAN TERMITES, AND CARPENTER ANTS*

*FOR USE ON TURFGRASS (INCLUDING SOD FARMS, LANDSCAPE ORNAMENTALS, FRUIT AND NUT TREES AND INTERIOR PLANTSCAPES.*

FOLIAR AND SYSTEMIC INSECT CONTROL

| | |
|---|---|
| ACTIVE INGREDIENT: | |
| Imidacloprid: 1-1(6-Chloro-3-pyridinyl)methyl]-N-nitro-2-imidazolidinimine | 21.4% |
| INERT INGREDIENTS: | 78.6% |
| Total: | 100.0% |

Contains 2 pounds of imidacloprid per gallon.

Shake well before using.

**EPA Reg. No. 53883-229** **EPA Est. No. 53883-TX-002**

Keep out of reach of children

## CAUTION

PRECAUCION AL USUARIO: Si usted no puede leer o entender ingles, no use este producto hasta que la etiqueta le haya sido explicada ampliamente.
(TO THE USER: If you cannot read or understand English, do not use this product until the label has been fully explained to you.)

| FIRST AID | |
|---|---|
| **If Swallowed** | • Call a poison control center or doctor immediately for treatment advice.<br>• Have person sip a glass of water *if* able to swallow.<br>• Do not induce vomiting unless told to do so by a poison control center or doctor.<br>• Do not give anything by mouth to an unconscious person. |
| **If Inhaled** | • Move person to fresh air.<br>• If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible.<br>• Call a poison control center or doctor for further treatment advice. |
| **If on Skin or Clothing** | • Take off contaminated clothing<br>• Rinse skin immediately with plenty of soap and water for 15 to 20 minutes.<br>• Call a poison control center or doctor for treatment advice. |
| **If in Eyes** | • Hold eyelids open and rinse slowly and gently with water for 15 to 20 minutes.<br>• Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.<br>• Call a poison control center or doctor for treatment advice. |
| HOT LINE NUMBER | |
| Have the product container or label with you when calling a poison central center or doctor, or going for treatment. You may also contact SafetyCall® International (866) 897-8050 for emergency medical treatment information. | |
| NOTE TO PHYSICIAN | |
| No specific antidote is available. Treat patient symptomatically. | |

## PRECAUTIONARY STATEMENTS

### HAZARDS TO HUMANS AND DOMESTIC ANIMALS

**CAUTION:** Harmful if swallowed, inhaled, or absorbed through skin. Avoid contact with skin, eyes, or clothing. Avoid breathing spray mist. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse. Keep children or pets away from treated area until dry.

**Personal Protective Equipment (PPE)**

**WPS and Termiticide Uses:**
Applicators and other handlers (mixers and loaders) who handle this product for uses covered by the Worker Protection Standard (40 CFR part 170) – such as sod farms; or who are using this product as a termiticide, must wear:

- Long-sleeved shirt and long pants
- Chemical resistant gloves made of any waterproof material such as barrier laminate, butyl rubber, nitrile rubber, neoprene rubber, natural rubber, polyethylene, polyvinylchloride (PVC) or viton. If you want more options, follow the instructions for category A on an EPA chemical-resistance category selection chart.
- Shoes plus socks

Follow manufacturer's instructions for cleaning/ maintaining personal protective equipment, PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

When used as a termiticide, once the product is diluted as directed on the label, shirt, pants, shoes and socks may be worn. All pesticide handlers must wear protective eyewear when working in a non-ventilated space or when applying termiticide by rodding or sub-slab injection.

**Non-WPS Uses:**
Applicators and other handlers must wear:

- Shirt and pants
- Gloves
- Shoes plus socks

**Engineering controls statements:** When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240(4)(4-6)], the handler PPE requirements may be reduced or modified as specified in the WPS.

## USER SAFETY RECOMMENDATIONS

**User should:**

- Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, or using tobacco.
- Remove and wash contaminated clothing before reuse.

## ENVIRONMENTAL HAZARDS

This product is highly toxic to aquatic invertebrates. Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters.

This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area.

This chemical demonstrates the properties and characteristics associated with chemicals detected in groundwater. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.

Apply this product only as specified on this label. Extreme care must be taken to avoid runoff. Apply only to soil or other fill substrate that will accept the solution at the specified rate. Do not treat soil that is water-saturated or frozen or in any conditions where run-off or movement from the treatment area (site) is likely to occur.

## DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation.

## AGRICULTURAL USE REQUIREMENTS

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR part 170. This Standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE) and restricted-entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Do not enter or allow worker entry into treated areas during the restricted-entry interval (REI) of 12 hours.

**Exception:** If the product is applied by drenching, the Worker Protection Standard, under certain circumstances, allows workers to enter the treated area if there will be no contact with anything that has been treated.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water is:

Coveralls

- Chemical resistant gloves made of any waterproof material such as barrier laminate, butyl rubber, nitrile rubber, neoprene rubber, natural rubber, polyethylene, polyvinylchloride (PVC) or viton. if you want more options, follow the instructions for category A on an EPA chemical-resistance category selection chart.
- Shoes plus socks

## NON-AGRICULTURAL USE REQUIREMENTS

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard for agricultural pesticides (40 CFR part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries, or greenhouses.

Keep children and pets off treated area until dry.

## APPLICATION AS A TERMITICIDE

DOMINION 2L TERMITICIDE/INSECTICIDE may be used in and around structures and building construction to prevent and control termite infestations.

## GENERAL USE INSTRUCTIONS

For subterranean termite control, specific treatment recommendations may differ due to regulations, treatment procedures, soil types, construction practices and other factors. The purpose of chemical soil treatment for termite control is to establish a continuous chemical treated zone (horizontal and/or vertical) between the wood and other cellulose material in the structure and the termite colonies in the soil. Follow all federal, state, and local regulations and treatment standards for protection of a structure from termites. The establishment of an aerial or above ground colony may require additional treatments to control the termites, as well as landscape modifications, and/or structural repairs to deny termites of a moisture source. Use a 0.05% to 0.1% dilution based on current recommendations. For a typical control situation, a 0.05% dilution is used. A 0.1% dilution may be used when a severe or persistent infestation exists..

When treating adjacent to an existing structure, the applicator must check the area to be treated, and immediately adjacent areas of the structure, for visible and accessible cracks and holes to prevent any leaks or significant exposures to persons occupying the structure. People present or residing in the structure during application must be advised to remove their pets and themselves from the structure if they see any signs of leakage. After application, the applicator is required to check for leaks. All leaks resulting in the deposition of termiticide in locations other than those prescribed on this label must be cleaned up prior to leaving the application site. Do not allow people or pets to contact contaminated areas or to reoccupy contaminated areas of the structure until the clean up is completed.

Structures that contain wells or cisterns within the foundation of the structure can only be treated using the treated backfill method described in the treatment around wells and cisterns section of this label. Consult state and local specifications for recommended distances of wells from treated area, or if such regulations do not exist, refer to Federal Housing Administration Specifications (H.U.D.) for guidance.

**MIXING:** Refer to **MIXING TABLE** for correct amount of DOMINION 2L TERMITICIDE/INSECTICIDE to be used.

Follow this procedure for mixing the termiticide dilution:

1. Fill tank to 1/3 full.
2. If using large sprayer, start pump to begin bypass agitation and place end of treating tool in tank to allow circulation through hose.
3. Add appropriate amount of DOMINION 2L TERMITICIDE/INSECTICIDE. Add remaining amount of water. Let pump

run and allow recirculation through the hose for 2 to 3 minutes.

| MIXING TABLE FOR DOMINION 2L TERMITICIDE/INSECTICIDE | | |
|---|---|---|
| EMULSION CONCENTRATE | GALLONS WATER | AMOUNT OF IMI 2 LB |
| 0.05% | 100 | 27.5 fl oz |
| | 50 | 13.8 fl. oz. |
| | 25 | 6.9 fl oz |
| | 1 | 0.3 fl oz |
| 0.1% | 100 | 55.0 fl. oz. |
| | 50 | 27.5 fl oz |
| | 25 | 13.8 fl oz |
| | 1 | 0.6 fl oz |

**IN-LINE INJECTION:** Use the table below to mix the appropriate amount of DOMINION 2L TERMITICIDE/INSECTICIDE for the desired injection volume of finished emulsion.

| MIXING TABLE - INJECTOR | |
|---|---|
| INJECTOR VOLUME | CONCENTRATION |
| 0.3 fl oz/gal | 0.05% |
| 0.6 fl oz/gal | 0.1% |

CONVERSION KEY: 128 fl oz = 1 gal; 16 fl oz = 1 pint; 8 pints = 1 gal; 1 fl oz = 29.5 mL

## APPLICATION VOLUME

The application volumes described in the DOMINION 2L TERMITICIDE/INSECTICIDE DIRECTIONS FOR USE should be used whenever possible. However, where soil conditions will not accept application of 4 gallons of DOMINION 2L TERMITICIDE/INSECTICIDE per 10 linear feet, twice the DOMINION 2L TERMITICIDE/INSECTICIDE concentration may be applied in 2 gallons of solution per 10 linear feet. For example, if 0.05% is the correct use rate to be applied in 4 gallons of water, then 2 gallons of 0.1% dilution may be used per 10 linear feet to deliver an equivalent amount of DOMINION 2L TERMITICIDE/INSECTICIDE per unit of soil.

## PRE-CONSTRUCTION TREATMENT

Do not apply at a lower dosage and/or concentration than specified on this label for application prior to installation of the finished grade.

Prior to each application, applicators must notify the general contractor, construction superintendent, or similar responsible party, of the intended termiticide application and intended sites of application and instruct the responsible person to notify construction workers and other individuals to leave the area to be treated during application and until the termiticide is absorbed into the soil.

**CONCRETE SLAB-ON-GROUND OR BASEMENTS:** Apply an overall treatment to the entire surface of soil or other substrate to be covered by the slab including areas to be under carports, porches, basement floor and entrance platforms. Apply at the rate of 1 gallon of solution to accurately and uniformly cover 10 square feet. If fill under slab is gravel or other coarse aggregate, apply at the rate of 1.5 gallons or sufficient volume of solution, to accurately and uniformly cover 10 square feet. in addition, apply 4 gallons of solution (see **APPLICATION VOLUME**) per 10 linear feet to provide a uniform treated zone in soil at critical areas such as along the inside of foundation walls, and around plumbing, bath traps, utility services, and other features that will penetrate the slab.

After completion of grading, make an application by trenching or trenching and rodding around the slab or foundation perimeter. Rodding may be done from the bottom of a shallow trench. When rodding, rod holes must be spaced in a manner that will allow for a continuous chemical treated zone, not to exceed 12 inches, to be deposited along the treated area. Rod holes should not extend below the footing. Apply 4 gallons of solution (see **APPLICATION VOLUME**) per 10 linear feet, per foot of depth to provide a uniform treated zone. When trenching, the trench along the outside foundation should be about 6 inches in width and 6 inches in depth. Use a low pressure spray (not to exceed 25 PSI at the treatment tool when the valve is open) to treat soil which will be placed in the trench after rodding. Mix the spray solution with soil as it is being placed in the trench. When treating voids in hollow masonry units, use 2 gallons of solution per 10 linear feet of wall. Apply solution so it will reach the footing by injecting into the lower areas of the wall, just above the floor or footing.

When treating foundations deeper than 4 feet, apply the termiticide as the backfill is being replaced, or if the construction contractor ,

fails to notify the applicator to permit this, treat the foundation to a minimum depth of 4 feet after the backfill has been installed. The applicator must trench and rod into the trench or trench along the foundation walls and around pillars and other foundation elements, at the rate prescribed from grade to a minimum depth of 4 feet. When the top of the footing is exposed, the applicator must treat the soil adjacent to the footing to a depth not to exceed the bottom of the footing. However, in no case should a structure be treated below the footing.

Rodding in trench followed by flooding of trench and treatment of backfill may provide a better opportunity to achieve a continuous chemical treated zone than using soil rodding alone to establish a vertical termiticide treated zone.

**CRAWL SPACES:** Application must be made by trenching or trenching and rodding downward along the inside and outside of foundation walls, around piers, interior supports in contact with the soil, plumbing, and utility services. Apply 4 gallons of solution (see **APPLICATION VOLUME**) per 10 linear feet, per foot of depth to provide a uniform treated zone. Rodding may be done from the bottom of a shallow trench to top of the footing or a minimum of 4 feet. When rodding, rod holes must be spaced in a manner that will allow for a continuous chemical treated zone to be deposited along the treated area. Rod holes should not extend below he footing. When trenching, the trench should be about 6 inches wide and 6 inches deep. Use a low pressure spray to treat soil which will be placed in the trench, mixing the spray solution with soil as it is being placed in the trench.

**HOLLOW BLOCK FOUNDATIONS OR VOIDS:** Hollow block foundations or voids in masonry resting on the footing may be treated to provide a continuous chemical treated zone in the voids at the footing. Apply 2 gallons of solution per 10 linear feet to the lower part of the void so that it reaches the top of the footing or soil.

Treatment of voids in block or rubble foundation walls must be closely examined. Applicators must inspect areas of possible runoff as a precaution against application leakage in the treated areas. Some areas may not be treatable or may require mechanical alteration prior to treatment.

All leaks resulting in the deposition of termiticide in locations other than those prescribed on this label must be cleaned up prior to leaving the application site (refer to **PRECAUTIONARY STATEMENTS**). Do not allow people or pets to contact or to reoccupy the contaminated areas of the structure until the clean up is completed.

## POST-CONSTRUCTION TREATMENT

**CONCRETE SLAB-ON-GROUND:** To apply a treatment under the slab, including attached porches, carports, entrance platforms, garages and similar slab structures, it may be necessary to drill through the slab or exterior foundation. Drill holes should be spaced in a manner that will allow for application of a continuous chemical treated zone. Treat all existing cracks and cold, construction or expansion joints. Also, treat around bath traps, plumbing and utility services which penetrate the slab. Apply 4 gallons of solution (see **APPLICATION VOLUME**) per 10 linear feet per foot of depth to provide a uniform treated zone. DO NOT MAKE TREATMENT UNTIL LOCATION OF HEAT OR AIR CONDITIONING DUCTS AND VENTS ARE KNOWN AND IDENTIFIED. USE EXTREME CAUTION TO AVOID CONTAMINATION OF DUCTS AND VENTS. Plug and fill all drilled holes in commonly occupied areas with a suitable sealant. Plugs must be of non-cellulose material or covered by an impervious, non-cellulose material.

An application should be made by trenching or trenching and nodding around the outside of the foundation wall. Apply 4 gallons of solution (see **APPLICATION VOLUME**) per 10 linear feet per foot of depth to provide a uniform treated zone. When trenching, the trench along the outside foundation should be about 6 inches wide and 6 inches deep. Use a low pressure spray to treat soil as it is being placed in the trench.

Rodding can be done from the bottom of a shallow trench. When rodding, rod holes should be spaced in a manner that will allow for a continuous chemical treated zone, not to exceed 12 inches, to be deposited along the treated area. Rod hole depth should not extend below the footing.

**BATH TRAPS:** Exposed soil or soil covered with tar or a similar type sealant beneath and around plumbing and/or drain pipe entry areas should be treated with 3 gallons of solution per square foot. An access door or inspection vent should be cut and installed, if not already present. After inspection and removal of any wood or cellulose debris, the soil can be treated by rodding or drenching the soil.

**CRAWL SPACES:** When there is insufficient clearance between floor joists and ground surfaces to allow applicator access, excavate, if possible, and treat according to crawl spaces (refer to **PRE-CONSTRUCTION TREATMENT**). If unable to excavate, crawl space soil treatment may be used to prevent surface access by termites. Apply 1 gallon of solution (see **APPLICATION VOLUME**) per 10 square feet to provide a uniform chemical treated zone. Use a very coarse spray at a pressure not exceeding 25 PSI at the treatment tool when the valve is open.

Where a crawl space cannot be reached with the application wand, use extension wands or other suitable equipment to apply a coarse spray on the soil at the above rates. Do not apply to inaccessible crawl space areas using pressures greater than 25 PSI at the treatment tool when the valve is open.

Treatment may also be made by drilling through the foundation wall or through the floor above and treating the soil perimeter at a rate of 1 gallon of solution per 10 square feet. Drill spacing must be at intervals not to exceed 16 inches. Many states have smaller intervals so check state regulations which may apply.

To prevent subterranean termites from constructing mudtubes between soil and crawl space wood members above, an overall soil treatment of this product may be applied. Remove all cellulose debris before application. Apply 1 gallon of solution (see **APPLICATION VOLUME**) per 10 square feet to provide a uniform chemical treated zone.

**SHALLOW FOUNDATIONS:** For shallow foundations, one foot or less in depth, dig a narrow trench approximately 6 inches wide and deep along the outside and inside of the foundation walls, being careful not to dig below the bottom of the footings. For foundations with exposed footings, dig a trench alongside the footing taking care not to undermine the footing. Apply 4 gallons of solution (see **APPLICATION VOLUME**) per 10 linear feet to the top of footer to provide a uniform treated zone. The dilution should be applied to the trench and mixed with the soil as it is placed in the trench.

**BASEMENTS - OUTSIDE PERIMETER:** Along the outside of the exterior walls, an application must be made by trenching or rodding within the trench. Rodding depth should be to the top of the footer, or to a minimum of 4 feet or according to state or local regulations, When rodding through a trench, dig a narrow trench about 6 inches wide and 6 inches deep. Apply 4 gallons of solution (see **APPLICATION VOLUME**) per 10 linear feet, per foot of depth to provide a uniform treated zone by rodding through the trench. Use a low pressure spray to treat soil which will be placed into the trench after rodding. Mix spray solution with the soil as it is being placed in the trench.

**BASEMENTS - INSIDE PERIMETER:** If necessary, treat by drilling along the perimeter of the interior walls. Applications also may be necessary around Sewer pipes, floor drains, conduits, expansion joints or any cracks or holes in the basement floor. Apply 4 gallons of solution (see **APPLICATION VOLUME**) per 10 linear feet to provide a uniform treated zone.

Drill holes should be spaced in a manner that will allow for application of a continuous chemical treated zone. Plug and fill all drill holes in commonly occupied areas of the building with a suitable sealant. Plugs must be of non-cellulose material or covered by an impervious, non-cellulose material.

**HOLLOW BLOCK FOUNDATION OR VOIDS:** Hollow block foundations or voids in masonry resting on the footing may be treated to provide a continuous chemical treated zone in the voids at the footing. Apply 2 gallons of solution per 10 linear feet to the lower part of the void so that it reaches the top of the footing or soil, Drill spacing must be at intervals not to exceed 16 inches. Many states have smaller intervals so check state regulations which may apply.

Treatment of voids in block or rubble foundation walls must be closely examined. Applicators must inspect areas of possible runoff as a precaution against application leakage in the treated areas. Some areas may not be treatable or may require mechanical alteration prior to treatment.

All leaks resulting in the deposition of termiticide in locations other than those prescribed on this label must be cleaned up prior to leaving the application site (refer to **PRECAUTIONARY STATEMENTS**). Do not allow people or pets to contact or to reoccupy the contaminated areas of the structure until the clean up is completed.

**PLENUMS:** For plenum-type structures which use a sealed underfloor space to circulate heated and/or cooled air throughout the structure, apply the dilution at the rate of 4 gallons of solution (see **APPLICATION VOLUME**) per 10 linear feet, per foot of depth of soil to provide a uniform treated zone adjacent to both sides of foundation walls, supporting piers, plumbing and conduits. The soil should be treated by trenching to a depth of 6 inches or trenching and rodding (where conditions permit) or to the top of the footing. When conditions will not permit trenching or rodding, a surface application adjacent to interior foundation walls may be made, but the treated strip shall not exceed a width of 18 inches, horizontally, from the foundation walls, piers or pipes. The surface application will be made at a rate of 1.5 gallons of solution per 10 square feet as a very coarse spray under low pressure (not to exceed 25 PSI when measured at the treating tool when valve is on).

When treating plenums, turn off the air circulation system of the structure until application has been completed and all termiticide has been absorbed by the soil.

**TREATMENT AROUND WELLS OR CISTERNS:** Do not contaminate wells or cisterns.

**Structures With Wells/Cisterns Inside Foundations:** Structures that contain wells or cisterns within the foundation of a structure can only be treated using the following techniques:

1. Do not apply within 5 feet of any well or cistern by rodding and/or trenching or by the backfill method. Treat soil between 5 and 10 feet from the well or cistern by the backfill method only. Treatment of soil adjacent to water pipes within 3 feet of grade should only be done by the backfill method.
   a) Trench and remove soil to be treated onto heavy plastic sheeting or similar material or into a wheelbarrow.
   b) Treat the soil at the rate of 4 gallons of solution per 10 linear feet per foot of depth of the trench, or 1 gallon per 1.0 cubic feet of soil. Mix thoroughly into the soil taking care to contain the liquid and prevent runoff or spillage.
   c) After the treated soil has absorbed the solution, replace the soil into the trench.

**Structures With Adjacent Wells/Cisterns and/or Other Water Bodies:** Applicators must inspect all structures with nearby water sources such as wells, cisterns, surface ponds, streams, and other bodies of water and evaluate, at a minimum, the treatment recommendations listed below prior to making an application.

1. Prior to treatment, if feasible, expose the water pipes) coming from the well to the structure, if the pipes) enter the structure within 3 feet of grade.
2. Prior to treatment applicators are advised to take precautions to limit the risk of applying the termiticide into subsurface drains

that could empty into any bodies of water. These precautions include evaluating whether application of the termiticide to the top of the footer may result in contamination of the subsurface drain. Factors such as depth to the drain system and soil type and degree of compaction should be taken into account in determining the depth of treatment.

3. When appropriate (i.e., on the water side of the structure), the treated backfill technique (described above) can also be used to minimize off-site movement of termiticide.

## FOAM APPLICATIONS

Construction practices, soil subsidence and other factors may create situations in which a continuous chemical treated zone cannot be achieved using conventional treatment alone. In situations where necessary, conventional application methods can be supplemented through use of foam generating equipment, or similar devices, to provide a continuous treated zone.

Foam application may be made alone or in combination with conventional application methods, provided that the labeled amount of active ingredient per unit area is used.

**Foam Application Use Directions:** Mix appropriate concentration of DOMINION 2L TERMITICIDE/INSECTICIDE in water and add the manufacturer's recommended quantity of foam agent to the DOMINION 2L TERMITICIDE/INSECTICIDE solution (see table for foaming recommendations). Apply a sufficient volume of DOMINION 2L TERMITICIDE/INSECTICIDE foam alone or in combination with liquid solution to provide a continuous treated zone at the recommended rate for specific application sites.

NOTE: Add the manufacturer's recommended quantity of foam agent to the DOMINION 2L TERMITICIDE/INSECTICIDE solution.

*[Only one of the tables below will be used based upon the size of container offered for sale]*
*[FOR 240 ML SIZE ONLY]*

**MIXING TABLE - DOMINION 2L TERMITICIDE/INSECTICIDE FOAM**

| IMI 2 lb (mL) | GALLONS OF WATER | FOAM EXPANSION RATIO | FINISHED FOAM (0.05% ai) |
|---|---|---|---|
| 160 | 1 | 20:1 | 20 gal |
| 80 | 1 | 10:1 | 10 gal |
| 40 | 1 | 5:1 | 5 gal |

**MIXING TABLE - DOMINION 2L TERMITICIDE/INSECTICIDE FOAM**

| IMI 2 lb (fl oz) | GALLONS OF WATER | FOAM EXPANSION RATIO | FINISHED FOAM (0.05% ai) |
|---|---|---|---|
| 6.9 | 1 | 25:1 | 25 gal |
| | 2.5 | 10:1 | |
| | 5 | 5:1 | |
| 13.8 | 1 | 50:1 | 50 gal |
| | 2.5 | 20:1 | |
| | 5 | 10:1 | |

Depending on the circumstances, foam applications may be used alone or in combination with liquid solution applications. Applications may be made behind veneers, piers, chimney bases, into rubble foundations, into block voids, wall voids, under slabs, stoops, porches, or to the soil in crawlspaces, and other similar voids.

Foam and liquid applications must be consistent with volume and active ingredient instructions in order to ensure proper application has been made. The volume and amount of active ingredient are essential to an effective treatment. At least 75% of the gallons of DOMINION 2L TERMITICIDE/INSECTICIDE must be applied as a typical liquid treatment. The remaining 25% or fewer gallons is delivered to appropriate locations using a foam application.

## RETREATMENT

Retreatment for subterranean termites can only be performed if there is clear evidence of reinfestation or disruption of the treated zone due to construction, excavation, or landscaping and/or evidence of the breakdown of the termiticide treated zone in the soil. The vulnerable or reinfested areas may be retreated in accordance with application techniques described in this product's labeling. The timing and type of these retreatments will vary, depending on factors such as termite pressure, soil types, soil conditions and other factors which may reduce the effectiveness of the treated zone. Retreatment may be made as either a spot or complete treatment.

When a structure is not known to be reinfested and the treated zone is not disturbed, but where the structure was last treated five or more years ago, retreatment may be performed if, in the judgment of the applicator, it is necessary to ensure adequate protection of the structure. In determining the timing of any retreatment, the applicator should consider efficacy and/or degradation data and/or site-specific conditions and previous experience that indicate a vulnerability of the structure to termite attack.

**Annual retreatment of the structure is prohibited unless there is clear evidence that reinfestation or treated zone disruption has occurred.**

When another registered termite control product/system is used as the primary treatment for prevention or control of subterranean termites and is applied to all label-specified areas, DOMINION 2L TERMITICIDE/INSECTICIDE may be applied as a spot application in a secondary treatment to critical areas of the structure including plumbing and utility entry sites, bath traps, expansion joints, foundation cracks. The outside foundation wall, and areas of known or suspected activity at either a pre-construction or post-construction timing. These secondary treatments must be made applied in amounts and concentration in accordance with label directions relevant to the treatment area(s) to receive the secondary treatment.

**PERIMETER PEST CONTROL**
Treat soil, turf or ground cover adjacent to the structure where ants are trailing or may find food or harborage. Apply to flower, shrub or ornamental plant beds adjacent to the structure where ants may find food or forage. To control ants tunneling in soil apply a 0.05% to 0.1% solution as a drench or soil injection at intervals to establish a continuous treated zone. Treat along the edge of walls, driveways or other hard surfaces where ants are tunneling beneath the surface.

Apply in sufficient water to cover the foliage and soil area being treated. Maximum application is once per month to maintain control.

Do not allow residents or pets into the immediate area during the application or contact with treated areas until spray has dried.

Do not use this product against native or imported fire ants, pharaoh or harvester ants.

**NOTE:** In instances of high pest pressures and quick knockdown or elimination at pest entry points is needed, additional treatments using DOMINION 2L TERMITICIDE/INSECTICIDE with targeted applications of a pyrethroid to places where pests enter the structure may be made. Read and follow all label directions for use of this companion product.

**GENERAL PRECAUTIONS FOR APPLICATIONS**
- After treatment, plug and fill all holes drilled in concrete slab areas of the building with a suitable sealant.
- Do not apply solution until location of heat pipes, ducts, water and sewer lines and electrical conduits are known and identified. Caution must be taken to avoid puncturing and injection into the structural elements.
- Do not plant for the purpose of consumption, edible plants into the treated areas of soil.
- Avoid contamination of public and private water supplies.
- Use anti-backflow equipment or an air gap on filling hoses.
- Consult State, Federal, or local authorities for information regarding the approved treatment practices for areas in close proximity to potable water supplies.

## APPLICATION ON TURFGRASS

DOMINION 2L TERMITICIDE/INSECTICIDE may be used to control insect pests on turfgrass in home lawns, business and office complexes, shopping complexes, multi-family residential complexes, golf courses, airports, cemeteries, parks, playgrounds, athletic fields and sod farms.

DOMINION 2L TERMITICIDE/INSECTICIDE controls soil inhabiting pests such as Northern & Southern masked chafers, Cyclocephala borealis, C. immaculafa, and/or C. lurida; Asiatic garden beetle, Maladera castanea; European chafer, Rhizofroqus majalls; Green June beetle, Cotinis nitida; May or June beetle, Phyllophaga spp.; Japanese beetle, Popillia japonica; Oriental beetle, Anomala orientalis; Billbugs. Spherophorus spp.; Annual bluegrass weevil, Hyperodes spp.; Black turfgrass ataenius, Ataenius spretulus and Aphodius spp. European Crane Fly Tipula paludosa, and mole crickets,. scapteriscus spp. DOMINION 2L TERMITICIDE/INSECTICIDE can also be used for suppression of cutworms and chinch bugs.

For optimum control, make applications preceding or during the egg laying period of the target pest. The active ingredient in DOMINION 2L TERMITICIDE/INSECTICIDE has enough residual activity so that applications can be made preceding the egg laying activity. Application timing can be based on historical monitoring of the site, previous records or experiences, current season adult trapping or other methods. Most favorable control will be achieved when applications are made prior to egg hatch of the target pests, followed by sufficient irrigation or rainfall to move the active ingredient through the thatch.

Do not make applications when turfgrass areas are waterlogged or the soil is saturated with water. Sufficient distribution of the active ingredient cannot be achieved under these conditions. The treated turf area must be in such a condition that the rainfall or irrigation will penetrate vertically in the soil profile. Applications cannot exceed a total of 1.6 pints (0.4 lb of active ingredient) per acre per year.

**APPLICATION EQUIPMENT FOR USE ON TURFGRASS**
Apply DOMINION 2L TERMITICIDE/INSECTICIDE in sufficient water to provide adequate distribution in the treated area. The use of accurately calibrated equipment normally used for the application of turfgrass insecticides is required. Use equipment which will produce a uniform, coarse droplet spray, using a low pressure setting to eliminate off target drift. Check calibration periodically to

ensure that equipment is working properly.

Do not apply through any irrigation system.

**RECOMMENDED APPLICATIONS**

**TURF GRASSES**

| PEST | RATE | APPLICATION INSTRUCTIONS |
|---|---|---|
| Larvae of:<br>Annual bluegrass weevil<br>Asiatic garden beetle<br>Billbug<br>Black turfgrass ataenius<br>Cutworms (suppression)<br>European chafer<br>European crane fly<br>Green June Beetle<br>Japanese beetle<br>Northern Masked chafer<br>Oriental beetle<br>*Phyllophaga* spp.<br>Southern masked chafer | 1 .25 to 1.6 pt/A<br>or<br>0.46 to 0.6 fl. oz. (14 to 17 mL) per 1000 sq. ft. | For best control of grubs, billbugs, annual bluegrass weevil, and European Crane Fly, apply prior to egg hatch of the target pest. Read **APPLICATION EQUIPMENT** section of this label. |
| Chinchbugs (suppression)<br>Mole crickets | 1.6 pt /A<br>or<br>0.6 fl. oz. (17 mL) per 1000 sq. ft. | For suppression of chinchbugs, apply before hatching of the first instar nymphs.<br><br>To control mole crickets apply before or during the peak egg hatch period. Use a curative insecticide in addition to DOMINION 2L TERMITICIDE/INSECTICIDE when adults or large nymphs are present and actively tunneling. Follow label instructions for other insecticides when tank-mixing. |
| Consult your local turf, state Agricultural Experiment Station, or State Extension Service Specialists for more specific information regarding timing of application.<br><br>**NOTE:** For best control, irrigation or rainfall should occur within 24 hours after application to move the active ingredient through the thatch. Do not apply more than 1.6 pt (0.4 lb of active ingredient) per acre per year. Avoid mowing turf or lawn area until after sufficient irrigation or rainfall has occurred so that uniformity of application will not be affected. | | |

## APPLICATION TO ORNAMENTALS

DOMINION 2L TERMITICIDE/INSECTICIDE is for use on ornamentals in commercial and residential landscapes and interior plantscapes. DOMINION 2L TERMITICIDE/INSECTICIDE is a systemic product and will be taken up into the plant system from root uptake. To assure optimum effectiveness, the product must be placed where the growing portion of the target plant can absorb the active ingredient. The addition of a nitrogen containing fertilizer, where applicable, into the solution may enhance the uptake of the active ingredient. Application can be made by foliar application or soil applications; including soil injection, drenches, and broadcast sprays. Foliar applications offer locally systemic activity against insect pests.

When making soil applications to plants with woody stems, systemic activity will be delayed until the active ingredient is taken up throughout the plant. In some cases, this translocation delay could take 60 days or longer. For this reason, applications should be made prior to anticipated pest infestation to achieve optimum levels of control.

For outdoor ornamentals, broadcast applications cannot exceed a total of 1.6 pints (0.4 lb of active ingredient) per acre per year.

### Ant Management Programs

Use DOMINION 2L TERMITICIDE/INSECTICIDE to control aphids, scale insects, mealybugs and other sucking pests on ornamentals to limit the honeydew available as a food source for ant populations. DOMINION 2L TERMITICIDE/INSECTICIDE applications can be then be supplemented with residual sprays, bait placements or other ant control tactics to further reduce the pest population.

**NOTE: Not for use in commercial greenhouses, nurseries, or on grass grown for seed, or on commercial fruit and nut trees.**

### APPLICATION EQUIPMENT FOR FOLIAR APPLICATIONS

DOMINION 2L TERMITICIDE/INSECTICIDE mixes readily with water and may be used in many types of application equipment. Mix product with the required amount of water and apply as desired dependent upon the selected use pattern.

When making foliar applications on hard to wet foliage such as holly, pine, or ivy, the addition of a spreader/ sticker is recommended. If concentrate or mist type spray equipment is used, an equivalent amount of product should be used on the area sprayed, as would be used in a dilute application.

DOMINION 2L TERMITICIDE/INSECTICIDE has been found to be compatible with commonly used fungicides, miticides, liquid fertilizers, and other commonly used insecticides. Check physical compatibility using the correct proportion of products in a small jar test if local experience is unavailable.

Do not apply through any irrigation system.

### RECOMMENDED APPLICATIONS

**FOR USE ONLY IN AND AROUND INDUSTRIAL AND COMMERCIAL BUILDINGS AND RESIDDENTIAL AREAS.**

| CROP | PEST | RATE | APPLICATION INSTRUCTIONS |
|---|---|---|---|
| Trees<br>Shrubs<br>Evergreens<br>Flowers<br>Foliage plants<br>Groundcovers<br>Interior plantscapes | Adelgids<br>Aphids<br>Japanese beetles<br>Lace bugs<br>Leaf beetles (including elm and viburnum leaf beetles)<br>Leafhoppers (including glassy-winged sharpshooter)<br>Mealybugs<br>Psyllids<br>Sawfly Larvae<br>Thrips (suppression)<br>Whiteflies | 1.5 fl. oz. (45 mL) per 100 gal of water | **Foliar Applications:** Begin applications before the onset of high pest populations and reapply as needed. |
| | White grub larvae (such as Japanese beetle larvae, Chafers, Phyllophaga spp. Asiatic garden beetle, Oriental beetle) | 0.46 to 0.6 fl. oz. (14 to 17 mL) per 1000 sq. ft. | **Broadcast Applications:** Use enough water to mix the product and thoroughly apply to the treatment area. Do not use less than 2 gallons of water per 1000 sq ft. For best results, irrigate after application to incorporate DOMINION 2L TERMITICIDE/INSECTICIDE into the upper soil layer.<br><br>For additional use directions, refer to the **FLOWERS and GROUND COVERS** section of this label. |

**SOIL INJECTION* AND SOIL DRENCH APPLICATIONS IN AND AROUND INDUSTRIAL AND COMMERCIAL BUILDINGS AND RESIDENTIAL AREAS, AND STATE, NATIONAL, AND PRIVATE WOODED AND FORESTED AREAS**

***No Soil injection Applications Allowed in Nassau or Suffolk Counties of New York.**

| PEST | CROP/RATE | APPLICATION INSTRUCTIONS | REMARKS |
|---|---|---|---|
| Adelgids<br>Aphids<br>Armored scales (suppression)<br>Black vine weevil larvae<br>Emerald ash borer<br>Eucalyptus longhorned borer<br>Flatheaded borer (including bronze birch and alder borer)<br>Japanese beetles<br>Lace bugs<br>Leaf beetles (including elm and viburnum leaf beetles)<br>Leafhoppers (including glassy-winged sharpshooter)<br>Leafminers<br>Mealybugs<br>Pine tip moth larvae<br>Psyllids<br>Royal palm bugs<br>Sawfly larvae<br>Soft scales<br>Thrips (suppression)<br>White grub larvae<br>Whitefies | **TREES**<br><br>0.1 to 0.2 fl. oz. (3 to 6 mL) per inch of trunk diameter (D.B.H.) | **SOIL INJECTION:**<br>**Grid System:** Space holes in a grid pattern on 2.5 foot centers, extending to the drip line of the tree.<br><br>**Circle System:** Apply in holes evenly spaced in circles, (use more than one circle dependent upon the size of the tree) beneath the drip line of the tree extending in from that line.<br><br>**Basal System:** Space injection holes evenly around the base of the tree trunk no more than 6 to 12 inches out from the base.<br><br>**Soil Drench:** Apply uniformly as a drench around the base of the tree in not less than 10 gallons of water per 1000 square feet. Direct application to the root area. Remove plastic or any other barrier that will stop solution from reaching the root zone. | Use enough water to mix the product and inject an equal amount of solution in each hole. Use low pressure and sufficient solution for distribution of the liquid into the treatment area. For best control, keep the treated area moist for 7 to 10 days.<br><br>Do not use less than 4 holes per tree.<br><br>**For Control of Specified Borers:** Trees with existing insect damage and stress may not recover after treatment with DOMINION 2L TERMITICIDE/INSECTICIDE. |
| | **SHRUBS**<br><br>0.1 to 0.2 fl. oz. (3 to 6 mL) per foot of shrub height | **Soil Injection:** Apply at the recommended dosage to each plant.<br><br>**Soil Drench:** Apply uniformly as a drench around the base of the tree in not less than 10 gallons of water per 1000 square feet. Direct application to the root area. Remove plastic or any other barrier that will stop solution from reaching the root zone. | Use enough water to mix the product and inject an equal amount of solution in each hole. Use low pressure and sufficient solution for distribution of the liquid into the treatment area. For best control, keep the treated area moist for 7 to 10 days.<br><br>Do not use less than 4 holes per shrub. |
| | **FLOWERS AND GROUNDCOVERS**<br><br>0.46 to 0.6 fl. oz. (14 to 17 mL) per 1000 sq ft | Apply as a broadcast treatment before or after planting, or apply after plants are established. Mix into soil. For best control on established plants, irrigate thoroughly after application. | |

FOLIAR APPLICATIONS FOR USE ONLY IN AND AROUND RESIDENTIAL AREAS

| CROP | PEST | RATES | APPLICATION INSTRUCTIONS |
|---|---|---|---|
| POME FRUITS<br>Apple<br>Crabapple<br>Loquat<br>Mayhaw<br>Pear<br>Pear (oriental)<br>Quince | **Aphids (except Wooly apple aphid)**<br>**Leafhoppers (including glassy-winged sharpshooter)**<br>**Leafminer**<br>**Mealybugs***<br>**San Jose scale*** | 1.5 ft oz (45 mL) per 100 gal<br>or<br>6.0 ft oz/A[1] | Apply specified dosage as foliar spray as needed after petal-fall is complete.<br><br>For control of rosy apple aphid, apply prior to leafrolling caused by the pest.<br><br>For first generation leafminer control, make first application as soon as petal-fall is complete. Greatest leafminer control will result from the earliest possible application. For second and succeeding generations of leafminer, optimal control is obtained from applications made early in the adult flight against egg and early instar larvae. A second application may be required 10 days later if severe pressure continues or if generations are overlapping. A single application may result in suppression only. DOMINION 2L TERMITICIDE/INSECTICIDE will not control late stage larvae.<br><br>For San Jose Scale, time applications to the crawler stage. Treat each generation.<br><br>For late season (preharvest) control of leafhopper species, apply DOMINION 2L TERMITICIDE/INSECTICIDE while most leafhoppers are in the nymphal stage.<br><br>For optimal control of mealybug, insure good spray coverage of the trunk and scaffolding limbs or other resting sites of the mealybug.<br><br>Do not apply more than 6.0 fluid ounces per acre in a single application. Do not make more than 5 applications.<br><br>Allow 10 or more days between applications. Allow at least 7 days between last application and harvest.<br><br>* Not for use in California for control on pears. |
| **Pecan*** | **Yellow pecan aphid**<br>**Black margined aphid**<br>**Pecan leaf phylloxera**<br>**Pecan spittlebug**<br>**Pecan stem phylloxera** | 1.5 fl. oz. (45 mL) per 100 gal<br>or<br>6.0 fl. oz./A[1] | Make foliar applications as pests begin to build before populations become extreme. Two applications at a 10 to 14 day interval may be required to achieve control. Scout and retreat if needed.<br><br>Thorough uniform coverage of foliage is necessary for optimal control. Addition of an organosilicone-based spray adjuvant at a rate not to exceed the adjuvant manufacturer's recommended use rate may improve coverage.<br><br>Do not apply more than a total of 18.0 fluid ounces of DOMINION 2L TERMITICIDE/INSECTICIDE per acre per year. Do not make more than 3 applications.<br><br>Allow 10 or more days between applications.<br><br>* Use on pecans not permitted in California unless directed by specific supplemental labeling. |

[1] The amount of DOMINION 2L TERMITICIDE/INSECTICIDE required per acre will depend on tree size and volume of foliage present. The rate per acre is based on a standard of 400 gallons of dilute spray solution per acre for large trees.

**FOLIAR APPLICATION FOR USE ONLY IN AND AROUND INDUSTRIAL AND COMMERCIAL BUILDINGS AND RESIDENTIAL AREAS.**

| CROP | PEST | RATE | APPLICATION INSTRUCTIONS |
|---|---|---|---|
| Grapes | Leafhoppers (including glassy-winged sharpshooter)<br>Mealybugs | 1.5 fl. oz. (45 mL) per 100 gal<br>or<br>3.0 fl. oz/A (90 mL/A) | Apply specified dosage as a foliar spray using 200 gallons of water per acre. Do not apply more than a total of 6.0 ounces of DOMINION 2L TERMITICIDE/INSECTICIDE per acre per year.<br><br>Allow at least 14 days between applications. Applications may be applied up to and including day of harvest. |

**RESTRICTIONS**

- Do not graze treated areas or use clippings from treated areas for feed or forage.
- Avoid runoff or puddling of irrigation water following application. Keep children and pets off treated area until dry.
- Avoid application of DOMINION 2L TERMITICIDE/INSECTICIDE to areas which are water logged or saturated, which will not allow penetration into the root zone of the plant.
- Do not apply more than 1.6 pt (0.4 lb of active ingredient) per acre per year.

Treated areas may be replanted with any crop specified on an imidacloprid label, or with any crop for which a tolerance exists for the active ingredient.

For crops not listed on an imidacloprid label, or for crops for which no tolerances for the active Ingredient have been established, a 12-month plant-back interval should be observed.

## STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

**Pesticide Storage:** Store in a cool, dry place and in such a manner as to prevent cross contamination with other pesticides, fertilizers, food, and feed. Store water soluble packets in original container and out of reach of children, preferably in a locked storage area.

Handle and open container in a manner as to prevent spillage. If the container is leaking, invert to prevent leakage. If container is leaking or material spilled for any reason or cause, carefully dam up spilled material to prevent runoff. Refer to Precautionary Statements on label for hazards associated with the handling of this material. Do not walk through spilled material. Absorb spilled material with absorbing type compounds and dispose of as directed for pesticide below. In spill or leak incidents, keep unauthorized people away.

**Pesticide Disposal: Wastes** resulting from the use of this product may be disposed of on site (in the treatment area) or at an approved waste disposal facility.

**Container Disposal:** Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill or by incineration, or, if allowed by State and local authorities, by burning. If burned, stay out of smoke.

## IMPORTANT: READ BEFORE USE

Read the entire Directions for Use, Conditions, Disclaimer of Warranties and Limitations of liability before using this product. If terms are not acceptable, return the unopened product container at once. By using this product, user or buyer accepts the following conditions, disclaimer of warranties and limitations of liability.

CONDITIONS: The directions for use of this product are believed to be adequate and must be followed carefully. However, because of manner of use and other factors beyond Control Solutions control it is impossible for Control Solutions, Inc. to eliminate all risks associated with the use of this product. As a result, crop injury or ineffectiveness is always possible. All such risks shall be assumed by the user or buyer.

DISCLAIMER OF WARRANTIES: TO THE EXTENT ALLOWED BYY APPLICABLE LAW, CONTROL SOLUTIONS, INC. MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE, THAT EXTEND BEYOND THE STATEMENTS MADE ON THIS LABEL. No agent of Control Solutions, Inc. is authorized to make any warranties beyond those contained herein or to modify the warranties contained herein. Control Solutions, Inc. disclaims any liability whatsoever for special, incidental or consequential damages, resulting from the use or handling of this product.

LIMITATIONS OF LIABILITY: TO THE EXTENT ALLOWED BY LAW, THE EXCLUSIVE REMEDY OF THE USER OR BUYER FOR ANY AND ALL LOSSES, INJURIES OR DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT, WHETHER IN CONTRACT, WARRANTY, TORT, NEGLIGENCE, STRICT LIABILITY OR OTHERWISE, SHALL NOT EXCEED THE PURCHASE PRICE PAID, OR AT CONTROL SOLUTIONS, INC.'S ELECTION, THE REPLACEMENT OF PRODUCT.

Control Solutions, Inc.
5903 Genoa-Red Bluff
Pasadena, TX 77507

# MATERIAL SAFETY DATA SHEET
## Dominion 2L Termiticide/Insecticide

**Control Solutions, Inc.**
**Spill Emergency Phone:** Chemtrec 800-424-9300
**Health Emergency Phone:** SafetyCall® International (866) 897-8050
Effective Date: July 24, 2007
EPA Reg. No. 53883-229

### 1. PRODUCT AND COMPANY IDENTIFICATION:

**PRODUCT NAME: Dominion 2L Termiticide/Insecticide**
Active Ingredient: Imidacloprid
Chemical Name: 1-[(6-Chloro-3-pyridinyl)methyl]-*N*-nitro-2-imidazolidinimine
Chemical Formula: $C_9H_{10}ClN_5O_2$

**COMPANY IDENTIFICATION:**
Control Solutions, Inc.
5903 Genoa-Red Bluff
Pasadena, TX 77507-1041
UNITED STATES

### 2. COMPOSITION/INFORMATION ON INGREDIENTS:

| | | |
|---|---|---|
| Imidacloprid | CAS No. 138261-41-3 | 21.40% |

### 3. HAZARD IDENTIFICATION

HAZARDS TO HUMANS AND DOMESTIC ANIMALS: Harmful if swallowed, inhaled or absorbed through skin. Avoid contact with skin, eyes, or clothing.

ENVIRONMENTAL HAZARDS: This product is highly toxic to aquatic invertebrates. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters.

This product is highly toxic to bees exposed to direct treatment or residues on the foliage of blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area.

This product is toxic to wildlife.

This chemical demonstrates the properties and characteristics associated with chemicals detected in groundwater. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.

### 4. FIRST AID

**IF ON SKIN OR CLOTHING:** Call a poison control center or doctor for treatment advice. Take off contaminated clothing. Rinse skin immediately with water for 15-20 minutes.

**IF IN EYES:** Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

**IF SWALLOWED:** Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not give anything by mouth to an unconscious person.

**IF INHALED:** Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration (preferably by mouth-to-mouth) if possible.

**NOTE TO PHYSICIAN:** No specific antidote is available. Treat patient symptomatically.

## 5. FIRE-FIGHTING MEASURES

**Flash point:** N/A

**Flammable Limits (LFL-UFL):** Unknown

**Fire and Explosion Hazards:** Can burn in fire releasing irritating and toxic gasses due to thermal decomposition or combustion.

**Means of Extinction:** Use foam, dry chemical, carbon dioxide or water spray.

**Fire Fighting Instructions:** Evacuate area and fight fire upwind a safe distance to avoid hazardous vapors and decomposition products. Cool closed containers exposed to fire with water spray. Dike and collect water used to fight fire to prevent environmental damage due to runoff. Foam or dry chemical extinguishing systems are preferred to prevent environmental damage due to runoff. Equipment or materials involved in pesticide fires may become contaminated.

**Firefighting Equipment:** Self-contained breathing apparatus with full face piece.

**Hazardous Combustion Products:** Hydrogen cyanide, hydrogen chloride, carbon monoxide and nitrogen oxide.

## 6. ACCIDENTAL RELEASE MEASURES

Clean up spills immediately observing the precautions in Section 8 of this MSDS. Isolate the hazard area and keep unnecessary and unprotected personnel from entering. Do not walk through spilled material and avoid breathing vapors and skin contact. Do not allow material to enter streams, sewers or other waterways or to contact vegetation.

For large spills, material should be recovered. For small spills, absorb with absorbent granules, spill control pads or other absorbent material. Carefully sweep up absorbed spilled material and place in covered container for disposal. Scrub contaminated area with soap and water and use dry absorbent granules to collect wash solution for disposal. Contaminated soil may have to be removed and disposed.

## 7. HANDLING AND STORAGE

Avoid breathing dust or vapor. Avoid contact with skin, eyes and clothing. Remove and wash contaminated clothing before reuse. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, or using tobacco.

Store in a cool, dry place and in such a manner as to prevent cross contamination with other pesticides, fertilizers, food, and feed. Store in original container and out of the reach of children, preferably in a locked storage area.

## 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

**Engineering Controls:** To avoid exceeding exposure limits, handle only with adequate ventilation. Facilities storing or utilizing this material should be equipped with an eyewash station and a safety shower.

**Protective Clothing:** Tight fitting safety goggles. Chemical resistant gloves made of waterproof material such as polyethylene or polyvinyl chloride (PVC). Long-sleeved shirt, long pants and shoes plus socks. A respirator is not required when handled under normal conditions. When handling in enclosed areas with inadequate ventilation, use a dust / mist filtering respirator (MSHA/NIOSH approval number prefix TC-21C).

**General:** Wash thoroughly with soap and water after handling. Discard clothing and other absorbent materials that have been heavily contaminated with this product; do not reuse them. Follow the

manufacturer's instructions for cleaning and maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

**Appearance:** Off-white viscous liquid
**Odor:** mild
**pH:** 7.62
**Flashpoint (PMA-4):** Not established
**Density:** 1.111 g/cm$^3$

## 10. STABILITY AND REACTIVITY

**CONDITIONS TO AVOID:** Extreme Temperatures.

**CHEMICAL STABILITY:** Stable but may decompose if heated.

**HAZARDOUS DECOMPOSITION PRODUCTS:** Hydrogen chloride, hydrogen cyanide and oxides of nitrogen and carbon.

**INCOMPATIBILITY WITH OTHER MATERIALS:** None known.

**POLYMERIZATION:** Will not occur.

## 11. TOXICOLOGICAL INFORMATION

**ACUTE ORAL TOXICITY**
Oral $LD_{50}$ (rat): 1,190 mg/kg

**ACUTE DERMAL TOXICITY**
Dermal $LD_{50}$ (rat): > 5,000 mg/kg

**ACUTE INHALATION TOXICITY**
Inhalation $LC_{50}$ (rat): > 3.452 mg/L

**EYE IRRITANT**
Rabbit – Non-Irritating.

**SKIN IRRITATION**
Rabbit – Non-Irritating

**SENSITIZATION**
Guinea Pig – Not a Contact Sensitizer

**MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:** None known.

**CARCINOGENICITY:**
**ACGIH:** Not listed
**IARC:** Not listed
**NTP:** Not listed
**OSHA:** Not listed

**MUTAGENIC DATA:** No evidence of mutagenic effects during *in vivo* and *in vitro* assays.

**ADDITIONAL DATA:** Not known to cause reproductive or birth defects at normal exposure levels.

## 12. ECOLOGICAL INFORMATION

This product is highly toxic to aquatic invertebrates. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters.

This product is highly toxic to bees exposed to direct treatment or residues on the foliage of blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area.

This product is toxic to wildlife.

This chemical demonstrates the properties and characteristics associated with chemicals detected in groundwater. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.

## 13. DISPOSAL CONSIDERATIONS

**Do not contaminate water, food or feed by disposal.**

**PESTICIDE DISPOSAL:** Pesticide wastes are toxic. Improper disposal of excess pesticide, or rinsate is a violation of Federal Law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste Representative at the nearest EPA Regional Office for guidance.

**CONTAINER DISPOSAL:** Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

## 14. TRANSPORT INFORMATION

DOT PROPER SHIPPING NAME: Not Regulated by DOT
DOT HAZARD CLASS OR DIVISION: N/A
DOT UN/NA NUMBER: N/A
DOT PACKING GROUP: N/A
REPORTABLE QUANTITY: N/A
MARINE POLLUTANT: Not Listed
DOT EMERGENCY RESPONSE GUIDE: N/A

## 15. REGULATORY INFORMATION

**FIFRA –**
All pesticides are governed under the Federal Insecticide, Fungicide, and Rodenticide Act. The regulatory information presented below is pertinent only when this product is handled outside of the normal use and application as a pesticide.

**SARA Title III – Section 302 Extremely Hazardous Substances**
Not Listed

**SARA Title III – Section 311/312 Hazard Categories**
Immediate

**SARA Title III – Section 312 Threshold Planning Quantity**
N/A

**SARA Title III – Section 313 Reportable Ingredients**
None

**CERCLA –**
None Listed

**CALIFORNIA PROP 65 STATUS –**
Not listed

## 16. OTHER INFORMATION

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by CPR.

**DISCLAIMER:**
Control Solutions, Inc. believes the information and recommendations provided above to be accurate. NO WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE, WARRANTY OF MERCHANTABILITY, OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, IS MADE CONCERNING THE INFORMATION PROVIDED HEREIN. The information provided above relates only to the specific product designated and may not be applicable

where such product is used in combination with any other materials or in any process. Use of this product is regulated by the U.S. Environmental Protection Agency (EPA). It is a violation of Federal law to use this product in a manner inconsistent with its labeling. Additionally, as the conditions and methods of use are beyond the control of Control Solutions, Inc., Control Solutions, Inc. expressly disclaims any and all liability as to any results obtained or arising from any use of the product or reliance on such information.

# SECTION 32 11 16.16

# SUBBASE COURSE FOR FLEXIBLE PAVING

## PART 1 GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C 117 | (2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing |
| ASTM C 131 | (2006)Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| ASTM C 136 | (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM C 29/C 29M | (2007) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate |
| ASTM D 1556 | (2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method |
| ASTM D 1557 | (2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3) |
| ASTM D 1883 | (2007) CBR (California Bearing Ratio) of Laboratory-Compacted Soils |
| ASTM D 2922 | (2005) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth) |
| ASTM D 2940 | (2003) Graded Aggregate Material for Bases or Subbases for Highways or Airports |
| ASTM D 3017 | (2005) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth) |
| ASTM D 4318 | (2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils |
| ASTM D 5106 | (2008) Steel Slag Aggregates for Bituminous Paving Mixtures |
| ASTM D 6155 | (2006) Nontraditional Coarse Aggregate for Bituminous Paving Mixtures |

| | |
|---|---|
| ASTM D 698 | (2007e1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.)) |
| ASTM D 75 | (2003) Standard Practice for Sampling Aggregates |

1.2 RELATED SECTIONS

Pervious pavement systems shall use Section 32 11 24 GRADED CRUSHED AGGREGATE BASE COURSE FOR PERVIOUS PAVEMENT.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-05 Design Data

Gradation curve

SD-06 Test Reports

Bearing ratio

Liquid limit

Plasticity index

Dry weight of slag

Percentage of wear

Gradation tests

Density tests

SD-07 Certificates

Source

Location and name.

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site and store aggregates in a manner that will prevent segregation and contamination.

1.5 CONSTRUCTION EQUIPMENT

Subject to approval of the Contracting Officer, special equipment as dictated by local conditions may be used. Calibrated equipment, such as scales, batching equipment, spreaders, and other similar equipment, shall have been calibrated by a calibration laboratory approved by the Contracting Officer or a state calibration laboratory within 12 months of

commencing work.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not construct course when atmospheric temperature is below 35 degrees F or when weather conditions could detrimentally affect quality of finished course. When temperature falls below 35 degrees F, protect areas of completed course against freezing.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

1.7.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

PART 2 PRODUCTS

2.1 MATERIALS

ASTM D 2940, except as modified herein. Material shall consist of natural, processed or blends of stone waste concrete, masonry, cement, tile, or other waste material from on-site work as specified; rock, crushed concrete, concrete block, or crushed slag from off-site grading or demolition work; recycled porcelain, concrete, stone, or other recycled material complying with ASTM D 6155; Class I or Class II Fill; steel slag complying with ASTM D 5106; gravel; stone; slag; chert; caliche; limerock; coral; shell; quarry and mine waste; sand; or screenings; and soil or other similar binding or filler material. Material may contain post-consumer or post-industrial recycled content. Obtain materials from sources approved by the Contracting Officer. Preliminary approval of pits shall not mean that material found in the deposit will be acceptable. Maximum dimensions of material particles shall not be greater than two-thirds the compacted thickness of the layer in which it is to be placed. Coarse aggregate shall have a percentage of wear of not more than 40 as determined by ASTM C 131. Material shall have a bearing ratio of at least 30 as determined by laboratory test on a four day soaked specimen in accordance with ASTM D 1883; compact the specimen in accordance with ASTM D 1557, Method B, C, or D. Material passing the No. 40 sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than 5 in accordance with ASTM D 4318. Slag shall be an air-cooled blast furnace product having a dry weight not less than 65 pounds per cubic foot when tested in accordance with ASTM C 29/C 29M and consisting of angular fragments uniform in density and quality and reasonably free from thin and elongated pieces, dirt, or other objectionable material. Grading shall be a minimum of 3/4 inch and a maximum of 1.5 inches. Gradation of the final composite mixture shall conform to the following size and shall be the basis of the gradation curve:

| Sieve Size (Square Openings) | Design Range (Percent Passing) | Job Mix Tolerance (Percent) |
|---|---|---|
| 2 inch | 100 | -3 |
| 1 1/2 inch | 90-100 | +5 |
| No. 4 | 30-60 | ±10 |
| No. 200 | 0-15 | +5 |

2.2 SOURCE QUALITY CONTROL

Prior to production and delivery of aggregates, take at least one initial sample in accordance with ASTM D 75. Collect each sample by taking three incremental samples at random from source material to make a composite sample of not less than 50 pounds. Repeat sampling procedure when source of material is changed or when deficiencies or variations from specified grading of materials are found in testing.

2.2.1 Geotextile

May be fabricated from 100 percent post-consumer recycled plastic.

PART 3 EXECUTION

3.1 GRADE CONTROL

Provide line and grade stakes for control. Place grade stakes in lanes parallel to centerline of areas to be paved and space for string lining or other control methods.

3.2 PLACING AND MIXING

Clean underlying surface of foreign substances and ensure proper compaction and smoothness before placement of course. Verify subsoils have a permeability between 0.5 and 3.0 inches per hour. Recondition, reshape, and recompact areas damaged by freezing, rainfall, or other weather conditions. Mix and place materials to obtain a uniform course for the water content and gradation specified. Construct course in one or more layers. Make each layer between 3 and 8 inches in compacted thickness. Tire shall be installed in accordance with ASTM D 6270.

3.3 COMPACTING AND FINISHING

Compact each layer to at least 100 percent of the maximum laboratory density determined in accordance with ASTM D 1557 for areas subject to heavy vehicular traffic. Compact each layer to at least 95 percent Standard Proctor Density per ASTM D 698 for pedestrian areas. Compact material inaccessible to rolling equipment by mechanical tamping. Finish surface of the layer by blading and rolling. Blade, roll, and tamp until surface is smooth and free from waves and irregularities. Aerate material excessively moistened by rain during construction. Aerate using blade graders, harrows, or other equipment until the moisture content is that needed to obtain specified density. Place and compact earth at edges of course for at least one foot of the shoulder.

3.4 FIELD QUALITY CONTROL

3.4.1 Sampling During Construction

Take one random sample of each 1000 tons of material placed, but not less than one random sample per day's run. Take samples in accordance with ASTM D 75.

3.4.2 Testing

3.4.2.1 Material

Make gradation tests from each sample in accordance with ASTM C 136.

Determine material passing the No. 200 sieve in accordance with ASTM C 117.

3.4.2.2 Smoothness Test

Test with a 10 foot straightedge applied parallel with and at right angles to centerline of the rolled area. Correct surface deviations in excess of 3/8 inch by loosening, adding or removing material, reshaping, watering, and compacting. When course is constructed in more than one layer, smoothness requirements apply only to the top layer.

3.4.2.3 Field Density Tests

ASTM D 1556 or ASTM D 2922, and ASTM D 3017. Take one field density test for each 300 square yards of each layer of course. When using ASTM D 2922 and ASTM D 3017 to test field compaction densities, verify the results of the tests by performing one test per day using ASTM D 1556 at locations previously tested by ASTM D 2922 and ASTM D 3017 and one additional test using ASTM D 1556 for every ten tests performed at locations previously tested by ASTM D 2922 and ASTM D 3017.

3.4.2.4 Laboratory Density Tests

ASTM D 1557, Method B, C, or D, for all material.

3.4.2.5 Thickness Test

Determine thickness of course from test holes not less than 3 inches in diameter. Obtain a thickness test for each 500 square yards of course. Where course deficiency is more than 1/2 inch, correct by scarifying, adding mixture of proper gradation, reblading, and recompacting. Where the measured thickness exceeds the indicated thickness by more than 1/2 inch, consider the measured thickness as the indicated or specified thickness plus 1/2 inch for determining the average. The average thickness shall be the average of the depth measurements and shall not underrun the thickness shown by more than 1/4 inch.

3.5 MAINTENANCE

After construction is completed, protect and maintain all areas of course against detrimental effects. Maintenance includes drainage, rolling, shaping, watering, or other action required to maintain course in proper condition. Maintain sufficient moisture by light sprinkling with water at the surface to prevent a dusty condition.

-- End of Section --

SECTION 32 11 24

GRADED CRUSHED AGGREGATE BASE COURSE FOR FLEXIBLE PAVEMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C 117 | (2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing |
| ASTM C 131 | (2006)Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| ASTM C 136 | (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM C 29/C 29M | (2007) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate |
| ASTM D 1556 | (2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method |
| ASTM D 1557 | (2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3) |
| ASTM D 1883 | (2007) CBR (California Bearing Ratio) of Laboratory-Compacted Soils |
| ASTM D 2217 | (1985; R 1998) Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants |
| ASTM D 2922 | (2005) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth) |
| ASTM D 3017 | (2005) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth) |
| ASTM D 4318 | (2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils |
| ASTM D 75 | (2003) Standard Practice for Sampling Aggregates |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Gradation

Bearing ratio

Liquid limit

Plasticity index

Percentage of wear

Density

Gradation

Smoothness

Density

Thickness

1.3 DELIVERY AND STORAGE

Inspect materials delivered to site for damage and store as to prevent segregation and contamination.

1.4 WEATHER LIMITATIONS

Do not construct base course when atmospheric temperature is below 35 degrees F or when rainfall or other weather conditions detrimentally affect the quality of the finished course.

1.5 CONSTRUCTION EQUIPMENT

Equipment shall be dependable and adequate for the purpose intended. Maintain equipment in satisfactory and safe operating condition. Subject to approval, special equipment dictated by local conditions may be used. Calibrated equipment, such as scales, batching equipment, spreaders, and similar items, shall have been recalibrated by an approved calibration laboratory or a State calibration laboratory within 12 months of commencing work.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aggregates

Consist of durable and sound crushed concrete, crushed masonry, crushed tile, crushed gravel, crushed stone, or crushed slag, free of lumps or balls of clay or other objectionable matter. Aggregate material shall contain in total a minimum of 5 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content. Crushed stone and gravel shall be free from flat, elongated, soft, or disintegrated pieces. Crushed gravel retained on a No. 4 sieve shall have at least 90 percent by weight with at least two fractured faces and 100 percent by weight with at least one fractured face. Base course materials samples shall have a bearing ratio of at least 100 as determined by laboratory tests on a 4-day soaked specimen in accordance with ASTM D 1883; compact specimen in accordance with ASTM D 1557, Method D. Determine grain size in accordance with ASTM C 136 and amount of material finer than 200 mesh sieve in accordance with ASTM C 117. Aggregate, other than slag, shall have a percentage of wear not exceeding 45 when tested in accordance with ASTM C 131, Grading A. Slag shall be an air-cooled, blast furnace product having a dry weight of not less than 65 pounds per cubic foot when tested in accordance with ASTM C 29/C 29M and shall consist of angular fragments uniform in density and quality, reasonably free from thin, elongated pieces, dirt, or other objectionable material. Soil binder material, that portion of material passing the No. 40 sieve, shall be of such composition that the composite material conforms to the requirements specified herein. The base course shall be of such nature that it can be compacted readily with watering and rolling to a firm, stable base and shall conform to one of the following sizes:

Percentage by Weight Passing
Square Mesh Laboratory Sieves

| | Size Numbers | | |
|---|---|---|---|
| Sieves | 1 | 2 | 3 |
| 2 inch | 100 | - | - |
| 1 1/2 inch | 70-100 | 100 | - |
| 1 inch | 45-80 | 60-100 | 100 |
| 1/2 inch | 30-60 | 30-65 | 40-70 |
| No. 4 | 20-50 | 20-50 | 20-50 |
| No. 10 | 15-40 | 15-40 | 15-40 |
| No. 40 | 5-25 | 5-25 | 5-25 |
| No. 200 | 0-10 | 0-10 | 0-10 |

That portion of the material passing the No. 40sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than 5 as determined by ASTM D 4318. Prepare samples in accordance with ASTM D 2217, Procedure A.

2.1.2 [Enter Appropriate Subpart Title Here]2.1.2.1 Asphalt-Treated Permeable Base

Asphalt binder shall be steam-refined asphalt, grade AR-8000. "Popcorn mix" aggregate shall conform to the following grading:

Percentage by Weight Passing
Square Mesh Laboratory Sieves

| Sieves | Percent Passing |
|---|---|
| 1 inch | 100 |
| 3/4 inch | 90-100 |
| 1/2 inch | 35-65 |
| 3/8 inch | 20-45 |
| No. 4 | 0-10 |
| No. 8 | 0-5 |

2.1.2.2 Cement-Treated Permeable Base

Portland cement binder shall be Type II Modified. Pozzolan shall not be substituted for portland cement. Aggregate shall conform to the 1 inch x No. 4 primary nominal coarse aggregate grading, with 52 to 85 percent by weight passing through a 3/4 inch sieve.

PART 3 EXECUTION

3.1 BASE COURSE

Construct the graded aggregate base course on a prepared subgrade or previously constructed subbase course, as indicated. Verify compacted subgrade, granular base, or stabilized soil is acceptable and ready to support paving and imposed loads. Provide line and grade stakes for control. Place grade stakes in lanes parallel to the centerline of areas to be paved and space for string lining or other control methods. The base course shall consist of aggregate processed, deposited, spread, and compacted on a prepared surface. The Contractor shall be responsible for protection of completed areas against detrimental effects. Recondition, reshape, and recompact areas damaged by freezing, rainfall, or other weather conditions.

3.2 OPENING AND OPERATION OF PITS

Perform stripping, clearing, processing, and blending in the opening of new pits and operation of existing pits as necessary to obtain acceptable material. Open pits in a manner to expose the vertical faces of the deposits for suitable working depths, following which the material shall be obtained in successive vertical cuts extending through the exposed strata. Waste strata and pockets of unsuitable materials overlaying or occurring in the deposit. Change or modify the method of operating the pits, and the processing and blending of the material when necessary to obtain material conforming to the specified requirements. Upon completion of the work, condition pits to drain readily and leave in a satisfactory condition.

3.3 MIXING OF MATERIALS

Mix aggregates in a stationary or traveling plant. Proportion aggregates by weight or volume in such quantities that specified gradation, liquid limit, and plasticity index requirements are met after the base course has been placed and compacted. Incorporate, during the mixing operation, water in quantities sufficient to provide the necessary moisture content for the specified compaction. Mixing operations shall produce satisfactory uniform blending and the method of discharging into trucks shall not produce

segregation.

## 3.4 PLACING

Do not dump mixed materials in piles, but place on prepared subgrade or subbase in layers of uniform thickness with a spreader. Place two compacted courses of 4 inches in thickness. Do not exceed 6 inches or have less than 3 inches in thickness for any compacted layer. Place layers so that when compacted, they will be true to grades or levels required with the least possible surface disturbance. Where the base course is constructed in more than one layer, clean previously constructed layers of loose and foreign matter. Maintain material water content during the placing period to obtain the compaction specified. Make adjustments in placing procedures or equipment to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to insure a satisfactory base course.

### 3.4.1 Stationary-Plant Method

Mix aggregates, binder material and water until a uniform homogeneous mixture is obtained. Do not dump materials in piles; place in layers of essentially uniform thickness, not to exceed 4 inches after compaction, by an approved spreader. Tail gate spreading will be acceptable only with permission, under conditions such as where space limitations prohibit use of the spreader.

### 3.4.2 Windrow Traveling-Plant Method

Place aggregates and binder materials in windrows of such cross section and proportions that, when picked up, mixed, and redeposited in windrows, the finished mixture shall conform to the specified requirements. Do not exceed the rated capacity of the traveling plant with the size of the windrow of the combined materials. Add water, in quantity sufficient to provide the necessary moisture content for compacting, to the aggregates at the time of mixing. Mix materials uniformly by the traveling plant, deposit in windrows of uniform cross section, and spread in a layer of uniform thickness to the required contour and grades.

## 3.5 COMPACTING AND FINISHING

Immediately following the placing, spread the finished mixture uniformly in a layer and bring to optimum moisture content. The loose thickness and the surface of the layer shall be such that the specified density and the required thickness shall be obtained after compaction. Compact the layer with steel-faced, vibrating or pneumatic-tired rollers, or other suitable compacting equipment or combinations thereof. Continue compacting until the layer is compacted through the full depth to a field density of at least 100 percent of the maximum density at optimum moisture content tested in accordance with ASTM D 1556, ASTM D 2922 and ASTM D 3017. In areas not accessible to rollers or compactors, compact the mixture with mechanical hand tampers. If the mixture is excessively moistened by rain, aerate by blade graders, or other suitable equipment. Aerate until the moisture content of the material is that needed to obtain the required density. Finish the surface of the layer by a combination of rolling and blading. Final surface shall be smooth and free from waves, irregularities, and ruts or soft yielding spots.

## 3.6 PROOF ROLLING

In addition to compacting the base course to the required density, proof roll the top surface of the completed base course by making eight coverages with a heavy rubber-tired roller having four tires with each tire loaded to 30,000 pounds or more and inflated to at least 150 psi. Make four coverages over other areas to be paved, excluding the runway over-runs, blast protection areas, and shoulders. A coverage is defined as one application of one tire print over each point in the surface of the designated area. When under the action of the proof rolling, the base course yields, pumps, or otherwise fails, remove, replace with suitable materials, and recompact materials in the base course or in the underlying layers indicated to be unsatisfactory. The speed of the roller shall not exceed 5 miles per hour. Obtain approval upon completion of the proof rolling of the base course.

## 3.7 FINISHING AT EDGES OF BASE COURSE

Place earth or other approved materials along the edges of the base course in such quantity that it will compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, place material to the thickness of each layer. In each operation, allow at least a one foot width of the shoulder to be rolled and compacted simultaneously with the rolling and compacting of each layer.

## 3.8 FIELD QUALITY CONTROL

Approve materials and material sources in advance of the use of such materials in the work. Replace base where samples are removed.

### 3.8.1 Sampling

#### 3.8.1.1 Aggregates at the Source

Prior to production and delivery of aggregates, take at least one initial sample in accordance with ASTM D 75. Collect each sample by taking three incremental samples at random from the source material to make a composite sample of not less than 50 pounds. Repeat above sampling when source of material is changed or when unacceptable deficiencies or variations from specified grading of materials are found in testing.

#### 3.8.1.2 During Construction

Take one random sample from each 1000 tons of completed course material, but not less than one random sample per day's run. Take samples in accordance with ASTM D 75.

#### 3.8.1.3 Sample Identification

Place each sample in a clean container, securely fastened to prevent loss of material. Tag each sample for identification and with the following information:

Contract No._____
Sample No._____ Quality _____
Date of Sample_____
Sampler_____
Source_____
Intended Use_____

For Testing_____

3.8.2 Testing

3.8.2.1 Aggregates

Test each sample of base course material without delay. Make gradation tests from each sample in accordance with ASTM C 136. Make sieve analysis on material passing the No. 200 sieve in accordance with ASTM C 117.

3.8.2.2 Smoothness Tests

Test with a 10 foot straightedge, applied parallel with and at right angles to the center line of the paved area. Correct deviations in the surface in excess of 1/2 inch by loosening, adding or removing material, reshaping, watering, and compacting. The smoothness requirements specified herein apply only to the top layer when base course is constructed in more than one layer.

3.8.2.3 Field Density Tests

ASTM D 1556 or ASTM D 2922. Take one test for each 100 square yards of each layer of base course.

3.8.2.4 Laboratory Density Tests

In accordance with ASTM D 1557, Method D.

3.8.2.5 Thickness Tests

Measure thickness of base course at intervals such that there will be a depth measurement for at least each 100 square yards of complete base course. Make depth measurements by test holes, at least 3 inches in diameter, through the base course. Where base course deficiency is more than 1/2 inch, correct by scarifying, adding mixture of proper gradation, reblading, and recompacting. Where the measured thickness is more than 1/2 inch thicker than indicated, consider it as the indicated thickness plus 1/2 inch for determining the average. The average thickness is the average of the depth measurements and shall not underrun the thickness indicated.

3.9 MAINTENANCE

After construction is completed, maintain the base course throughout, except where portion of the succeeding course is under construction thereon. Maintenance includes drainage, rolling, shaping, and watering, as necessary, to maintain the course in proper condition. Correct deficiencies in thickness, composition, construction, smoothness, and density, which develop during the maintenance, to conform to the requirements specified herein. Maintain sufficient moisture by light sprinkling with water at the surface to prevent a dusty condition.

-- End of Section --

Vulcan Materials Company

# Basic Quality Statistical Summary Report

Plant 141-Long Beach Yard
Product 476-B-Base
Specification ALDOT 825 B

| Sieve/Test | Tests | Average | Target | Specification |
|---|---|---|---|---|
| 1 1/2" (37.5mm) | 5 | 100.0 | | 90-100 |
| 1" (25mm) | 5 | 94.4 | | 75-98 |
| 3/4" (19mm) | 5 | 85.9 | | |
| 1/2" (12.5mm) | 5 | 74.7 | | 60-85 |
| 3/8" (9.5mm) | 5 | 67.9 | | |
| #4 (4.75mm) | 5 | 53.8 | | 40-70 |
| #8 (2.36mm) | 5 | 39.9 | | 28-54 |
| #10 (2mm) | 5 | 36.6 | | |
| #16 (1.18mm) | 5 | 27.5 | | 19-42 |
| #30 (0.6mm) | 5 | 20.1 | | |
| #40 (0.425mm) | 5 | 17.6 | | |
| #50 (0.3mm) | 5 | 15.6 | | 9-32 |
| #100 (0.15mm) | 5 | 12.3 | | |
| #200 (75um) | 5 | 10.04 | | 4-18 |
| PAN (0um) | 5 | 0.00 | | |

DAMMON ENGINEERING INC
Project: Stennis ROF
Date: 5.12.09
Reviewed: X
Reviewed as Noted:
Revise and Resubmit:
Rejected:
Other:

Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. This contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his or her work with that of all other trades and performing all in a safe and satisfactory manner.

Submittal Item: Base Course
Comments

QC Vulcan Materials Company

## BROADMOOR, L.L.C.

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

Robert Wilson 5.12.09
DQC Manager Date



Jeffrey McCollins 5-12-09
QC Officer Date

SECTION 32 11 26.16

BITUMINOUS CONCRETE BASE COURSE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO T 102 | (1983; R 2004) Spot Test of Asphaltic Materials |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C 131 | (2006)Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| ASTM C 136 | (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM C 183 | (2002) Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement |
| ASTM D 1073 | (2007) Fine Aggregate for Bituminous Paving Mixtures |
| ASTM D 1188 | (2007) Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens |
| ASTM D 1559 | (1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus |
| ASTM D 2172 | (2005) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures |
| ASTM D 242 | (2004) Mineral Filler for Bituminous Paving Mixtures |
| ASTM D 2726 | (2008) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures |
| ASTM D 3381 | (2005) Viscosity-Graded Asphalt Cement for Use in Pavement Construction |
| ASTM D 3625 | (1996; R 2005) Standard Practice for Effect of Water on Bituminous-Coated Aggregate Using Boiling Water |

| | |
|---|---|
| ASTM D 546 | (2005) Sieve Analysis of Mineral Filler for Bituminous Paving Mixtures |
| ASTM D 692 | (2000; R 2004) Coarse Aggregate for Bituminous Paving Mixtures |
| ASTM D 75 | (2003) Standard Practice for Sampling Aggregates |
| ASTM D 946 | (1982; R 2005) Penetration-Graded Asphalt Cement for Use in Pavement Construction |
| ASTM D 979 | (2001; R 2006e1) Sampling Bituminous Paving Mixtures |
| ASTM D 995 | (1995b; R 2002) Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-05 Design Data

Bituminous material job-mix formula

Submit a job-mix formula prior to preparing and placing bituminous mixture. Formula shall indicate definite percentage of each sieve fraction, percentage of bitumen, percentage of each aggregate, temperature of mixture leaving mixer, number of blows of compaction per side of molded specimen, stability, flow, percent of voids total mix, percent of voids in mineral aggregate, and temperature/viscosity relationship of asphalt cement.

SD-06 Test Reports

Abrasion test reports on aggregate

Stripping test reports on aggregate

Bituminous mix test reports

Density test reports

Thickness test reports

Smoothness test reports

1.3 QUALITY ASSURANCE

1.3.1 Safety Requirements

Provide adequate and safe stairways with handrails to mixer platform and safe and protected ladders or other means for accessibility to plant

operations. Guard equipment and exposed steam or other high temperature lines which endanger personnel or create a fire hazard or cover with a suitable type of insulation. Provide hearing protection to Contractor employees and roller and spreader operators in vicinity of equipment which may emit hazardous noise levels.

## 1.4 DELIVERY AND STORAGE

Inspect materials delivered to the site for damage and store to prevent segregation.

## 1.5 ENVIRONMENTAL CONDITIONS

Construct bituminous courses when underlaying course is dry and do not construct when atmospheric temperature is below 40 degrees F.

## 1.6 CONSTRUCTION EQUIPMENT

Calibrated equipment, such as asphalt distributors, scales, batching equipment, spreaders and similar equipment, shall have been recalibrated by an approved calibration laboratory within 6 months of commencing work.

### 1.6.1 Mixing Plant

Design, coordinate, and operate mixing plant to produce a mixture within job-mix formula tolerances. The mixing plant shall meet requirements of ASTM D 995, except as specified otherwise herein. The plant shall be a batch type, continuous mixing type, or drum dryer-mixer type with a minimum capacity of 100 tons per hour. Mixing plant and equipment shall remain accessible at all times for checking its adequacy, inspecting its operation, verifying weights, proportions, character of materials, and checking mixture temperatures. The plant and plant size shall meet the requirements of Section 01 57 19.00 20 TEMPORARY ENVIRONMENTAL CONTROLS.

#### 1.6.1.1 Plant Screens for Batch and Continuous Mix Plants

Use screens to obtain accurate gradation. Allow no bin to contain more than 10 percent oversize or undersize. Inspect screens each day prior to commencing work for plugged, worn or broken screens. Clean plugged screens and replace worn or broken screens with new screens prior to beginning operations.

#### 1.6.1.2 Bins

Divide bins into at least three compartments arranged to insure separate and adequate storage of appropriate fractions of aggregate.

#### 1.6.1.3 Dust Control

Equip plant with a dust collector designed to waste or return in a constant flow all or part of the material collected. Recover quantity as necessary to provide and maintain composition specified. Plant shall have a mixer cover and such additional housing to insure proper control of dust.

### 1.6.2 Paving Equipment

#### 1.6.2.1 Spreading Equipment

Self-propelled electronically controlled type, unless other equipment is

authorized by the Contracting Officer. Equip spreading equipment of the self-propelled electronically controlled type with hoppers, tamping or vibrating devices, distributing screws, electronically adjustable screeds, and equalizing devices. Capable of spreading hot bituminous mixtures without tearing, shoving, or gouging and to produce a finished surface of specified grade and smoothness. Operate spreaders, when laying mixture, at variable speeds between 5 and 45 feet per minute. Design spreader with a quick and efficient steering device; a forward and reverse traveling speed; and automatic devices to adjust to grade and confine the edges of the mixture to true lines. The use of a spreader that leaves indented areas or other objectionable irregularities in the fresh laid mix during operations will not be permitted.

1.6.2.2 Rolling Equipment

Self-propelled pneumatic-tired rollers supplemented by three-wheel and tandem type steel wheel rollers. The number, type and weight of rollers shall be sufficient to compact the mixture to the required density without detrimentally affecting the compacted material. All rollers shall be suitable for rolling hot-mix bituminous pavements and capable of reversing without backlash. Pneumatic-tired rollers shall be capable of being operated both forward and backward without turning on the mat, and without loosening the surface being rolled. Equip rollers with suitable devices and apparatus to keep the rolling surfaces wet and prevent adherence of bituminous mixture.

a. Vibratory Rollers: At the Contractor's option, vibratory rollers especially designed for bituminous concrete compaction may be used provided rollers do not impair stability of pavement structure and any underlying layers. Repair depressions in pavement surfaces resulting from use of vibratory rollers at no cost to the Government. Rollers shall be self-propelled, single or dual vibrating drums, and steel drive wheels, as applicable; equipped with variable amplitude and separate controls for energy and propulsion.

1.6.2.3 Hand Tampers

Hand tampers shall weigh not less than 25 pounds and have a tamping face of not more than 50 square inches.

1.6.2.4 Mechanical Hand Tampers

Commercial type, operated by pneumatic pressure or by internal combustion.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aggregates

Grade and proportion aggregates and filler such that combined mineral aggregate conforms to grading specified herein.

2.1.1.1 Coarse Aggregates

ASTM D 692, except as modified herein. Crushed gravel shall have at least 75 percent by weight of pieces having two or more fractured faces. Percentage of wear (Los Angeles abrasion test), except for slag, shall not

exceed 50 at 500 revolutions in accordance with ASTM C 131. Weight of slag shall be not less than 65 pounds per cubic foot. Reject aggregates which show stripping when tested in accordance with ASTM D 3625. However, "anti-stripping" agent(s) may be used subject to certified laboratory performance test(s) on the aggregate to be used and approval of the Contracting Officer.

2.1.1.2 Fine Aggregate

ASTM D 1073, except gradation as specified herein.

2.1.1.3 Mineral Filler

Provide not less than two-thirds non-plastic material passing 200 mesh sieve to meet requirements of ASTM D 242when tested in accordance with ASTM D 546. Material passing a 200 mesh sieve may be limestone dust or other suitable non-plastic material and supplement as required by adding limestone dust, portland cement, or non-plastic material as required to obtain composition specified.

2.1.2 Asphalt Cement

ASTM D 946, penetration grade 85-100 or ASTM D 3381, viscosity grade AC-20. Asphalt shall show a negative spot when tested in accordance with AASHTO T 102. Furnish Contracting Officer temperature-viscosity relationship of the asphalt cement.

2.1.3 Composition of Mixtures

Gradation in accordance with typical gradations listed herein for selected maximum aggregate size when tested in accordance with ASTM C 136. Gradation shall be within job mix formula tolerance limitations specified herein. Grade combined aggregate and filler smoothly from coarse to fine with no variance from low limit on one sieve to high limit on adjacent sieve. Table I is based on aggregates of uniform specific gravity; percentages passing various sieves are subject to appropriate correction when aggregates of varying specific gravities are used. Determine stability and flow by ASTM D 1559 using 75 blows per side of molded specimen, meeting the following requirements:

a. Stability (minimum), 1500 pounds.

b. Flow 0.01 inch, Not more than 20 nor less than 8.

TABLE I

GRADATION OF AGGREGATES

TOTAL PERCENT PASSING (BY WEIGHT)

| SIEVE SIZE |
|---|
| 1 1/2 inch |
| 1 inch |
| 3/4 inch |
| 1/2 inch |
| 3/8 inch |
| No. 4 |
| No. 8 |

TABLE I

GRADATION OF AGGREGATES

TOTAL PERCENT PASSING (BY WEIGHT)

| SIEVE SIZE |
|---|
| No. 16 |
| No. 30 |
| No. 50 |
| No. 100 |
| No. 200 |

c. Bituminous content: Base percentage on approved job-mix formula.

2.1.4 Variations

Variations from approved job-mix formula shall not exceed the following; however, in no case shall job-mix formula, with tolerances applied, fall outside the general limits for aggregate gradation and bituminous material specified herein:

| Aggregate | Tolerance (plus or minus) |
|---|---|
| 1/2 inch or larger | 8 percent |
| 3/8 inch and No. 4 | 7 percent |
| No. 8 and 16 | 6 percent |
| No. 30 and 50 | 5 percent |
| No. 100 | 4 percent |
| No. 200 | 3 percent |

PART 3 EXECUTION

3.1 MIXING

Produce bituminous mixture in a plant as specified herein. Stockpile fine and coarse aggregates separately and feed to drier by separate mechanical feeders in a manner to produce an asphaltic concrete mixture within tolerances specified for job-mix formula. Heat and dry aggregates thoroughly. Make temperature of aggregate, mineral filler, and asphalt in mixer such that viscosity of asphalt in mixture shall be in the range of 150 to 300 centistokes kinematic or 75-150 seconds, Saybolt-Furol. Provide adequate dry storage for mineral filler at mixing plant. After aggregates have been prepared, accurately weigh or measure and convey them into mixer in proportionate amounts of each aggregate size required. Weigh or feed mineral filler by some accurate and uniform measurement, and add separately, and in a dry condition, as near as possible to center of mixer. Introduce required amount of asphalt for each batch, or calibrated amount for continuous mixing, into mixer. In batch mixing, charge aggregates into mixer, add asphalt, and continue mixing for at least 25 seconds or longer to obtain a homogeneous mixture. When a continuous mixer is used, mixing time shall be not less than 30 seconds to obtain a homogeneous mixture. Temperature of asphalt at time of mixing shall not exceed 350 degrees F. When prepared in a twin pugmill mixer, depth of mixture shall be not greater than the tips of mixer blades when blades are in a vertical position. Reject overheated and carbonized mixtures, and mixtures that foam, segregate, or strip. When excessive moisture causes foaming, segregation, or stripping, remove all aggregates in hot bins and

place in their respective stockpiles; for drum-drier plant mixes, waste the mix, except as otherwise approved by the Contracting Officer.

## 3.2 TRANSPORTATION OF BITUMINOUS MIXTURES

Transport bituminous mixture from paving plant to the site in trucks having tight, clean, smooth beds which have been painted or sprayed with a limewater, soap, or detergent solution at least once a day to prevent adhesion of the mixture to truck bodies. Cover each load with canvas or other suitable material of ample size to protect it from the weather and to prevent loss of heat. Make deliveries so that spreading and rolling of all mixture prepared for a day's run can be completed during daylight, unless satisfactory artificial light is provided. Deliver mixture to the area to be paved in such a manner that temperature at the time of dumping the spreader shall be not less than 225 degrees F or that required to obtain the specified compaction. Reject any load that has become wet prior to placing.

## 3.3 PLACING

Provide line and grade stakes as necessary for control. Place grade stakes in lanes parallel to centerline of area to be paved, and suitably space for string lines. Place and compact bituminous courses in such thicknesses to achieve density and smoothness requirements. Maximum lift of bituminous base course shall not exceed 6 inches. Prior to laying the base course, clean underlying course of foreign and objectionable matter with power blowers, power brooms, or hand brooms in places inaccessible to power equipment, and inspect for compaction and smoothness requirements. The range of temperatures of the mixtures at the time of spreading shall be between 225 degrees F and 300 degrees F. Reject bituminous mixture having a temperature outside these limits when dumped into the hopper of the spreader. Adjust mechanical spreader and regulate speed so that the surface of the course is smooth, and when compacted conforms to depth, cross sections, grades, and contours indicated. When irregularities of surface or deficiency in depth is more than specified tolerances, remove defective work and replace with new material. Whenever possible, place the mixture in strips not less than 10 feet wide. Overlap rolling to previously placed strip and extend to overlap first strip. Place mixture as continuously as possible. Shovelers and rakers shall follow spreading equipment, adding hot mixture and raking as required to produce a course that, when completed, shall conform to requirements specified. In areas where the use of machine spreading is impractical, mixture may be spread by hand. Distribute mixture into place from dump boards by means of hot shovels and spread with hot rakes in a uniformly loose layer of such thickness that, when completed, it conforms to required grade and thickness. Do not dump loads any faster than they can be handled by shovelers and rakers. Paint contact surfaces of previously constructed curbs, manholes, and similar structures with a thin coat of emulsion or other approved bituminous material prior to placing the bituminous mixture.

## 3.4 JOINTS

All joints shall present the same texture, density, and smoothness as other portions of the course. Carefully make joints between old and new pavements or within new pavements in a manner as to ensure a thorough and continuous bond between old and new sections of the course. Paint all vertical contact surfaces of previously constructed sections with a thin uniform coat of emulsion or other approved bituminous material just before the fresh mixture is placed.

3.4.1 Transverse

The roller shall pass over the unprotected end of the freshly laid mixture only when the laying of the course is to be discontinued. Except when an approved bulkhead is used, cut back the edge of the previously laid course to expose an even, vertical surface for the full thickness of the course. When required, rake fresh mixture against the joints, thoroughly tamp with hot tampers, smooth with hot smoothers, and roll. In all cases, transverse joints in adjacent lanes shall be offset a minimum of 2 feet.

3.4.2 Longitudinal

Place longitudinal joints so that they shall not coincide with that of underlying course and shall be separated by at least one foot. When edges of longitudinal joints are irregular, honeycombed, or poorly compacted, cut back unsatisfactory sections of joint to expose an even, vertical surface for the full thickness of the course. Prior to placing adjacent asphalt concrete, roll joint first, then proceed to opposite side and roll, moving each time toward the joint.

3.5 COMPACTION OF MIXTURE

Affect compaction by rolling. Begin rolling as soon after placing as the mixture will bear the roller without undue displacement. Delays in rolling freshly spread mixture will not be tolerated. Start rolling longitudinally at extreme sides of lanes and proceed toward center of pavement, overlapping on successive strips by at least one-half the width of rear wheel of roller. Alternate trips of roller shall be slightly different lengths. Affect initial longitudinal rolling by the use of steel roller. Make tests for conformity with specified crown, grade, and smoothness immediately after initial compression. Before continuing rolling, correct any variations by removing or adding materials, then roll course using pneumatic-tired rollers or tandem rollers, while mixture is hot and in condition suitable for proper compaction. Speed of rollers shall not exceed 3 miles per hour and at all times be slow enough to avoid displacement of hot mixture. Correct any displacement of mixture at once by use of rakes and apply fresh mixture or remove mixture as required. Continue rolling until all roller marks are eliminated and course has a density of at least 97 percent of that attained in a laboratory specimen of the same mixture prepared in accordance with ASTM D 1559. During rolling, moisten rollers to prevent adhesion of mixture to rolling surfaces, but do not permit an excess of water. Provide sufficient rollers for each spreading machine in operation on the job and to handle plant output. In places not accessible to rollers, compact mixture with hot pneumatic or manual hand tampers. Skin patching of an area that has been rolled is not permitted. Remove any mixture that becomes mixed with foreign material or is defective, replace with fresh mixture, and compact to density of surrounding area. Roller shall pass over unprotected edge of course only when laying of course is to be discontinued for a length of time to permit mixture to become cold. Contractor shall provide workmen who are capable of performing work incidental to correction of pavement irregularities. After final rolling, permit no traffic of any kind on the pavement until the surface temperature has cooled to at least 120 degrees F. Measure surface temperature with surface thermometers or other satisfactory methods.

3.6 FIELD SAMPLING AND TESTING

Approve materials and material sources not less than 14 days prior to use

of such materials in work.

3.6.1 Sampling

3.6.1.1 Aggregates at Source

Prior to production and delivery of aggregates, take at least one initial sample in accordance with ASTM D 75 at the source or from each stockpile. Collect each sample by taking three incremental samples at random from source material to make a composite sample of not less than 50 pounds. Make repetition of the above sampling when source of material is changed or when unacceptable deficiencies or variations from specified grading of materials are found in testing.

3.6.1.2 Cold Feed Aggregate Sampling

Take two samples daily from belt conveying materials from cold feed. Collect materials in three increments at random to make a representative composite sample of not less than 50 pounds. Take samples in accordance with ASTM D 75.

3.6.1.3 Coarse and Fine Aggregates

Take 50 pounds sample from cold feed at least once daily for sieve analyses and specific gravity tests. Additional samples may be required to perform more frequent tests on mineral fillers, or will be required when analyses show deficiencies, or unacceptable variances or deviations. Method of sampling is as described herein for aggregates.

3.6.1.4 Mineral Filler

ASTM C 183. Take samples large enough to provide ample material for testing.

3.6.1.5 Pavement and Mixture

Take samples for the determination of mix properties, thickness and density of the completed pavements. Furnish all tools, labor and material for samples and for satisfactory replacement of pavement. Take samples and test at not less than frequency specified hereinafter and at the beginning of plant operations; for each day's work as a minimum; each change in the mix or equipment; and as often as directed. Accomplish sampling in accordance with ASTM D 979.

3.6.1.6 Sample Identification

Furnish each sample in a clean container, securely fastened to prevent loss of material. Tag each sample for identification. Tag shall contain the following information:

Contract No._____
Sample No. _____Quantity_____
Date of Sample_____
Sample _____
Source _____
Intended use_____
For testing_____

3.6.2 Testing

3.6.2.1 Aggregate

a. Gradation: ASTM C 136 for fine and coarse aggregate. ASTM D 546 for mineral filler.

b. Abrasion: ASTM C 131 for wear (Los Angeles test). Perform one test initially prior to incorporation into work and whenever source is changed.

c. Stripping Test: ASTM D 3625. Perform a stripping test initially on all aggregate prior to incorporation into work and whenever source is changed.

3.6.2.2 Bituminous Mix

ASTM D 2172. Test one sample for each 500 tons, or fraction thereof, of the uncompacted mix for extraction. Sieve analysis per ASTM C 136. Test one sample for each 500 tons, or fraction thereof, for stability and flow in accordance with ASTM D 1559.

3.6.2.3 Pavement Course

a. Density: For each 100 tons of bituminous course placed, determine the representative laboratory density by averaging the density of 4 laboratory specimens prepared in accordance with ASTM D 1559; samples for these specimens shall be taken from trucks delivering mixture to the site; the Contractor shall record in an approved manner the project areas represented by the laboratory densities. From each representative area so recorded, determine field density of the pavement by averaging the densities of 4 inchdiameter cores obtained from the base course; take one core for each 1000 square yards or fraction thereof of course placed. Determine density of the laboratory prepared specimens and the cored samples in accordance with ASTM D 1188 or ASTM D 2726, as applicable. The maximum allowable deficiency at any point shall not be more than 2 percent less than the specified density. The average density shall be not less than the specified density. When the deficiency is more than the specified tolerances, the Contractor shall correct each such representative area or areas by removing the pavement in question and replacing with new pavement.

b. Thickness: Determine thickness of the course from samples taken for the field density test. The maximum allowable deficiency at any point shall not be more than 1/4 inch less than the indicated thickness for the course. The average thickness of the course shall be not less than the indicated thickness. Where the deficiency is more than the specified tolerances, the contractor shall correct each such representative area or areas by removing the pavement in question and replacing with new pavement.

c. Smoothness: Straightedge test the compacted surface of the course as the work progresses. Apply straightedge parallel with and at right angles to the centerline after final rolling. Unevenness of the course shall not vary more than plus or minus 1/4 inch in 10 feet. Correct any portion of the pavement showing irregularities greater than that specified.

-- End of Section --

SECTION 32 12 10

BITUMINOUS TACK AND PRIME COATS
**08/08**

PART 1 GENERAL

1.1 UNIT PRICES

1.1.1 Measurement

The bituminous material paid for will be the measured quantities used in the accepted work, provided that the measured quantities are not 10 percent over the specified application rate. Any amount of bituminous material more than 10 percent over the specified application rate for each application will be deducted from the measured quantities, except for irregular areas where hand spraying of the bituminous material is necessary. Express measured quantities in 2000 pound tons or gallons at 60 degrees F. Volumes measured at temperatures other than 60 degrees F shall be corrected in accordance with ASTM D 1250.

1.1.2 Payment

The quantities of bituminous material, determined as specified above, will be paid for at the respective contract unit prices. Payment shall constitute full compensation for all operations necessary to complete the work as specified herein.

1.1.3 Waybills and Delivery Tickets

Before the final statement is allowed, file with the Contracting Officer certified waybills and certified delivery tickets for all bituminous materials used in the construction of the pavement covered by the contract. These submittals are required for Unit Pricing bid only. Do not remove bituminous material from storage until the initial outage and temperature measurements have been taken. The delivery or storage units will not be released until the final outage has been taken.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO M 81 | (1992; R 2004) Cut-Back Asphalt (Rapid-Curing Type) |
| AASHTO T 102 | (1983; R 2004) Spot Test of Asphaltic Materials |
| AASHTO T 40 | (2002; R 2006) Sampling Bituminous Materials |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D 1250 | (2007) Standard Guide for Use of the Petroleum Measurement Tables |
| ASTM D 140 | (2001; R 2007) Sampling Bituminous Materials |
| ASTM D 2026 | (1997; R 2004) Cutback Asphalt (Slow-Curing Type) |
| ASTM D 2028 | (1997; R 2004) Cutback Asphalt (Rapid-Curing Type) |
| ASTM D 2995 | (1999; R 2004) Determining Application Rate of Bituminous Distributors |
| ASTM D 977 | (2005) Emulsified Asphalt |

U.S. GREEN BUILDING COUNCIL (USGBC)

| | |
|---|---|
| LEED | (2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC) |

## 1.3 SYSTEM DESCRIPTION

### 1.3.1 General Requirements

Plant, equipment, machines and tools used in the work are subject to approval and shall be maintained in a satisfactory working condition at all times. Calibrated equipment such as asphalt distributors, scales, batching equipment, spreaders and similar equipment, should have been recalibrated by a calibration laboratory within 12 months prior to commencing work by such laboratory from the date of recalibration, during the term of the contract.

### 1.3.2 Bituminous Distributor

Provide a distributor with pneumatic tires of such size and number that the load produced on the base surface does not exceed 650 psi of tire width to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. Design and equip the distributor to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, with a pressure range of 25 to 75 psi and with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Include with the distributor equipment a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. Equip the distributor to circulate and agitate the bituminous material during the heating process.

1.3.3 Heating Equipment for Storage Tanks

The equipment for heating the bituminous material shall be steam, electric, or hot oil heaters. Provide steam heaters consisting of steam coils and equipment for producing steam, so designed that the steam cannot get into the material. Fix an armored thermometer to the tank with a temperature range from 40 to 400 degrees F so that the temperature of the bituminous material may be determined at all times.

1.3.4 Power Brooms and Power Blowers

Use power brooms and power blowers suitable for cleaning the surfaces to which the bituminous coat is to be applied.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Waybills and Delivery Tickets

Waybills and delivery tickets, during progress of the work.

[ Local/Regional Materials

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project in accordance with LEED.]

SD-06 Test Reports

Sampling and Testing

Copies of all test results for emulsified asphalt, and bituminous materials, within 24 hours of completion of tests. Certified copies of the manufacturer's test reports indicating temperature viscosity relationship for cutback asphalt, compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

1.5 QUALITY ASSURANCE

Use Local/Regional Materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. Tack and prime coat materials may be locally available.]

1.6 DELIVERY, STORAGE, AND HANDLING

Inspect the materials delivered to the site for contamination and damage. Unload and store the materials with a minimum of handling.

## 1.7 ENVIRONMENTAL REQUIREMENTS

Apply bituminous coat only when the surface to receive the bituminous coat is dry. Apply bituminous coat only when the atmospheric temperature in the shade is 50 degrees F or above and when the temperature has not been below 35 degrees F for the 12 hours prior to application, unless otherwise directed.

# PART 2 PRODUCTS

## 2.1 PRIME COAT

Provide asphalt conforming to AASHTO M 81 and specified in the following two subparagraphs.

### 2.1.1 Cutback Asphalt

Provide cutback asphalt conforming to ASTM D 2026, Grade SC-70.

### 2.1.2 Emulsified Asphalt

Provide emulsified asphalt conforming to ASTM D 977, Type SS-1.

## 2.2 TACK COAT

Provide asphalt conforming to ASTM D 2028 or AASHTO M 81.

### 2.2.1 Cutback Asphalt

Provide cutback asphalt conforming to ASTM D 2026, Grade SC-70.

### 2.2.2 Emulsified Asphalt

Provide emulsified asphalt conforming to ASTM D 977, Type SS-1. Dilute the emulsified asphalt with equal parts of water. The base asphalt used to manufacture the emulsion shall show a negative spot when tested in accordance with AASHTO T 102 using standard naphtha.

# PART 3 EXECUTION

## 3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, remove all loose material, dirt, clay, or other objectionable material from the surface to be treated by means of a power broom or blower supplemented with hand brooms. The surface shall be dry and clean at the time of treatment.

## 3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

### 3.2.1 Tack Coat

Apply bituminous material for the tack coat in quantities of not less than 0.05 gallon nor more than 0.15 gallon per square yard of pavement surface.

3.2.2 Prime Coat

Apply bituminous material for the prime coat in quantities of not less than 0.15 gallon nor more than 0.40 gallon per square yard of pavement surface.

3.3 APPLICATION TEMPERATURE

3.3.1 Viscosity Relationship

Asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 centistokes, kinematic. Furnish the temperature viscosity relation to the Contracting Officer.

3.3.2 Temperature Ranges

The viscosity requirements determine the application temperature to be used. The following is a normal range of application temperatures:

Liquid Asphalts

| | |
|---|---|
| [SC-70 | 120-225 degrees F] |
| [SC-250 | 165-270 degrees F] |
| [MC-30 | 85-190 degrees F] |
| [MC-70 | 120-225 degrees F] |
| [MC-250 | 165-270 degrees F] |
| [RC-70 | 120-200 degrees F*] |
| [RC-250 | 165-250 degrees F*] |

Paving Grade Asphalts

Penetration Grades

| | |
|---|---|
| [200-300 | plus 265 degrees F] |
| [120-150 | plus 270 degrees F] |
| [85-100 | plus 280 degrees F] |

Viscosity Grades

| | |
|---|---|
| [AC 2.5 | plus 270 degrees F] |
| [AC 5 | plus 280 degrees F] |
| [AC 10 | plus 280 degrees F] |
| [AR 1000 | plus 275 degrees F] |
| [AR 2000 | plus 285 degrees F] |
| [AR 4000 | plus 290 degrees F] |

Emulsions

| | |
|---|---|
| [RS-1 | 70-140 degrees F] |
| [MS-1 | 70-160 degrees F] |
| [HFMS-1 | 70-160 degrees F] |
| [SS-1 | 70-160 degrees F] |
| [SS-1h | 70-160 degrees F] |
| [CRS-1 | 125-185 degrees F] |

| | |
|---|---|
| [CSS-1 | 70-160 degrees F] |
| [CSS-1h | 70-160 degrees F] |

These temperature ranges exceed the flash point of the material and care should be taken in their heating.

## 3.4 APPLICATION

### 3.4.1 General

Following preparation and subsequent inspection of the surface, apply the bituminous prime or tack coat with the Bituminous Distributor at the specified rate with uniform distribution over the surface to be treated. Properly treat all areas and spots missed by the distributor with the hand spray. Until the succeeding layer of pavement is placed, maintain the surface by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, spread clean dry sand to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment are permitted within 25 feet of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions. Prevent all traffic, except for paving equipment used in constructing the surfacing, from using the underlying material, whether primed or not, until the surfacing is completed. The bituminous coat shall conform to all requirements as described herein.

### 3.4.2 Prime Coat

Apply a prime coat at locations shown on the Drawings. The prime coat is required if it will be at least 7 days before the surfacing (Asphalt cement hot mix concrete) layer is constructed on the underlying (base course, etc.) compacted material. The type of liquid asphalt and application rate will be as specified herein. Protect the underlying from any damage (water, traffic, etc.) until the surfacing is placed. If the Contractor places the surfacing within seven days, the choice of protection measures or actions to be taken is at the Contractor's option. Repair (recompact or replace) damage to the underlying material caused by lack of, or inadequate, protection by approved methods at no additional cost to the Government. If the Contractor opts to use the prime coat, apply as soon as possible after consolidation of the underlying material.] Apply the bituminous material uniformly over the surface to be treated at a pressure range of 25 to 75 psi and at the rate of not less than 0.20 gallon not more than 0.30 gallon per square yard. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, spread building paper on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper and to ensure that all sprayers will operate at full force on the surface to be treated. Immediately after application remove and destroy the building paper.

### 3.4.3 Tack Coat

Apply tack coat at the locations shown on the drawings. Apply the tack coat when the surface to be treated is dry. Immediately following the preparation of the surface for treatment, apply the bituminous material by means of the bituminous distributor, within the limits of temperature specified herein and at a rate of not less than 0.05 gallon nor more than 0.15 gallon of diluted emulsion per square yard. Apply the bituminous material so that uniform distribution is obtained over the entire surface

to be treated. Treat lightly coated areas and spots missed by the distributor with the bituminous material. Following the application of bituminous material, allow the surface to cure without being disturbed for period of time necessary to permit setting of the tack coat. Apply the bituminous tack coat only as far in advance of the placing of the overlying layer as required for that day's operation. Maintain and protect the treated surface from damage until the succeeding course of pavement is placed.

## 3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of pavement, allow the bituminous coat to cure and to obtain evaporation of any volatiles or moisture. Maintain the coated surface until the succeeding layer of pavement is placed, by protecting the surface against damage and by repairing and recoating deficient areas. Allow the prime coat to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course.

## 3.6 FIELD QUALITY CONTROL

Samples of the bituminous material shall be tested for compliance with the applicable specified requirements. A sample shall be obtained and tested by the Contractor as directed, under the supervision of the Contracting Officer. The sample may be retained and tested by the Government at no cost to the Contractor.

## 3.7 SAMPLING AND TESTING

Perform sampling and testing by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved.

### 3.7.1 Sampling

The samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140 or AASHTO T 40. Sources from which bituminous materials are to be obtained shall be selected and notification furnished the Contracting Officer within 15 days after the award of the contract.

### 3.7.2 Calibration Test

Furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibrate the bituminous distributor in accordance with ASTM D 2995.

### 3.7.3 Trial Applications

Before providing the complete bituminous coat, apply three lengths of at least 100 feet for the full width of the distributor bar to evaluate the amount of bituminous material that can be satisfactorily applied.

#### 3.7.3.1 Tack Coat Trial Application Rate

Unless otherwise authorized, apply the trial application rate of bituminous tack coat materials in the amount of 0.05 gallons per square yard. Other

trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.3.2 Prime Coat Trial Application Rate

Unless otherwise authorized, apply the trial application rate of bituminous materials in the amount of 0.25 gallon per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.4 Sampling and Testing During Construction

Perform quality control sampling and testing as required in paragraph FIELD QUALITY CONTROL.

3.8 TRAFFIC CONTROLS

Keep traffic off surfaces freshly treated with bituminous material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces.

-- End of Section --

SECTION 32 12 17

HOT MIX BITUMINOUS PAVEMENT
**04/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO MP 1a | (2004) Performance Graded Asphalt Binder |

ASPHALT INSTITUTE (AI)

| | |
|---|---|
| AI MS-02 | (6th Edition; 1997) Mix Design Methods for Asphalt |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C 117 | (2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing |
| ASTM C 127 | (2007) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate |
| ASTM C 128 | (2007a) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate |
| ASTM C 131 | (2006)Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| ASTM C 136 | (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM C 188 | (1995; R 2003) Standard Test Method for Density of Hydraulic Cement |
| ASTM C 29/C 29M | (2007) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate |
| ASTM C 88 | (2005) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate |
| ASTM D 1073 | (2007) Fine Aggregate for Bituminous Paving Mixtures |

| | |
|---|---|
| ASTM D 1188 | (2007) Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens |
| ASTM D 140 | (2001; R 2007) Sampling Bituminous Materials |
| ASTM D 1559 | (1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus |
| ASTM D 2041 | (2003a) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures |
| ASTM D 2172 | (2005) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures |
| ASTM D 242 | (2004) Mineral Filler for Bituminous Paving Mixtures |
| ASTM D 2726 | (2008) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures |
| ASTM D 3381 | (2005) Viscosity-Graded Asphalt Cement for Use in Pavement Construction |
| ASTM D 4867/D 4867M | (2004) Effect of Moisture on Asphalt Concrete Paving Mixtures |
| ASTM D 546 | (2005) Sieve Analysis of Mineral Filler for Bituminous Paving Mixtures |
| ASTM D 692 | (2000; R 2004) Coarse Aggregate for Bituminous Paving Mixtures |
| ASTM D 70 | (2008) Specific Gravity and Density of Semi-Solid Bituminous Materials (Pycnometer Method) |
| ASTM D 75 | (2003) Standard Practice for Sampling Aggregates |
| ASTM D 854 | (2006e1) Specific Gravity of Soil Solids by Water Pycnometer |
| ASTM D 946 | (1982; R 2005) Penetration-Graded Asphalt Cement for Use in Pavement Construction |
| ASTM D 979 | (2001; R 2006e1) Sampling Bituminous Paving Mixtures |
| ASTM D 995 | (1995b; R 2002) Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-05 Design Data

Job-mix formula

Submit a job-mix formula, prepared specifically for this project, for approval prior to preparing and placing the bituminous mixture. Design mix using procedures contained in Chapter V, Marshall Method of Mix Design, of AI MS-02. Formulas shall indicate physical properties of the mixes as shown by tests made by a commercial laboratory approved by the Contracting Officer, using materials identical to those to be provided on this project. Submit formulas with material samples. Job-mix formula for each mixture shall be in effect until modified in writing by the Contractor and approved by the Contracting Officer. Provide a new job-mix formula for each source change. Submittal shall include all tests indicated in MIX DESIGN section of this specification.

ASPHALT CEMENT BINDER

MIX DESIGN

SD-06 Test Reports

Specific gravity test of asphalt

Coarse aggregate tests

Weight of slag test

Percent of crushed pieces in gravel

Fine aggregate tests

Specific gravity of mineral filler

Bituminous mixture tests

Aggregates tests

Bituminous mix tests

Pavement courses

Submit in accordance with paragraph entitled "Mock-Up Test Section."

## 1.3 QUALITY ASSURANCE

### 1.3.1 Safety Requirements

Provide adequate and safe stairways with handrails to the mixer platform, and safe and protected ladders or other means for accessibility to plant operations. Guard equipment and exposed steam or other high temperature lines or cover with a suitable type of insulation.

### 1.3.2 Mock-Up Test Section

Prior to full production of the binder and wearing course(s), prepare a quantity of bituminous mixture according to the job-mix formula. Construct a test section 200 feet long by not less than 10 feet wide and of the same compacted depth specified for the construction of the course which the test section represents. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment used in construction of the test section shall be the same type and weight to be used on the remainder of the course represented by the test section. Test not less than two samples of the mixture produced at the plant for gradation, asphalt cement content, stability, flow, air voids, voids in mineral aggregate, and in weight. Obtain not less than three cores from the test strip for density and thickness tests. Check the test section for smoothness and finish surface texture. If the test section should prove to be unsatisfactory, make the necessary adjustments to the mix design, plant operation, transportation, laydown, or rolling procedures. Additional test sections, as required, shall be constructed and evaluated for conformance to the specified requirements. When test sections do not conform to specified requirements, remove and replace the bituminous pavement. A marginal quality test section that has been placed in an area of little or no traffic may be left in place. If a second test section also does not meet specified requirements, remove both sections at the Contractor's expense. Full production shall not begin without the Contracting Officer's approval.

### 1.3.3 Required Data

Job-mix formula shall show the following:

a. Source and proportions, percent by weight, of each ingredient of the mixture;

b. Correct gradation, the percentages passing each size sieve listed in the specifications for the mixture to be used, for the aggregate and mineral filler from each separate source and from each different size to be used in the mixture and for the composite mixture;

c. Amount of material passing the No. 200 sieve determined by dry sieving;

d. Number of blows of hammer compaction per side of molded specimen;

e. Temperature viscosity relationship of the asphalt cement;

f. Stability, flow, percent voids in mineral aggregate, percent air voids, unit weight;

g. Asphalt absorption by the aggregate;

h. Effective asphalt content as percent by weight of total mix;

i. Temperature of the mixture immediately upon completion of mixing;

j. Asphalt performance grade, viscosity grade, penetration range; and

k. Curves for the leveling binder and wearing course(s).

1.3.4 Charts

Plot and submit, on a grain size chart, the specified aggregate gradation band, the job-mix gradation and the job-mix tolerance band.

1.3.5 Selection of Optimum Asphalt Content

Base selection on percent of total mix and the average of values at the following points on the curves for each mix:

a. Stability: Peak

b. Unit Weight: Peak

c. Percent Air Voids: Median

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for damage and store with a minimum of handling. Store aggregates in such a manner as to prevent segregation, contamination, or intermixing of the different aggregate sizes.

1.5 ENVIRONMENTAL CONDITIONS

Place bituminous mixture only during dry weather and on dry surfaces. Place courses only when the surface temperature of the underlying course is greater than 45 degrees F for course thicknesses greater than one inch and 55 degrees F for course thicknesses one inch or less.

1.6 CONSTRUCTION EQUIPMENT

Calibrated equipment, such as scales, batching equipment, spreaders and similar equipment, shall have been recalibrated by a calibration laboratory approved by the Contracting Officer within 12 months of commencing work.

1.6.1 Mixing Plant

Design, coordinate, and operate the mixing plant to produce a mixture within the job-mix formula tolerances and to meet the requirements of ASTM D 995, including additional plant requirements specified herein. The plant shall be a batch type, continuous mix type or drum-dryer mixer type, and shall have sufficient capacity to handle the new bituminous construction. Minimum plant capacity shall be 100 tons per hour. The mixing plant and equipment shall remain accessible at all times for inspecting operation, verifying weights, proportions and character of materials, and checking mixture temperatures. The plant and plant site shall meet the requirements of Section 01 57 19.00 20 TEMPORARY ENVIRONMENTAL CONTROLS.

1.6.1.1 Cold Aggregate Feeder

Provide plant with a feeder or feeders capable of delivering the maximum number of aggregate sizes required in their proper proportion. Provide adjustment for total and proportional feed and feeders capable of being locked in any position. When more than one cold elevator is used, feed each elevator as a separate unit and install individual controls integrated with a master control.

1.6.1.2 Dryer

Provide rotary drum-dryer which continuously agitates the mineral aggregate during the heating and drying process. When one dryer does not dry the aggregate to specified moisture requirements, provide additional dryers.

1.6.1.3 Plant Screens and Bins for Batch and Continuous Mix Plants

Use screen to obtain accurate gradation and allow no bin to contain more than 10 percent oversize or undersize. Inspect screens each day prior to commencing work for plugged, worn, or broken screens. Clean plugged screens and replace worn or broken screens with new screens prior to beginning operations. Divide hot aggregate bins into at least three compartments arranged to ensure separate and adequate storage of appropriate fractions of the aggregate.

1.6.1.4 Testing Laboratory

Provide a testing laboratory for control and acceptance testing functions during periods of mix production, sampling and testing, and whenever materials subject to the provisions of these specifications are being supplied or tested. The laboratory shall provide adequate equipment, space, and utilities as required for the performance of the specified tests.

1.6.1.5 Surge and Storage Bins

Use for temporary storage of hot bituminous mixtures will be permitted under the following conditions:

a. When stored in surge bins for a period of time not to exceed 3 hours.

b. When stored in insulated and heated storage bins for a period of time not to exceed 12 hours. If it is determined by the Contracting Officer that there is an excessive amount of heat loss, segregation and oxidation of the mixture due to temporary storage, discontinue use of surge bins or storage bins.

1.6.1.6 Drum-Dryer Mixer

Do not use drum-dryer mixer if specified requirements of the bituminous mixture or of the completed bituminous pavement course cannot be met. If drum-dryer mixer is prohibited, use either batch or continuous mix plants meeting the specifications and producing a satisfactory mix.

1.6.2 Paving Equipment

1.6.2.1 Spreading Equipment

Self-propelled electronically controlled type, unless other equipment is

authorized by the Contracting Officer. Equip spreading equipment of the self-propelled electronically controlled type with hoppers, tamping or vibrating devices, distributing screws, electronically adjustable screeds, and equalizing devices. Capable of spreading hot bituminous mixtures without tearing, shoving, or gouging and to produce a finished surface of specified grade and smoothness. Operate spreaders, when laying mixture, at variable speeds between 5 and 45 feet per minute. Design spreader with a quick and efficient steering device; a forward and reverse traveling speed; and automatic devices to adjust to grade and confine the edges of the mixture to true lines. The use of a spreader that leaves indented areas or other objectionable irregularities in the fresh laid mix during operations is prohibited.

1.6.2.2 Rolling Equipment

Self-propelled pneumatic-tired rollers supplemented by three-wheel and tandem type steel wheel rollers. The number, type and weight of rollers shall be sufficient to compact the mixture to the required density without detrimentally affecting the compacted material. Rollers shall be suitable for rolling hot-mix bituminous pavements and capable of reversing without backlash. Pneumatic-tired rollers shall be capable of being operated both forward and backward without turning on the mat, and without loosening the surface being rolled. Equip rollers with suitable devices and apparatus to keep the rolling surfaces wet and prevent adherence of bituminous mixture. Vibratory rollers especially designed for bituminous concrete compaction may be used provided rollers do not impair stability of pavement structure and underlying layers. Repair depressions in pavement surfaces resulting from use of vibratory rollers. Rollers shall be self-propelled, single or dual vibrating drums, and steel drive wheels, as applicable; equipped with variable amplitude and separate controls for energy and propulsion.

1.6.2.3 Hand Tampers

Minimum weight of 25 pounds with a tamping face of not more than 50 square inches.

1.6.2.4 Mechanical Hand Tampers

Commercial type, operated by pneumatic pressure or by internal combustion.

PART 2 PRODUCTS

2.1 AGGREGATES

Grade and proportion aggregates and filler so that combined mineral aggregate conforms to specified grading.

2.1.1 Coarse Aggregates

ASTM D 692, except as modified herein. At least 75 percent by weight of aggregate retained on the No. 4 sieve shall have two or more fractured faces. Percentage of wear, Los Angeles test, except for slag, shall not exceed 40 in accordance with ASTM C 131. Weight of slag shall not be less than 70 pounds per cubic foot. Soundness test is required in accordance with ASTM C 88; after 5 cycles, loss shall not be more than 12 percent when tested with sodium sulfate or 18 percent when tested with magnesium sulfate.

2.1.2 Fine Aggregate

ASTM D 1073, except as modified herein. Fine aggregate shall be produced by crushing stone, slag or gravel that meets requirements for wear and soundness specified for coarse aggregate. Where necessary to obtain the gradation of aggregate blend or workability, natural sand may be used. Quantity of natural sand to be added shall be approved by the Contracting Officer and shall not exceed 15 percent of weight of coarse and fine aggregate and material passing the No. 200sieve.

2.1.3 Mineral Filler

Nonplastic material meeting the requirements of ASTM D 242.

2.1.4 Aggregate Gradation

The combined aggregate gradation shall conform to gradations specified in Table I, when tested in accordance with ASTM C 136 and ASTM C 117, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine.

Table I. Aggregate Gradations

| | Gradation 1 | Gradation 2 | Gradation 3 |
|---|---|---|---|
| Sieve Size, inch | Percent Passing by Mass | Percent Passing by Mass | Percent Passing by Mass |
| 1 | 100 | --- | --- |
| 3/4 | 76-96 | 100 | --- |
| 1/2 | 68-88 | 76-96 | 100 |
| 3/8 | 60-82 | 69-89 | 76-96 |
| No. 4 | 45-67 | 53-73 | 58-78 |
| No. 8 | 32-54 | 38-60 | 40-60 |
| No. 16 | 22-44 | 26-48 | 28-48 |
| No. 30 | 15-35 | 18-38 | 18-38 |
| No. 50 | 9-25 | 11-27 | 11-27 |
| No. 100 | 6-18 | 6-18 | 6-18 |
| No. 200 | 3-6 | 3-6 | 3-6 |

2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall conform to ASTM D 3381 Table 2, Viscosity Grade AASHTO MP 1a Performance Grade (PG) ASTM D 946 Penetration Grade. Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the Contracting OfficerEngineer. The supplier is defined as the last source of any modification to the binder. The Contracting OfficerEngineer may sample and test the binder at the mix plant at any time before or during mix production. Samples for this verification testing shall be obtained by the Contractor in accordance with ASTM D 140 and in the presence of the Contracting OfficerEngineer. These samples shall be furnished to the Contracting OfficerEngineer for the verification testing, which shall be at no cost to the Contractor. Samples of the asphalt cement specified shall be submitted for approval not less than 14 days before start of the test section.

## 2.3 MIX DESIGN

The Contractor shall develop the mix design. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF). No hot-mix asphalt for payment shall be produced until a JMF has been approved. The hot-mix asphalt shall be designed using procedures contained in AI MS-02 and the criteria shown in Table II. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867/D 4867M is less than 75, the aggregates shall be rejected or the asphalt mixture treated with an approved anti-stripping agent. The amount of anti-stripping agent added shall be sufficient to produce a TSR of not less than 75. If an antistrip agent is required, it shall be provided by the Contractor at no additional cost.

### 2.3.1 JMF Requirements

The job mix formula shall be submitted in writing by the Contractor for approval at least 14 days prior to the start of the test section and shall include as a minimum:

a. Percent passing each sieve size.

b. Percent of asphalt cement.

c. Percent of each aggregate and mineral filler to be used.

d. Asphalt viscosity grade, penetration grade, or performance grade.

e. Number of blows of hammer per side of molded specimen.

f. Laboratory mixing temperature.

g. Lab compaction temperature.

h. Temperature-viscosity relationship of the asphalt cement.

i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.

j. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-02.

k. Specific gravity and absorption of each aggregate.

l. Percent natural sand.

m. Percent particles with two or more fractured faces (in coarse aggregate).

n. Fine aggregate angularity.

o. Percent flat or elongated particles (in coarse aggregate).

p. Tensile Strength Ratio.

q. Antistrip agent (if required) and amount.

r. List of all modifiers and amount.

s. Percentage and properties (asphalt content, binder properties, and aggregate properties) of RAP in accordance with paragraph RECYCLED HOT-MIX ASPHALT, if RAP is used.

Table II. Marshall Design Criteria

| Test Property | 75 Blow Mix | 50 Blow Mix |
|---|---|---|
| Stability, pounds minimum | *2150 | *1350 |
| Flow, 0.01 inch | 8-16 | 8-18 |
| Air voids, percent | 3-5 | 3-5 |
| Percent Voids in mineral aggregate (minimum) | See Table III | See Table III |
| TSR, minimum percent | 75 | 75 |

* This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.

Table III. Minimum Percent Voids in Mineral Aggregate (VMA)**

| Aggregate (See Table 2) | Minimum VMA, percent |
|---|---|
| Gradation 1 | 13.0 |
| Gradation 2 | 14.0 |
| Gradation 3 | 15.0 |

** Calculate VMA in accordance with AI MS-02, based on ASTM D 2726 bulk specific gravity for the aggregate.

2.3.2 Adjustments to JMF

The JMF for each mixture shall be in effect until a new formula is approved in writing by the Contracting Officer. Should a change in sources of any materials be made, a new mix design shall be performed and a new JMF approved before the new material is used. The Contractor will be allowed to adjust the JMF within the limits specified below to optimize mix volumetric properties. Adjustments to the JMF shall be limited to plus or minus 3 percent on the 1/2 inch, No. 4, and No. 8 sieves; plus or minus 1.0 percent on the No. 200 sieve; and plus or minus 0.40 percent binder content. If adjustments are needed that exceed these limits, a new mix design shall be developed. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table I; this is acceptable.

2.4 [Enter Appropriate Subpart Title Here]2.4.1 RAP Aggregates and Asphalt Cement

The blend of aggregates used in the recycled mix shall meet the requirements of paragraph AGGREGATES. The percentage of asphalt in the RAP shall be established for the mixture design according to ASTM D 2172 using the appropriate dust correction procedure.

2.4.2 RAP Mix

The blend of new asphalt cement and the RAP asphalt binder shall meet the penetration, viscosity, dynamic shear rheometer at high temperature and bending beam at low temperature requirements in paragraph ASPHALT CEMENT BINDER. The virgin asphalt cement shall not be more than two standard asphalt material grades different than that specified in paragraph ASPHALT CEMENT BINDER.

2.5 SOURCE QUALITY CONTROL

Employ a commercial laboratory approved by the Contracting Officer to perform testing. The laboratory used to develop the JMF and the laboratory used to perform all sampling and testing shall meet the requirements of ASTM D 3666. A certification signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the Contracting Officer prior to the start of construction. The certification shall contain as a minimum:

a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.

b. A listing of equipment to be used in developing the job mix.

c. A copy of the laboratory's quality control system.

d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

2.5.1 Tests

Perform testing in accordance with the following:

a. Specific Gravity Test of Asphalt: ASTM D 70

b. Coarse Aggregate Tests:

(1) Bulk Specific Gravity: ASTM C 127

(2) Abrasion Loss: ASTM C 131

(3) Soundness Loss: ASTM C 88

c. Weight of Slag Test: ASTM C 29/C 29M

d. Percent of Crushed Pieces in Gravel: Count by observation and weight

e. Fine Aggregate Tests:

(1) Bulk Specific Gravity: ASTM C 128

(2) Soundness Loss: ASTM C 88

f. Specific Gravity of Mineral Filler: ASTM C 188 or ASTM D 854

g. Bituminous Mixture Tests:

(1) Bulk Specific Gravity: ASTM D 1188 or ASTM D 2726

(2) Theoretical Maximum Specific Gravity: ASTM D 2041

(3) Tensile Strength Ratio: ASTM D 4867/D 4867M

2.5.2 Specimens

ASTM D 1559 for the making and testing of bituminous specimens with the following exceptions:

a. Compaction: Apply 75 blows of the hammer to each flat face of the specimens for mix..

b. Curves: Plot curves for the leveling, binder, and wearing course(s) to show the effect on the test properties of at least four different percentages of asphalt on the unit weight, stability, flow, air voids, and voids in mineral aggregate; each point on the curves shall represent the average of at least four specimens.

c. Cooling of Specimen: After compaction is completed, allow the specimen to cool in air to the same temperature approximately as that of the water, 77 degrees F, to be used in the specific gravity determination.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Preparation of Asphalt Binder Material

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 160 degrees C 325 degrees F when added to the aggregates. Modified asphalts shall be no more than 174 degrees C 350 degrees F when added to the aggregate.

3.1.2 Preparation of Mineral Aggregates

Store different size aggregate in separate stockpiles so that different sizes will not mix. Stockpile different-sized aggregates in uniform layers by use of a clam shell or other approved method so as to prevent segregation. The use of bulldozers in stockpiling of aggregate or in feeding aggregate to the dryer is prohibited. Feed aggregates into the cold elevator by means of separate mechanical feeders so that aggregates are graded within requirements of the job-mix formulas and tolerances specified. Regulate rates of feed of the aggregates so that moisture content and temperature of aggregates are within tolerances specified herein. Dry and heat aggregates to the temperature necessary to achieve the mixture determined by the job mix formula within the job tolerance

specified. Provide adequate dry storage for mineral filler.

### 3.1.3 Preparation of Bituminous Mixture

Accurately weigh aggregates and dry mineral filler and convey into the mixer in the proportionate amounts of each aggregate size required to meet the job-mix formula. In batch mixing, after aggregates and mineral filler have been introduced into the mixer and mixed for not less than 15 seconds, add asphalt by spraying or other approved methods and continue mixing for a period of not less than 20 seconds, or as long as required to obtain a homogeneous mixture. The time required to add or spray asphalt into the mixer will not be added to the total wet-mixing time provided the operation does not exceed 10 seconds and a homogeneous mixture is obtained. When a continuous mixer is employed, mixing time shall be more than 35 seconds to obtain a homogeneous mixture. Additional mixing time, when required, will be as directed by the Contracting Officer. When mixture is prepared in a twin-pugmill mixer, volume of the aggregates, mineral filler, and asphalt shall not extend above tips of mixer blades when blades are in a vertical position. Overheated and carbonized mixtures, or mixtures that foam or show indication of free moisture, will be rejected. When free moisture is detected in batch or continuous mix plant produced mixtures, waste the mix and withdraw the aggregates in the hot bins immediately and return to the respective stockpiles; for drum-dryer mixer plants, waste the mix, including that in surge or storage bins that is affected by free moisture.

### 3.1.4 Transportation of Bituminous Mixtures

Transport bituminous material from the mixing plant to the paving site in trucks having tight, clean, smooth beds that have been coated with a minimum amount of concentrated solution of hydrated lime and water or other approved coating to prevent adhesion of the mixture to the truck. Petroleum products will not be permitted for coating truck. If air temperature is less than 60 degrees F or if haul time is greater than 30 minutes, cover each load with canvas or other approved material of ample size to protect the mixture from the loss of heat. Make deliveries so that the spreading and rolling of all the mixture prepared for one day's run can be completed during daylight, unless adequate approved artificial lighting is provided. Deliver mixture to area to be paved so that the temperature at the time of dumping into the spreader is within the range specified herein. Reject loads that are below minimum temperature, that have crusts of cold unworkable material, or that have been wet excessively by rain. Hauling over freshly laid material is prohibited.

### 3.1.5 Surface Preparation of Underlying Course

Prior to the laying of the asphalt concrete, clean underlying course of foreign or objectionable matter with power blowers or power brooms, supplemented by hand brooms and other cleaning methods where necessary. During the placement of multiple lifts of bituminous concrete, each succeeding lift of bituminous concrete shall have its underlying lift cleaned and provided with a bituminous tack coat if the time period between the placement of each lift of bituminous concrete exceeds 14 days, or the underlying bituminous concrete has become dirty.

### 3.1.6 Spraying of Contact Surfaces

Spray contact surfaces of previously constructed pavement with a thin coat of bituminous materials to act as an anti-stripping agent, conforming to

specifications. Paint contact surfaces of structures with a thin coat of emulsion or other approved bituminous material prior to placing the bituminous mixture. Tack coat the previously placed primed coats on base courses when surface has become excessively dirty and cannot be cleaned or when primed surface has cured to the extent that it has lost all bonding effect.

## 3.2 PLACEMENT

### 3.2.1 Machine Spreading

The range of temperatures of the mixtures at the time of spreading shall be between 250 degrees F and 300 degrees F. Bituminous concrete having temperatures less than minimum spreading temperature when dumped into the spreader will be rejected. Adjust spreader and regulate speed so that the surface of the course is smooth and continuous without tears and pulling, and of such depth that, when compacted, the surface conforms with the cross section, grade, and contour indicated. Unless otherwise directed, begin the placing along the centerline of areas to be paved on a crowned section or on the high side of areas with a one-way slope. Place mixture in consecutive adjacent strips having a minimum width of 10 feet, except where the edge lanes require strips less than 10 feet to complete the area. Construct longitudinal joints and edges to true line markings. Establish lines parallel to the centerline of the area to be paved, and place string lines coinciding with the established lines for the spreading machine to follow. Provide the number and location of the lines needed to accomplish proper grade control. When specified grade and smoothness requirements can be met for initial lane construction by use of an approved long ski-type device of not less than 30 feet in length and for subsequent lane construction by use of a short ski or shoe, in-place string lines for grade control may be omitted. Place mixture as nearly continuous as possible and adjust the speed of placing as needed to permit proper rolling.

### 3.2.2 Shoveling, Raking, and Tamping After Machine-Spreading

Shovelers and rakers shall follow the spreading machine. Add or remove hot mixture and rake the mixture as required to obtain a course that when completed will conform to requirements specified herein. Broadcasting or fanning of mixture over areas being compacted is prohibited. When segregation occurs in the mixture during placing, suspend spreading operation until the cause is determined and corrected. Correct irregularities in alinement left by the spreader by trimming directly behind the machine. Immediately after trimming, compact edges of the course by tamping laterally with a metal lute or by other approved methods. Distortion of the course during tamping is prohibited.

### 3.2.3 Hand-Spreading in Lieu of Machine-Spreading

In areas where the use of machine spreading is impractical, spread mixture by hand. The range of temperatures of the mixtures when dumped onto the area to be paved shall be between 250 and 300 degrees F. Mixtures having temperatures less than minimum spreading temperature when dumped onto the area to be paved will be rejected. Spread hot mixture with rakes in a uniformly loose layer of a thickness that, when compacted, will conform to the required grade, thickness, and smoothness. During hand spreading, place each shovelful of mixture by turning the shovel over in a manner that will prevent segregation. Do not place mixture by throwing or broadcasting from a shovel. Do not dump loads any faster than can be properly handled

by the shovelers and rakers.

## 3.3 COMPACTION OF MIXTURE

Compact mixture by rolling. Begin rolling as soon as placement of mixture will bear rollers. Delays in rolling freshly spread mixture shall not be permitted. Start rolling longitudinally at the extreme sides of the lanes and proceed toward center of pavement, or toward high side of pavement with a one-way slope. Operate rollers so that each trip overlaps the previous adjacent strip by at least one foot. Alternate trips of the roller shall be of slightly different lengths. Conduct tests for conformity with the specified crown, grade and smoothness immediately after initial rolling. Before continuing rolling, correct variations by removing or adding materials as necessary. If required, subject course to diagonal rolling with the steel wheeled roller crossing the lines of the previous rolling while mixture is hot and in a compactible condition. Speed of the rollers shall be slow enough to avoid displacement of hot mixture. Correct displacement of mixture immediately by use of rakes and fresh mixture, or remove and replace mixture as directed. Continue rolling until roller marks are eliminated and course has a density of at least 95 percent but not more than 100 percent of that attained in a laboratory specimen of the same mixture prepared in accordance with ASTM D 1559. During rolling, moisten wheels of the rollers enough to prevent adhesion of mixture to wheels, but excessive water is prohibited. Operation of rollers shall be by competent and experienced operators. Provide sufficient rollers for each spreading machine in operation on the job and to handle plant output. In places not accessible to the rollers, compact mixture thoroughly with hot hand tampers. Skin patching of an area after compaction is prohibited. Remove mixture that becomes mixed with foreign materials or is defective and replace with fresh mixture compacted to the density specified herein. Roller shall pass over unprotected edge of the course only when laying of course is to be discontinued for such length of time as to permit mixture to become cold.

## 3.4 JOINTS

Joints shall present the same texture and smoothness as other portions of the course, except permissible density at the joint may be up to 2 percent less than the specified course density. Carefully make joints between old and new pavement or within new pavements in a manner to ensure a thorough and continuous bond between old and new sections of the course. Vertical contact surfaces of previously constructed sections that are coated with dust, sand, or other objectionable material shall be painted with a thin uniform coat of emulsion or other approved bituminous material just before placing fresh mixture.

### 3.4.1 Transverse

Roller shall pass over unprotected end of freshly laid mixture only when laying of course is to be discontinued. Except when an approved bulkhead is used, cut back the edge of previously laid course to expose an even, vertical surface for the full thickness of the course. When required, rake fresh mixture against joints, thoroughly tamp with hot tampers, smooth with hot smoothers, and roll. Transverse joints in adjacent lanes shall be offset a minimum of 2 feet.

### 3.4.2 Longitudinal Joints

Space 6 inches apart. Do not allow joints to coincide with joints of

existing pavement or previously placed courses. Spreader screed shall overlap previously placed lanes 2 to 3 inches and be of such height to permit compaction to produce a smooth dense joint. With a lute, push back mixture placed on the surface of previous lanes to the joint edge. Do not scatter mix. Remove and waste excess material. When edges of longitudinal joints are irregular, honeycombed, or poorly compacted, cut back unsatisfactory sections of joint and expose an even vertical surface for the full thickness of the course. When required, rake fresh mixture against joint, thoroughly tamp with hot tampers, smooth with hot smoothers, and roll while hot.

## 3.5 FIELD QUALITY CONTROL

### 3.5.1 Sampling

#### 3.5.1.1 Aggregates At Source

Prior to production and delivery of aggregates, take at least one initial sample in accordance with ASTM D 75 from each stockpile. Collect each sample by taking three incremental samples at random from the source material to make a composite sample of not less than 50 pounds. Repeat the sampling when the material source changes or when testing reveals unacceptable deficiencies or variations from the specified grading of materials.

#### 3.5.1.2 Cold Feed Aggregate Sampling

Take two samples daily from the belt conveying materials from the cold feed. Collect materials in three increments at random to make a representative composite sample of not less than 50 pounds. Take samples in accordance with ASTM D 75.

#### 3.5.1.3 Coarse and Fine Aggregates

Take a 50 pound sample from the cold feed at least once daily for sieve analyses and specific gravity tests. Additional samples may be required to perform more frequent tests when analyses show deficiencies, or unacceptable variances or deviations. The method of sampling is as specified herein for aggregates.

#### 3.5.1.4 Mineral Filler

ASTM D 546. Take samples large enough to provide ample material for testing.

#### 3.5.1.5 Pavement and Mixture

Take plant samples for the determination of mix properties and field samples for thickness and density of the completed pavements. Furnish tools, labor and material for samples, and satisfactory replacement of pavement. Take samples and tests at not less than frequency specified hereinafter and at the beginning of plant operations; for each day's work as a minimum; each change in the mix or equipment; and as often as directed. Accomplish sampling in accordance with ASTM D 979.

3.5.2 Testing

3.5.2.1 Aggregates Tests

a. Gradation: ASTM C 136.

b. Mineral Filler Content: ASTM D 546.

c. Abrasion: ASTM C 131 for wear (Los Angeles test). Perform one test initially prior to incorporation into the work and each time the source is changed.

3.5.2.2 Bituminous Mix Tests

Test one sample for each 500 tons, or fraction thereof, of the uncompacted mix for extraction in accordance with ASTM D 2172; perform a sieve analysis on each extraction sample in accordance with ASTM C 136 and ASTM C 117. Test one sample for each 100 tons or fraction thereof for stability and flow in accordance with ASTM D 1559. Test one sample for each material blend for Tensile Strength Ratio in accordance with ASTM D 4867/D 4867M.

3.5.2.3 Pavement Courses

Perform the following tests:

a. Density: For each 100 tons of bituminous mixture placed, determine the representative laboratory density by averaging the density of four laboratory specimens prepared in accordance with ASTM D 1559. Samples for laboratory specimens shall be taken from trucks delivering mixture to the site; record in a manner approved by the Contracting Officer the project areas represented by the laboratory densities. From each representative area recorded, determine field density of pavement by averaging densities of 4 inch diameter cores obtained from leveling, binder, and wearing course(s); take one core for each 1000 square yards or fraction thereof of course placed. Determine density of laboratory prepared specimens and cored samples in accordance with ASTM D 1188 or ASTM D 2726, as applicable. Separate pavement layers by sawing or other approved means. Maximum allowable deficiency at any point, excluding joints, shall not be more than 2 percent less than the specified density for any course. The average density of each course, excluding joints, shall be not less than the specified density. Joint densities shall not be more than 2 percent less than specified course densities and are not included when calculating average course densities. When the deficiency exceeds the specified tolerances, correct each such representative area or areas by removing the deficient pavement and replacing with new pavement.

b. Thickness: Determine thickness of binder and wearing courses from samples taken for the field density test. The maximum allowable deficiency at any point shall not be more than 1/4 inch less than the thickness for the indicated course. Average thickness of course or of combined courses shall be not less than the indicated thickness. Where a deficiency exceeds the specified tolerances, correct each such representative area or areas by removing the deficient pavement and replacing with new pavement.

c. Smoothness: Straightedge test the compacted surface of leveling, binder, and wearing courses as work progresses. Apply straightedge parallel with and at right angles to the centerline after final rolling. Unevenness of binder courses shall not vary more than 1/4 inch in 10 feet; variations in the wearing course shall not vary more than 1/8 inch in 10 feet. Correct each portion of the pavement showing irregularities greater than that specified.

d. Finished Grades: Finish grades of each course placed shall not vary from the finish elevations, profiles, and cross sections indicated by more than 1/2 inch. Finished surface of the final wearing course will be tested by the Contracting Officer by running lines of levels at intervals of 25 feet longitudinally and transversely to determine elevations of completed pavement. Within 45 days after completion of final placement, perform a level survey at the specified grid spacing and plot the results on a plan drawn to the same scale as the drawings. Elevations not in conformance with the specified tolerance shall be noted on the plan in an approved manner. The survey shall be performed by a registered land surveyor. The Contracting Officer will inform the Contractor in writing of paved areas that fail to meet the final grades indicated within the specified tolerances. Correct deficient paved areas by removing existing work and replacing with new materials that meet the specifications. Skin patching for correcting low areas is prohibited.

e. Finish Surface Texture of Wearing Course: Visually check final surface texture for uniformity and reasonable compactness and tightness. Final wearing course with a surface texture having undesirable irregularities such as segregation, cavities, pulls or tears, checking, excessive exposure of coarse aggregates, sand streaks, indentations, ripples, or lack of uniformity shall be removed and replaced with new materials.

## 3.6 PROTECTION

Do not permit vehicular and aircraft traffic, including heavy equipment, on pavement until surface temperature has cooled to at least 120 degrees F. Measure surface temperature by approved surface thermometers or other satisfactory methods.

-- End of Section --

SECTION 32 17 23.00 20

PAVEMENT MARKINGS
**04/06**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D 2240 | (2005) Standard Test Method for Rubber Property - Durometer Hardness |
| ASTM D 2621 | (1987; R 2005) Infrared Identification of Vehicle Solids from Solvent-Reducible Paints |
| ASTM D 2697 | (2003; R 2008) Volume Nonvolatile Matter in Clear or Pigmented Coatings |
| ASTM D 3335 | (1985a; R 2005) Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy |
| ASTM D 3718 | (1985a; R 2005) Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy |
| ASTM D 3924 | (1980; R 2005) Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials |
| ASTM D 3960 | (2005) Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings |
| ASTM D 4505 | (2005) Preformed Retroflective Pavement Marking Tape for Extended Service Life |
| ASTM D 4541 | (2002) Pull-Off Strength of Coatings Using Portable Adhesion Testers |
| ASTM D 471 | (2006; R 2008) Standard Test Method for Rubber Property - Effect of Liquids |
| ASTM D 522 | (1993a; R 2008) Mandrel Bend Test of Attached Organic Coatings |
| ASTM D 711 | (1989; R 2004) No-Pick-Up Time of Traffic Paint |
| ASTM D 792 | (2008) Density and Specific Gravity |

| | |
|---|---|
| | (Relative Density) of Plastics by Displacement |
| ASTM D 823 | (1995; R 2007) Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels. |
| ASTM E 28 | (1999; R 2004) Softening Point of Resins Derived from Naval Stores by Ring and Ball Apparatus |
| ASTM G 53 | (1996) Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials |

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

| | |
|---|---|
| ICRI 03732 | (1997) Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| FED-STD-595 | (Rev B; Am 1) Colors Used in Government Procurement |
| FS A-A-2886 | (Rev A)Paint, Traffic, Solvent Based |
| FS TT-B-1325 | (Rev C) Beads (Glass Spheres) Retro-Reflective (Metric) |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Reflective media for roads and streets

Paints for roads and streets

High Build Acrylic Coating (HBAC); G

Thermoplastic compound

Raised Pavement Markers and Adhesive

Equipment; G

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the

equipment operation.

Qualifications

Documentation on personnel qualifications, as specified.

SD-06 Test Reports

Reflective media for roads and streets

Paints for roads and streets

High Build Acrylic Coating (HBAC); G

Thermoplastic compound

Raised Pavement Markers and Adhesive

Certified reports from sampling and testing made in accordance with paragraph entitled "Sampling and Testing" prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

SD-07 Certificates

Reflective media for roads and streets

Paints for roads and streets

Volatile Organic Compound, (VOC)

Certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

Thermoplastic compound

Construction equipment list

SD-08 Manufacturer's Instructions

Paints for airfields

Paints for roads and streets

Thermoplastic compound

Submit manufacturer's Material Safety Data Sheets.

1.3 DELIVERY AND STORAGE

Deliver paints, paint materials and thermoplastic compound materials in original sealed containers that plainly show the designated name, specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer. Provide storage facilities at the job site, only in areas approved by the Contracting Officer or authorized representative, for maintaining materials at temperatures recommended by the manufacturer. Make available paint stored

at the project site or segregated at the source for sampling not less than 30 days prior to date of required approval for use to allow sufficient time for testing. Notify the Contracting Officer when paint is available for sampling.

1.4 WEATHER LIMITATIONS

Apply paint to clean, dry surfaces, and unless otherwise approved, only when the air and pavement surface temperature is at least 5 degrees above the dew point and the air and pavement temperatures are above 40 degrees F and less than 95 degrees F for oil-based materials; above 50 degrees F and less than 110 degrees F for water-based materials. Maintain paint temperature within these same limits.

1.5 EQUIPMENT

Machines, tools, and equipment used in the performance of the work shall be approved by the Contracting Officer and maintained in satisfactory operating condition. Submit construction equipment list for approval by the Contracting Officer.

1.5.1 Mobile and Maneuverable

Application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

1.5.2 Paint Application Equipment

1.5.2.1 Hand-Operated, Push-Type Machines

Provide hand-operated push-type applicator machine of a type commonly used for application of paint to pavement surfaces. Paint applicator machine shall be acceptable for marking small street and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified.

1.5.3 Thermoplastic Application Equipment

1.5.3.1 Thermoplastic Material

Thermoplastic material shall be applied to the primed pavement surface by spray techniques or by the extrusion method, wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of, suitable equipment for heating and controlling the flow of material. By either method, the markings shall be applied with equipment that is capable of providing continuous uniformity in the dimensions of the stripe.

1.5.3.2 Application Equipment

a. Application equipment shall provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe or spray gun shall prevent accumulation and clogging. All parts of the equipment which come into contact with the material shall be easily accessible and exposable for cleaning and maintenance. All mixing and conveying parts up to and including the extrusion shoes and spray guns shall maintain the

material at the required temperature with heat-transfer oil or electrical-element-controlled heat.

b. The application equipment shall be constructed to ensure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off stripe ends squarely and shall provide a method of applying "skiplines". The equipment shall be capable of applying varying widths of traffic markings.

c. The applicator shall be equipped with a drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow. The bead dispenser shall be automatically operated and shall begin flow prior to the flow of composition to assure that the strip is fully reflectorized.

1.5.3.3 Mobile and Maneuverable

Application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. The equipment used for the placement of thermoplastic pavement markings shall be of two general types: mobile applicator and portable applicator.

1.5.3.4 Mobile Application Equipment

The mobile applicator shall be defined as a truck-mounted, self-contained pavement marking machine that is capable of hot applying thermoplastic by either the extrusion or spray method. The unit shall be equipped to apply the thermoplastic marking material at temperatures exceeding 375 degrees F, at widths varying from 3 to 12 inches and in thicknesses varying from 0.040 to 0.200 inch and shall have an automatic drop-on bead system. The mobile unit shall be capable of operating continuously and of installing a minimum of 20,000 lineal feet of longitudinal markings in an 8-hour day.

The mobile unit shall be equipped with a melting kettle which holds a minimum of 6000 pounds of molten thermoplastic material. The kettle shall be capable of heating the thermoplastic composition to temperatures of 375 to 425 degrees F. A thermostatically controlled heat transfer liquid shall be used. Heating of the composition by direct flame shall not be allowed. Oil and material temperature gauges shall be visible at both ends of the kettle. The mobile unit shall be equipped with a minimum of two extrusion shoes located one on each side of the truck, and shall be capable of marking simultaneous edgeline and centerline stripes. Each extrusion shoe shall be a closed, oil-jacketed unit; shall hold the molten thermoplastic at a temperature of 375 to 425 degrees F; and shall be capable of extruding a line of 3 to 8 inches in width; and at a thickness of not less than 0.120 inch nor more than 0.190 inch, and of generally uniform cross section. The mobile unit shall be equipped with a spray gun system. The spray system shall consist of a minimum of four spray guns, located two on each side of the truck, and shall be capable of marking simultaneous edgeline and centerline stripes. The spray system shall be surrounded (jacketed) with heating oil to maintain the molten thermoplastic at a temperature of 375 to 425 degrees F; and shall be capable of spraying a stripe of 3 to 12 inches in width, and in thicknesses varying from 0.060 inch to 0.098 inch, and of generally uniform cross section.

The mobile unit shall be equipped with an electronic programmable line pattern control system. The control system shall be capable of applying skip or solid lines in any sequence, through any and all of the extrusion

shoes, or the spray guns, and in programmable cycle lengths. In addition, the mobile unit shall be equipped with an automatic counting mechanism capable of recording the number of lineal feet of thermoplastic markings applied to the pavement surface with an accuracy of 0.5 percent.

1.5.3.5 Portable Application Equipment

The portable applicator shall be defined as hand-operated equipment, specifically designed for placing special markings such as crosswalks, stopbars, legends, arrows, and short lengths of lane, edge and centerlines. The portable applicator shall be capable of applying thermoplastic pavement markings by the extrusion method. The portable applicator shall be loaded with hot thermoplastic composition from the melting kettles on the mobile applicator. The portable applicator shall be equipped with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding the molten thermoplastic at a temperature of 375 to 425 degrees F, of extruding a line of 3 to 12 inches in width, and in thickness of not less than 0.120 inch nor more than 0.190 inch and of generally uniform cross section.

1.5.4 Reflective Media Dispenser

The dispenser for applying the reflective media shall be attached to the paint dispenser and shall operate automatically and simultaneously with the applicator through the same control mechanism. The dispenser shall be capable of adjustment and designed to provide uniform flow of reflective media over the full length and width of the stripe at the rate of coverage specified in paragraph APPLICATION, at all operating speeds of the applicator to which it is attached.

1.5.5 Preformed Tape Application Equipment

Mechanical application equipment shall be used for the placement of preformed marking tape. Mechanical application equipment shall be defined as a mobile pavement marking machine specifically designed for use in applying precoated, pressure-sensitive pavement marking tape of varying widths, up to 12 inches. The applicator shall be equipped with rollers, or other suitable compactive device, to provide initial adhesion of the preformed, pressure-sensitive marking tape with the pavement surface. Additional hand-operated rollers shall be used as required to properly seat the thermoplastic tape.

1.5.6 Surface Preparation Equipment

1.5.6.1 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 150 cfm of air at a pressure of not less than 90 psi at each nozzle used, and shall be equipped with traps that will maintain the compressed air free of oil and water.

1.5.6.2 Waterblast Equipment

The water pressure shall be specified at 2600 psi at 140 degrees F in order

to adequately clean the surfaces to be marked.

1.5.7 Marking Removal Equipment

Equipment shall be mounted on rubber tires and shall be capable of removing markings from the pavement without damaging the pavement surface or joint sealant. Waterblasting equipment shall be capable of producing an adjustable, pressurized stream of water. Sandblasting equipment shall include an air compressor, hoses, and nozzles. The compressor shall be equipped with traps to maintain the air free of oil and water.

1.5.7.1 Shotblasting Equipment

Shotblasting equipment shall be capable of producing an adjustable depth of removal of marking and pavement. Each unit shall be self-cleaning and self-contained, shall be able to confine dust and debris from the operation, and shall be capable of recycling the abrasive for reuse.

1.5.7.2 Chemical Equipment

Chemical equipment shall be capable of application and removal of chemicals from the pavement surface, and shall leave only non-toxic biodegradeable residue.

1.5.8 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

1.6 MAINTENANCE OF TRAFFIC

1.6.1 Lighting

When night operations are necessary, all necessary lighting and equipment shall be provided. Lighting shall be directed or shaded to prevent interference with aircraft, the air traffic control tower, and other base operations. All lighting and related equipment shall be capable of being removed from the runway within 15 minutes of notification of an emergency. Night work must be coordinated with the Airfield Manager and approved in advance by the Contracting Officer or authorized representative. The Government reserves the right to accept or reject night work on the day following night activities by the Contractor.

1.6.2 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

1.7 WEATHER LIMITATIONS FOR REMOVAL

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 40 degrees F and rising at the beginning of operations, except those involving shot or sand blasting. Operation shall cease during

thunderstorms. Operation shall cease during rainfall, except for waterblasting and removal of previously applied chemicals. Waterblasting shall cease where surface water accumulation alters the effectiveness of material removal.

## 1.8 QUALIFICATIONS

The Contractor shall submit documentation certifying that pertinent personnel are qualified for equipment operation and handling of chemicals.

# PART 2 PRODUCTS

## 2.1 MATERIALS

Provide materials conforming to the requirements specified herein.

### 2.1.1 Paints for Roads and Streets

FS A-A-2886, FS TT-P-1952, High Build Acrylic Coating (HBAC), color as selected.

### 2.1.2 Reflective Media for Airfields

FS TT-B-1325, Type I, Gradation A.

### 2.1.3 Reflective Media for Roads and Streets

FS TT-B-1325, Type I, Gradation A.

### 2.1.4 Thermoplastic Compound

The thermoplastic reflectorized pavement marking compound shall be extruded or sprayed in a molten state onto a primed pavement surface. Following a surface application of glass beads and upon cooling to normal pavement temperatures, the marking shall be an adherent reflectorized strip of the specified thickness and width that is capable of resisting deformation by traffic.

#### 2.1.4.1 Composition Requirements

The binder component shall be formulated as a hydrocarbon resin. The pigment, beads and filler shall be uniformly dispersed in the binder resin. The thermoplastic composition shall be free from all skins, dirt, and foreign objects and shall comply with the following requirements:

| | Percent by Weight | |
|---|---|---|
| Component | White | Yellow |
| Binder | 17 min | 17 min |
| Titanium dioxide | 10 min | - |
| Glass beads | 20 min | 20 min |
| Calcium carbonate and inert fillers | 49 min | * |
| Yellow pigments | - | * |

*Amount and type of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, providing the other composition requirements of this specification are met.

2.1.4.2 Physical Properties

a. Drying time: When installed at 70 degrees F and in thicknesses between 0.120 and 0.190 inch, the composition shall be completely solid and shall show no damaging effect from traffic after curing 15 minutes.

b. Softening point: The composition shall have a softening point of not less than 194 degrees F when tested in accordance with ASTM E 28.

c. Specific gravity: The specific gravity of the composition shall be between 1.9 and 2.2 as determined in accordance with ASTM D 792.

2.1.4.3 Primer

a. Asphalt concrete primer: The primer for asphalt concrete pavements shall be a thermosetting adhesive with a solids content of pigment reinforced synthetic rubber and synthetic plastic resin dissolved or dispersed in a volatile organic solvent. The solids content shall not be less than 10 percent by weight at 70 degrees F and 60 percent relative humidity. A wet film thickness of 0.005 inch, plus or minus 0.001 inch, shall dry to a tack-free condition in less than 5 minutes.

b. Portland cement concrete primer: The primer for portland cement concrete pavements shall be an epoxy resin primer. The primer shall be of the type recommended by the manufacturer of the thermoplastic composition.

2.1.5 PREFORMED TAPE

The preformed tape shall be an adherent reflectorized strip in accordance with ASTM D 4505 Type I or IV, Class optional.

2.1.6 High Build Acrylic Coating (HBAC)

Formulate High Build Acrylic Coating (HBAC) to meet the requirements of Table I.

2.1.6.1 Preapproved HBAC Vendors and Materials

Table II presents a partial list of HBAC vendors and materials. Up to specifications's date of issue, preapproved materials met specification requirements. It is the user's responsibility to confirm preapproved material formulations have not changed and specification requirements will be met. Other products may meet HBAC requirements.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Allow new pavement surfaces to cure for a period of not less than 30 days before application of marking materials. Thoroughly clean surfaces to be marked before application of the paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods as required. Remove rubber deposits, residual curing compounds, and other coatings adhering to the pavement by water blasting orapproved chemical removal method. For Portland

Cement Concrete pavement, grinding, light shot blasting, and light scarification, to a resulting profile equal to ICRI 03732 CSP 2, CSP 3, and CSP 4, respectively, can be used in addition to water blasting, to either remove existing coatings or for surface preparation on most pavements: shot blasting shall not be used on airfield pavements due to the potential of Foreign Object Damage (FOD) to aircraft. Scrub affected areas, where oil or grease is present on old pavements to be marked, with several applications of trisodium phosphate solution or other approved detergent or degreaser and rinse thoroughly after each application. After cleaning oil-soaked areas, seal with shellac or primer recommended by the manufacturer to prevent bleeding through the new paint. Do not commence painting in any area until pavement surfaces are dry and clean.

3.1.1 Early Painting of Rigid Pavements

Pretreat rigid pavements that require early painting with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride. Apply the solution to the areas to be marked.

3.1.2 Early Painting of Asphalt Pavements

For asphalt pavement systems requiring painting application at less than 30 days, apply the paint and beads at half the normal application rate, followed by a second application at the normal rate after 30 days.

3.2 APPLICATION

3.2.1 Testing for Moisture

Apply pavement markings to dry pavement only. The Contractor shall test the pavement surface for moisture before beginning work after each period of rainfall, fog, high humidity, or cleaning, or when the ambient temperature has fallen below the dew point. Do not commence marking until the pavement is sufficiently dry and the pavement condition has been approved by the CO or authorized representative. Employ the "plastic wrap method" to test the pavement for moisture as follows: Cover the pavement with a 300 mm by 300 mm (12 inch by 12 inch) section of clear plastic wrap and seal the edges with tape. After 15 minutes, examine the plastic wrap for any visible moisture accumulation inside the plastic. Do not begin marking operations until the test can be performed with no visible moisture accumulation inside the plastic wrap.

3.2.2 Rate of Application

3.2.2.1 Reflective Markings

Apply paint evenly to the pavement area to be coated at a rate of 105 plus or minus 5 square feet per gallon. Apply High Build Acrylic Coating (HBAC) at a rate of 50 square feet per gallon. Apply glass spheres uniformly to the wet paint plus or minus (0.5) pounds of glass spheres per gallon. Collect and record readings for white and yellow retroreflective markings at the rate of one reading per 1000 linear feet. The minimum acceptable average for white markings is 200 millicandelas per square meter per lux (mcd/m2/lx) (measured with Mirolux 12 Retroreflectometer or similar instrument as agreed). The minimum acceptable average for yellow markings is 175 millicandelas per square meter per lux (mcd/m2/lx). Readings shall be computed by averaging a minimum of 10 readings taken within the area at random locations. Areas not meeting the retroreflective requirements stated above shall be re-marked.

3.2.2.2 Nonreflective Markings

Apply paint evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet per gallon. Apply High Build Acrylic Coating (HBAC) at a rate of 50 square feet per gallon.

3.2.2.3 Thermoplastic Compound

After surface preparation has been completed, prime the asphalt or concrete pavement surface with spray equipment. Allow primer materials to "set-up" prior to applying the thermoplastic composition. After the primer has "set-up", apply the thermoplastic at temperatures no lower than 375 degrees F nor higher than 425 degrees F at the point of deposition. Immediately after installation of the marking, apply drop-on reflective glass spheres mechanically at the rate of one pound per 20 square feet such that the spheres are held by and imbedded in the surface of the molten material. Apply all extruded thermoplastic markings at the specified width and at a thickness of not less than 0.125 inch nor more than 0.190 inch. Apply all sprayed thermoplastic markings at the specified width and the thickness designated in the contract plans. If the plans do not specify a thickness, apply centerline markings at a wet thickness of 0.090 inch, plus or minus 0.005 inch, and edgeline markings at a wet thickness of 0.060 inch, plus or minus 0.005 inch.

3.2.3 Painting

Apply paint pneumatically with approved equipment at rate of coverage specified herein. Provide guidelines and templates as necessary to control paint application. Take special precautions in marking numbers, letters, and symbols. Manually paint numbers, letters, and symbols. Sharply outline all edges of markings. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. Discontinue painting operations if there is a deficiency in drying of the markings until cause of the slow drying is determined and corrected.

3.2.4 Reflective Media

Application of reflective media shall immediately follow the application of paint. Accomplish drop-on application of the glass spheres to ensure even distribution at the specified rate of coverage. Should there be malfunction of either paint applicator or reflective media dispenser, discontinue operations until deficiency is corrected.

3.2.5 Thermoplastic Compound

Place thermoplastic pavement markings upon dry pavement. At the time of installation the pavement surface temperature shall be a minimum of 40 degrees F and rising. Thermoplastics, as placed, shall be free from dirt or tint. Apply all centerline, skipline, edgeline, and other longitudinal type markings with a mobile applicator. Place all special markings, crosswalks, stop bars, legends, arrows, and similar patterns with a portable applicator, using the extrusion method.

3.2.6 Raised Pavement Markers

Prefabricated markers shall be aligned carefully at the required spacing or as directed and permanently fixed in place by means of epoxy adhesives. To

ensure good bond, areas where markers will be set shall be thoroughly cleaned by water blasting and use of compressed air prior to applying adhesive.

## 3.3 FIELD TESTING, INSPECTION, AND DEMONSTRATIONS

### 3.3.1 Sampling and Testing

As soon as the paint and reflective and thermoplastic materials are available for sampling, obtain by random selection from the sealed containers, two quart samples of each batch in the presence of the Contracting Officer. Accomplish adequate mixing prior to sampling to ensure a uniform, representative sample. A batch is defined as that quantity of material processed by the manufacturer at one time and identified by number on the label. Clearly identify samples by designated name, specification number, batch number, project contract number, intended use, and quantity involved. Test samples by an approved laboratory. If a sample fails to meet specification, replace the material in the area represented by the samples and retest the replacement material as specified above. Submit copy of the test results to the Contracting Officer. Include in the report of test results a listing of any specification requirements not verified by the test laboratory. At the discretion of the Contracting Officer, samples provided may be tested by the Government for verification.

### 3.3.2 Inspection

Examine material at the job site to determine that it is the material referenced in the report of test results or certificate of compliance. A certificate of compliance shall be accompanied by test results substantiating conformance to the specified requirements.

### 3.3.3 Surface Preparations and Application Procedures

Surface preparations and application procedures will be examined by the Contracting Officer to determine conformance with the requirements specified. Approve each separate operation prior to initiation of subsequent operations.

## 3.4 TRAFFIC CONTROL AND PROTECTION

Place warning signs near the beginning of the work site and well ahead of the work site for alerting approaching traffic from both directions. Place small markers along newly painted lines to control traffic and prevent damage to newly painted surfaces. Mark painting equipment with large warning signs indicating slow-moving painting equipment in operation. Do not use foil-backed material for temporary pavement marking because of its potential to conduct electricity during accidents involving downed power lines.

## 3.5 QUALITY ASSURANCE

Demonstrate success of bond of reflective media, new paint marking and the pavement surface, vacuum cured surface of new marking after a seven (7) day dry time. Inspect newly applied markings for signs of bond failure based on visual inspection and comparison to results from Test Stripe Demonstration paragraph.

3.5.1 Reflective Media and Coating Bond Verification

Within seven (7) days after pavement marking application, use industrial vacuum to sweep new markings. Visually inspect the pavement markings and the material captured by the vacuum. Verify that no significant loss of reflective media has occurred to the pavement marking due to the vacuum cleaning.

3.5.2 Reflective Media and Coating Application Verification

Use a wet film thickness gauge to masure the application of wet paint.

Use a microscope or magnifying glass to evaluate the embedment of glass beads in the paint. Verify the glass bead embedment with approximately 50% of the beads embedded and 50% of the beads exposed.

TABLE I
REQUIREMENTS FOR HIGH BUILD ACRYLIC COATINGS (HBAC)

| Test | Minimum Requirement (and Maximum where indicated) |
|---|---|
| Resin System (ASTM D 2621) | Waterborne 100% Acrylic |
| Percent Volume Solids (ASTM D 2697) | 58% |
| Volatile Organic Compound, max. (ASTM D 3960) | 1.25 lbs/gal |
| White (FED-STD-595) | 37925 |
| Yellow (FED-STD-595) | 33538 |
| Shore D Hardness (ASTM D 2240) | 45 |
| 1/8 inch Mandrel Bend @ 5 mils Dry Film Thickness (DFT, one-week cure (ASTM D 522, Method B) | No visual defects at bend (Conditions @ ASTM D 3924) |
| Adhesion to Concrete and Asphaltic Pavements (ASTM D 4541) | 140 psi or 100% cohesive failure in pavement |
| Accelerated Weathering, Yellow, 2500 Hours UV Exposure (ASTM G 53: see note 1) | Max. color loss to 33655 (FED-STD-595) |
| Water Absorption @ 168 Hours Immersion Tap Water (ASTM D 471) | 9.0% max. weight increase (conditions @ ASTM D 3924) |
| Application @ 65 mils Wet,One Coat, One-week Cure, (see note 2) | No visual cracking or curling (conditions @ ASTM D 3924) |
| No Pick-Up @ 25 mils (ASTM D 711) | Wet 10 minutes max. |
| Lead (ASTM D 3335) | 0.06% max. |
| Cadmium (ASTM D 3335) | 0.06% max. |
| Chromium (ASTM D 3718) | 0.00% |

Notes:
(1) Properly mix and apply yellow paint at 10 mils +/- 2 mils DFT over a suitably sized, clean aluminum substrate (ASTM D 823), and cure for a minimum of 48 hours: four individual yellow samples shall be prepared. Expose three samples to continuous Ultraviolet (UV) light for 2500 hours, without cycles condensation, in accordance to ASTM G 53: UVA-340 lamps shall be used in the testing apparatus. Following exposure, compare the three exposed samples to the "one" non-exposed sample using FED-STD-595 colors 33538 and 33655 as visual references: evaluate exposed samples for degree of visual color loss. Yellow paint shall receive a passing rating if each exposed sample appears equivalent to the non-exposed sample, and in addition,

TABLE I
REQUIREMENTS FOR HIGH BUILD ACRYLIC COATINGS (HBAC)

displays color loss no greater than FED-STD-595 color 33655.

(2) Using double-stick, foam mounting tape (or equal) with a nominal thickness of 65 mils, apply a rectangular mold with inner dimensions of 3 in by 10 in to a clean aluminum sample approximately sized at 6 in by 12 in by 1/8 in. Do not remove the tape's plastic backing. Mix and apply excess paint into mold. Remove excess paint, by squeegee or other appropriate draw down technique, to a uniform thickness equal to the tape's height. Paint application and draw down shall be performed within a period of no more than 60 seconds. Approximately one to two minutes following the draw down, remove tape from sample and allow coating to cure for a minimum period of one week ASTM D 3924. Using a micrometer or other appropriate device, measure cured coating thickness (less sample thickness) to confirm resulting coating application was at or above 38 mils DFT. Inspect coating for visual signs of cracking and curling. Following a one week cure, coating shall receive a passing rating if applied greater than 38 mils DFT and visually free of both cracking and curling.

TABLE II
PREAPPROVED HBACs

| Manufacturer | Products |
|---|---|
| TMT-Pathway<br>1021 N. Mission Road<br>Los Angeles, CA 90033<br>(800) 338-7680 | Legend Build, #2712A9, White<br>Legend Build, #2713A9, Yellow |
| Pervo Paints<br>6624 Stanford Ave.<br>Los Angeles, CA 90001<br>(323) 758-1147 | Pervo 6050, White<br>Pervo 6053, Yellow |
| Vogel Traffic Services<br>1920 Albany Place South<br>PO Box 140<br>Orange City, IA 51041<br>(712) 737-4016 | UC-1516, White<br>UC-3588, Yellow |

-- End of Section --

SECTION 32 31 13.53

HIGH-SECURITY CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 116 | (2005) Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric |
| ASTM A 121 | (2007) Standard Specification for Metallic-Coated Carbon Steel Barbed Wire |
| ASTM A 153/A 153M | (2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| ASTM A 176 | (1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip |
| ASTM A 478 | (1997; R 2008) Standard Specification for Chromium-Nickel Stainless Steel Weaving and Knitting Wire |
| ASTM A 702 | (1989; R 2006) Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought |
| ASTM A 780 | (2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings |
| ASTM A 824 | (2001; R 2007) Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence |
| ASTM B 117 | (2007a) Standing Practice for Operating Salt Spray (Fog) Apparatus |
| ASTM C 94/C 94M | (2007) Standard Specification for Ready-Mixed Concrete |
| ASTM F 1043 | (2008) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework |
| ASTM F 1083 | (2008) Standard Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures |

| | |
|---|---|
| ASTM F 1184 | (2005) Industrial and Commercial Horizontal Slide Gates |
| ASTM F 567 | (2007) Standard Practice for Installation of Chain Link Fence |
| ASTM F 626 | (2008) Standard Specification for Fence Fittings |
| ASTM F 900 | (2005) Industrial and Commercial Swing Gates |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| FS RR-F-191 | (Rev K) Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories) |
| FS RR-F-191/3 | (Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces) |
| FS RR-F-191/4 | (Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Accessories) |

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit Installation Drawings for the following items in accordance with paragraph entitled, "ASSEMBLY AND INSTALLATION DRAWINGS" of this section.

Fence Installation
Location of gate, corner, end, and pull posts
Gate Assembly; G, AE
Gate Hardware and Accessories; G, AE
Gate Operator; G, AE

SD-03 Product Data

Submit Manufacturer's catalog data for the following items:

Fence Installation
Gate Assemblies
Gate Hardware and Accessories

SD-06 Test Reports

Weight in ounces for zinc coating

SD-07 Certificates

Chain Link Fence

Submit reports, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

Zinc Coating
Fabric
Barbed Wire
Stretcher Bars
Gate Hardware and Accessories
Concrete

GATE OPERATOR
Motor Operated Cantilever Slide Gate

Submit certification that gate is in compliance with ASTM F2200-05, Standard Specification for Automated Vehicular Gate Construction per section 2.01 C.

SD-08 Manufacturer's Instructions

Submit Manufacturer's instructions for the following items:

Fence Installation
Gate Assembly
Hardware Assembly
Accessories

SD-10 Operation and Maintenance Data

Gate Operator

Submit operating and maintenance instructions

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

1.4 QUALITY ASSURANCE

1.3.1 Required Report Data

Submit reports of chain-link fencing listing and accessories regarding weight in ounces for zinc coating.

Submit reports demonstrating full compliance with the following standards:
FS RR-F-191 (Rev K)
FS RR-F-191/1 (Rev D)
FS RR-F-191/2 (Rev D)
FS RR-F-191/3 (Rev D)
FS RR-F-191/4 (Rev D)

1.5 Assembly and Installation Drawings

Prepare complete Fence Installation Drawings; Gate Fabrication and

Installation Drawings for review and approval by the A/E prior to fabrication. Drawing details shall include, but are not limited to:

Fence Installation
Location of gate, corner, end, and pull posts
Gate Assembly
Gate Hardware and Accessories.

PART 2 PRODUCTS

2.1 FENCE FABRIC

Fence fabric must conform to the following:

Provide ASTM A 392, Class 1, zinc-coated steel wire with minimum coating weight of 1.2 ounces of zinc per square foot of coated surface. Fabricate fence fabric of 9 gauge wire woven in 2 inch mesh conforming to ASTM A 116. Fabric height must be as shown. Fabric must be twisted and barbed on the top selvage and knuckled on the bottom selvage.

Secure fabric to posts using stretcher bars or ties spaced 15 inches on center, or by integrally weaving to integral fastening loops of end, corner, pull, and gate posts for full length of each post. Install fabric on opposite side of posts from area being secured.

2.2 POSTS

2.2.1 Metal Posts for Chain Link Fence

Provide posts conforming to ASTM F 1083, zinc-coated. Group IA, with external coating Type A steel pipe. Group IC steel pipe, zinc-coated with external coating Type A or Type B and Group II , roll-formed steel sections, meeting the strength and coating requirements of ASTM F 1043 and ASTM A 702. Group III, ASTM F 1043 steel H-section may be used for line posts in lieu of line post shapes specified for the other classes. Provide sizes as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Provide gate post for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184. Post spacing shall conform to the recommended guidelines as set forth in the CLFMI "Wind Load Guide for the Selection of Line Post Spacing and Size" unless specified to exceed those guidelines.

FS RR-F-191/3 line posts; Class 1, steel pipe, Grade A. End, corner, and pull posts; Class 1, steel pipe, Grade A.

2.2.2 Accessories

Provide accessories conforming to ASTM F 626. Ferrous accessories shall be zinc or aluminum coated.

Furnish truss rods for each terminal post. Provide truss rods with turnbuckles or other equivalent provisions for adjustment.

Barbed wire supporting arms must be of the 45 degree outward angle 3-strand arm type and of the design required for the post furnished. Arms must be secured by bolting.

Furnish post caps per manufacturer's standard accessories.

Provide 9 gauge steel tie wire for attaching fabric to rails, braces, and posts and match the coating of the fence fabric. Tie wires for attaching fabric to tension wire on high security fences shall be 16 gage stainless steel. The tie wires must be double loop tie wires 6.5 inches in length. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified.

## 2.3 BRACES AND RAILS

ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Braces and rails shall be Group IA, steel pipe, size NPS 1-1/4 and be zinc coated (Type A). Group II, formed steel sections, size 1-21/32 inch, conforming to ASTM F 1043, may be used as braces and rails if Group II line posts are furnished.

Braces, and top rail; Class 1, steel pipe, Grade A, in minimum sizes listed in FS RR-F-191/3 for each class and grade. Steel pipe, Class 1, Grade B shall meet the following performance criteria when subjected to salt spray testing in accordance with ASTM B 117:

Exterior 1,000 hours with maximum 5 percent red rust
Interior 650 hours with maximum 5 percent red rust.

## 2.4 WIRE

### 2.4.1 Wire Ties

FS RR-F-191/4. Provide wire ties constructed of the same material as the fencing fabric.

### 2.4.2 Barbed Wire

Provide barbed wire conforming to ASTM A 121 zinc-coated, Type Z, Class 3, or aluminum-coated, Type A, with 12.5 gauge wire with 14 gauge, round, 4-point barbs spaced no more than 5 inches apart.

### 2.4.3 Tension Wire

Provide Type I or Type II tension wire, Class 4 coating, in accordance with ASTM A 824.

## 2.5 BARBED TAPE

Provide reinforced barbed tape, double coil, for fence toppings fabricated from 430 series stainless steel with a hardness range of Rockwell (30N) 37-45 conforming to the requirements of ASTM A 176. Provide stainless steel strip 0.025 inch thick by 1 inch wide before fabrication. Each barb shall be a minimum of 1.2 inch in length, in groups of 4, spaced on 4 inch centers. The stainless steel core wire shall have a 0.098 inch diameter with a minimum tensile strength of 140 psi and be in accordance with ASTM A 478. Use sixteen gauge stainless steel twistable wire ties for attaching the barbed tape to the barbed wire and to the fence for ground application].

## 2.6 CONCRETE

ASTM C 94/C 94M, using 3/4 inch maximum size aggregate, and having minimum

compressive strength of 3000 psi at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

## 2.7 GATES

### 2.7.1 Manually Operated Cantilever Slide, and personnel Swing Gate Assemblies

Provide gate assembly conforming to ASTM F 900 and/or ASTM F 1184. Gate must be the type and swing shown. Gate frames must conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 1-1/2. Gate frames must conform to strength and coating requirements of ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1-1/2. Gate fabric shall be as specified for chain link fabric.

### 2.7.2 Gate Leaves

For gate leaves, more than 8 feet wide, provide either intermediate members and diagonal truss rods or tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Provide intermediate braces on all gate frames with an electro-mechanical lock. Attach fabric to the gate frame by method standard with the manufacturer except that welding will not be permitted.

### 2.7.3 Gate Hardware and Accessories

Furnish and install latches, hinges, stops, keepers, rollers, and other hardware items as required for the operation of the gate. Arrange latches for padlocking so that the padlock will be accessible from both sides of the gate. Provide stops for holding the gates in the open position. For high security applications, each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.

## 2.8 PADLOCKS

Padlocks as specified in section 08 71 00 DOOR HARDWARE.

## 2.9 Motor Operated Cantilever Slide Gate

### 2.9.1 Product/Manufacturer

The cantilever sliding gate system shall be model "Fortress Structural Cantilever Slide Gate" as manufactured by Tymetal Corp., 2549 State Route 40, Greenwich, NY 12834 - (800) 328-4283, or approved equal.

### 2.9.2 Gate Construction

The gate frame shall be generally fabricated from 6063-T6 aluminum alloy extrusions. The top member shall be a 3 inch x 5 inch (76mm x 127mm) aluminum structural channel/tube extrusion weighing not less than 3.0 lb/lf (4.3 kg/m). This frame member shall be "keyed" to interlock with the "keyed" track member. If fabricated as a single horizontal piece, the bottom member shall be a 2 inch x 5 inch (51mm x 127mm) aluminum structural tube weighing not less than 2.0 lb/lf (2.9kg/m). The gate frame shall be

fabricated in one section.

The vertical members at the ends of the opening portion of the frame shall be "P" shaped in cross section with a nominal base dimension of no less than 2 inch x 2 inch (51 mm x 51mm) and weighing not less than 1.6 lb/lf (2.3kg/m). The intermediate vertical members shall alternate between 2 inch x 2 inch (51mm 51mm) and 1 inch x 2 inch (25mm x 51mm) in cross section weighing not less than 1.1 lb/lf (1.6kg/m) and 0.82 lb/lf (1.2 kg/m) respectively. The spacing for the vertical intermediates shall be less than 50% of the gate frame height.

The gate frame shall have two separate semi-enclosed "keyed" tracks, extruded from 6105 - T5 aluminum alloy, weighing not less than 2.9 lb/lf (4.2kg/m). The track member to be located on each side of the top primary. When interlocked with and welded to the "keyed" top member, it forms a composite structure with the top of the gate frame. Welds to be placed alternately along the top and side of the track at 9 inches (229mm) centers with welds "being a minimum of 2 inch (51mm)."

The gate frame is to be supported from the track by four (4) swivel type, self-aligning, 4-wheeled, sealed lubricant, ball-bearing truck assemblies with stainless steel races. Each truck is to be attached to a hot dipped, galvanized steel hanger bracket which in turn is to be attached to a 4" 0.0. (102mm) support post. The bottom of each support post is to be equipped with a pair of 3 inch (76mm) UHMV guide wheels.

Diagonal "X" bracing of 3/16 inch (5mm) minimum diameter stainless steel aircraft cable shall be installed to brace the gate panels and to provide a ready means of vertical adjustment.

The gate shall be completed by installation of approved filler as specified. The gate filler will be chain link fencing as specified herein.

Structural Cantilever Slide Gate dimensions shall be as shown on the detail drawings. gate shall be customized as required to facilitate use of specified Electric Gate Operator. (see paragraph below)

2.9.3 Posts

Double support posts shall be a minimum 4 inch O.D. (102mm) round or 4 inch (102mm) square galvanized steel in accordance with ASTM F1184-03. All posts shall be supported in concrete footings as specified by the design team.

2.9.4 Finish

Gate to be mill finish aluminum. Gate posts shall be galvanized, as specified herein.Text

2.9.5 Electric Gate Operator

Gate operator shall be model RGS SL-1000, as manufactured by Rotary Gate Systems, Pensacola, FL 324514. Operator shall include APEX Controller, and 2 remote control devices.

## PART 3 EXECUTION

### 3.1 FENCE INSTALLATION

Perform complete installation conforming to ASTM F 567.

#### 3.1.1 Line and Grade

Install fence to the lines and grades indicated. Clear the area on either side of the fence line to the extent indicated. Space line posts equidistant at intervals not exceeding 10 feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Provide fabric continuous between terminal posts; however, runs between terminal posts shall not exceed 500 feet. Repair any damage to galvanized surfaces, including welding, with paint containing zinc dust in accordance with ASTM A 780.

#### 3.1.2 Excavation

Clear all post holes of loose material. Spread waste material where directed. Eliminate ground surface irregularities along the fence line to the extent necessary to maintain a 1 inch clearance between the bottom of the fabric and finish grade.

### 3.2 POST INSTALLATION

#### 3.2.1 Earth and Bedrock

Set posts plumb and in alignment. Set posts in concrete to the depth indicated on the drawings.

Posts set in concrete must be set in holes not less than the diameter shown on the drawings. Thoroughly consolidate concrete and grout around each post, free of voids and finished to form a dome. Allow concrete and grout to cure for 72 hours prior to attachment of nay item to the posts.

Test fence post rigidity by applying a 50 pound force on the post, perpendicular to the fabric, at 5 feet above ground. Post movement measured at the point where the force is applied shall be less than or equal to 3/4 inch from the relaxed position. Test every tenth post for rigidity. When a post fails this test, make further tests on the next four posts on either side of the failed post. All failed posts shall be removed, replaced, and retested at the Contractor's expense.

### 3.3 RAILS

### 3.4 FABRIC INSTALLATION

Install chain link fabric on the side of the post indicated. Attach fabric to terminal posts with stretcher bars and tension bands. Space bands at approximately 15 inch intervals. Install fabric and pull taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fasten fabric to line posts at approximately 15 inch intervals and fastened to all rails and tension wires at approximately 12 inch intervals.

Cut fabric by untwisting and removing pickets. Accomplish splicing by

weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 1 plus or minus 1/2 inch above the ground.

After the fabric installation is complete, exercise the fabric by applying a 50 pound push-pull force at the center of the fabric between posts; the use of a 30 pound pull at the center of the panel shall cause fabric deflection of not more than 2.5 inches when pulling fabric from the post side of the fence; every second fence panel shall meet this requirement; all failed panels must be resecured and retested at the Contractor's expense.

## 3.5 SUPPORTING ARMS

Install barbed wire supporting arms and barbed wire as indicated on the drawings and as recommended by the manufacturer. Anchor supporting arms with 3/8 inch diameter plain pin rivets or, at the Contractor's option, with studs driven by low-velocity explosive-actuated tools for steel, wrought iron, ductile iron, or malleable iron. Studs driven by an explosive-actuated tool shall not be used with gray iron or other material that can be fractured. Use a minimum of two studs per support arm. Pull barbed wire taut and attach to the arms with clips or other means that will prevent easy removal.

## 3.6 MANUALLY OPERATED GATE INSTALLATION

Install gates at the locations shown. Mount gates to swing as indicated. Install latches, stops, and keepers as required. Install Slide gates as recommended by the manufacturer.

Attach padlocks to gates or gate posts with chains. Weld or otherwise secure hinge pins, and hardware assembly to prevent removal.

Submit Six copies of operating and maintenance instructions, a minimum of 2 weeks prior to field training. Operating instructions shall outline the step-by-step procedures required for system startup, operation, and shutdown. Include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Include in the maintenance instructions routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. Also include the general gate layout, equipment layout and simplified wiring and control diagrams of the system as installed.

## 3.7 GROUNDING

Ground fencing as recommended by fencing manufacturer.

## 3.8 Motorized Sliding gate and Operator Installation

### 3.8.1 Field Conditions

Final grades and installation conditions shall be examined. Installation shall not begin until all unsatisfactory conditions are corrected.

### 3.8.2 Installation

Equipment in this section shall be installed in strict accordance with the manufacturer's printed instruction unless otherwise shown on the contract

drawings.

The gate and operator installation shall conform to ASTM F1184-03 standards for aluminum cantilever slide gates, Type II, Class 2, ASTM F2200-05 and UL 325.

3.8.2 Operation, testing and Instruction

The installer of gate and gate operator shall test all features of equipment under the observation of the Contracting Officer. The Contracting Officer will determine when the gate and operator installation is complete and operating appropriately.

The representative for the Gate Operator shall provide a 2 hour minimum training session, based on Operation and Maintenance manuals. This training session shall be scheduled through the Contracting Officer and presented to attendees determined by the Contracting Officer. Instruction should include standard operating procedures, maintenance requirements, trouble-shooting techniques, with demonstration and explanation of all Controls, both manual and electronic.

3.8 CLEANUP

Remove waste fencing materials and other debris from the work site each workday.

SECTION 33 11 00

WATER DISTRIBUTION
**10/06**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO HB-17 | (2002; Errata 2003; Errata 2005) Standard Specifications for Highway Bridges |

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

| | |
|---|---|
| AREMA Eng Man | (2008) Manual for Railway Engineering |

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|---|---|
| AWWA B300 | (2004) Hypochlorites |
| AWWA B301 | (2004) Liquid Chlorine |
| AWWA C104/A21.4 | (2003) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water |
| AWWA C105/A21.5 | (2005) Polyethylene Encasement for Ductile-Iron Pipe Systems |
| AWWA C110/A21.10 | (2008) Ductile-Iron and Gray-Iron Fittings for Water |
| AWWA C111/A21.11 | (2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings |
| AWWA C115/A21.15 | (2005) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges |
| AWWA C151/A21.51 | (2002; Errata 2002) Ductile-Iron Pipe, Centrifugally Cast, for Water |
| AWWA C153/A21.53 | (2006) Ductile-Iron Compact Fittings for Water Service |
| AWWA C200 | (2005) Steel Water Pipe - 6 In. (150 mm) and Larger |
| AWWA C203 | (2002) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied |

| | |
|---|---|
| AWWA C205 | (2007) Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. (100 mm) and Larger - Shop Applied |
| AWWA C206 | (2003) Field Welding of Steel Water Pipe |
| AWWA C207 | (2007) Standard for Steel Pipe Flanges for Waterworks Service-Sizes 100 mm through 3600 mm 4 in. through 144 in. |
| AWWA C208 | (2007) Standard for Dimensions for Fabricated Steel Water Pipe Fittings |
| AWWA C209 | (2006) Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections and Fitting for Steel Water Pipe |
| AWWA C210 | (2007) Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines |
| AWWA C300 | (2004) Reinforced Concrete Pressure Pipe, Steel-Cylinder Type |
| AWWA C301 | (2007) Prestressed Concrete Pressure Pipe, Steel-Cylinder Type |
| AWWA C303 | (2002) Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type |
| AWWA C500 | (2002; R 2003) Metal-Seated Gate Valves for Water Supply Service |
| AWWA C502 | (2005) Dry-Barrel Fire Hydrants |
| AWWA C503 | (2005) Wet-Barrel Fire Hydrants |
| AWWA C504 | (2006) Standard for Rubber-Seated Butterfly Valves |
| AWWA C508 | (2001) Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS |
| AWWA C509 | (2001) Resilient-Seated Gate Valves for Water Supply Service |
| AWWA C600 | (2005) Installation of Ductile-Iron Water Mains and Their Appurtenances |
| AWWA C605 | (2005) Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water |
| AWWA C606 | (2006) Grooved and Shouldered Joints |
| AWWA C651 | (2005; Errata 2005) Standard for Disinfecting Water Mains |

| | |
|---|---|
| AWWA C701 | (2007) Standard for Cold-Water Meters - Turbine Type for Customer Service |
| AWWA C800 | (2005) Underground Service Line Valves and Fittings |
| AWWA C900 | (2007; Errata 2008) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution |
| AWWA C901 | (2008) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13mm) Through 3 In. (76 mm), for Water Service |
| AWWA C905 | (1997) Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings 14 In. Through 48 In. (350 mm through 1,200 mm) |
| AWWA C906 | (2007) Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) through 63 In., (1,575 mm) for Water Distribution and Transmission |
| AWWA C909 | (2002) Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 IN through 12 IN (100 mm Through 300 mm), for Water Distribution |
| AWWA C950 | (2007) Fiberglass Pressure Pipe |
| AWWA M11 | (2004) Manual: Steel Pipe: A Guide for Design and Installation |
| AWWA M23 | (2002) Manual: PVC Pipe - Design and Installation |
| AWWA M9 | (1995) Manual: Concrete Pressure Pipe |

ASME INTERNATIONAL (ASME)

| | |
|---|---|
| ASME B16.1 | (2005) Standard for Gray Iron Threaded Fittings; Classes 125 and 250 |
| ASME B16.15 | (2006) Cast Bronze Threaded Fittings Classes 125 and 250 |
| ASME B16.18 | (2001; R 2005) Cast Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.22 | (2001; R 2005) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.26 | (2006) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes |
| ASME B16.3 | (2006) Malleable Iron Threaded Fittings, Classes 150 and 300 |

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|---|---|
| ASME B16.4 | (2006) Standard for Gray Iron Threaded Fittings; Classes 125 and 250 |
| ASME B18.2.2 | (1987; R 2005) Standard for Square and Hex Nuts |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 307 | (2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength |
| ASTM A 53/A 53M | (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A 536 | (1984e1; R 2004) Standard Specification for Ductile Iron Castings |
| ASTM A 563 | (2007a) Standard Specification for Carbon and Alloy Steel Nuts |
| ASTM A 746 | (2003) Standard Specification for Ductile Iron Gravity Sewer Pipe |
| ASTM B 32 | (2008) Standard Specification for Solder Metal |
| ASTM B 42 | (2002e1) Standard Specification for Seamless Copper Pipe, Standard Sizes |
| ASTM B 61 | (2008) Standard Specification for Steam or Valve Bronze Castings |
| ASTM B 62 | (2002) Standard Specification for Composition Bronze or Ounce Metal Castings |
| ASTM B 88 | (2003) Standard Specification for Seamless Copper Water Tube |
| ASTM C 150 | (2007) Standard Specification for Portland Cement |
| ASTM C 94/C 94M | (2007) Standard Specification for Ready-Mixed Concrete |
| ASTM D 1527 | (1999; R 2005) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80 |
| ASTM D 1599 | (2005) Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings |
| ASTM D 1784 | (2008) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds |

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| ASTM D 1785 | (2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120 |
| ASTM D 2235 | (2004) Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings |
| ASTM D 2241 | (2005) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) |
| ASTM D 2282 | (1999; R 2005) Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (SDR-PR) |
| ASTM D 2464 | (2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM D 2466 | (2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 |
| ASTM D 2467 | (2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM D 2468 | (1996a) Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40 |
| ASTM D 2564 | (2004e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems |
| ASTM D 2657 | (2007) Heat Fusion Joining Polyolefin Pipe and Fittings |
| ASTM D 2774 | (2008) Underground Installation of Thermoplastic Pressure Piping |
| ASTM D 2855 | (1996; R 2002) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings |
| ASTM D 2996 | (2001; R 2007e1) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe |
| ASTM D 2997 | (2001; R 2007e1) Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe |
| ASTM D 3139 | (1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals |
| ASTM D 3839 | (2008) Underground Installation of |

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|---|---|
| | "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe |
| ASTM D 4161 | (2001; R 2005) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals |
| ASTM F 1483 | (2005) Oriented Poly(Vinyl Chloride), PVCO, Pressure Pipe |
| ASTM F 402 | (2005) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings |
| ASTM F 477 | (2008) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

| | |
|---|---|
| MSS SP-80 | (2008) Bronze Gate, Globe, Angle and Check Valves |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 24 | (2006) Standard for the Installation of Private Fire Service Mains and Their Appurtenances |
| NFPA 325 | (1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids |
| NFPA 49 | (2003) Hazardous Chemicals Data |
| NFPA 704 | (2006) Identification of the Hazards of Materials for Emergency Response |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 246 | (1993; Rev thru Dec 1998) Hydrants for Fire-Protection Service |
| UL 262 | (2004) Standard for Gate Valves for Fire-Protection Service |
| UL 312 | (2004) Check Valves for Fire-Protection Service |
| UL 789 | (2004; Rev thru Aug 2008) Indicator Posts for Fire-Protection Service |

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

| | |
|---|---|
| UBPPA UNI-B-3 | (1992) Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch) |

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| UBPPA UNI-B-8 | (2000) Recommended Practice for the Direct Tapping of Polyvinyl Chloride (PVC) Pressure Water Pipe (Nominal Diameters 6-12 Inch) |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Piping Materials

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Hydrants

Indicator posts

Corporation stops

Valve boxes

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on and rubber-gasketed bell-and-spigot joints. Include information concerning gaskets with submittal for joints and couplings.

SD-05 Design Data

Design calculations of water piping

SD-06 Test Reports

Bacteriological Disinfection

Test results from commercial laboratory verifying disinfection

SD-07 Certificates

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Shop-applied lining and coating

Lining

Fire hydrants

Displacement Type Meters

Compound Type Meters

Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

SD-08 Manufacturer's Instructions

Delivery, storage, and handling

Installation procedures for water piping

## 1.3 DELIVERY, STORAGE, AND HANDLING

### 1.3.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves and hydrants free of dirt and debris.

### 1.3.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place any other material or pipe inside a pipe or fitting after the coating has been applied. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Store rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

#### 1.3.2.1 Coated and Wrapped Steel Pipe

Handle steel pipe with coating in accordance with the provisions of AWWA C203.

#### 1.3.2.2 Polyethylene (PE) Pipe, Fittings, and Accessories

Handle PE pipe, fittings, and accessories in accordance with AWWA C901.

1.3.2.3 Miscellaneous Plastic Pipe and Fittings

Handle Polyvinyl Chloride (PVC), pipe and fittings in accordance with the manufacturer's recommendations. Store plastic piping and jointing materials that are not to be installed immediately under cover out of direct sunlight.

Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325.

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Piping Materials

2.1.1.1 Ductile-Iron Piping

a. Pipe and Fittings: Pipe, except flanged pipe, AWWA C151/A21.51. Flanged pipe, AWWA C115/A21.15.] Fittings, AWWA C110/A21.10 or AWWA C153/A21.53 ; fittings with push-on joint ends conforming to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104/A21.4, twice the standard thickness.

b. Joints and Jointing Material:

(1) Joints: Joints for pipe and fittings shall be push-on joints or mechanical joint unless otherwise indicated. Provide mechanical joints where indicated. Provide flanged joints where indicated. Provide mechanically coupled type joints using a sleeve-type mechanical coupling where indicated. Provide grooved or shouldered] type joints where indicated. Provide insulating joints where indicated. Joints made with sleeve-type mechanical coupling may be used in lieu of push-on joint, subject to the limitations specified in paragraph entitled "Sleeve-Type Mechanical Couplings." Grooved or shouldered type joints may be used in lieu of flanged joint or push-on joint, except where joint is buried.

(2) Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly, AWWA C111/A21.11.

(3) Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111/A21.11.

(4) Flanged Joints: Bolts, nuts, and gaskets for flanged connections as recommended in the Appendix to AWWA C115/A21.15. Flange for setscrewed flanges shall be of ductile iron, ASTM A 536, Grade 65-45-12, and conform to the applicable requirements of ASME B16.1, Class 250. Setscrews for setscrewed flanges shall be 190,000 psi tensile strength, heat treated and zinc-coated steel. Gasket and lubricants for setscrewed flanges, in accordance with applicable requirements for mechanical-joint gaskets specified in AWWA C111/A21.11. Design of setscrewed gasket shall provide for

confinement and compression of gasket when joint to adjoining flange is made.

(5) Insulating Joints: Designed to effectively prevent metal-to-metal contact at the joint between adjacent sections of piping. Joint shall be of the flanged type with insulating gasket, insulating bolt sleeves, and insulating washers. Gasket shall be of the dielectric type, full face, and in other respects as recommended in the Appendix to AWWA C115/A21.15. Bolts and nuts, as recommended in the Appendix to AWWA C115/A21.15.

(6) Sleeve-Type Mechanical Coupled Joints: As specified in paragraph entitled "Sleeve-Type Mechanical Couplings."

(7) Grooved and Shouldered Type Joints: Grooved and shouldered pipe ends and couplings, AWWA C606. Joint dimension shall be as specified in AWWA C606 for rigid joints , except that where joints are indicated to be flexible, joint dimensions shall be as specified for flexible joints.

2.1.1.2 Polyvinyl Chloride (PVC) Plastic Piping

a. Pipe and Fittings: Pipe, AWWA C900, shall be plain end or gasket bell end, Pressure Class 150 (DR 18) 200 (DR 14)with cast-iron-pipe-equivalent OD. Molecularly Oriented Polyvinyl Chloride (PVCO) pressurepipe, AWWA C909,shall be plain end or gasket bell end, Pressure Class 150 with cast-iron-pipe-equivalent outside diameter.

b. Pipe 14 through 36 diameter: AWWA C905.

c. Fittings for PVC pipe: Fittings shall be gray iron or ductile iron, AWWA C110/A21.10 or AWWA C153/A21.53, and have cement-mortar lining, AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with PVC plastic pipe specified in this paragraph. Iron fittings and specials shall be cement-mortar lined in accordance with AWWA C104/A21.4. Fittings and specials may be of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C605 and AWWA C900. Pipe, couplings and fittings for PVCO plastic pipe shall be manufactured of material conforming to ASTM F 1483 and ASTM D 1784, Class 12454-B. Schedule 80 PVC fittings shall conform to ASTM D 2467.

d. Joints and Jointing Material: Joints for pipe shall be push-on joints, ASTM D 3139. Joints between pipe and metal fittings, valves, and other accessories shall be push-on joints ASTM D 3139, or compression-type joints/mechanical joints, ASTM D 3139 and AWWA C111/A21.11. Provide each joint connection with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe, ASTM F 477. Gaskets for push-on joints and compression-type joints/mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories, AWWA C111/A21.11, respectively, for push-on joints and mechanical joints. Mechanically coupled joints using a sleeve-type mechanical coupling, as specified in paragraph entitled "Sleeve-Type Mechanical Couplings," may be used as an

optional jointing method in lieu of push-on joints on plain-end PVC plastic pipe, subject to the limitations specified for mechanically coupled joints using a sleeve-type mechanical coupling and to the use of internal stiffeners as specified for compression-type joints in ASTM D 3139.

2.1.1.3 Polyethylene (PE) Plastic Piping

Pipe, tubing, and heat-fusion fittings shall conform to AWWA C906.

2.1.1.4 Reinforced Thermosetting Resin Pipe (RTRP)

a. Pipe shall have a quick-burst strength greater than or equal to four times the normal working pressure of the pipe. The quick-burst strength test shall conform to the requirements of ASTM D 1599.

b. Fittings and specials required for closures, curves, bends, branches and connections to valves, pipe, or structures shall be approved by the Contracting Officer and conform to the details furnished by the manufacturer and to AWWA C300, AWWA C301, or AWWA C303, as applicable.

c. Joints shall be bell and spigot gasket coupling utilizing an elastomeric gasket in accordance with ASTM D 4161.

d. RTRP-I, Grade 1 and 2 Pipe and Joints: RTRP-I pipe shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of 150 psi at 73 degrees F. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996. Joints shall be bell and spigot with elastomeric gasket, mechanical coupling with elastomeric gasket, threaded and bonded coupling, or tapered bell and spigot with compatible adhesive. All RTRP-I materials shall be products of a single manufacturer.

e. RTRP-II, Grade 1 and 2: RTRP-II shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe. Joints shall be the bell and spigot type with elastomeric gasket, bell and spigot with adhesive, butt-jointed with adhesive bonded reinforced overlay, mechanical, flanged, threaded or commercially available proprietary joints, provided they are capable of conveying water at the pressure and temperature of the pipe.

2.1.1.5 Reinforced Plastic Mortar Pressure Pipe (RPMP)

a. RPMP shall be produced by centrifugal casting and shall have an OD 12 to 48 inches equal to ductile-iron, with a 150 psi pressure rating and with a minimum pipe stiffness of 36 psi. RPMP shall be in accordance with AWWA C950.

b. Fittings and specials shall be compatible with the pipe supplied. Filament wound or molded fittings up to 6 inches shall conform to AWWA C950. Iron fittings shall be cement-mortar lined in accordance with AWWA C104/A21.4 and shall conform to AWWA C110/A21.10 and AWWA C111/A21.11. Fittings shall be suitable

for working and testing pressures specified for the pipe.

c. Joints shall be bell and spigot gasket coupling utilizing an elastomeric gasket in accordance with ASTM D 4161.

]2.1.1.6 Reinforced and Prestressed Concrete Piping

a. Piping and Fittings: Prestressed steel cylinder type reinforced concrete pipe, AWWA C301. Steel cylinder type reinforced concrete pipe, not prestressed, AWWA C300.] Pretensioned steel cylinder type reinforced concrete pipe, AWWA C303. Pipe shall be designed for the following minimum conditions:

Water hammer - 40 percent of pressure rating

Live load - AASHTO H 20 truck loading

Do not order pipe until design calculations have been approved. Fittings shall conform to the same specification as that used for the pipe and shall be designed as specified for the pipe. Cement used in the manufacture of the pipe and fittings shall be Type II conforming to ASTM C 150.] Identification marking for pipe and fittings shall include the pressure rating.

b. Jointing Material: Gaskets shall be as specified in the referenced specification for the pipe. Rubber-gasket joints shall be of the type using a bell and spigot joint design of steel.

2.1.1.7 Steel Piping

a. Pipe and Fittings: Pipe, AWWA C200. Fittings, AWWA C208 and to AWWA C200, with reference to the requirements specified therein for "Special Sections." Pipe and fittings for underground lines shall have cement-mortar lining and cement-mortar coal-tar enamel coal-tar epoxy coating. Pipe and fittings for aboveground lines shall have cement-mortar lining. Ends of pipe and fittings shall be suitable for the joints and jointing materials used.

1. Pipe shall be welded or seamless with plain or shouldered and grooved ends in accordance with AWWA C606 for use with mechanical couplings or bell-and-spigot ends with rubber gaskets. Bell-and-spigot ends for sizes less than 6 inches diameter shall be as required by AWWA C200.

2. Fittings and specials shall be made of the same material as the pipe. Specials and fittings may be made of standard steel tube turns or segmentally welded sections, with ends to accommodate the type of couplings or joints specified for the pipe. The thickness rating of pipe fittings and specials shall be not less than the thickness specified and the pressure rating calculated for the pipe with which they are used. Protective materials for fittings and specials shall be as specified for the pipe. Specials and fittings that cannot be mechanically lined, coated, and wrapped shall be lined, coated, and wrapped by hand, using the same material used for the pipe with the same

number of applications of each material, smoothly applied.

b. Wall Thickness for Pipe and Fittings: Wall thickness of steel pipe and fittings shall be determined by the manufacturer of the pipe. and calculated in the following manner. Design for the following minimum conditions:

Water hammer.....40 percent of pressure rating

Live load.....AASHTO H 20 truck loading

Allowable deflection.....2 percent of nominal pipe diameter

Calculate pipe wall thickness on the basis of an allowable fiber stress in the steel equal to 50 percent of the minimum yield strength of the steel used in the manufacture of the pipe. Design procedure shall be in accordance with the methods given in AWWA M11, Chapter 4, "Determination of Pipe Wall Thickness," Chapter 5, "Water Hammer and Pressure Surge," and Chapter 6, "External Load." Wall thickness of fittings shall be not less than that required for the pipe. Fittings shall be designed to withstand the hydrostatic pressure test specified herein in paragraphs entitled "Testing Procedure," and "Special Testing Requirements." When necessary to meet the pressure test requirements, fittings shall be reinforced in accordance with methods given in AWWA M11, Chapter 13, "Supplementary Design Data and Details."

c. Joints and Jointing Materials

(1) Joints: Joints for pipe and fittings shall be rubber-gasketed bell-and-spigot joints , welded joints, or the mechanically coupled type using a sleeve-type mechanical coupling , unless otherwise specified. Provide flanged joints where indicated. Provide mechanically coupled type joints using a sleeve type mechanical coupling where indicated. Joints shall be grooved or shouldered type where indicated. Provide insulating joints where indicated. Grooved or shouldered type joints may be used in lieu of flanged joints.

(2) Rubber-Gasketed Bell-and-Spigot Joints: Design of joints and pipe ends shall be in accordance with the pipe manufacturer's standard for this type of joint, as approved, except that the joint shall also meet the requirements specified for rubber-gasketed joints and rubber gaskets in AWWA C200.

(3) Welded Joints: Electrodes shall be of the quality specified in AWWA C206.

(4) Sleeve-Type Mechanical Coupled Joints: As specified in paragraph entitled "Sleeve-Type Mechanical Couplings."

(5) Grooved and Shouldered Type Joints: Pipe ends shall be grooved by roll grooving or shall have welded-on adapters with cut grooves. Grooves made by roll grooving shall have dimensions as recommended by the coupling manufacturer. Cut grooves in adapters shall have dimensions conforming to AWWA C606. Couplings and shouldered pipe ends, AWWA C606. Joint dimensions shall be as specified in AWWA C606 for rigid joint , except that where joints

are indicated to be flexible, joint dimensions shall be as specified for flexible joints.

(6) Flanged Joints: Provide pipe ends with steel flanges, AWWA C207. Bolts and nuts for flanged connections, AWWA C207. Rubber gaskets, AWWA C207; asbestos gaskets will not be allowed.

(7) Insulating Joints: Design to prevent metal-to-metal contact at the joint between adjacent sections of piping. Joint shall be of the flanged type with insulating gasket, insulating bolt sleeves, and insulating washers. Gasket shall be of the dielectric type, full face, and in other respects as recommended in the Appendix to AWWA C115/A21.15. Bolts and nuts shall be as recommended in the Appendix to AWWA C115/A21.15.

d. Lining and Coating:

(1) Cement-Mortar Lining: AWWA C205, shop-applied.

(2) Cement-Mortar Coating: AWWA C205, shop-applied.

(3) Coal-Tar Enamel Coating: Except as otherwise specified, prepare, prime, and coat piping with hot-applied coal-tar enamel and a bonded single layer of felt wrap in accordance with AWWA C203. Asbestos felt shall not be used; felt material shall be fibrous-glass mat as specified in Section 10 of AWWA C203. Shop-apply coating.

(4) Coal-Tar Epoxy Coating: Clean, prime, and topcoat piping with coal-tar epoxy coating system in accordance with AWWA C210. Shop-apply coating.

2.1.1.8 Piping Beneath Railroad Right-of-Way

Piping passing under the right-of-way of a commercial railroad shall conform to the specifications for pipelines conveying nonflammable substances in Chapter 1, Part 5 of the AREMA Eng Man, except for casing pipe, provide ductile-iron pipe in lieu of cast-iron pipe. Ductile-iron pipe shall conform to and have strength computed in accordance with ASTM A 746.

2.1.2 Valves, Hydrants, and Other Water Main Accessories

2.1.2.1 Gate Valves on Buried Piping

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be nonrising stem type with double-disc gates and mechanical-joint ends or push-on joint ends as appropriate for the adjoining pipe, (2) AWWA C509 shall be nonrising stem type with mechanical-joint ends [or resilient-seated gate valves 3 to 12 inches in size], and (3) UL 262 shall be inside-screw type with operating nut, double-disc or split-wedge type gate, and shall have mechanical-joint ends or push-on joint ends as appropriate for the pipe to which it is joined. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have 0-ring stem seals [, except for those valves for which gearing is specified, in which case use conventional packing in place of 0-ring seal]. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. In lieu of

mechanical-joint ends and push-on joint ends, valves may have special ends for connection to cement piping or to sleeve-type mechanical coupling. Valve ends and gaskets for connection to cement piping or to sleeve-type mechanical coupling shall conform to the applicable requirements specified respectively for the joint or coupling. Where a post indicator is shown, the valve shall have an indicator post flange; indicator post flange for AWWA C500 valve shall conform to the applicable requirements of UL 262. Valves shall be of one manufacturer.

2.1.2.2 Gate Valves in Valve Pit(s) and Aboveground Location

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be outside-screw-and-yoke rising-stem] nonrising stem type with double-disc solid-wedge gates and flanged ends, (2) AWWA C509 shall be outside-screw-and-yoke rising-stem nonrising stem] type with flanged ends, and (3) UL 262 shall be outside-screw-and-yoke inside-screw type, shall have double-disc or split-wedge solid or one-piece type gate and flanged ends. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Provide valves with handwheels that open by counterclockwise rotation of the valve stem. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. In lieu of flanged ends, valves may have grooved [or] shouldered ends suitable for grooved of shouldered type joints, as specified in paragraph entitled "Ductile-Iron Piping." Valves shall be of one manufacturer.

2.1.2.3 Check Valves

Swing-check type, AWWA C508 or UL 312. Valves conforming to: (1) AWWA C508 shall have iron or steel body and cover and flanged ends, and (2) UL 312 shall have cast iron or steel body and cover, flanged ends. Materials for UL 312 valves shall conform to the reference standards specified in AWWA C508. Valves shall have clear port opening. Valves shall be spring-loaded weight-loaded where indicated. Flanges shall be Class 125 conforming to ASME B16.1. In lieu of flanged ends, valves may have grooved or shouldered ends suitable for grooved or shouldered type joints, as specified in paragraph entitled "Ductile-Iron Piping." Valves shall be of one manufacturer.

2.1.2.4 Rubber-Seated Butterfly Valves

Rubber-seated butterfly valves shall conform to the performance requirements of AWWA C504. Wafer type valves conforming to the performance requirements of AWWA C504 in all respects, but not meeting laying length requirements will be acceptable if supplied and installed with a spacer providing the specified laying length. All tests required by AWWA C504 shall be met. Flanged-end valves shall be installed in an approved pit and provided with a union or sleeve-type coupling in the pit to permit removal. Mechanical-end valves 3 through 10 inches in diameter may be direct burial if provided with a suitable valve box, means for manual operation, and an adjacent pipe joint to facilitate valve removal. Valve operators shall restrict closing to a rate requiring approximately 60 seconds, from fully open to fully closed.

2.1.2.5 Pressure Reducing Valves

Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. The valves shall be of the hydraulically-operated, pilot controlled, globe or angle type, and may be

actuated either by diaphragm or piston. The pilot control shall be the diaphragm-operated, adjustable, spring-loaded type, designed to permit flow when controlling pressure exceeds the spring setting. Ends shall be threaded flanged. Valve bodies shall be bronze, cast iron or cast steel with bronze trim. Valve stem shall be stainless steel. Valve discs and diaphragms shall be synthetic rubber. Valve seats shall be bronze. Pilot controls shall be bronze with stainless steel working parts.

2.1.2.6 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

2.1.2.7 Fire Hydrants

Dry-barrel type or wet-barrel type , except that flush-type hydrants shall be provided where indicated. Paint hydrants with at least one coat of primer and two coats of yellow enamel paint, except use red enamel paint for tops of hydrants in non-potable water systems. Stencil hydrant number and main size on the hydrant barrel using black stencil paint.

a. Dry-Barrel Type and Wet-Barrel Type Fire Hydrants: Dry-barrel type hydrants, AWWA C502 or UL 246, "Base Valve" design, shall have 6 inch inlet, 5 1/4 inch valve opening, one 4 1/2 inch pumper connection, and two 2 1/2 inch hose connections. Wet-barrel type hydrants, AWWA C503 or UL 246, "Wet Barrel" design, shall have 6 inch inlet, one 4 1/2 inch pumper connection, and two 2 1/2 inch hose connections. Pumper connection and hose connections shall be individually valved with independent nozzle gate valves. Inlet shall have mechanical-joint or push-on joint end mechanical-joint end only , except where flanged end is indicated; end shall conform to the applicable requirements as specified for the joint. Size and shape of operating nut, cap nuts, and threads on hose and pumper connections shall be as specified in AWWA C502 or AWWA C503 or UL 246 indicated. Hydrants indicated as "traffic type," shall have frangible sections as mentioned in AWWA C502 breakable features as mentioned in AWWA C50. The traffic type hydrant shall have special couplings joining upper and lower sections of hydrant barrel and upper and lower sections of hydrant stem and shall be designed to have the special couplings break from a force not less than that which would be imposed by a moving vehicle; hydrant shall operate properly under normal conditions.

b. Flush-Type Fire Hydrants: Hydrants shall conform to the applicable requirements of AWWA C502, except that they shall be of a design that will permit placement of hydrant below surface of pavement. Hydrants shall have 6 inch inlet, 4 1/4 inch minimum valve opening, one 4 1/2 inch pumper connection, and one 2 1/2 inch hose connection. Hose and pumper connections and operating nuts shall be readily accessible, and enclosed in a cast iron box with top flush with pavement and having cast-iron cover with flush lifting handle. Inlet shall have mechanical-joint or push-on joint end, except where flanged end is indicated. Size and shape of operating nut and cap nuts and threads on hose and pumper connections shall be as specified in AWWA C502 indicated.

]2.1.2.8 Indicator Posts

UL 789. Provide for gate valves where indicated.

2.1.2.9 Valve Boxes

Provide a valve box for each gate valve on buried piping , except where indicator post is shown. Valve boxes shall be of cast iron or precast concrete of a size suitable for the valve on which it is to be used and shall be adjustable. Cast-iron boxes shall have a minimum cover and wall thickness of 3/16 inch. Precast concrete boxes installed in locations subjected to vehicular traffic shall be designed to withstand the following AASHTO load designation as outline in AASHTO HB-17. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches. Cast-iron box shall have a heavy coat of bituminous paint.

2.1.2.10 Valve Pits

Valve pits shall be constructed at locations indicated or as required above and in accordance with the details shown.

2.1.2.11 Turbine Type Meters

Turbine type meters shall conform to AWWA C701 . The main casing shall be bronze or cast iron protected by corrosion resistant coating with stainless steel external fasteners. Registers shall be straight-reading type, and shall read in U.S. gallons. Connections shall be suitable to the type of pipe and conditions encountered. Meters shall comply with the accuracy and capacity requirements of AWWA C701.

2.1.2.12 Meter Vaults

Large meters shall be installed in reinforced concrete vaults.

2.1.2.13 Sleeve-Type Mechanical Couplings

Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. Gaskets shall be designed for resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111/A21.11. Bolts shall be track-head type, ASTM A 307, Grade A, with nuts, ASTM A 563, Grade A; or round-head square-neck type bolts, ASME B18.5.2.1M and ASME B18.5.2.2M with hex nuts, ASME B18.2.2. Bolts shall be 5/8 inch in diameter. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Mechanically coupled joints using a sleeve-type mechanical coupling shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint. Mechanical couplings shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight setting or shifting in

the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline.

2.1.2.14 Bonded Joints

For all ferrous pipe, a metallic bond shall be provided at each joint, including joints made with flexible couplings, caulking, or rubber gaskets, of ferrous metallic piping to effect continuous conductivity. The bond wire shall be Size 1/0 copper conductor suitable for direct burial shaped to stand clear of the joint. The bond shall be of the thermal weld type.

]2.1.2.15 Tracer Wire for Nonmetallic Piping

Provide bare copper or aluminum wire not less than 0.10 inch in diameter in sufficient length to be continuous over each separate run of nonmetallic pipe.

2.2 WATER SERVICE LINE MATERIALS

2.2.1 Piping Materials

2.2.1.1 Copper Pipe and Associated Fittings

Pipe, ASTM B 42, regular, threaded ends. Fittings shall be brass or bronze, ASME B16.15, 125 pound.

2.2.1.2 Copper Tubing and Associated Fittings

Tubing, ASTM B 88, Type K. Fittings for solder-type joint, ASME B16.18 or ASME B16.22; fittings for compression-type joint, ASME B16.26, flared tube type.

2.2.1.3 Plastic Piping

Plastic pipe and fittings shall bear the seal of the National Sanitation Foundation (NSF) for potable water service. Plastic pipe and fittings shall be supplied from the same manufacturer.

a. Polyvinyl Chloride (PVC) Plastic Piping with Screw Joints: ASTM D 1785, Schedule 40; or ASTM D 2241, with SDR as necessary to provide 150 psi minimum pressure rating. Fittings, ASTM D 2466 or ASTM D 2467. Pipe and fittings shall be of the same PVC plastic material. Solvent cement for jointing, ASTM D 2564. Pipe couplings, when used shall be tested as required by ASTM D 2464.

b. Polyvinyl Chloride (PVC) Plastic Piping with Elastomeric-Gasket Joints:

   Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 40, with joints meeting the requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified.

c. Polyvinyl Chloride (PVC) Plastic Piping with Solvent Cement Joints:

   Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure.

d. Polyethylene (PE) Plastic Pipe: Pipe tubing, and heat fusion fitting shall conform to AWWA C901.

e. Acrylonitrile-butadiene-styrene (ABS) Plastic Piping: ASTM D 1527 or ASTM D 2282, with pipe schedule or SDR as necessary to provide 150 psi minimum pressure rating. Fittings, ASTM D 2468, as required to provide barrel wall thickness not less than that of the pipe. Solvent cement for jointing, ASTM D 2235.

f. Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe: AWWA C909, plain end or gasket bell end, Pressure Class 150 with cast iron pipe equivalent outside diameter.

2.2.1.4 Reinforced Thermosetting Resin Piping (RTRP)

a. Pipe shall have a quick-burst strength greater than or equal to four times the normal working pressure of the pipe. The quick-burst strength test shall conform to the requirements of ASTM D 1599.

b. Fittings and specials shall be compatible with the pipe supplied. Filament wound or molded fittings up to 6 inches shall conform to AWWA C950. Iron fittings shall be cement-mortar lined in accordance with AWWA C104/A21.4 and shall conform to AWWA C110/A21.10 and AWWA C111/A21.11. Fittings shall be suitable for working and testing pressures specified for the pipe.

c. Joints shall be bell and spigot gasket coupling utilizing an elastomeric gasket in accordance with ASTM D 4161.

d. RTRP-I, Grade 1 and 2 Pipe and Joints: RTRP-I pipe shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of 150 psi at 73 degrees F. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996. Joints shall be bell and spigot with elastomeric gasket, mechanical coupling with elastomeric gasket, threaded and bonded coupling, or tapered bell and spigot with compatible adhesive. All RTRP-I materials shall be products of a single manufacturer.

e. RTRP-II pipe shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe. Joints shall be the bell and spigot type with elastomeric gasket, bell and spigot with adhesive, butt-jointed with adhesive bonded reinforced overlay, mechanical, flanged, threaded or commercially available proprietary joints, provided they are capable of conveying water at the pressure and temperature of the pipe.

2.2.1.5 Reinforced Plastic Mortar Pressure Piping (RPMP)

a. RPMP pipe shall be produced by centrifugal casting and shall have an OD 12 to 48 inches equal to ductile-iron, with a 150 psi pressure rating and with a minimum pipe stiffness of 36 psi. RPMP shall be in accordance with AWWA C950.

b. Fittings and specials shall be compatible with the pipe

supplied. Filament wound or molded fittings up to 6 inches shall conform to AWWA C950. Iron fittings shall be cement-mortar lined in accordance with AWWA C104/A21.4 and shall conform to AWWA C110/A21.10 and AWWA C111/A21.11. Fittings shall be suitable for working and testing pressures specified for the pipe.

c. Joints shall be bell and spigot gasket coupling utilizing an elastomeric gasket in accordance with ASTM D 4161.

2.2.1.6 Steel Piping and Associated Fittings

Pipe, ASTM A 53/A 53M, Standard Weight, zinc-coated. Fittings, ASME B16.4, Class 125, zinc coated; or ASME B16.3, Class 150, zinc coated, threaded.

2.2.1.7 Protective Materials for Steel Pipe Less than 3 Inches

Protective materials for steel pipe, except as otherwise specified, shall be mechanically applied in a factory or plant especially equipped for the purpose. The materials shall, unless otherwise indicated on the drawings, consist of one of the following for the indicated pipe material and size:

a. Pipe and fittings less than 3 inches in diameter shall be thoroughly cleaned of foreign material by wire brushing and solvent cleaning, and then given 1 coat of coal-tar primer and 2 coats of coal-tar enamel conforming to AWWA C203; threaded ends of pipe and fittings shall be adequately protected prior to coating.

2.2.1.8 Ductile-Iron Piping

Comply with "Ductile-Iron Piping" subparagraph under paragraph "Water Distribution Main Materials."

2.2.1.9 Insulating Joints

Joints between pipe of dissimilar metals shall have a rubber-gasketed or other suitable approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact between adjacent sections of piping.

2.2.2 Water Service Line Appurtenances

2.2.2.1 Corporation Stops

Ground key type; bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be suitable for solder-joint, or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800; coupling nut for connection to flared copper tubing, ASME B16.26.

2.2.2.2 Curb or Service Stops

Ground key, round way, inverted key type; made of bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be as appropriate for connection to the service piping. Arrow shall be cast into body of the curb or service stop indicating direction of flow.

2.2.2.3 Service Clamps

Service clamps used for repairing damaged cast-iron, steel, PVC or

asbestos-cement pipe shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.2.2.4 Goosenecks

Type K copper tubing. Joint ends for goosenecks shall be appropriate for connecting to corporation stop and service line. [Where multiple gooseneck connections are required for an individual service, goosenecks shall be connected to the service line through a suitable approved brass or bronze branch connection; the total clear area of the branches shall be at least equal to the clear area of the service line.] Length of goosenecks shall be in accordance with standard practice.

2.2.2.5 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.2.2.6 Check Valves

Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve.

a. Valves 2 inches and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

2.2.2.7 Gate Valves 3 Inch Size and Larger on Buried Piping

Gate valves 3 inch size and larger [on buried piping] AWWA C500 or UL 262 and of one manufacturer. Valves, AWWA C500, nonrising stem type with double-disc gates. Valves, UL 262, inside-screw type with operating nut, split wedge or double disc type gate, and designed for a hydraulic working pressure of 175 psi. Materials for UL 262 valves conforming to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have 0-ring stem seals and shall be bolted and constructed so as to permit easy removal of parts for repair.

2.2.2.8 Gate Valves Smaller than 3 Inch in Size on Buried Piping

Gate valves smaller than 3 inch size on Buried Piping MSS SP-80, Class 150, solid wedge, nonrising stem. Valves shall have flanged or threaded end connections, with a union on one side of the valve. Provide handwheel operators.

2.2.2.9 Gate Valve 3 Inch Size and Larger

Gate valves 3 inch size and larger in valve chambers or valve pits and aboveground locations, AWWA C500 or UL 262 and of one make. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Provide valves with handwheels that open by a counterclockwise rotation of the valve stem. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair.

2.2.2.10 Gate Valves Smaller Than 3 Inch Size in Valve Pits

MSS SP-80, Class 150, solid wedge, inside screw, rising stem. Valves shall have flanged or threaded end connections, with a union on one side of the valve and a handwheel operator.

2.2.2.11 Curb Boxes

Provide a curb box for each curb or service stop. Curb boxes shall be of cast iron of a size suitable for the stop on which it is to be used. Provide a round head. Cast the word "WATER" on the lid. Each box shall have a heavy coat of bituminous paint.

2.2.2.12 Valve Boxes

Provide a valve box for each gate valve on buried piping. Valve boxes shall be of cast iron or precast concrete of a size suitable for the valve on which it is to be used and shall be adjustable. Precast concrete boxes installed in locations subjected to vehicular traffic shall be designed to withstand AASHTO load designation as outline in AASHTO HB-17. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches. Cast-iron box shall have a heavy coat of bituminous paint.

2.2.2.13 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound.

2.2.2.14 Meter Boxes

Meter boxes shall be of cast iron, concrete, or plastic. The boxes shall be of sufficient size to completely enclose the meter and shutoff valve or service stop. Meter boxes set in paved areas subject to vehicular traffic shall be cast iron, or concrete with cast iron lid and cast iron meter reader lid. Boxes set in sidewalks, not subject to vehicular traffic, shall be concrete with cast iron lid and cast iron meter reader lid. Plastic boxes and lids \shall not be used in unpaved areas or grass areas not subject to vehicular traffic. Box height shall extend from invert of the meter to final grade at the meter location. The lid shall have the

word "WATER" cast in it.

2.2.2.15 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

Terminate the work covered by this section at a point approximately 5 feet from the building. Where water lines cross under gravity sewer lines, encase sewer line fully in concrete for a distance of at least 10 feet on each side of the crossing, unless sewer line is made of pressure pipe with rubber-gasketed joints and no joint is located within 3 feet horizontally of the crossing. Lay water lines which cross sewer force mains and inverted siphons at least 2 feet above these sewer lines; when joints in the sewer line are closer than 3 feet horizontally from the water line, encase these joints in concrete. Do not lay water lines in the same trench with gas lines, fuel lines o electric wiring. Copper tubing shall not be installed in the same trench with ferrous piping materials. Where nonferrous metallic pipe, e.g. copper tubing, cross any ferrous piping, provide a minimum vertical separation of 12 inches between pipes.

Where water piping is required to be installed within 1 m 3 feet of existing structures, the water pipe shall be sleeved as required in Paragraph "Casting Pipe". The Contractor shall install the water pipe and sleeve ensuring that there will be no damage to the structures and no settlement or movement of foundations or footings.

Terminate the work covered by this section at a point approximately 5 feet from the building. Do not lay water lines in the same trench with gas lines fuel lines or electric wiring.

a. Water Piping Installation Parallel With Sewer Piping

(1) Normal Conditions: Lay water piping at least 10 feet horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.

(2) Unusual Conditions: When local conditions prevent a horizontal separation of 10 feet, the water piping may be laid closer to a sewer or sewer manhole provided that:

(a) The bottom (invert) of the water piping shall be at least 18 inches above the top (crown) of the sewer piping.

(b) Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling. Approved waste water disposal method shall be utilized.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of Water Piping Crossing Sewer Piping

(1) Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least 18 inches between the bottom of the water piping and the top of the sewer piping.

(2) Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sewer piping passing over or under water piping shall be constructed of AWWA-approved ductile iron water piping, pressure tested in place without leakage prior to backfilling.

(b) Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least 18 inches between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 20 feet, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.

c. Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 23 00.00 20 Excavation and Fill.

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe in a neat workmanlike manner accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports where indicated and where necessary for fastening work into

place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation. Depth of cover over top of pipe shall not be less than 2 1/2 feet.

3.1.1.4 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.1.1.5 Connections to Existing Water Lines

Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped, except as otherwise specified, tap concrete pipe in accordance with AWWA M9 for tapping concrete pressure pipe.

3.1.1.6 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.1.7 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.2 Special Requirements for Installation of Water Mains

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

a. Jointing: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11. Make flanged joints with the gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other equipment and accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or

fitting has dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions. Use setscrewed flanges to make flanged joints where conditions prevent the use of full-length flanged pipe and assemble in accordance with the recommendations of the setscrewed flange manufacturer. Assemble insulating joints as specified for flanged joints, except that bolts with insulating sleeves shall be full size for the bolt holes. Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled.

b. Allowable Deflection: The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

c. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage , except where metal harness is indicated. Thrust blocks shall be in accordance with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94/C 94M, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength. Metal harness shall be in accordance with the requirements of AWWA C600 for thrust restraint, using tie rods and clamps as shown in NFPA 24 , except as otherwise indicated.

d. Exterior Protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet, using polyethylene film, in accordance with AWWA C105/A21.5.

3.1.2.2 Installation of PVC Plastic Water Main Pipe

Installation of PVC Plastic Water Main Pipe and Associated Fittings: Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines"; with the requirements of UBPPA UNI-B-3 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Jointing: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of UBPPA UNI-B-3 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the requirements of UBPPA UNI-B-3 for joining

PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical joints with the gaskets, glands, bolts, nuts, and internal stiffeners previously specified for this type joint; assemble in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer using internal stiffeners as previously specified for compression-type joints.

b. Offset: Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

c. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage, except where metal harness is indicated. Thrust blocks shall be in accordance with the requirements of UBPPA UNI-B-3 for reaction or thrust blocking and plugging of dead ends, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94/C 94M, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

d. Fittings: Install in accordance with AWWA C605.

3.1.2.3 Installation of Polyethylene (PE) Plastic Piping

a. General Installation:

PE pipes shall be installed in accordance with ASTM D 2774.

b. Jointing:

Jointing shall comply with ASTM D 2657, Technique I-Socket Fusion or Technique II-Butt Fusion.

c. Offsets:

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

3.1.2.4 Installation of Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Piping

a. General Installation:

Install PVCO Pressure piping in accordance with AWWA C605.

b. Jointing:

As required for PVC piping.

c. Anchorage:

As required for PVC piping.

d. Offsets:

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

3.1.2.5 Installation of RTRP I, RTRP II and RPMP Piping

a. General:

RTRP shall be installed in accordance with ASTM D 3839. RPMP shall be installed in accordance with the manufacturer's recommendations.

b. RTRP I Jointing: Assembly of the pipe shall be done in conformance with the manufacturer's written instruction and installation procedures. Field joints shall be prepared as specified by the pipe manufacturer. Several pipe joints having interference-fit type couplings may be field bonded and cured simultaneously. However, the pipe shall not be moved and additional joints shall not be made until the previously laid joints are completely cured. Joints not having interference-fit type coupling shall be fitted with a clamp which shall hold the joint rigidly in place until the joint cement has completely cured. The clamps shall have a protective material on the inner surface to prevent damage to the plastic pipe when the clamp is tightened in place. The pipe manufacturer shall provide a device or method to determine when the joint is pulled against the pipe stop. Additionally, the pipe manufacturer shall furnish a gauge to measure the diameter of the spigot ends to ensure the diameter conforms to the tolerances specified by the manufacturer. All pipe ends shall be gauged. Factory certified tests shall have been satisfactorily performed to verify that short-term rupture strength is 1,500 psior greater when carried out in accordance with ASTM D 1599. At any ambient temperature, field bonded epoxy-cemented joints shall be cured with a self-regulating, thermostatically temperature controlled, electrical heating blanket for the time and temperature recommended by the manufacturer for the applicable size and type of joint, or by an alternate heating method recommended by the manufacturer and approved by the Contracting Officer. The joint sections shall not be moved during heating, or until the joint has cooled to ambient temperature.

c. RTRP II Jointing: A reinforced overlay joint shall be used to join sections together through a placement of layers of reinforcement fiberglass roving, mat, tape or fabric thoroughly saturated with compatible catalyzed resin.

d. RPMP Jointing: Bell and spigot gasket-sealing coupling shall be used to connect pipes. The spigot shall be lubricated prior to push-together assembly.

e. Fittings and Specials for RTRP and RPMP Pipe: Metal to RTRP and RPMP pipe connections shall be made by bolting steel flanges to

RTRP and RPMP pipe flanges. Cast-iron fitting with gasket bell or mechanical joint may be used with RTRP if pipe has cast iron outside diameter. Steel flanges shall be flat-faced type. Where raised-face steel flanges are used, spacer rings shall be used to provide a flat-face seat for RTRP and RPMP pipe flanges. A full-face Buna "N" gasket 1/8 inch thick with a shore hardness of 50-60 shall be used between all flanged connections. The RTRP and RPMP pipe flange shall have raised sealing rings. Flat washers shall be used under all nuts and bolts on RTRP and RPMP pipe flanges. Bolts and nuts shall be of noncorrosive steel and torqued to not more than 100 foot pounds.Flanges shall not be buried. A concrete pit shall be provided for all flanged connections.

f. Allowable Offsets:

(1) RTRP

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

(2) RPMP

For pipe with bell and spigot rubber gasket joints, maximum allowable deflections from a straight line or grade shall be 4 degrees determined by the diameter, unless a lesser amount is recommended by the manufacturer. Short-radius curves and closures shall be formed by short lengths of pipe or fabricated specials specified.

3.1.2.6 Installation of Reinforced and Prestressed Concrete Piping

Except as otherwise specified in the following subparagraphs, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines;" with the laying and joining requirements specified in AWWA M9, Chapter 14, "Guide Specifications for Installation of Pipe"; and with the recommendations given in AWWA M9, Chapter 7, "Thrust Restraining Methods."

a. Jointing: Make joints with the gaskets specified for concrete pipe joints, using an approved lubricant recommended by the manufacturer. Assemble joints in accordance with the joining requirements specified in AWWA M9, Chapter 14, "Guide Specifications for Installation of Pipe," and with the recommendations given for laying the pipe in AWWA M9, Chapter 6, "Installation by Trenching or Tunneling--Methods and Equipment."

b. Allowable Offsets: Maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall be 5 degrees for reinforced concrete pipe unless a lesser amount is recommended by the manufacturer. Long radius curves in reinforced concrete pipe shall be formed by straight pipe in which spigot rings are placed on a bevel. Slight deflections may be made by straight pipe, provided that the maximum joint opening caused by such deflection does not exceed the maximum recommended by the pipe manufacturer. Short radius curves and closures shall be formed by shorter lengths of pipe, bevels, or fabricated specials specified.

c. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage, except where metal harness is indicated. Thrust blocks shall be in accordance with the recommendations of AWWA M9, Chapter 7, "Thrust Restraining Methods," except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94/C 94M, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength. Metal harness shall be in accordance with the recommendations for tied joints in AWWA M9, Chapter 7, "Thrust Restraining Methods."

3.1.2.7 Installation of Steel Piping

Unless otherwise specified, install pipe and fittings in accordance with AWWA M11, Chapter 12, "Transportation, Installation, and Testing."

a. Jointing: Make rubber-gasketed bell-and-spigot joints with the gaskets previously specified for this type joint, using an approved lubricant recommended by the pipe manufacturer; assemble in accordance with the recommendations of the pipe manufacturer. Make welded joints in accordance with AWWA C206 and with the recommendations given for installation of pipe in AWWA M11, Chapter 12, "Transportation, Installation, and Testing." Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer. Make flanged joints with the gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other equipment and accessories. Align bolt holes for each flanged joint. Use full-size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without straining the flange. When flanged pipe or fitting has dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions. Make grooved type joints with the couplings specified for this type joint connecting pipe with roll-grooved ends or pipe with welded-on cut-grooved adapters, each with dimensions as previously specified for this type joint. Groove pipe ends in the field only with approved groove rolling equipment and groove adapters in the field only with approved groove cutting equipment; groove rolling and groove cutting equipment shall be designed especially for the purpose and produced by a manufacturer of grooved joint couplings. Obtain approval for field-cut grooves before assembling the joint. Make shouldered type joints with the couplings specified for this type joint connecting pipe with the shouldered ends specified for this type joint. Assemble insulating joints as specified for flanged joints, except that bolts with insulating sleeves shall be full size for the bolt holes. Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled. Finish joints on piping with cement-mortar lining and on piping with cement-mortar coating as specified in Appendix on Field Joints in AWWA C205. Finish joints on piping with coal-tar enamel or coal-tar epoxy coating by cleaning, priming, coating, and wrapping with a cold-applied tape coating conforming to and applied in accordance with AWWA C209.

b. Allowable Offsets: For pipe with bell-and-spigot rubber-gasket joints, maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets shall be 5 degrees unless a lesser amount is recommended by the manufacturer. Short-radius curves and closures shall be formed by short lengths of pipe or fabricated specials specified.

c. Pipe Anchorage: Provide concrete thrust blocks (reaction backing] for pipe anchorage, except where metal harness is indicated. Thrust blocks shall be in accordance with the recommendations for thrust restraint in AWWA M11, Chapter 13, "Supplementary Design Data and Details," except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94/C 94M, having a minimum compressive strength of 2500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength. Metal harness shall be in accordance with the recommendations for joint harnesses in AWWA M11, Chapter 13, "Supplementary Design Data and Details" , except as otherwise indicated. Metal harness shall be fabricated by the pipe manufacturer and furnished with the pipe.

]3.1.2.8 Installation of Valves and Hydrants

a. Installation of Valves: Install gate valves, AWWA C500 and UL 262, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves, AWWA C509, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509. Install gate valves on PVC water mains in accordance with the recommendations for appurtenance installation in AWWA M23, Chapter 7, "Installation." Install check valves in accordance with the applicable requirements of AWWA C600 for valve-and-fitting installation , except as otherwise indicated. Make and assemble joints to gate valves and check valves as specified for making and assembling the same type joints between pipe and fittings.

b. Installation of Hydrants: Install hydrants , except for metal harness in accordance with AWWA C600 for hydrant installation and as indicated. Make and assemble joints as specified for making and assembling the same type joints between pipe and fittings. Provide metal harness as specified under pipe anchorage requirements for the respective pipeline material to which hydrant is attached. Install hydrants with the 4 1/2 inch connections facing the adjacent paved surface. If there are two paved adjacent surfaces, contact the Contracting Officer for further instructions.

3.1.2.9 Installation Beneath Railroad Right-of-Way

Install piping passing under the right-of-way of a commercial railroad in accordance with the specifications for pipelines conveying nonflammable substances in Chapter 1, Part 5, of the AREMA Eng Man. For PVC plastic water main pipe, also install in accordance with the recommendations of

AWWA M23 for installation of casings.

]3.1.3 Installation of Water Service Piping

3.1.3.1 Location

Connect water service piping to the building service where the building service has been installed. Where building service has not been installed, terminate water service lines approximately 5 feet from the building line at a point directed by the Contracting Officer; such water service lines shall be closed with plugs or caps.

3.1.3.2 Service Line Connections to Water Mains

Connect service lines to the main by a corporation stop and gooseneck and install a service stop below the frostline. Connect service lines 2 inch size to the main with a rigid connection or a corporation stop and gooseneck and install a gate valve on service line below the frostline. Connect service lines to the main with a rigid connection and install a gate valve on service line below the frostline. Connect service lines to ductile-iron water mains in accordance with AWWA C600 for service taps. Connect service lines to PVC plastic water mains in accordance with UBPPA UNI-B-8 and the recommendations of AWWA M23, Chapter 9, "Service Connections." Connect service lines to concrete water mains in accordance with the recommendations of AWWA M9, Chapter 12, "Tapping Concrete Pressure Pipe." Connect service lines to steel water mains in accordance with the recommendations of the steel water main pipe manufacturer and with the recommendations for special and valve connections and other appurtenances in AWWA M11, Chapter 13, "Supplementary Design Data and Details."

3.1.4 Special Requirements for Installation of Water Service Piping

3.1.4.1 Installation of Metallic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of AWWA C600 for pipe installation, unless otherwise specified.

a. Jointing:

(1) Screwed Joints: Make screwed joints up tight with a stiff mixture of graphite and oil, inert filler and oil, or graphite compound; apply to male threads only. Threads shall be full cut; do not leave more than three threads on the pipe exposed after assembling the joint.

(2) Joints for Copper Tubing: Cut copper tubing with square ends; remove fins and burrs. Handle tubing carefully; replace dented, gouged, or otherwise damaged tubing with undamaged tubing. Make solder joints using ASTM B 32, 95-5 tin-antimony or Grade Sn96 solder. Solder and flux shall contain not more than 0.2 percent lead. Before making joint, clean ends of tubing and inside of fitting or coupling with wire brush or abrasive. Apply a rosin flux to the tubing end and on recess inside of fitting or coupling. Insert tubing end into fitting or coupling for the full depth of the recess and solder. For compression joints on flared tubing, insert tubing through the coupling nut and flare tubing.

(3) Flanged Joints: Make flanged joints up tight, taking care to

avoid undue strain on flanges, valves, fittings, and accessories.

b. Protection of Buried Steel Service Line Piping: Unless otherwise specified, prepare, prime, and coat exterior surface of zinc-coated steel pipe and associated fittings to be buried with hot-applied coal-tar enamel with a bonded single layer of felt wrap in accordance with AWWA C203. For the felt wrap material, use fibrous-glass mat as specified in AWWA C203; use of asbestos felt will not be permitted. Use solvent wash only to remove oil, grease, and other extraneous matter from zinc-coated pipe and fittings.

3.1.4.2 Installation of Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of ASTM D 2774 and ASTM D 2855, unless otherwise specified. Handle solvent cements used to join plastic piping in accordance with ASTM F 402.

a. Jointing: Make solvent-cemented joints for PVC plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with ASTM D 2855. Make solvent-cemented joints for ABS plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with the recommendations of the pipe manufacturer, as approved. Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

b. Plastic Pipe Connections to Appurtenances: Connect plastic pipe service lines to corporation stops and gate valves in accordance with the recommendations of the plastic pipe manufacturer.

3.1.4.3 Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with NFPA 24.

3.1.4.4 Location of Meters

Meters and meter boxes shall be installed at the locations shown on the drawings. The meters shall be centered in the boxes to allow for reading and ease of removal or maintenance.

3.1.5 Disinfection

Prior to disinfection, obtain Contracting Officer approval of the proposed method for disposal of waste water from disinfection procedures. Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 and 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping

being placed into service. Disinfection of systems supplying nonpotable water is not required.

## 3.2 FIELD QUALITY CONTROL

### 3.2.1 Field Tests and Inspections

Prior to hydrostatic testing, obtain Contracting Officer approval of the proposed method for disposal of waste water from hydrostatic testing. The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.

### 3.2.2 Testing Procedure

Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." Test ductile-iron water mains and water service lines in accordance with the requirements of AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600; no leakage will be allowed at joints made by any other method. Test PVC plastic water mains and water service lines made with PVC plastic water main pipe in accordance with the requirements of UBPPA UNI-B-3 for pressure and leakage tests. The amount of leakage on pipelines made of PVC plastic water main pipe shall not exceed the amounts given in UBPPA UNI-B-3, except that at joints made with sleeve-type mechanical couplings, no leakage will be allowed. Test concrete water mains in accordance with the recommendations in AWWA M9, Chapter 10, "Hydrostatic Testing and Disinfection of Mains." The amount of leakage on concrete pipelines shall not exceed 20 gallons per 24 hours per inch of pipe diameter per mile of pipeline. Test steel water mains in accordance with applicable requirements of AWWA C600 for hydrostatic testing. The amount of leakage on steel pipelines with rubber-gasketed bell-and-spigot joints shall not exceed 20 gallons per 24 hours per inch of pipe diameter per mile of pipeline; no leakage will be allowed at joints made by any other method. Repair of welded joints to stop leakage shall be done by welding only. Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at copper pipe joints, copper tubing joints (soldered, compression type, brazed), plastic pipe joints, flanged joints and screwed joint].

### 3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 2 inches in diameter, hydrostatic test pressure shall be not less than 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

3.3 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION 33 30 00

SANITARY SEWERS
**04/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|---|---|
| AWWA C104/A21.4 | (2003) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water |
| AWWA C110/A21.10 | (2008) Ductile-Iron and Gray-Iron Fittings for Water |
| AWWA C111/A21.11 | (2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings |
| AWWA C605 | (2005) Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water |
| AWWA C900 | (2007; Errata 2008) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution |
| AWWA M23 | (2002) Manual: PVC Pipe - Design and Installation |

ASME INTERNATIONAL (ASME)

| | |
|---|---|
| ASME B1.20.1 | (1983; R 2006) Pipe Threads, General Purpose (Inch) |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C 150 | (2007) Standard Specification for Portland Cement |
| ASTM C 270 | (2008a) Standard Specification for Mortar for Unit Masonry |
| ASTM C 443 | (2005a) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets |
| ASTM C 478 | (2008) Standard Specification for Precast Reinforced Concrete Manhole SectionS |
| ASTM C 76 | (2008a) Standard Specification for |

| | |
|---|---|
| | Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe |
| ASTM C 923 | (2008) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals |
| ASTM C 969 | (2002) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines |
| ASTM C 972 | (2000; R 2006) Compression-Recovery of Tape Sealant |
| ASTM C 990 | (2008) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants |
| ASTM D 1784 | (2008) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds |
| ASTM D 1785 | (2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120 |
| ASTM D 2241 | (2005) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) |
| ASTM D 2321 | (2005) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications |
| ASTM D 2464 | (2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM D 2466 | (2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 |
| ASTM D 2467 | (2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM D 2680 | (2001) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping |
| ASTM D 2751 | (2005) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings |
| ASTM D 3034 | (2008) Standard Specification for Type PSM |

| | |
|---|---|
| | Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings |
| ASTM D 3139 | (1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals |
| ASTM D 3212 | (2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals |
| ASTM D 3753 | (2005e1) Glass-Fiber-Reinforced Polyester Manholes and Wetwells |
| ASTM D 412 | (2006ae1e2) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension |
| ASTM D 624 | (2000; R 2007) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers |
| ASTM F 477 | (2008) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| ASTM F 949 | (2006a) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| FS A-A-60005 | (Basic) Frames.Covers, Gratings, Steps, Sump and Catch Basin, Manhole |

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

| | |
|---|---|
| UBPPA UNI-B-6 | (1998) Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe |

## 1.2 SYSTEM DESCRIPTION

### 1.2.1 Sanitary Sewer Gravity Pipeline

Provide new and modify existing exterior sanitary gravity sewer piping and appurtenances. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein more than 5 feet outside of building walls.

### 1.2.2 Sanitary Sewer Pressure Lines

Provide pressure lines of polyvinyl chloride (PVC) plastic pressure pipe.

### 1.2.3 USACE Project

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. Replace

damaged material and redo unacceptable work at no additional cost to the Government. Backfilling shall be accomplished after inspection by the Contracting Officer. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions

Drawings of existing conditions, as specified.

SD-02 Shop Drawings

Drawings

Installation and As-Built drawings, as specified.

Precast concrete manhole
Metal items
Frames, covers, and gratings

Details, as specified.

SD-03 Product Data

Pipeline materials

Submit manufacturer's standard drawings or catalog cuts.

SD-06 Test Reports

Reports

Test and inspection reports, as specified.

SD-07 Certificates

Portland Cement

Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes.

1.4 QUALITY ASSURANCE

1.4.1 Installer Qualifications

Install specified materials by a licensed underground utility Contractor licensed for such work in the state where the work is to be performed. Installing Contractor's License shall be current and be state certified or state registered.

1.4.2 Drawings

b. Submit As-Built Drawings for the complete sanitary sewer system showing complete detail with all dimensions, both above and below grade, including invert elevation.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

1.5.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.5.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.5.1.3 Cement, Aggregate, and Reinforcement

As specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE.

1.5.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Concrete Gravity Sewer Piping

2.1.1.1 Concrete Gravity Pipe and Fittings

Pipe shall be reinforced concrete pipe conforming to ASTM C 76. Circular pipe with elliptical reinforcement shall have a readily visible line at least 12 inches long painted or otherwise applied on the inside and outside

of the pipe at each end so that when the pipe is laid in the proper position, the line will be at the center of the top of the pipe. Fittings and specials shall conform to the applicable requirements specified for the pipe and shall be of the same strength as the pipe.

2.1.1.2 Jointing Materials for Concrete Gravity Piping

Gaskets and pipe ends for rubber gasket joint shall conform to ASTM C 443. Gaskets shall be suitable for use with sewage.

2.1.2 ABS Composite Plastic Piping

2.1.2.1 ABS Composite Plastic Pipe and Fittings

ASTM D 2680.

2.1.2.2 Jointing Materials for ABS Composite Plastic Piping

Solvent cement and primer shall conform to ASTM D 2680.

2.1.3 ABS Solid-Wall Plastic Piping

2.1.3.1 ABS Solid-Wall Plastic Pipe and Fittings

ASTM D 2751, SDR 35, with ends suitable for either solvent cement joints or elastomer joints.

2.1.3.2 ABS Solid-Wall Plastic Joints and Jointing Materials

Solvent cement for solvent cement joints shall conform to ASTM D 2235. Elastomeric joints shall conform to ASTM D 3212. Gaskets for elastomeric joints shall conform to ASTM F 477.

2.1.4 PVC Plastic Gravity Sewer Piping

2.1.4.1 PVC Plastic Gravity Pipe and Fittings

ASTM D 3034, SDR 35, or ASTM F 949 with ends suitable for elastomeric gasket joints.

2.1.4.2 PVC Plastic Gravity Joints and Jointing Material

Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.

2.1.5 PVC Plastic Pressure Pipe and Associated Fittings

2.1.5.1 PVC Plastic Pressure Pipe and Fittings

a. Pipe and Fittings Less Than 4 inch Diameter: Pipe, couplings and fittings shall be manufactured of materials conforming to ASTM D 1784, Class 12454B.

(1) Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D 1785, Schedule 80, with joints meeting requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified. Fittings for threaded pipe shall conform to requirements of ASTM D 2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings. Pipe couplings when used, shall be tested as

required by ASTM D 2464.

(2) Push-On Joint: ASTM D 3139, with ASTM F 477 gaskets. Fittings for push-on joints shall be iron conforming to AWWA C110/A21.10 or AWWA C111/A21.11. Iron fittings and specials shall shall be cement-mortar lined (standard thickness) in accordance with AWWA C104/A21.4.

(3) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure. Fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467.

b. Pipe and Fittings 4 inch Diameter to 12 inch: Pipe shall conform to AWWA C900 and shall be plain end or gasket bell end, Pressure Class 150 (DR 18), with cast-iron-pipe-equivalent OD. Fittings shall be gray-iron or ductile-iron conforming to AWWA C110/A21.10 or AWWA C153/A21.53 and shall have cement-mortar lining conforming to AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with the PVC plastic pressure pipe specified in this paragraph.

2.1.5.2 PVC Plastic Pressure Joints and Jointing Material

Joints for pipe, 4 inch to 12 inch diameter, shall be push-on joints as specified in ASTM D 3139. Joints between pipe and fittings shall be push-on joints as specified in ASTM D 3139 or shall be compression-type joints/mechanical-joints as respectively specified in ASTM D 3139 and AWWA C111/A21.11. Each joint connection shall be provided with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe shall conform to ASTM F 477. Gaskets for push-on joints and compression-type joints/mechanical-joints for joint connections between pipe and fittings shall be as specified in AWWA C111/A21.11, respectively, for push-on joints and mechanical-joints.

## 2.2 CONCRETE MATERIALS

### 2.2.1 Cement Mortar

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

### 2.2.2 Portland Cement

Portland cement shall conform to ASTM C 150, Type II for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking.

### 2.2.3 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94/C 94M, compressive strength of 4000 psi at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 2500 psi minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

## 2.3 MISCELLANEOUS MATERIALS

### 2.3.1 Precast Concrete Manholes & Glass-Fiber-Reinforced Polyester Manholes

Precast concrete manhole risers, base sections, and tops shall conform to ASTM C 478. Glass-Fiber-Reinforced Polyester Manholes shall conform to ASTM D 3753.

### 2.3.2 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to ASTM C 443. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C 923 or ASTM C 990.

### 2.3.3 External Preformed Rubber Joint Seals

An external preformed rubber joint seal shall be an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" shall be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Proplene Di Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and values are listed in the following tables:

Properties, Test Methods and Minimum Values for Rubber used in Preformed Joint Seals

| Physical Properties | Test Methods | EPDM | Neoprene | Butyl mastic |
|---|---|---|---|---|
| Tensile, psi | ASTM D 412 | 1840 | 2195 | - |
| Elogation percent | ASTM D 412 | 553 | 295 | 350 |
| Tear Resistance, ppi | ASTM D 624 (Die B) | 280 | 160 | - |
| Rebound, percent, 5 minutes | ASTM C 972 (mod.) | - | - | 11 |
| Rebound, percent, 2 hours | ASTM C 972 | - | - | 12 |

### 2.3.4 Metal Items

#### 2.3.4.1 Frames, Covers, and Gratings for Manholes

FS A-A-60005, cast iron; figure numbers shall be as indicated:

a. Traffic manhole: Provide in paved areas.

Frame: Figure 1, Size 22A
Cover: Figure 8, Size 22A

Steps: Figure 19

b. Non-traffic manhole:

Frame: Figure 4, Size 22
Cover: Figure 12, Size 22
Steps: Figure 19

Frames and covers shall be cast iron, ductile iron or reinforced concrete. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 400 pounds. Reinforced concrete frames and covers shall be as indicated or shall conform to ASTM C 478. The word "Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.4.2 Manhole Steps

Zinc-coated steel conforming to 29 CFR 1910.27. Aluminum steps or rungs will not be permitted. Steps are not required in manholes les 4 feet deep.

2.3.4.3 Manhole Ladders

A steel ladder shall be provided where the depth of a manhole exceeds 12 feet. The ladder shall not be less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.1.1.1 Location

The work covered by this section shall terminate at a point approximately 5 feet from the building. Where the location of the sewer is not clearly defined by dimensions on the drawings, do not lay sewer line closer horizontally than 10 feet to a water main or service line. Install pressure sewer lines beneath water lines only, with the top of the sewer line being at least 2 feet below bottom of water line. Where sanitary sewer lines pass below water lines, lay pipe so that no joint in the sewer line will be closer than 3 feet, horizontal distance, to the water line.

a. Sanitary piping installation parallel with water line:

1 Normal conditions: Sanitary piping or manholes shall be laid at least 10 feet horizontally from a water line whenever possible. The distance shall be measured edge-to-edge.

2 Unusual conditions: When local conditions prevent a horizontal separation of 10 feet, the sanitary piping or manhole may be laid closer to a water line provided that:

(aa) The top (crown) of the sanitary piping shall be at least 18 inches below the bottom (invert) of the water main.

(bb) Where this vertical separation cannot be obtained, the sanitary piping shall be constructed of AWWA-approved ductile iron water pipe pressure tested in place without leakage prior to backfilling.

(cc) The sewer manhole shall be of watertight construction and tested in place.]

b. Installation of sanitary piping crossing a water line:

1 Normal conditions: Lay sanitary sewer piping by crossing under water lines to provide a separation of at least 18 inches between the top of the sanitary piping and the bottom of the water line whenever possible.

(2 Unusual conditions: When local conditions prevent a vertical separation described above, use the following construction:

(aa) Sanitary piping passing over or under water lines shall be constructed of AWWA-approved ductile iron water pipe, pressure tested in place without leakage prior to backfilling.

(bb) Sanitary piping passing over water lines shall, in addition, be protected by providing:

(1). A vertical separation of at least 18 inches between the bottom of the sanitary piping and the top of the water line.

(2). Adequate structural support for the sanitary piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.

(3). That the length, minimum 20 feet, of the sanitary piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the water line.]

c. Sanitary sewer manholes: No water piping shall pass through or come in contact with any part of a sanitary sewer manhole.]

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 23 00.00 20 Excavation and Fill.

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the bell ends in the upgrade direction. Adjust spigots in bells to give a uniform space all around. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are

as indicated. Laser beam method may be used in lieu of batterboards for the same purpose. Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of ASTM D 2680; saddles for ABS pipe shall comply with Table 3 of ASTM D 2751; and saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

3.1.1.4 Connections to Existing Lines

Obtain approval from the Contracting Officer before making connection to existing line. Conduct work so that there is minimum interruption of service on existing line.

3.1.2 Special Requirements

3.1.2.1 Installation of Concrete Gravity Sewer Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the provisions for rubber gasket jointing and jointing procedures of ACPA 01-103 or of ACPA 01-102, Chapter 9, "Installation, Inspection and Construction Testing." Make joints with the gaskets specified for concrete gravity sewer pipe joints. Clean and dry surfaces receiving lubricants, cements, or adhesives. Affix gaskets to pipe not more than 24 hours prior to the installation of the pipe. Protect gaskets from sun, blowing dust, and other deleterious agents at all times. Before installation of the pipe, inspect gaskets and remove and replace loose or improperly affixed gaskets. Align each pipe section with the previously installed pipe section, and pull the joint together. If, while pulling the joint, the gasket becomes loose and can be seen through the exterior joint recess when the pipe is pulled up to within 1 inch of closure, remove the pipe and remake the joint.

3.1.2.2 Installation of ABS Composite Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the plastic pipe manufacturer. Make joints with the primer and solvent cement specified for this joint and assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with ASTM F 402.

3.1.2.3 Installation of ABS Solid-Wall Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the plastic pipe manufacturer. Make solvent cement joints with the solvent cement previously specified for this type joint. Make elastomeric joints with the gaskets specified for this type joint and assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with ASTM F 402.

3.1.2.4 Installation of PVC Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM D 2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of ASTM D 2321 for assembly of joints.

Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.5 Installation of PVC Plastic Pressure Pipe and Fittings

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section; with the requirements of AWWA C605 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Pipe Less Than 4 Inch Diameter:

1 Threaded joints shall be made by wrapping the male threads with joint tape or by applying an approved thread lubricant, then threading the joining members together. The joints shall be tightened with strap wrenches which will not damage the pipe and fittings. The joint shall be tightened no more than 2 threads past hand-tight.

2 Push-On Joints: The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. Care shall be exercised to ensure that the gasket remains in proper position in the bell or coupling while making the joint.

3 Solvent-weld joints shall comply with the manufacturer's instructions.

b. Pipe 4 Inch Diameter Joints: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to fittings, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of AWWA C605 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical-joints with the gaskets, glands, bolts, nuts, and internal stiffeners specified for this type joint and assemble in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel.

c. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to ASTM C 94/C 94M having a minimum compressive strength of 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the

same minimum compressive strength.

3.1.3 Concrete Work

Cast-in-place concrete is included in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE. The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.1.4 Manhole Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes. Cast-in-place concrete work shall be in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.1.5 Miscellaneous Construction and Installation

3.1.5.1 Connecting to Existing Manholes

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.1.5.2 Metal Work

a. Workmanship and finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

b. Field painting: After installation, clean cast-iron frames,

covers, gratings, and steps not buried in concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

## 3.2 FIELD QUALITY CONTROL

### 3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. Perform field tests and provide labor, equipment, and incidentals required for testing. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

### 3.2.2 Tests for Nonpressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line. When pressure piping is used in a nonpressure line for nonpressure use, test this piping as specified for nonpressure pipe.

#### 3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

a. Infiltration tests and exfiltration tests: Perform these tests for sewer lines made of the specified materials, not only concrete, in accordance with ASTM C 969. Make calculations in accordance with the Appendix to ASTM C 969.

b. Low-pressure air tests: Perform tests as follows:

1 ABS composite plastic pipelines: Test in accordance with the applicable requirements of UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

2 PVC plastic pipelines: Test in accordance with UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

### 3.2.3 Tests for Pressure Lines

Test pressure lines in accordance with the applicable standard specified in this paragraph, except for test pressures. For hydrostatic pressure test, use a hydrostatic pressure 50 psi in excess of the maximum working pressure of the system, but not less than 100 psi, holding the pressure for a period of not less than one hour. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test. Test PVC plastic pressure lines in accordance with the requirements

of AWWA C605 for pressure and leakage tests, using the allowable leakage given therein.

-- End of Section --

SECTION 33 34 00

FORCE MAINS AND INVERTED SIPHONS; SEWER
**04/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO HB-17 | (2002; Errata 2003; Errata 2005) Standard Specifications for Highway Bridges |

AMERICAN PETROLEUM INSTITUTE (API)

| | |
|---|---|
| API Spec 6D | (2008; Errata 2008; Errata 2008) Specification for Pipeline Valves |

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|---|---|
| AWWA C105/A21.5 | (2005) Polyethylene Encasement for Ductile-Iron Pipe Systems |
| AWWA C110/A21.10 | (2008) Ductile-Iron and Gray-Iron Fittings for Water |
| AWWA C111/A21.11 | (2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings |
| AWWA C115/A21.15 | (2005) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges |
| AWWA C151/A21.51 | (2002; Errata 2002) Ductile-Iron Pipe, Centrifugally Cast, for Water |
| AWWA C200 | (2005) Steel Water Pipe - 6 In. (150 mm) and Larger |
| AWWA C203 | (2002) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied |
| AWWA C207 | (2007) Standard for Steel Pipe Flanges for Waterworks Service-Sizes 100 mm through 3600 mm 4 in. through 144 in. |
| AWWA C208 | (2007) Standard for Dimensions for Fabricated Steel Water Pipe Fittings |
| AWWA C210 | (2007) Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of |

| | |
|---|---|
| | Steel Water Pipelines |
| AWWA C300 | (2004) Reinforced Concrete Pressure Pipe, Steel-Cylinder Type |
| AWWA C301 | (2007) Prestressed Concrete Pressure Pipe, Steel-Cylinder Type |
| AWWA C303 | (2002) Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type |
| AWWA C500 | (2002; R 2003) Metal-Seated Gate Valves for Water Supply Service |
| AWWA C508 | (2001) Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS |
| AWWA C600 | (2005) Installation of Ductile-Iron Water Mains and Their Appurtenances |
| AWWA C900 | (2007; Errata 2008) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution |
| AWWA C909 | (2002) Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 IN through 12 IN (100 mm Through 300 mm), for Water Distribution |

ASME INTERNATIONAL (ASME)

| | |
|---|---|
| ASME B16.1 | (2005) Standard for Gray Iron Threaded Fittings; Classes 125 and 250 |
| ASME B16.3 | (2006) Malleable Iron Threaded Fittings, Classes 150 and 300 |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A 53/A 53M | (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM C 478 | (2008) Standard Specification for Precast Reinforced Concrete Manhole Sections |
| ASTM D 1784 | (2008) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds |
| ASTM D 1785 | (2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120 |
| ASTM D 2122 | (1998; R 2004) Determining Dimensions of Thermoplastic Pipe and Fittings |

| | |
|---|---|
| ASTM D 2241 | (2005) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) |
| ASTM D 2464 | (2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM D 2564 | (2004e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems |
| ASTM D 2657 | (2007) Heat Fusion Joining Polyolefin Pipe and Fittings |
| ASTM D 2774 | (2008) Underground Installation of Thermoplastic Pressure Piping |
| ASTM D 2996 | (2001; R 2007e1) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe |
| ASTM D 3035 | (2008) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter |
| ASTM D 3139 | (1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals |
| ASTM D 3308 | (2006) PTFE Resin Skived Tape |
| ASTM D 3350 | (2008) Polyethylene Plastics Pipe and Fittings Materials |
| ASTM D 3754 | (2006) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe |
| ASTM D 4101 | (2008) Standard Specification for Polypropylene Injection and Extrusion Materials |
| ASTM D 4161 | (2001; R 2005) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals |
| ASTM F 1483 | (2005) Oriented Poly(Vinyl Chloride), PVCO, Pressure Pipe |
| ASTM F 477 | (2008) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

| | |
|---|---|
| DIPRA TRD | (2002) Thrust Restraint Design for Ductile |

Iron Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-78 (2005a) Cast Iron Plug Valves, Flanged and Threaded Ends

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Hydrostatic Tests.

Copies of test results.

1.3 DELIVERY, STORAGE, AND HANDLING

Do not damage pipe, fittings and accessories, and pipe coatings during delivery, handling, and storage.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

Piping for force mains less than 4 inches in diameter shall be galvanized steel, polyvinyl chloride (PVC) plastic, polyethylene (PE) plastic or polypropylene plastic. Piping less than 4 inches in diameter inside pump stations shall be galvanized steel. Piping for force mains and inverted siphons 4 inches in diameter and larger shall be ductile iron, steel, concrete pressure pipe, PVC plastic, Oriented PVC PE plastic, or reinforced thermosetting resin pipe (RTRP). Piping 8 inches in diameter and larger may also be reinforced plastic mortar pressure (RPMP) pipe. Piping 4 inches in diameter and larger inside pump stations shall be ductile iron pipe with bolted flange joints. Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Concrete Pressure Pipe

Concrete pressure pipe and fittings shall conform to AWWA C300, AWWA C301, or AWWA C303, as applicable for the service requirements, with rubber gasket joints of the type using steel bell and spigot joint rings.

2.1.2 Plastic Pipe

2.1.2.1 PE Pipe

ASTM D 3350 and ASTM D 3035, minimum pressure rating of 100 psi at 73.4 degrees F.

2.1.2.2 Polypropylene Pipe

ASTM D 2122 and ASTM D 4101.

2.1.2.3 PVC Pipe

a. PVC Pipe and Fittings Less Than 4 inches Diameter: ASTM D 1785, Schedule 80, or ASTM D 2241, SDR 26, with screw joints, push-on joints, or solvent weld joints.

b. PVC Pipe and Fittings 4 inches Diameter and Larger: ASTM D 2241, SDR 26, or AWWA C900, with push-on joints.

2.1.2.4 Oriented Polyvinyl Chloride (PVCO) Plastic Pipe

Pipe, couplings, and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454-B. Pipe shall conform to AWWA C909, Class 150, and to ASTM F 1483 and shall have an outside diameter equal to cast iron outside diameter.

2.1.3 RPMP Pipe

RPMP shall be produced by centrifugal casting and shall have an outside diameter equal to ductile iron pipe dimensions from 18 inch to 48 inch. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner. The minimum pipe stiffness shall be 36 psi. RPMP shall be in accordance with ASTM D 3754.

2.1.4 RTRP Lines

ASTM D 2996, 350 psi rated, cast iron pipe dimensions only, with elastomeric gasket joints. Fittings: AWWA C110/A21.10, rated150 psi. When mechanical joint fittings are used, inside sleeves provided by the manufacturer shall be used.

2.1.5 Ductile Iron Pipe

a. Ductile Iron Pipe: AWWA C151/A21.51, working pressure not less than 150 psi, unless otherwise shown or specified.

b. River Crossing Pipe: AWWA C151/A21.51, minimum thickness Class 54 with joints in compliance with applicable requirements of AWWA C110/A21.10.

c. Fittings, Mechanical: AWWA C110/A21.10, rated for 150 psi.

d. Fittings, Push-On: AWWA C110/A21.10 and AWWA C111/A21.11, rated for 150 psi.

2.1.6 Steel Pipe

a. Steel Pipe, 6 inches Diameter and Larger: AWWA C200.

b. Steel Pipe Less Than 6 inches Diameter: ASTM A 53/A 53M, standard weight, threaded end, galvanized.

c. Fittings, 6 inches Diameter and Larger: AWWA C200, fabricated in compliance with AWWA C208.

d. Fittings Less Than 6 inches Diameter: ASME B16.3, galvanized.

2.2 JOINTS

2.2.1 PE Piping

a. Heat Fusion Joints: ASTM D 2657.

b. Flanged Joints: ASME B16.1 or AWWA C207.

c. Mechanical Joints: ASME B16.1.

2.2.2 Polypropylene Piping

Heat Fusion Joints: ASTM D 2657.

2.2.3 PVC Piping

a. Screw Joint Fittings: ASTM D 2464, Schedule 80.

b. Push-On Joint Fittings: ASTM D 3139, with ASTM F 477gaskets.

c. Solvent Cement: ASTM D 2564.

d. Couplings for use with plain end pipe shall have centering rings or stops to ensure the coupling is centered on the joint.

2.2.4 PVCO Pipe

Joints shall conform to ASTM D 3139. Elastomeric gaskets shall conform to ASTM F 477.

2.2.5 Ductile Iron Piping

a. Push-on Joints: AWWA C111/A21.11.

b. Mechanical Joints: AWWA C111/A21.11 as modified by AWWA C151/A21.51.

c. Flanged Joints: AWWA C115/A21.15.

2.2.6 Steel Piping

a. Push-on Joints: AWWA C200.

b. Mechanical Joints: AWWA C200.

c. Flanged Joints: AWWA C207.

2.2.7 RPMP Piping

Joints shall be bell and spigot gasket coupling utilizing an elastomeric gasket in accordance with ASTM D 4161 and ASTM F 477.

2.3 VALVES

2.3.1 Gate Valves

Gate valves 3 inches and larger shall comply with AWWA C500. Valves for buried service shall be non-rising stem (NRS), 2 inch square nut operated

with joints applicable to the pipe or installation. Buried valves shall be furnished with extension stems comprising socket, extension stem and operating nut, and shall be of an appropriate length to bring operating nut to within 6 inches of grade. One 4 foot "T" handle valve wrench shall be furnished for each quantity of 6 buried valves. Gate valves that are exposed or installed inside shall be outside screw and yoke (OS&Y), handwheel operated with flange ends unless otherwise indicated. Gate valve operating nuts and handwheels shall have an arrow and the word "OPEN" cast in raised letters to indicate the direction of opening. Gate valves 14 inches and larger shall be equipped with gearing to reduce operating effort. Gate valves 14 inches and larger installed in horizontal lines in horizontal position with stems horizontal shall be equipped with bronze track, roller and scrapers to support the weight of the gate for its full length of travel. Gate valves 14 inches and larger installed in vertical pipe lines with stems horizontal shall be fitted with slides to assist the travel of the gate assembly.

2.3.2 Check Valves

Provide check valves that permit free flow of sewage forward and provide a positive check against backflow. Designe check valves for a minimum working pressure of 150 psi or as indicated. The body shall be iron. The manufacturer's name, initials, or trademark and also the size of the valve, working pressure, and direction of flow shall be directly cast on the body.

a. Ball Check Valves shall be iron body, shall have flanged ends, and shall be the non-slam type. Flanges shall be the 125 pound type complying with ASME B16.1. Ball shall be stainless steel unless otherwise specified.

b. Swing Check Valves shall comply with AWWA C508 and shall be iron body, bronze mounted, and shall have flanged ends. Flanges shall be the 125 pound type complying with ASME B16.1.

2.3.3 Plug Valves

Cast iron valves shall comply with MSS SP-78. Steel plug valves shall comply with API Spec 6D.

2.3.4 Pinch Valves

Pinch valves shall be double acting, jam-proof type with unobstructed streamlined flows and built-in operator. The body shall be iron with a non-rising handwheel. The sleeve shall be of pure gum rubber, neoprene, Buna N or hypalon as required for service. The valve shall have flanged ends. Flanges shall be of the 125 pound type complying with ASME B16.1.

2.3.5 Air Release Valves

Air release valves shall be designed to permit release of air from an empty pipe during filling and shall be capable of discharging accumulated air in the line while the line is in operation and under pressure. Valves shall be attached by means of threaded pipe connections. Valves shall be vented to the atmosphere.

a. Manual Air Release Valves: Manual air release valves shall consist of a 3 inch gate valve and 3 inch ductile iron pipe and fittings. The valve shall be installed with its line of flow in the horizontal position.

b. Automatic Air Release Valve: Automatic air release valves shall be of the compound lever type capable of withstanding operating pressures of 150 psi. The valves shall have a 1/2 inch outlet. The body and cover of the valve shall be of iron with a stainless steel float. All internal parts shall be stainless steel or bronze. The valve shall be specifically adapted for use with sewage. Each valve shall be complete with hose and blow-off valves to permit backflushing without dismantling the valve.

2.4 VALVE VAULTS

Cast iron or concrete, except designt concrete vaults installed in locations subject to vehicular traffic to withstand AASHTO load designation as outlined in AASHTO HB-17. Cast iron vaults shall be the extension type with slide type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. The vault length shall be adaptable, without full extension, to the depth of cover over the pipe at the valve locations. Cast the word "SEWER" in the cover.

2.5 VALVE VAULTS

Valve vaults shall be precast concrete units conforming to ASTM C 478.

2.6 MISCELLANEOUS MATERIALS

Miscellaneous materials shall comply with the following requirements:

2.6.1 Pipe Coatings and Linings

a. Steel, interior: AWWA C203 or AWWA C210.

b. Steel, exterior, buried: AWWA C203.

c. Steel, exterior, exposed: AWWA C210.

2.6.2 Joint Lubricants

Joint lubricants shall be as recommended by the pipe manufacturer.

2.6.3 Bolts, Nuts and Glands

AWWA C111/A21.11.

2.6.4 Joint Compound

A stiff mixture of graphite and oil or inert filler and oil.

2.6.5 Joint Tape

ASTM D 3308.

2.6.6 Bond Wire

Bond wire type RHW or USE, Size 1/0 AWG, neoprene jacketed copper conductor shaped to stand clear of the joint.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Pipe, pipe fittings, and appurtenances shall be installed at the locations indicated. Excavation, trenching, and backfilling shall be as specified in DIVISION 31, EARTHWORK.

#### 3.1.1 Adjacent Facilities

Installation of force mains and inverted siphons near adjacent facilities shall be as specified in Section 33 30 00 SANITARY SEWERS.

#### 3.1.2 Cutting

Pipe shall be cut in a neat manner with mechanical cutters. Wheel cutters shall be used where practicable. Sharp and rough edges shall be ground smooth and loose material removed from the pipe before laying.

#### 3.1.3 Laying

Except where otherwise authorized, pipe shall be laid with bells facing the direction of laying. Before lowering and while suspended, the pipe shall be inspected for defects. Defective material shall be rejected. Pipe shall be laid in compliance with the following:

a. Ductile Iron: AWWA C600.

b. Steel: AWWA C600.

c. Concrete: Manufacturer's instructions.

d. Polyvinyl Chloride: Manufacturer's instructions.

e. Polyethylene: ASTM D 2774.

f. Polypropylene: ASTM D 2774.

g. Reinforced Thermosetting Resin: Manufacturer's instructions.

h. Reinforced Plastic Mortar: Manufacturer's Instructions.

#### 3.1.4 Jointing

##### 3.1.4.1 Concrete Pressure Pipe

The manufacturer's instructions shall be followed when lubricating and installing rubber gaskets. Joints shall comply with the manufacturer's instructions. The external annular space shall be filled with cement mortar or with a portland cement-filled polyurethane loop. For pipe 24 inch diameter and larger, the internal annular space shall be filled with cement mortar and struck off to ensure a smooth and continuous surface between pipe sections. Pipe less than 24 inch diameter shall have a rope or trowelable mastic affixed to the concrete face of the bell socket before joining the sections of pipe. The mastic shall not be detrimental to the rubber gasket and shall fill the interior annular space when the pipe sections are pushed together.

3.1.4.2 Joints for PE Pipe

Heat fusion joints shall comply with the manufacturer's instructions concerning equipment, temperature, melt time, heat coat, and joining time. Flanged and mechanical joints shall be made in compliance with the manufacturer's instructions.

3.1.4.3 Joints for Polypropylene Pipe

Heat fusion joints shall comply with the manufacturer's instructions concerning equipment, temperature, melt time, heat coat, and joining time.

3.1.4.4 Joints for PVC Pipe

a. Threaded joints shall be made by wrapping the male threads with joint tape or by applying an approved thread lubricant, then threading the joining members together. The joint shall be tightened with strap wrenches which will not damage the pipe and fittings. The joint shall be tightened no more than 2 threads past hand-tight.

b. Push-on joints: The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. The gasket shall remain in proper position in the bell or coupling while the joint is made.

c. Solvent-weld joints shall comply with the manufacturer's instructions.

3.1.4.5 Joints for RPMP Pipe

Joints shall be elastomeric gasket in accordance with ASTM D 4161.

3.1.4.6 Joints for RTRP Lines

Elastomeric gasket joints shall comply with the manufacturer's instructions.

3.1.4.7 Joints for Ductile Iron Pipe

Installation of mechanical and push-on type joints shall comply with AWWA C600 and the manufacturer's instructions. Installation of flanged joints shall comply with manufacturer's instructions.

3.1.4.8 Joints for Steel Pipe

Screw joints shall be made tight with joint tape or joint compound applied with a brush to the male threads only. Installation of mechanical joints, push-on joints, and flanged joints shall comply with the manufacturer's instructions.

3.1.5 Coating and Lining

Field coating of non-galvanized steel pipe shall comply with AWWA C203. The applied materials shall be tested by means of a spark-type electrical device in compliance with AWWA C203. Flaws and holidays in the coating or lining of the pipe and the pipe joints shall be repaired; the repaired areas shall be at least equal in thickness to the minimum required for the pipe.

### 3.1.6 PE Pipe Encasement

When installed underground, pipe shall be encased with polyethylene in accordance with AWWA C105/A21.5.

### 3.1.7 Installation of Valves

Prior to installation, valves shall be cleaned of all foreign matter and inspected for damage. Valves shall be fully opened and closed to ensure that all parts are properly operating. Valves shall be installed with the stem in the vertical position.

### 3.1.8 Installation of Valve Boxes

Valve boxes shall be installed over each outside gate valve, unless otherwise indicated. Valve boxes shall be centered over the valve. Fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides or to undisturbed trench face, if less than 4 feet.

### 3.1.9 Installation of Valve Vaults

Valve vaults shall be installed as indicated.

### 3.1.10 Drain Lines

Drain lines shall be installed where indicated. The drain line shall consist of a tee in the main line with a 4 inch diameter branch, a 4 inch diameter elbow, and a 4 inch gate valve.

### 3.1.11 Thrust Restraint

Thrust Restraint shall be as specified in Section 33 11 00 WATER DISTRIBUTION. Plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, shall be provided with thrust restraint. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

#### 3.1.11.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

#### 3.1.11.2 Restrained Joints

For ductile iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA TRD.

3.1.12 Grout

Grout for exterior joint protection on concrete pipes shall be a mix of 1 part portland cement, 2 parts sand, and of sufficient liquid consistency to flow into the joint recess beneath the diaper. Grout for interior joint protection shall be a mix of 1 part portland cement and 1 part sand. A polyurethane foam loop, impregnated with portland cement, may be substituted for grout for exterior joints.

3.1.13 Bonded Joints

Where indicated, a metallic bond shall be provided at each joint, including joints made with flexible couplings or rubber gaskets, of ferrous-metallic piping to effect continuous conductivity. The bond shall be of the thermal-weld type.

3.2 HYDROSTATIC TESTS

The pipeline shall be subjected to both a pressure test and a leakage test. The method proposed for disposal of waste water from hydrostatic tests shall be approved by the Contracting Officer. The Contracting Officer shall be notified at least 7 days in advance of equipment tests. The final test report shall be delivered to the Contracting Officer within 30 days of the test.

3.2.1 Pressure Test

After the pipe has been installed, joints completed, thrust blocks have been in place for at least five days, and the trench has been partially backfilled, leaving the joints exposed for examination, the pipe shall be filled with water to expel all air. The pipeline shall be subjected to a test pressure of 100 psi or 150 percent of the working pressure, whichever is greater, for a period of at least one hour. Each valve shall be opened and closed several times during the test. The exposed pipe, joints, fitting, and valves shall be examined for leaks. Visible leaks shall be stopped or the defective pipe, fitting, joints, or valve shall be replaced.

3.2.2 Leakage Test

The leakage test may be conducted subsequent to or concurrently with the pressure test. The amount of water permitted as leakage for the line shall be placed in a sealed container attached to the supply side of the test pump. No other source of supply will be permitted to be applied to the pump or line under test. The water shall be pumped into the line by the test pump as required to maintain the specified test pressure as described for pressure test for a 2 hour period. Exhaustion of the supply or the inability to maintain the required pressure will be considered test failure. PE pipe can experience diametric expansion and pressure elongation during initial testing. The manufacturer shall be consulted prior to testing for special testing considerations. Allowable leakage shall be determined by the following I-P formula:

L = NDP/K Where:

L = Allowable leakage in gallons per hour.

N = Number of joints in length of pipeline tested.

D = Nominal diameter of the pipe in inches.

P = Square root of the test pressure in psig.

K = 7400 for pipe materials.

At the conclusion of the test, the amount of water remaining in the container shall be measured and the results recorded in the test report.

3.2.3 Retesting

If any deficiencies are revealed during any test, such deficiencies shall be corrected and the tests shall be reconducted until the results of the tests are within specified allowances, without additional cost to the Government.

-- End of Section --

SECTION 33 40 00

STORM DRAINAGE UTILITIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

| | |
|---|---|
| ACI 346 | (2001) Specification for Cast-in-Place Concrete Pipe |

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO M 198 | (2008) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants |
| ASTM C 1103 | (2003) Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines |
| ASTM C 1103M | (2003) Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric) |
| ASTM C 139 | (2005) Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes |
| ASTM C 14 | (2007) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe |
| ASTM C 1433 | (2008) Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers |
| ASTM C 1433M | (2008a) Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers (Metric) |
| ASTM C 14M | (2007) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe (Metric) |
| ASTM C 231 | (2008c) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method |

| | |
|---|---|
| ASTM C 270 | (2008a) Standard Specification for Mortar for Unit Masonry |
| ASTM C 32 | (2005) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale) |
| ASTM C 443 | (2005a) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets |
| ASTM C 443M | (2007) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric) |
| ASTM C 444 | (2003) Perforated Concrete Pipe |
| ASTM C 444M | (2003) Perforated Concrete Pipe (Metric) |
| ASTM C 478 | (2008) Standard Specification for Precast Reinforced Concrete Manhole Sections |
| ASTM C 478M | (2008e1) Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric) |
| ASTM C 506 | (2008a) Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe |
| ASTM C 506M | (2008a) Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe (Metric) |
| ASTM C 507 | (2008a) Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe |
| ASTM C 507M | (2008a) Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe (Metric) |
| ASTM C 55 | (2006e1) Concrete Brick |
| ASTM C 564 | (2008) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings |
| ASTM C 62 | (2008) Building Brick (Solid Masonry Units Made from Clay or Shale) |
| ASTM C 655 | (2007) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe |
| ASTM C 700 | (2007a) Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated |
| ASTM C 76 | (2008a) Standard Specification for |

| | |
|---|---|
| | Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe |
| ASTM C 76M | (2008a) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric) |
| ASTM C 828 | (2006) Low-Pressure Air Test of Vitrified Clay Pipe Lines |
| ASTM C 877 | (2008) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections |
| ASTM C 877M | (2002; E 2005) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections (Metric) |
| ASTM C 923 | (2008) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals |
| ASTM C 923M | (2008b) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric) |
| ASTM C 924 | (2002) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method |
| ASTM C 924M | (2002) Testing Concrete Pipe Sewer Liner by Low-Pressure Air Test Method (Metric) |
| ASTM D 1056 | (2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber |
| ASTM D 1171 | (1999; R 2007) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens) |
| ASTM D 1557 | (2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3) |
| ASTM D 1751 | (2004; R 2008) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) |
| ASTM D 1752 | (2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion |
| ASTM D 1784 | (2008) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) |

| | |
|---|---|
| | Compounds |
| ASTM D 2167 | (2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method |
| ASTM D 2321 | (2005) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications |
| ASTM D 2729 | (2003) Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings |
| ASTM D 3034 | (2008) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings |
| ASTM D 3212 | (2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals |
| ASTM D 3350 | (2008) Polyethylene Plastics Pipe and Fittings Materials |
| ASTM D 6938 | (2007a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) |
| ASTM F 1417 | (1992; R 2005) Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air |
| ASTM F 477 | (2008) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| ASTM F 679 | (2008) Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings |
| ASTM F 714 | (2008) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter |
| ASTM F 794 | (2003) Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter |
| ASTM F 894 | (2007) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe |
| ASTM F 949 | (2006a) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When

used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Placing Pipe

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed. Certification on the ability of frame and cover or gratings to carry the imposed live load.

## 1.3 DELIVERY, STORAGE, AND HANDLING

### 1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

### 1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

# PART 2 PRODUCTS

## 2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

### 2.1.1 Concrete Pipe

Manufactured in accordance with and conform to ASTM C 76, Class III, or ASTM C 655.

#### 2.1.1.1 Reinforced Arch Culvert and Storm Drainpipe

Manufactured in accordance with and conform to ASTM C 506.

2.1.1.2 Reinforced Elliptical Culvert and Storm Drainpipe

Manufactured in accordance with and conform to ASTM C 507.

2.1.1.3 Nonreinforced Pipe

Manufactured in accordance with and conform to ASTM C 14, Class 1.

2.1.1.4 Cast-In-Place Nonreinforced Conduit

ACI 346, except that testing shall be the responsibility of and at the expense of the Contractor. In the case of other conflicts between ACI 346 and project specifications, requirements of ACI 346 shall govern.

2.1.2 [Enter Appropriate Subpart Title Here]2.1.2.1 PVC Pipe

ASTM D 2729.

2.1.3 PVC Pipe

The pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, shall be submitted prior to installation of the pipe.

2.1.3.1 Type PSM PVC Pipe

ASTM D 3034, Type PSM, maximum SDR 35, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.3.2 Profile PVC Pipe

ASTM F 794, Series 46, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.3.3 Smooth Wall PVC Pipe

ASTM F 679 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.3.4 Corrugated PVC Pipe

ASTM F 949 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.2 DRAINAGE STRUCTURES

2.2.1 Precast Reinforced Concrete Box

Manufactured in accordance with and conform to ASTM C 1433.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 4000 psi concrete under Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after

discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to ASTM C 139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

2.3.4 Brick

Brick shall conform to ASTM C 62, Grade SW; ASTM C 55, Grade S-I or S-II; or ASTM C 32, Grade MS. Mortar for jointing and plastering shall consist of one part portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 1/2 inch of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

2.3.5 Precast Reinforced Concrete Manholes

Conform to ASTM C 478. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall be smoothed to a uniform surface on both interior and exterior of the structure.

2.3.6 Prefabricated Corrugated Metal Manholes

Manholes shall be of the type and design recommended by the manufacturer. Manholes shall be complete with frames and cover, or frames and gratings.

2.3.7 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48/A 48M, Class 35B; cast ductile iron, ASTM A 536, Grade 65-45-12; or cast aluminum, ASTM B 26/B 26M, Alloy 356.OT6. Weight, shape, size, and waterway openings

for grates and curb inlets shall be as indicated on the plans.

2.3.8 Joints

2.3.8.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C 443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.8.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C 877.

2.3.8.3 Flexible Watertight, Gasketed Joints

a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 7 inches wide and approximately 3/8 inch thick, meeting the requirements of ASTM D 1056, Type 2 A1, and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D 1171. Rubber O-ring gaskets shall be 13/16 inch in diameter for pipe diameters of 36 inches or smaller and 7/8 inch in diameter for larger pipe having 1/2 inch deep end corrugation. Rubber O-ring gaskets shall be 1-3/8 inches in diameter for pipe having 1 inch deep end corrugations. O-rings shall meet the requirements of AASHTO M 198 or ASTM C 443. Flexible plastic gaskets shall conform to requirements of AASHTO M 198, Type B.

b. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded. Watertight joints shall be tested and shall meet the test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.

2.3.8.4 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.3.8.5 Smooth Wall PE Plastic Pipe

Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.

2.4 DOWNSPOUT BOOTS

Boots used to connect exterior downspouts to the storm-drainage system shall be of gray cast iron conforming to ASTM A 48/A 48M, Class 30B or 35B. Shape and size shall be as indicated.

2.5 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C 923.

2.6 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.6.1 Concrete, Clay, PVC and PE Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to AASHTO M 198 or ASTM C 443. Test requirements for joints in clay pipe shall conform to ASTM C 425. Test requirements for joints in PVC and PE plastic pipe shall conform to ASTM D 3212.

2.7 EROSION CONTROL RIPRAP

Provide nonerodible rock not exceeding 15 inches in its greatest dimension and choked with sufficient small rocks to provide a dense mass with a minimum thickness ofas indicated.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of DIVISION 31, EARTHWORK and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 12 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified, without any overexcavation. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in DIVISION 31, EARTHWORK.

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of the pipe or pipe arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.2.2 Plastic Pipe

Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

| TYPE OF PIPE | MAXIMUM ALLOWABLE DEFLECTION (%) |
|---|---|
| Corrugated Steel and Aluminum Alloy | 5 |
| Concrete-Lined Corrugated Steel | 3 |
| Ductile Iron Culvert | 3 |
| Plastic | 5 |

Not less than 30 days after the completion of backfilling, the Government may perform a deflection test on the entire length of installed flexible pipe using a mandrel or other suitable device. Installed flexible pipe showing deflections greater than those indicated above shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced.

3.3.1 Concrete, PVC

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 3 feet apart, whichever is less.

3.3.3 Jacking Pipe Through Fills

Methods of operation and installation for jacking pipe through fills shall conform to requirements specified in Volume 1, Chapter 1, Part 4 of AREMA Eng Man.

3.4 JOINTING

3.4.1 Concrete

3.4.1.1 Cement-Mortar Bell-and-Spigot Joint

The first pipe shall be bedded to the established gradeline, with the bell end placed upstream. The interior surface of the bell shall be thoroughly cleaned with a wet brush and the lower portion of the bell filled with mortar as required to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into a bell so that sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

3.4.1.2 Cement-Mortar Oakum Joint for Bell-and-Spigot Pipe

A closely twisted gasket shall be made of jute or oakum of the diameter required to support the spigot end of the pipe at the proper grade and to

make the joint concentric. Joint packing shall be in one piece of sufficient length to pass around the pipe and lap at top. This gasket shall be thoroughly saturated with neat cement grout. The bell of the pipe shall be thoroughly cleaned with a wet brush, and the gasket shall be laid in the bell for the lower third of the circumference and covered with mortar. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted in the bell, and carefully driven home. A small amount of mortar shall be inserted in the annular space for the upper two-thirds of the circumference. The gasket shall be lapped at the top of the pipe and driven home in the annular space with a caulking tool. The remainder of the annular space shall be filled completely with mortar and beveled at an angle of approximately 45 degrees with the outside of the bell. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint thus made shall be wrapped with cheesecloth. Placing of this type of joint shall be kept at least five joints behind laying operations.

3.4.1.3 Cement-Mortar Diaper Joint for Bell-and-Spigot Pipe

The pipe shall be centered so that the annular space is uniform. The annular space shall be caulked with jute or oakum. Before caulking, the inside of the bell and the outside of the spigot shall be cleaned.

a. Diaper Bands: Diaper bands shall consist of heavy cloth fabric to hold grout in place at joints and shall be cut in lengths that extend one-eighth of the circumference of pipe above the spring line on one side of the pipe and up to the spring line on the other side of the pipe. Longitudinal edges of fabric bands shall be rolled and stitched around two pieces of wire. Width of fabric bands shall be such that after fabric has been securely stitched around both edges on wires, the wires will be uniformly spaced not less than 8 inches apart. Wires shall be cut into lengths to pass around pipe with sufficient extra length for the ends to be twisted at top of pipe to hold the band securely in place; bands shall be accurately centered around lower portion of joint.

b. Grout: Grout shall be poured between band and pipe from the high side of band only, until grout rises to the top of band at the spring line of pipe, or as nearly so as possible, on the opposite side of pipe, to ensure a thorough sealing of joint around the portion of pipe covered by the band. Silt, slush, water, or polluted mortar grout forced up on the lower side shall be forced out by pouring, and removed.

c. Remainder of Joint: The remaining unfilled upper portion of the joint shall be filled with mortar and a bead formed around the outside of this upper portion of the joint with a sufficient amount of additional mortar. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind actual laying of pipe. No backfilling around joints shall be done until joints have been fully inspected and approved.

3.4.1.4 Cement-Mortar Tongue-and-Groove Joint

The first pipe shall be bedded carefully to the established gradeline with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the pipe. The grooved end of the first pipe shall be thoroughly cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned with a wet brush; while in

horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe shall be inserted in the grooved end of the first pipe until mortar is squeezed out on interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside.

3.4.1.5 Cement-Mortar Diaper Joint for Tongue-and-Groove Pipe

The joint shall be of the type described for cement-mortar tongue-and-groove joint in this paragraph, except that the shallow excavation directly beneath the joint shall not be filled with mortar until after a gauze or cheesecloth band dipped in cement mortar has been wrapped around the outside of the joint. The cement-mortar bead at the joint shall be at least 1/2 inch, thick and the width of the diaper band shall be at least 8 inches. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind the actual laying of the pipe. Backfilling around the joints shall not be done until the joints have been fully inspected and approved.

3.4.1.6 Plastic Sealing Compound Joints for Tongue-and-Grooved Pipe

Sealing compounds shall follow the recommendation of the particular manufacturer in regard to special installation requirements. Surfaces to receive lubricants, primers, or adhesives shall be dry and clean. Sealing compounds shall be affixed to the pipe not more than 3 hours prior to installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Sealing compounds shall be inspected before installation of the pipe, and any loose or improperly affixed sealing compound shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint with mastic-type sealant, a slight protrusion of the material is not visible along the entire inner and outer circumference of the joint when the joint is pulled up, the pipe shall be removed and the joint remade. After the joint is made, all inner protrusions shall be cut off flush with the inner surface of the pipe. If nonmastic-type sealant material is used, the "Squeeze-Out" requirement above will be waived.

3.4.1.7 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.1.8 External Sealing Band Joint for Noncircular Pipe

Surfaces to receive sealing bands shall be dry and clean. Bands shall be installed in accordance with manufacturer's recommendations.

3.4.2 Corrugated Metal Pipe

3.4.2.1 Field Joints

Transverse field joints shall be designed so that the successive connection of pipe sections will form a continuous line free of appreciable irregularities in the flow line. In addition, the joints shall meet the general performance requirements described in ASTM A 798/A 798M. Suitable transverse field joints which satisfy the requirements for one or more of the joint performance categories can be obtained with the following types of connecting bands furnished with suitable band-end fastening devices: corrugated bands, bands with projections, flat bands, and bands of special design that engage factory reformed ends of corrugated pipe. The space between the pipe and connecting bands shall be kept free from dirt and grit so that corrugations fit snugly. The connecting band, while being tightened, shall be tapped with a soft-head mallet of wood, rubber or plastic, to take up slack and ensure a tight joint. Field joints for each type of corrugated metal pipe shall maintain pipe alignment during construction and prevent infiltration of fill material during the life of the installations. The type, size, and sheet thickness of the band and the size of angles or lugs and bolts shall be as indicated or where not indicated, shall be as specified in the applicable standards or specifications for the pipe.

3.4.2.2 Flexible Watertight, Gasketed Joints

Installation shall be as recommended by the gasket manufacturer for use of lubricants and cements and other special installation requirements. The gasket shall be placed over one end of a section of pipe for half the width of the gasket. The other half shall be doubled over the end of the same pipe. When the adjoining section of pipe is in place, the doubled-over half of the gasket shall then be rolled over the adjoining section. Any unevenness in overlap shall be corrected so that the gasket covers the end of pipe sections equally. Connecting bands shall be centered over adjoining sections of pipe, and rods or bolts placed in position and nuts tightened. Band Tightening: The band shall be tightened evenly, even tension being kept on the rods or bolts, and the gasket; the gasket shall seat properly in the corrugations. Watertight joints shall remain uncovered for a period of time designated, and before being covered, tightness of the nuts shall be measured with a torque wrench. If the nut has tended to loosen its grip on the bolts or rods, the nut shall be retightened with a torque wrench and remain uncovered until a tight, permanent joint is assured.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete, precast concrete segmental blocks, prefabricated corrugated metal, or bituminous coated corrugated metal; complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 12 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 12 inches.

3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.4 Compaction

3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and

gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under airfield and heliport pavements, paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.7.5 Determination of Density

Testing is the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 6938. When ASTM D 6938 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 6938 results in a wet unit weight of soil and ASTM D 6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 6938. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.8 PIPELINE TESTING

3.8.1 Leakage Tests

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall conform to ASTM C 828. Low pressure air testing for concrete pipes shall conform to ASTM C 924. Low pressure air testing for plastic pipe shall conform to ASTM F 1417. Low pressure air testing

procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 or ASTM C 924, after consultation with the pipe manufacturer. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C 1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 0.2 gallons per inch in diameter per 100 feet of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished.

3.8.2 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

a. Pull-through device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided that the device meets the applicable requirements specified in this paragraph, including those for diameter of the device. Ball, cylinder, or circular sections shall conform to the following:

1 A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.

2 A homogeneous material throughout, with a density greater than 1.0 as related to water at 39.2 degrees F, and a surface Brinell hardness of not less than 150.

3 Center bored and through bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of not less than 70,000 psi, with eyes or loops at each end for attaching pulling cables.

4 Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

b. Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved by the Contracting Officer prior to use.

c. Pull-through device: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions as specified.

d. Deflection measuring device procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, remove pipe which has excessive deflection, replace with new pipe, and completely retest in same manner and under same conditions.

e. Warranty period test: Pipe found to have a deflection of greater than 5 percent of average inside diameter when deflection test is performed just prior to end of one-year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection.

## 3.9 FIELD PAINTING

After installation, clean cast-iron frames, covers, gratings, and steps not buried in masonry or concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint.

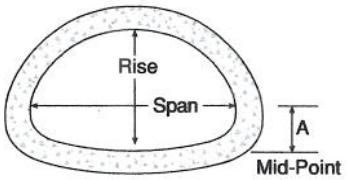
-- End of Section --

**Concrete Arch Pipe** **#41**

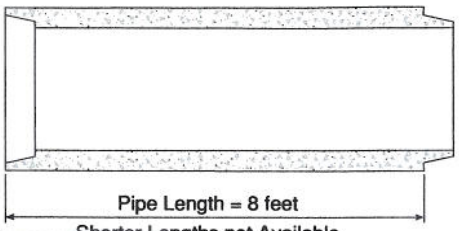
Hanson

- Flared end sections are not permitted.
- Pipe to be reinforced, Class III minimum.
- Portland cement for concrete pipe to conform to ASTM C 150, Type II, with a compressive strength of 4000 psi.
- Bed and backfill pipe in conformance with specifications.
- Provide security barriers in accordance with UFC 3-200-10N.
- Preformed joint sealant to conform to ASTM C 443.

## Reinforced Concrete Pipe

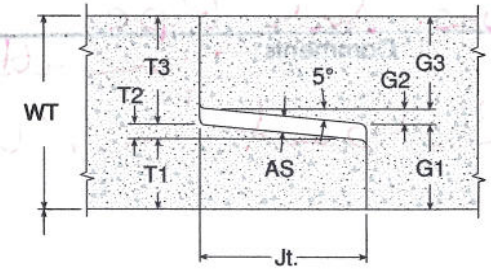



End View




**Pipe Data**

| Span (in.) | Rise (in.) | Rd. Equiv Pipe Size (in.) | Metric Equiv. Rise (mm) | Metric Equiv. Span (mm) | Opening Sq. Ft. (in.) | Weight (lb./ft.) | Mid-Point A (in.) |
|---|---|---|---|---|---|---|---|
| 18 | 11 | 15 | 460 | 280 | 1.1 | 188 | 4 11/16 |
| 22 | 13 | 18 | 560 | 345 | 1.6 | 233 | 6 |
| 29 | 18 | 24 | 725 | 460 | 2.9 | 325 | 5 29/32 |
| 36 | 23 | 30 | 920 | 570 | 4.4 | 392 | 7 11/16 |
| 44 | 27 | 36 | 1,110 | 675 | 6.5 | 537 | 8 9/16 |
| 51 | 31 | 42 | 1,300 | 795 | 8.7 | 696 | 10 1/16 |
| 58 | 36 | 48 | 1,485 | 915 | 11.4 | 885 | 11 19/32 |
| 65 | 40 | 54 | 1,650 | 1,015 | 14.3 | 1,079 | 13 |
| 73 | 45 | 60 | 1,855 | 1,145 | 17.7 | 1,333 | 14 11/16 |
| 88 | 54 | 72 | 2,235 | 1,370 | 25.6 | 1,856 | 17 |




**Joint Dimensions**

| Size (in.) | Wall (in.) | Jt. (in.) | G1 (in.) | G2 (in.) | G3 (in.) | T1 (in.) | T2 (in.) | T3 (in.) | AS (in.) |
|---|---|---|---|---|---|---|---|---|---|
| 18 x 11 | 3 | 2 1/4 | 1.281 | 0.197 | 1.522 | 1.000 | 0.197 | 1.803 | 0.28 |
| 22 x 13 | 3 1/8 | 2 1/4 | 1.406 | 0.197 | 1.522 | 1.125 | 0.197 | 1.803 | 0.28 |
| 29 x 18 | 3 1/2 | 2 3/4 | 1.516 | 0.234 | 1.750 | 1.250 | 0.234 | 2.016 | 0.27 |
| 36 x 23 | 3 1/2 | 3 | 1.594 | 0.262 | 1.644 | 1.313 | 0.262 | 1.925 | 0.28 |
| 44 x 27 | 4 | 3 1/2 | 1.719 | 0.306 | 1.975 | 1.438 | 0.306 | 2.256 | 0.28 |
| 51 x 31 | 4 1/2 | 3 1/2 | 1.906 | 0.306 | 2.288 | 1.625 | 0.306 | 2.569 | 0.28 |
| 58 x 36 | 5 | 3 1/2 | 2.281 | 0.306 | 2.413 | 2.000 | 0.306 | 2.694 | 0.28 |
| 65 x 40 | 5 1/2 | 5 | 2.625 | 0.437 | 2.438 | 2.313 | 0.437 | 2.750 | 0.31 |
| 73 x 45 | 6 | 5 | 2.938 | 0.437 | 2.625 | 2.375 | 0.437 | 3.188 | 0.56 |
| 88 x 54 | 7 | 6 | 3.188 | 0.525 | 3.287 | 2.625 | 0.525 | 3.850 | 0.56 |

Note:

(a.) Joint Material: Preformed Flexible Mastic (Federal Spec. SS-S-210A) Bituminous Plastic Cement. (M.D.O.T. Section 707.04)

(b.) All Pipe manufactured according to ASTM Spec. C-506 & AASHTO M-206.

**-No Scale-**
All dimensions subject to allowable specification tolerances.

| TITLE | PLANT | SECTION.PAGE | DATE | |
|---|---|---|---|---|
| **Reinforced Concrete Arch Pipe, 15" - 72"** | | 3.7 | 5-15-03 | Hanson |

Project Name: Stennis Riverine
Contract: N69450-05-DC096
Bem proj.: 3013-70

Submittal: 02300-01
Reviewed
Reviewed by: J. Collins
Date: 3/25/09

**DAMMON ENGINEERING INC**

**Date:** 3.31.09 **Project:** Stennis ROF

**Reviewed:** _____

**Reviewed as Noted:** X

**Revise and Resubmit:** _____

**Rejected:** _____

**Other:** _____

**Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. This contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his or her work with that at all other trades and performing all in a safe and satisfactory manner.**

**Submittal Item:** Conc. Arch Pipe

**Comments** – See attached

Robert Lucas

**BROADMOOR, L.L.C.**

I hereby agree that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract number N69450-05-D-0096, is in compliance with the contract documents, can be installed in the allocated spaces, and is submitted for Government approval.

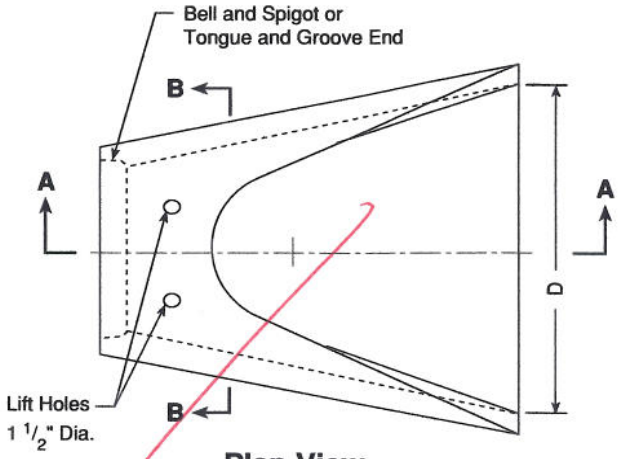
Robert Lucas 3.31.09

DQC Manager Date

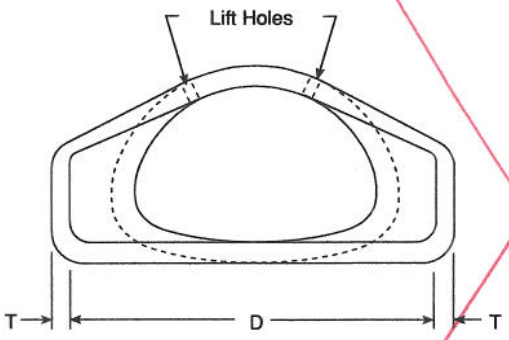
QC Officer 3/31/09

Date

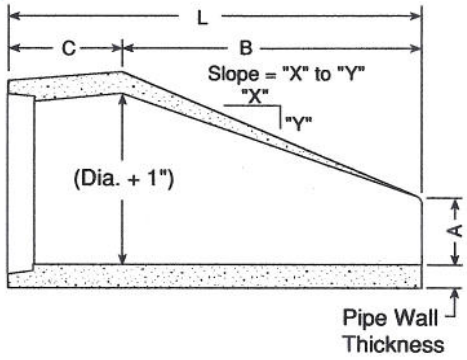
## Precast Drainage Structures




**Plan View**




**Section B-B**




**Section A-A**

### Standard Dimensions

| Equiv. Size (In.) | Span-Rise (Nominal) (In.) | Metric Equiv. (mm) | Wall Thick. (In.) | Weight Lbs. per Section | Slope | A (In.) | B (In.) | C (In.) | D (In.) | L (in.) |
|---|---|---|---|---|---|---|---|---|---|---|
| 18 | 22 x 13 | 560 x 345 | 2 1/2 | 1,050 | 3:1 | 7 | 27 | 45 | 36 | 72 |
| 24 | 29 x 18 | 725 x 460 | 3 | 1,580 | 3:1 | 8 | 39 | 33 | 48 | 72 |
| 30 | 36 x 23 | 920 x 570 | 3 1/2 | 2,250 | 3:1 | 10 | 48 | 24 | 60 | 72 |
| 36 | 44 x 27 | 1110 x 675 | 4 | 3,900 | 3:1 | 10 | 60 | 36 | 72 | 96 |
| 42 | 51 x 31 | 1300 x 795 | 4 1/2 | 5,420 | 3:1 | 15 | 60 | 36 | 78 | 96 |
| 48 | 58 x 36 | 1485 x 915 | 5 | 6,540 | 3:1 | 21 | 60 | 36 | 84 | 96 |
| 54 | 65 x 40 | 1650 x 1015 | 5 1/2 | 7,640 | 3:1 | 25 | 60 | 36 | 90 | 96 |
| 60 | 73 x 45 | 1855 x 1145 | 6 | 9,510 | 3:1 | 26 | 75 | 21 | 96 | 96 |
| 72 | 88 x 54 | 2235 x 1370 | 7 | 14,840 | 3:1 | 35 | 78 | 22 | 120 | 100 |

Note:

(a.) Joint Material: Preformed Flexible Mastic (Federal Spec. SS-S-210A), Bituminous Plastic Cement.

**-No Scale-**
All dimensions subject to allowable specification tolerances.

| TITLE | PLANT | SECTION.PAGE | DATE | |
|---|---|---|---|---|
| **Flared End Section For Concrete Arch Pipe** | | 8.37 | 5-15-03 | Hanson |

# TECHNICAL DATA BULLETIN

# BUTYL-NEK

*Preformed Plastic Joint Sealant for*

Pipe, Box, Vaults, Manholes

| | TEST METHOD | REQUIRED | RAM-NEK | BUTYL-NEK | RUB'R-NEK | BRAND X |
|---|---|---|---|---|---|---|
| **Chemical Composition** | | | | | | |
| Hydrocarbon, % by weight | ASTM D 4-80 | 50-70 | 68.29 | 64.86 | 55.0 | 51 |
| Inert Mineral Filler, % by weight | AASHTO T111 | 30-50 | 30.02 | 33.45 | 45.0 | 35 |
| Volatile Matter, % by weight | ASTM D 6-80 | 2.0 Max. | 1.69 | 1.69 | 0.0 | 1.2 |
| **Physical Properties*** | | | | | | |
| Specific gravity, @ 77F. | ASTM D 71-84 | 1.2-1.35 | 1.3343 | 1.3319 | 1.29 | 1.25 |
| Ductility at 77F, cm | ASTM D 113-85 | 5.0 min. | 6.0 | 6.0 | 5.0 | 10 |
| Softening Point, Ring & Ball, @ 77F | ASTM D 36-86 | 320 min. | 325 | 325 | ----- | ----- |
| Penetration, Cone, @ 77 F, 150 g, 5 sec., in 0.1 mm | ASTM D 217-82 | 50-120 | 86 | 75 | 70 | 55-60 |
| Flash Point, Cleveland Open Cup, F | ASTM D 92-85 | 600 min. | 615° | 620° | 600° | 450° |
| Fire Point, Cleveland Open Cup, F | ASTM D 92-85 | 625 min. | 635° | 635° | 625° | 475° |
| Compression Test @77° F lbf/in³ | ASTM C 972 | 100 max. | N/A | 100 | ----- | ---- |
| Compression Test @ 32° F lbf/in³ | ASTM D 972 | 200 max. | N/A | 198 | ----- | ---- |
| **Sag or Flow Resistance** | | | | | | |
| Sag or flow resistance, in vertical position for 5 days @ 135 F | FS SS-S-210A sect. 4.5.3/ASTM C 990 | No sagging | No visible changes | No visible changes | — | — |
| **Chemical Resistance** | | | | | | |
| 30 days immersion @ room temperature in each of the following: | FS SS-S-2120A sect. 3.6/ASTM C 990 | | | | | |
| 5% Solution of Caustic Potash | | No visible Deterioration | Complies | Complies | Complies | Complies |
| 5% Solution of Hydrochloric Acid | | No visible Deterioration | Complies | Complies | Complies | Complies |
| 5% Solution of Sulfuric Acid | | No visible Deterioration | Complies | Complies | Complies | Complies |
| Saturated Hydrogen Sulfide Solution | | No visible Deterioration | Complies | Complies | Complies | Complies |

BUTYL-NEK meets or exceeds the requirements of of Federal Specification SS-S-210(210A), AASHTO M-198B, and ASTM C-990-91.

*For additional information, literature or to place an order please call (800)231-4549*

SECTION 33 71 02.00 20

UNDERGROUND ELECTRICAL DISTRIBUTION
**08/08**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

| | |
|---|---|
| ACI 318M | (2008) Metric Building Code Requirements for Structural Concrete and Commentary |
| ACI SP-66 | (2004) ACI Detailing Manual |

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO HB-17 | (2002; Errata 2003; Errata 2005) Standard Specifications for Highway Bridges |
| AASHTO M 198 | (2008) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants |

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

| | |
|---|---|
| AEIC CS8 | (2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM B 1 | (2001; R 2007) Standard Specification for Hard-Drawn Copper Wire |
| ASTM B 3 | (2001; R 2007) Standard Specification for Soft or Annealed Copper Wire |
| ASTM B 8 | (2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft |
| ASTM B 800 | (2005) Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes-Annealed and Intermediate Tempers |
| ASTM B 801 | (2007) Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation |

| | |
|---|---|
| ASTM C 478 | (2008) Standard Specification for Precast Reinforced Concrete Manhole Sections |
| ASTM C 857 | (2007) Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures |
| ASTM F 512 | (2006) Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C2 | (2007; Errata 2007; INT 2008) National Electrical Safety Code |
| IEEE Std 100 | (2000) The Authoritative Dictionary of IEEE Standards Terms |
| IEEE Std 386 | (2006) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V |
| IEEE Std 400.2 | (2004) Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF) |
| IEEE Std 48 | (1996; R 2003) Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV |
| IEEE Std 81 | (1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)Normal Measurements |

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

| | |
|---|---|
| NETA ATS | (2003) Acceptance Testing Specifications |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA C119.1 | (2006) Sealed Insulated Underground Connector Systems Rated 600 Volts |
| NEMA TC 6 & 8 | (2003) Standard for Polyvinyl Chloride PVC Plastic Utilities Duct for Underground Installations |
| NEMA TC 9 | (2004) Standard for Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation |
| NEMA WC 71 | (1999) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy |
| NEMA WC 74 | (2006) Standard for 5-46 kV Shielded Power |

| | |
|---|---|
| | Cable for use in the Transmission and Distribution of Electric Energy |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

| | |
|---|---|
| TIA-758-A | (2004) Customer-Owned Outside Plant Telecommunications Cabling Standard |

U.S. DEPARTMENT OF AGRICULTURE (USDA)

| | |
|---|---|
| RUS Bull 1751F-644 | (2002) Underground Plant Construction |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| CID A-A-60005 | (Basic; Notice 1) Frames, Covers, Gratings, Steps, Sump And Catch Basin, Manhole |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1072 | (2006; Rev thru Sep 2007) Medium-Voltage Power Cables |
| UL 1242 | (2006; Rev thru Jul 2007) Standard for Electrical Intermediate Metal Conduit -- Steel |
| UL 467 | (2007) Standard for Grounding and Bonding Equipment |
| UL 486A-486B | (2003; Rev thru Aug 2006) Standard for Wire Connectors |
| UL 510 | (2005; Rev thru Aug 2005) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape |
| UL 514A | (2004; Rev thru Aug 2007) Standard for Metallic Outlet Boxes |
| UL 514B | (2004; Rev thru Aug 2007) Standard for Conduit, Tubing and Cable Fittings |
| UL 6 | (2007) Standard for Electrical Rigid Metal Conduit-Steel |
| UL 651 | (2005; Rev thru May 2007) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings |
| UL 651A | (2000; Rev thru Sep 2007) Type EB and A Rigid PVC Conduit and HDPE Conduit |
| UL 83 | (20086) Standard for |

| | |
|---|---|
| | Thermoplastic-Insulated Wires and Cables |
| UL 854 | (2004; Rev thru Oct 2007) Service-Entrance Cables |

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

b. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

c. In the text of this section, "medium voltage cable splices," and "medium voltage cable joints" are used interchangeably and have the same meaning.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Precast underground structures; G

SD-03 Product Data

Medium voltage cable; G

Medium voltage cable terminations; G

Precast concrete structures; G

Sealing Material

Pulling-In Irons

Manhole frames and covers; G

Composite/fiberglass handholes; G

Cable supports (racks, arms and insulators); G

SD-06 Test Reports

Arc-proofing test for cable fireproofing materials; G

Medium voltage cable qualification and production tests; G

Field Acceptance Checks and Tests; G

Arc-proofing test for cable fireproofing tape; G

Cable Installation Plan and Procedure

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

SD-07 Certificates

Cable splicer/terminator; G

Cable Installer Qualifications

1.4 QUALITY ASSURANCE

1.4.1 Precast Underground Structures

Submittal required for each type used. Provide calculations and drawings for precast manholes and handholes bearing the seal of a registered professional engineer including:

a. Material description (i.e., f'c and Fy)

b. Manufacturer's printed assembly and installation instructions

c. Design calculations

d. Reinforcing shop drawingsin accordance with ACI SP-66

e. Plans and elevations showing opening and pulling-in iron locations and details

1.4.2 Certificate of Competency for Cable Splicer/Terminator

Certification of the qualification of the cable splicer/terminator shall be submitted, for approval, 30 days before splices or terminations are to be made in medium voltage (5 kV to 35 kV) cables. The certification shall include the training, and experience of the individual on the specific type and classification of cable to be provided under this contract. The certification shall indicate that the individual has had three or more years recent experience splicing and terminating medium voltage cables. The certification shall also list a minimum of three splices/terminations that have been in operation for more than one year. In addition, the individual may be required to perform a dummy or practice

splice/termination in the presence of the Contracting Officer, before being approved as a qualified cable splicer. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice/termination kit, and detailed manufacturer's instructions for the cable to be spliced. The Contracting Officer reserves the right to require additional proof of competency or to reject the individual and call for certification of an alternate cable splicer.

### 1.4.3 Cable Installer Qualifications

Provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. Provide a resume showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

### 1.4.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

### 1.4.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

#### 1.4.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

#### 1.4.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

PART 2 PRODUCTS

2.1 CONDUIT, DUCTS, AND FITTINGS

2.1.1 Rigid Metal Conduit

UL 6.

2.1.2 Intermediate Metal Conduit

UL 1242.

2.1.3 Plastic Conduit for Direct Burial

UL 651, Schedule 40.

2.1.4 Plastic Duct for Concrete Encasement

NEMA TC 6 & 8 and ASTM F 512, UL 651A Type EPC-20-PVC, Type EPC-35-PVC, UL 651 EPC-40-PVC.

2.1.5 Innerduct

Provide corrugated or solid wall polyethylene (PE) or PVC innerducts with pullwire. Size as indicated.

2.1.6 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials. Inflatable bladders may be used as an option.

2.1.7 Fittings

2.1.7.1 Metal Fittings

UL 514B.

2.1.7.2 PVC Conduit Fittings

UL 514B, UL 651.

2.1.7.3 PVC Duct Fittings

NEMA TC 9.

2.1.7.4 Outlet Boxes for Steel Conduit

Outlet boxes for use with rigid or flexible steel conduit shall be cast-metal cadmium or zinc-coated if of ferrous metal with gasketed closures and shall conform to UL 514A.

## 2.2 LOW VOLTAGE INSULATED CONDUCTORS AND CABLES

Insulated conductors shall be rated 600 volts and conform to the requirements of NFPA 70, including listing requirements. Wires and cables manufactured more than 24 months prior to date of delivery to the site shall not be accepted. Service entrance conductors shall conform to UL 854, type USE.

### 2.2.1 Conductor Types

Cable and duct sizes indicated are for copper conductors and THHN/THWN unless otherwise noted. Conductors No. 10 AWG and smaller shall be solid copper. Conductors No. 8 AWG and larger shall be stranded copper. Conductors No. 4/0 AWG and smaller shall be copper. Conductors 250 KCMIL and larger shall be either copper or aluminum, at the Contractor's option. As an exception, do not substitute aluminum for copper if the equivalent aluminum conductor size would exceed 500 kcmil. Should the Contractor choose to use aluminum for conductors 250 KCMIL and larger, the Contractor shall be responsible for: Increasing the conductor size to have the same ampacity as the copper size indicated; increasing the conduit and pull box sizes to accommodate the larger size aluminum conductors in accordance with NFPA 70; ensuring that the pulling tension rating of the aluminum conductor is sufficient; relocating equipment, modifying equipment terminations, resizing equipment, and resolving to the satisfaction of the Contracting Officer problems that are direct results of the use of aluminum conductors in lieu of copper.

### 2.2.2 Conductor Material

Unless specified or indicated otherwise or required by NFPA 70, wires in conduit, other than service entrance, shall be 600-volt, Type THWN/THHN conforming to UL 83. Copper conductors shall be annealed copper complying with ASTM B 3 and ASTM B 8. Aluminum conductors shall be Type AA-8000 aluminum conductors complying with ASTM B 800 and ASTM B 801, and shall be of an aluminum alloy listed or labeled by UL as "component aluminum-wire stock (conductor material). Type EC/1350 is not acceptable. Intermixing of copper and aluminum conductors is not permitted.

### 2.2.3 In Duct

Cables shall be single-conductor cable.

### 2.2.4 Cable Marking

Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout the cable length.

Each cable shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

Conductors shall be color coded. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Conductor identification shall be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, heat shrink type sleeves,or colored electrical tape.

Control circuit terminations shall be properly identified. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutrals shall be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems shall be as follows

a. 208/120 volt, three-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, three-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

c. 120/240 volt, single phase: Black and red

## 2.3 LOW VOLTAGE WIRE CONNECTORS AND TERMINALS

Shall provide a uniform compression over the entire conductor contact surface. Use solderless terminal lugs on stranded conductors.

a. For use with copper conductors: UL 486A-486B.

b. For use with aluminum conductors: UL 486A-486B. For connecting aluminum to copper, connectors shall be the circumferentially compressed, metallurgically bonded type.

## 2.4 LOW VOLTAGE SPLICES

Provide splices in conductors with a compression connector on the conductor and by insulating and waterproofing using one of the following methods which are suitable for continuous submersion in water and comply NEMA C119.1.

### 2.4.1 Heat Shrinkable Splice

Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which shall be applied in accordance with the manufacturer's written instructions.

### 2.4.2 Cold Shrink Rubber Splice

Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation shall not require heat or flame, or any additional materials such as covering or adhesive. It shall be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

## 2.5 MEDIUM VOLTAGE CABLE

Cable (conductor) sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than 24 months prior to date of delivery to the site shall not be accepted. Provide single conductor type cables unless otherwise indicated.

### 2.5.1 Cable Configuration

Provide Type MV cable, conforming to NEMA WC 74 and UL 1072 . Provide cables manufactured for use in duct applications. Cable shall be rated 15 kV with 133 percent insulation level.

### 2.5.2 Conductor Material

Provide concentric-lay-stranded, Class B for compact round conductors. Provide soft drawn copper cables complying with ASTM B 3 and ASTM B 8 for regular concentric and compressed stranding.

### 2.5.3 Insulation

Provide ethylene-propylene-rubber (EPR) insulation conforming to the requirements of NEMA WC 71.

### 2.5.4 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper tape or wire shield for each phase.

### 2.5.5 Jackets

Cables shall be provided with a PVC jacket.

## 2.6 MEDIUM VOLTAGE CABLE TERMINATIONS

IEEE Std 48 Class 1; of the molded elastomer, prestretched elastomer, or heat-shrinkable elastomer. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, or armor. Terminations shall be provided in a kit, including: skirts, stress control terminator, ground clamp, connectors, lugs, and complete instructions for assembly and installation. Terminations shall be the product of one manufacturer, suitable for the type, diameter, insulation class and level, and materials of the cable terminated. Do not use separate parts of copper or copper alloy in contact with aluminum alloy parts in the construction or installation of the terminator.

2.6.1 Cold-Shrink Type

Terminator shall be a one-piece design, utilizing the manufacturer's latest technology, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber. Termination shall not require heat or flame for installation. Termination kit shall contain all necessary materials (except for the lugs). Termination shall be designed for installation in low or highly contaminated indoor and outdoor locations and shall resist ultraviolet rays and oxidative decomposition.

2.6.2 Heat Shrinkable Type

Terminator shall consist of a uniform cross section heat shrinkable polymeric construction stress relief tubing and environmentally sealed outer covering that is nontracking, resists heavy atmospheric contaminants, ultra violet rays and oxidative decomposition. Provide heat shrinkable sheds or skirts of the same material. Termination shall be designed for installation in low or highly contaminated indoor or outdoor locations.

2.6.3 Separable Insulated Connector Type

IEEE Std 386. Provide connector with steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material. Provide connectors of the loadbreak or deadbreak type as indicated, of suitable construction for the application and the type of cable connected, and that include cable shield adaptors. Provide external clamping points and test points.

a. 200 Ampere loadbreak connector ratings: Voltage: 15 kV, 95 kV BIL. Short time rating: 10,000 rms symmetrical amperes.

2.7 TELECOMMUNICATIONS CABLING

Provide telecommunications cabling in accordance with Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP).

2.8 TAPE

2.8.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.8.2 Buried Warning and Identification Tape

Provide detectable tape in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL.

2.8.3 Fireproofing Tape

Provide tape composed of a flexible conformable unsupported intumescent elastomer. Tape shall be not less than .030 inch thick, noncorrosive to cable sheath, self-extinguishing, noncombustible, and shall not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.9 PULL ROPE

Shall be plastic or flat pull line (bull line) having a minimum tensile

strength of 200 pounds.

## 2.10 GROUNDING AND BONDING

### 2.10.1 Driven Ground Rods

Provide copper-clad steel ground rods conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used for rods 20 feet or longer.

### 2.10.2 Grounding Conductors

Stranded-bare copper conductors shall conform to ASTM B 8, Class B, soft-drawn unless otherwise indicated. Solid-bare copper conductors shall conform to ASTM B 1 for sizes No. 8 and smaller. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Aluminum is not acceptable.

## 2.11 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE. In addition, provide concrete for encasement of underground ducts with 3000 psi minimum 28-day compressive strength. Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise.

## 2.12 UNDERGROUND STRUCTURES

Provide precast concrete underground structures or standard type cast-in-place manhole types as indicated, conforming to ASTM C 857 and ASTM C 478. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking. Covers shall fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable.

### 2.12.1 Precast Concrete Structures, Risers and Tops

In lieu of cast-in-place, Contractors, at their option, may provide precast concrete underground structures subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes.

#### 2.12.1.1 General

Precast concrete structures shall have the same accessories and facilities as required for cast-in-place structures. Likewise, precast structures shall have plan area and clear heights not less than those of cast-in-place structures. Concrete materials and methods of construction shall be the same as for cast-in-place concrete construction, as modified herein. Slope

in floor may be omitted provided precast sections are poured in reinforced steel forms. Concrete for precast work shall have a 28-day compressive strength of not less than 4000 psi. Structures may be precast to the design and details indicated for cast-in-place construction, precast monolithically and placed as a unit, or structures may be assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

2.12.1.2 Design for Precast Structures

ACI 318M. In the absence of detailed on-site soil information, design for the following soil parameters/site conditions:

a. Angle of Internal Friction (phi) = 30 degrees

b. Unit Weight of Soil (Dry) = 110 pcf, (Saturated) = 130 pcf

c. Coefficient of Lateral Earth Pressure (Ka) = 0.33

d. Ground Water Level = 3 feet below ground elevation

e. Vertical design loads shall include full dead, superimposed dead, and live loads including a 30 percent magnification factor for impact. Live loads shall consider all types and magnitudes of vehicular (automotive, industrial, or aircraft) traffic to be encountered. The minimum design vertical load shall be for H20 highway loading per AASHTO HB-17.

f. Horizontal design loads shall include full geostatic and hydrostatic pressures for the soil parameters, water table, and depth of installation to be encountered. Also, horizontal loads imposed by adjacent structure foundations, and horizontal load components of vertical design loads, including impact, shall be considered, along with a pulling-in iron design load of 6000 pounds.

g. Each structural component shall be designed for the load combination and positioning resulting in the maximum shear and moment for that particular component.

h. Design shall also consider the live loads induced in the handling, installation, and backfilling of the manholes. Provide lifting devices to ensure structural integrity during handling and installation.

2.12.1.3 Construction

Structure top, bottom, and wall shall be of a uniform thickness of not less than 6 inches. Thin-walled knock-out panels for designed or future duct bank entrances shall not be permitted. Quantity, size, and location of duct bank entrance windows shall be as directed, and cast completely open by the precaster. Size of windows shall exceed the nominal duct bank envelope dimensions by at least 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows shall be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank

envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. Provide drain sumps a minimum of 12 inches in diameter and 4 inches deep for precast structures.

2.12.1.4 Joints

Provide tongue-and-groove joints on mating edges of precast components. Shiplap joints are not allowed. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M 198, Type B. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

2.12.2 Manhole Frames and Covers

Provide cast iron frames and covers for manholes conforming to CID A-A-60005. Cast the words "ELECTRIC" or "TELECOMMUNICATIONS" in the top face of power and telecommunications manhole covers, respectively.

2.12.3 Composite/Fiberglass Handholes and Covers

Provide handholes and covers of polymer concrete, reinforced with heavy weave fiberglass.

2.13 CABLE SUPPORTS (RACKS, ARMS, AND INSULATORS)

The metal portion of racks and arms shall be zinc-coated after fabrication.

2.13.1 Cable Racks

The wall bracket shall be 4 inches by approximately 1-1/2 inch by 3/16 inch channel steel, 48 inches long (minimum) in manholes. Slots for mounting cable rack arms shall be spaced at 8 inch intervals.

2.13.2 Rack Arms

Cable rack arms shall be steel or malleable iron or glass reinforced nylon and shall be of the removable type. Rack arm length shall be a minimum of 8 inches and a maximum of 12 inches.

2.13.3 Insulators

Insulators for metal rack arms shall be dry-process glazed porcelain. Insulators are not required for nylon arms.

2.14 CABLE TAGS IN MANHOLES

Provide tags for each power cable located in manholes. The tags shall be polyethylene. Do not provide handwritten letters. The first position on the power cable tag shall denote the voltage. The second through sixth positions on the tag shall identify the circuit. The next to last position shall denote the phase of the circuit and shall include the Greek "phi" symbol. The last position shall denote the cable size. As an example, a tag could have the following designation: "11.5 NAS 1-8(Phase A)500," denoting that the tagged cable is on the 11.5kV system circuit number NAS

1-8, underground, Phase A, sized at 500 kcmil.

### 2.14.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

## 2.15 SOURCE QUALITY CONTROL

### 2.15.1 Arc-Proofing Test for Cable Fireproofing Tape

Manufacturer shall test one sample assembly consisting of a straight lead tube 12 inches long with a 2 1/2 inch outside diameter, and a 1/8 inch thick wall, and covered with one-half lap layer of arc and fireproofing material per manufacturer's instructions. The arc and fireproofing tape shall withstand extreme temperature of a high-current fault arc 13,000 degrees K for 70 cycles as determined by using an argon directed plasma jet capable of constantly producing and maintaining an arc temperature of 13,000 degrees K. Temperature (13,000 degrees K) of the ignited arc between the cathode and anode shall be obtained from a dc power source of 305 (plus or minus 5) amperes and 20 (plus or minus 1) volts. The arc shall be directed toward the sample assembly accurately positioned 5 (plus or minus 1) millimeters downstream in the plasma from the anode orifice by fixed flow rate of argon gas (0.18 g per second). Each sample assembly shall be tested at three unrelated points. Start time for tests shall be taken from recorded peak current when the specimen is exposed to the full test temperature. Surface heat on the specimen prior to that time shall be minimal. The end point is established when the plasma or conductive arc penetrates the protective tape and strikes the lead tube. Submittals for arc-proofing tape shall indicate that the test has been performed and passed by the manufacturer.

### 2.15.2 Medium Voltage Cable Qualification and Production Tests

Results of AEIC CS8 qualification and production tests as applicable for each type of medium voltage cable.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Install equipment and devices in accordance with the manufacturer's published instructions and with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable. In addition to these requirements, install telecommunications in accordance with TIA-758-A and RUS Bull 1751F-644.

## 3.2 CABLE INSPECTION

Prior to installation, each cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end

seal is broken, moisture shall be removed from cable prior to installation in accordance with the cable manufacturer's recommendations.

## 3.3 CABLE INSTALLATION PLAN AND PROCEDURE

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature limits for installation, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, maximum allowable pulling tension, and maximum allowable sidewall bearing pressure. The Contractor shall then perform pulling calculations and prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS. Cable shall be installed strictly in accordance with the cable manufacturer's recommendations and the approved installation plan.

Calculations and pulling plan shall include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall bearing pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

## 3.4 UNDERGROUND FEEDERS SUPPLYING BUILDINGS

Terminate underground feeders supplying building at a point 5 feet outside the building and projections thereof, except that conductors shall be continuous to the terminating point indicated. Coordinate connections of the feeders to the service entrance equipment with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Conduit shall be PVC. Protect ends of underground conduit with plastic plugs until connections are made.

Encase the underground portion of the conduit in a concrete envelope and bury as specified for underground duct with concrete encasement.

## 3.5 UNDERGROUND STRUCTURE CONSTRUCTION

Provide standard type precast construction as specified herein. Precast concrete shall be fully cured. Locate duct entrances and windows in the center of end walls (shorter) and near the corners of sidewalls (longer) to facilitate cable racking and splicing. Covers for underground structures shall fit the frames without undue play. Steel and iron shall be formed to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets.

### 3.5.1 Precast Concrete Construction

Set commercial precast structures on 6 inches of level, 90 percent compacted granular fill, 3/4 inch to 1 inch size, extending 12 inches beyond the structure on each side. Compact granular fill by a minimum of four passes with a plate type vibrator. Installation shall additionally conform to the manufacturer's instructions.

### 3.5.2 Pulling-In Irons

Provide steel bars bent as indicated, and cast in the walls and floors. Alternatively, pipe sleeves may be precast into the walls and floors where required to accept U-bolts or other types of pulling-in devices possessing the strengths and clearances stated herein. The final installation of pulling-in devices shall be made permanent. Cover and seal exterior projections of thru-wall type pulling-in devices with an appropriate protective coating. In the floor the irons shall be a minimum of 6 inches from the edge of the sump, and in the walls the irons shall be located within 6 inches of the projected center of the duct bank pattern or precast window in the opposite wall. However, the pulling-in iron shall not be located within 6 inches of an adjacent interior surface, or duct or precast window located within the same wall as the iron. If a pulling-in iron cannot be located directly opposite the corresponding duct bank or precast window due to this clearance limitation, locate the iron directly above or below the projected center of the duct bank pattern or precast window the minimum distance required to preserve the 6 inch clearance previously stated. In the case of directly opposing precast windows, pulling-in irons consisting of a 3 foot length of No. 5 reinforcing bar, formed into a hairpin, may be cast-in-place within the precast windows simultaneously with the end of the corresponding duct bank envelope. Irons installed in this manner shall be positioned directly in line with, or when not possible, directly above or below the projected center of the duct bank pattern entering the opposite wall, while maintaining a minimum clear distance of 3 inches from any edge of the cast-in-place duct bank envelope or any individual duct. Pulling-in irons shall have a clear projection into the structure of approximately 4 inches and shall be designed to withstand a minimum pulling-in load of 6000 pounds. Irons shall be hot-dipped galvanized after fabrication.

### 3.5.3 Cable Racks, Arms and Insulators

Cable racks, arms and insulators shall be sufficient to accommodate the cables. Racks in power manholes shall be spaced not more than 3 feet apart, and each manhole wall shall be provided with a minimum of two racks. Racks in signal manholes shall be spaced not more than 16 1/2 inches apart with the end rack being no further than 12 inches from the adjacent wall. Methods of anchoring cable racks shall be as follows:

a. Provide a 5/8 inch diameter by 5 inch long anchor bolt with 3 inch foot cast in structure wall with 2 inch protrusion of threaded portion of bolt into structure. Provide 5/8 inch steel square head nut on each anchor bolt. Coat threads of anchor bolts with suitable coating immediately prior to installing nuts.

b. Provide concrete channel insert with a minimum load rating of 800 pounds per foot. Insert channel shall be steel of the same length as "vertical rack channel;" channel insert shall be cast flush in structure wall. Provide 5/8 inch steel nuts in channel insert to receive 5/8 inch diameter by 3 inch long steel, square head anchor bolts.

c. Provide concrete "spot insert" at each anchor bolt location, cast flush in structure wall. Each insert shall have minimum 800 pound load rating. Provide 5/8 inch diameter by 3 inch long steel, square head anchor bolt at each anchor point. Coat threads of anchor bolts with suitable coating immediately prior to installing bolts.

### 3.5.4 Field Painting

Cast-iron frames and covers not buried in concrete or masonry shall be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint.

## 3.6 UNDERGROUND CONDUIT AND DUCT SYSTEMS

### 3.6.1 Requirements

Depths to top of the conduit shall be in accordance with NFPA 70. Run conduit in straight lines except where a change of direction is necessary. Numbers and sizes of ducts shall be as indicated. Ducts shall have a continuous slope downward toward underground structures and away from buildings, laid with a minimum slope of 3 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in structures.

### 3.6.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

### 3.6.3 Conduit Cleaning

As each conduit run is completed, for conduit sizes 3 inches and larger, draw a flexible testing mandrel approximately 12 inches long with a diameter less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs.

### 3.6.4 Multiple Conduits

Separate multiple conduits by a minimum distance of 2 1/2 inches, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 12 inches. Stagger the joints of the conduits by rows (horizontally) and layers (vertically) to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, ties, and locking device on top to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.

### 3.6.5 Conduit Plugs and Pull Rope

New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weephole or screen to allow water drainage. Provide a plastic pull rope having 3 feet of slack at each end of unused or empty conduits.

### 3.6.6 Conduit and Duct Without Concrete Encasement

Provide not less than 3 inches clearance from the conduit to each side of the trench. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4 inch sieve. The first 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 3 to 6 inch layers. Provide color, type and depth of warning tape as specified in Section 31 23 00.00 20 EXCAVATION AND FILL.

#### 3.6.6.1 Encasement Under Roads and Structures

Under roads, paved areas, and railroad tracks, install conduits in concrete encasement of rectangular cross-section providing a minimum of 3 inch concrete cover around ducts. Concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks.

### 3.6.7 Duct Encased in Concrete

Construct underground duct lines of individual conduits encased in concrete. Do not mix different kinds of conduit in any one duct bank. Concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 2 1/2 inches,

except separate light and power conduits from control, signal, and telecommunications conduits by a minimum concrete thickness of 12 inches. Before pouring concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring shall be done by driving reinforcing rods adjacent to duct spacer assemblies and attaching the rods to the spacer assembly. Provide color, type and depth of warning tape as specified in Section 31 00 00 EARTHWORK.

3.6.7.1 Connections to Manholes

Duct bank envelopes connecting to underground structures shall be flared to have enlarged cross-section at the manhole entrance to provide additional shear strength. Dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 12 inches in each direction. Perimeter of the duct bank opening in the underground structure shall be flared toward the inside or keyed to provide a positive interlock between the duct bank and the wall of the structure. Use vibrators when this portion of the encasement is poured to assure a seal between the envelope and the wall of the structure.

3.6.7.2 Connections to Existing Underground Structures

For duct bank connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and extend into the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

3.6.7.3 Partially Completed Duct Banks

During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, and, and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately one footapart. Restrain reinforcing assembly from moving during concrete pouring.

3.7 CABLE PULLING

Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with tape or wire shield shall have a bending radius not less than 12 times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.7.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

## 3.8 CABLES IN UNDERGROUND STRUCTURES

Do not install cables utilizing the shortest path between penetrations, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space open for future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground structure.

### 3.8.1 Cable Tag Installation

Install cable tags in each manhole as specified, including each splice. Tag wire and cable provided by this contract. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes.

## 3.9 CONDUCTORS INSTALLED IN PARALLEL

Conductors shall be grouped such that each conduit of a parallel run contains 1 Phase A conductor, 1 Phase B conductor, 1 Phase C conductor, and 1 neutral conductor.

## 3.10 LOW VOLTAGE CABLE SPLICING AND TERMINATING

Make terminations and splices with materials and methods as indicated or specified herein and as designated by the written instructions of the manufacturer. Do not allow the cables to be moved until after the splicing material has completely set. Make splices in underground distribution systems only in accessible locations such as manholes,handholes, or aboveground termination cabinets.

### 3.10.1 Terminating Aluminum Conductors

a. Use particular care in making up joints and terminations. Remove surface oxides by cleaning with a wire brush or emery cloth. Apply joint compound to conductors, and use UL-listed solid aluminum connectors for connecting aluminum conductors. When connecting aluminum to copper conductors, use connectors specifically designed for this purpose.

b. Terminate aluminum conductors to copper bus either by: (1) in line splicing a copper pigtail to the aluminum conductor (copper pigtail shall have a ampacity at least that of the aluminum conductor); or (2) using a circumferential compression type, aluminum bodied terminal lug UL listed for AL/CU and steel Belleville spring washers, flat washers, bolts, and nuts. Belleville spring washers shall be cadmium-plated hardened steel. Install the Belleville spring washers with the crown up toward the nut or bolt head, with the concave side of the Belleville bearing on a heavy-duty, wide series flat washer of larger diameter than the Belleville. Tighten nuts sufficient to flatten Belleville and leave in that position. Lubricate hardware with joint compound prior to making connection. Wire brush and apply joint compound to conductor prior to inserting in lug.

c. Terminate aluminum conductors to aluminum bus by using all-aluminum nuts, bolts, washers, and lugs. Wire brush and apply inhibiting compound to conductor prior to inserting in lug. Lubricate hardware with joint compound prior to making connection; if bus contact surface is unplated, scratch-brush and coat with joint compound (without grit).

## 3.11 MEDIUM VOLTAGE CABLE TERMINATIONS

Make terminations in accordance with the written instruction of the termination kit manufacturer.

## 3.12 MEDIUM VOLTAGE CABLE JOINTS

Provide power cable joints (splices) suitable for continuous immersion in water. Make joints only in accessible locations in manholes or handholes by using materials and methods in accordance with the written instructions of the joint kit manufacturer.

### 3.12.1 Joints in Shielded Cables

Cover the joined area with metallic tape, or material like the original cable shield and connect it to the cable shield on each side of the splice. Provide a bare copper ground connection brought out in a watertight manner and grounded to the manhole grounding loop as part of the splice installation. Ground conductors, connections, and rods shall be as specified elsewhere in this section. Wire shall be trained to the sides of the enclosure to prevent interference with the working area.

## 3.13 CABLE END CAPS

Cable ends shall be sealed at all times with coated heat shrinkable end caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

## 3.14 FIREPROOFING OF CABLES IN UNDERGROUND STRUCTURES

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in underground structures.

### 3.14.1 Fireproofing Tape

Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Install tape in accordance with manufacturer's instructions.

## 3.15 GROUNDING SYSTEMS

Provide grounding system as indicated, in accordance with NFPA 70 and IEEE C2, and as specified herein.

Noncurrent-carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding the following values:

| | |
|---|---|
| Pad-mounted transformers without protective fences | 5 ohms |
| Ground in manholes | 5 ohms |
| Grounding other metal enclosures of primary voltage electrical and electrically-operated equipment | 5 ohms |

3.15.1 Grounding Electrodes

Provide cone pointed driven ground rods driven full depth plus 6 inches, installed to provide an earth ground of the appropriate value for the particular equipment being grounded. If the specified ground resistance is not met, an additional ground rod shall be provided in accordance with the requirements of NFPA 70 (placed not less than 6 feet from the first rod). Should the resultant (combined) resistance exceed the specified resistance, measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.15.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.15.3 Grounding Conductors

Provide bare grounding conductors, except where installed in conduit with associated phase conductors. Ground cable sheaths, cable shields, conduit, and equipment with No. 6 AWG. Ground other noncurrent-carrying metal parts and equipment frames of metal-enclosed equipment. Ground metallic frames and covers of handholes and pull boxes with a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.15.4 Ground Cable Crossing Expansion Joints

Protect ground cables crossing expansion joints or similar separations in structures and pavements by use of approved devices or methods of installation which provide the necessary slack in the cable across the joint to permit movement. Use stranded or other approved flexible copper cable across such separations.

3.15.5 Manhole Grounding

Loop a 4/0 AWG grounding conductor around the interior perimeter, approximately 12 inches above finished floor. Secure the conductor to the

manhole walls at intervals not exceeding 36 inches. Connect the conductor to the manhole grounding electrode with 4/0 AWG conductor. Connect all incoming 4/0 grounding conductors to the ground loop adjacent to the point of entry into the manhole. Bond the ground loop to all cable shields, metal cable racks, and other metal equipment with a minimum 6 AWG conductor.

## 3.16 EXCAVATING, BACKFILLING, AND COMPACTING

Provide in accordance with NFPA 70 and Section 31 23 00.00 20 EXCAVATION AND FILL.

### 3.16.1 Reconditioning of Surfaces

#### 3.16.1.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct. Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding, and provide topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.

#### 3.16.1.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.

## 3.17 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

### 3.17.1 Concrete Slabs for Equipment

Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. Top of concrete slab shall be approximately 4 inches above finished grade with gradual slope for drainage. Edges above grade shall have 1/2 inch chamfer. Slab shall be of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

### 3.17.2 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

## 3.18 FIELD QUALITY CONTROL

### 3.18.1 Performance of Field Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

#### 3.18.1.1 Medium Voltage Cables

Perform tests after installation of cable, splices, and terminators and before terminating to equipment or splicing to existing circuits.

a. Visual and Mechanical Inspection

(1) Inspect exposed cable sections for physical damage.

(2) Verify that cable is supplied and connected in accordance with contract plans and specifications.

(3) Inspect for proper shield grounding, cable support, and cable termination.

(4) Verify that cable bends are not less than ICEA or manufacturer's minimum allowable bending radius.

(5) Inspect for proper fireproofing.

(6) Visually inspect jacket and insulation condition.

(7) Inspect for proper phase identification and arrangement.

b. Electrical Tests

(1) Perform a shield continuity test on each power cable by ohmmeter method. Record ohmic value, resistance values in excess of 10 ohms per 1000 feet of cable must be investigated and justified.

(2) Perform acceptance test on new cables before the new cables are connected to existing cables and placed into service, including terminations and joints. Perform maintenance test on complete cable system after the new cables are connected to existing cables and placed into service, including existing cable, terminations, and joints. Tests shall be very low frequency (VLF) alternating voltage withstand tests in accordance with IEEE Std 400.2. VLF test frequency shall be 0.05 Hz minimum for a duration of 60 minutes using a sinusoidal waveform. Test voltages shall be as follows:

| CABLE RATING | AC TEST VOLTAGE for ACCEPTANCE TESTING |
|---|---|
| 5 kV | 10kV rms(peak) |
| 8 kV | 13kV rms(peak) |
| 15 kV | 20kV rms(peak) |
| 25 kV | 31kV rms(peak) |
| 35 kV | 44kV rms(peak) |

| CABLE RATING | AC TEST VOLTAGE for MAINTENANCE TESTING |
|---|---|
| 5 kV | 7kV rms(peak) |

| | |
|---|---|
| 8 kV | 10kV rms(peak) |
| 15 kV | 16kV rms(peak) |
| 25 kV | 23kV rms(peak) |
| 35 kV | 33kV rms(peak) |

3.18.1.2 Grounding System

a. Visual and mechanical inspection

Inspect ground system for compliance with contract plans and specifications

b. Electrical tests

Perform ground-impedance measurements utilizing the fall-of-potential method in accordance with IEEE Std 81. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable megohmmeter tester in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

3.18.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

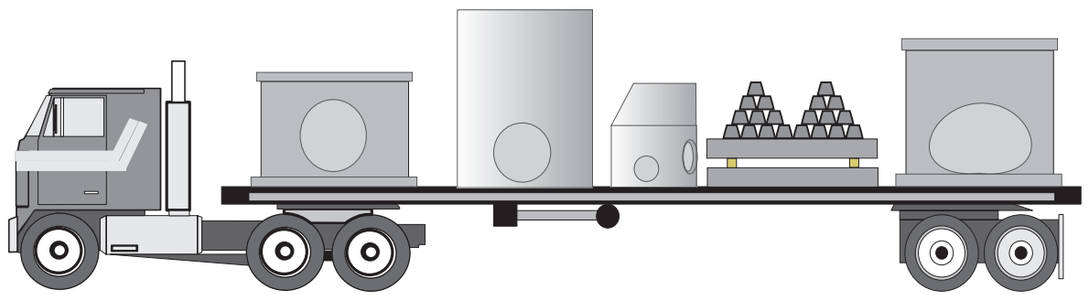
-- End of Section --

- Parking Bumpers
- Sanitary Sewer
- Splash Blocks
- Electric Handholds
- Catch Basins
- Vaults & Manholes
- Curb Inlets
- Highway Catch Basins
- Headwalls
- Highway Manholes
- Grease & Sand Traps
- Dilution - Basins
- Barrier Walls

# Custom Precast Products, Inc.

P.O. Drawer 242  Lumberton, MS 39455  ( 601 ) 796-8531

NATIONAL PRECAST CONCRETE ASSOCIATION
MEMBER



JOB: STENNIS SPACE CENTER / PICAYUNE, MS.

CONTR.: H.T.E.

REF. :  SHOP DRAWINGS

## SPECIAL NOTES !!!

1. BY APPROVING THE SUBMITTAL PACKAGE THE UNDERSIGNED HEREBY AGREES TO INDEMNIFY AND HOLD CUSTOM PRECAST PRODUCTS, INC. HARMLESS FROM ANY LIABILITY DUE TO THE FAILURE OF THE UNDERSIGNED, WHETHER BY OMISSION OR COMMISSION, TO COMPLY WITH ANY AND ALL OSHA RULES AND REGULATIONS. THE UNDERSIGNED HEREBY ACKNOWLEDGES AND AGREES IT SHALL REMAIN FULLY RESPONSIBLE FOR INSURING THAT IT HAS MET ALL OSHA STANDARDS AND THAT CUSTOM PRECAST PRODUCTS, INC. IS NOT RESPONSIBLE, IN ANY MANNER, FOR THE ACTIONS OR INACTIONS OF THE UNDERSIGNED.

2. CPPI RECOMMENDS THAT ALL SUBMITTAL DRAWINGS BE REVIEWED AND APPROVED BY THE PROJECT ENGINEER AND THE CONTRACTOR.

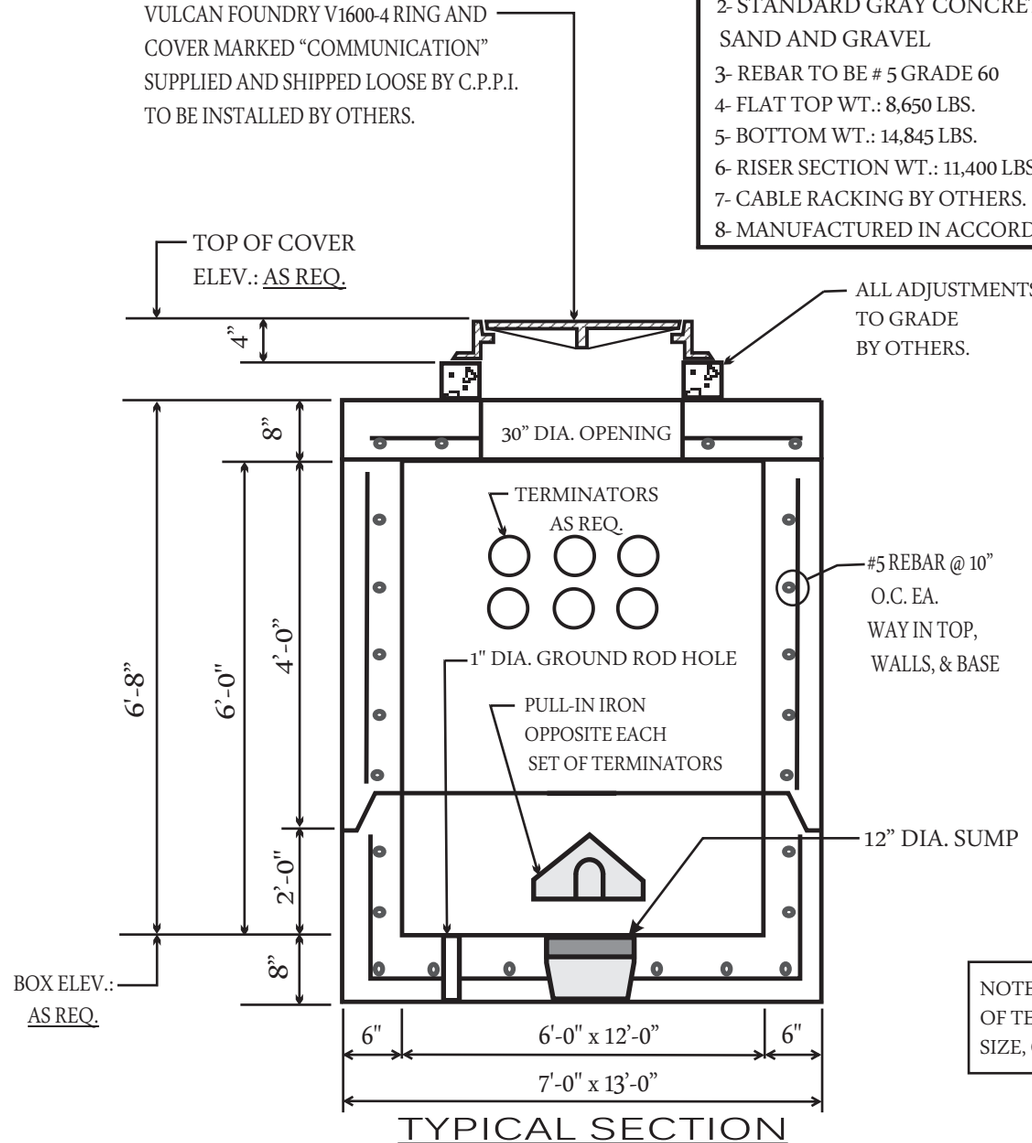
3. THESE APPROVED SHOP DRAWINGS SUPERCEDES ALL OTHER DRAWINGS ON THIS PROJECT.

4. C.P.P.I. DOES NOT ACCEPT BACK CHARGES. IF THERE ARE ANY PROBLEMS WITH OUR PRODUCT THE CONTRACTOR NEEDS TO NOTIFY C.P.P.I. AT 1-800-585-3112 TO HAVE THE PROBLEM FIXED. ( NOTE: ALL PRODUCTS ARE BUILT STRICTLY FROM APPROVED SUBMITTAL DRAWINGS. )

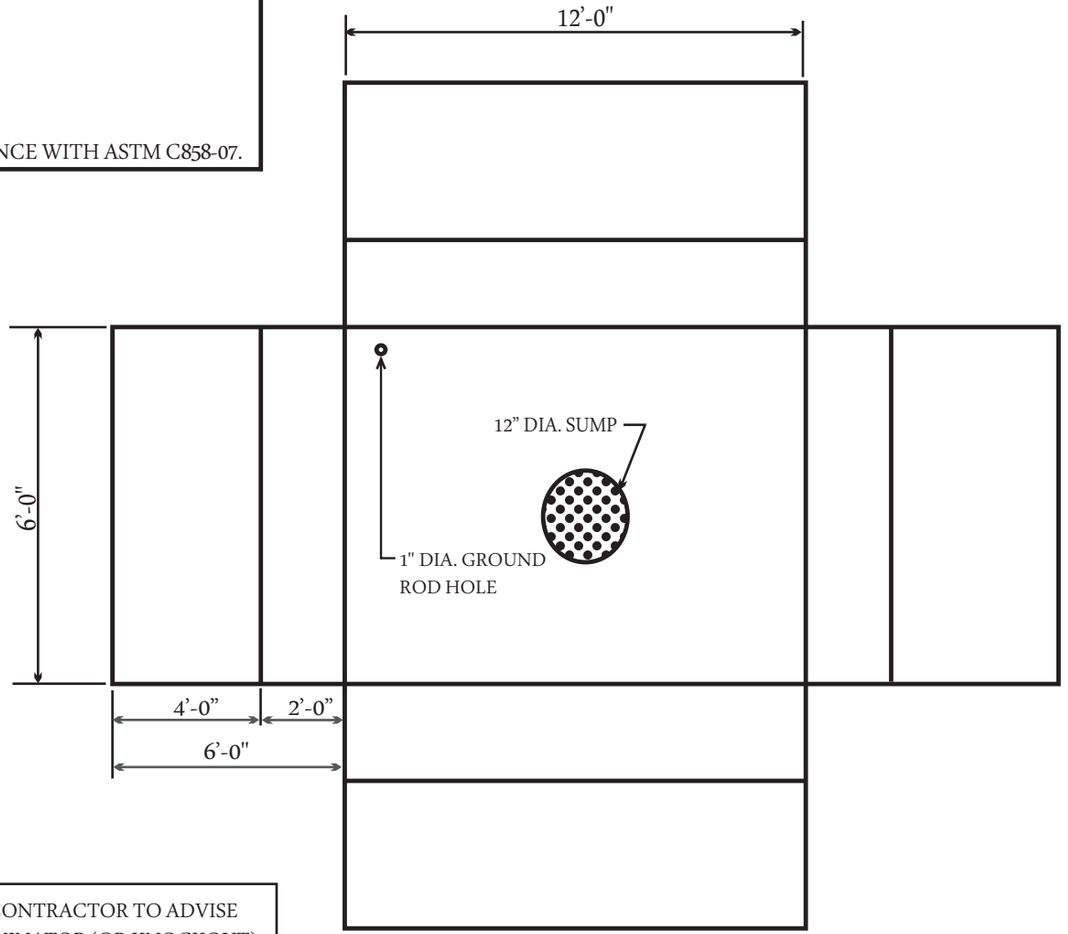
# NOTES

1- CONCRETE TO BE 4,000 PSI IN 28 DAYS
2- STANDARD GRAY CONCRETE WITH RIVER RUN SAND AND GRAVEL
3- REBAR TO BE # 5 GRADE 60
4- FLAT TOP WT.: 8,650 LBS.
5- BOTTOM WT.: 14,845 LBS.
6- RISER SECTION WT.: 11,400 LBS.
7- CABLE RACKING BY OTHERS.
8- MANUFACTURED IN ACCORDANCE WITH ASTM C858-07.

☐ NO EXCEPTIONS TAKEN
☐ APPROVED WITH CHANGES
☐ RESUBMIT
APPROVED BY:




TYPICAL SECTION




FOLD OUT VIEW

LOOKING DOWN ON BOX WITH SIDES FOLDED OUT
(FLAT TOP & RING/COVER REMOVED FOR CLARITY)

NOTE: CONTRACTOR TO ADVISE OF TERMINATOR (OR KNOCKOUT) SIZE, QUANTITIES, AND LOCATIONS.

(NO SCALE)

JOB: STENNIS SPACE CENTER / PICAYUNE, MS.
CONTR.: H.T.E.

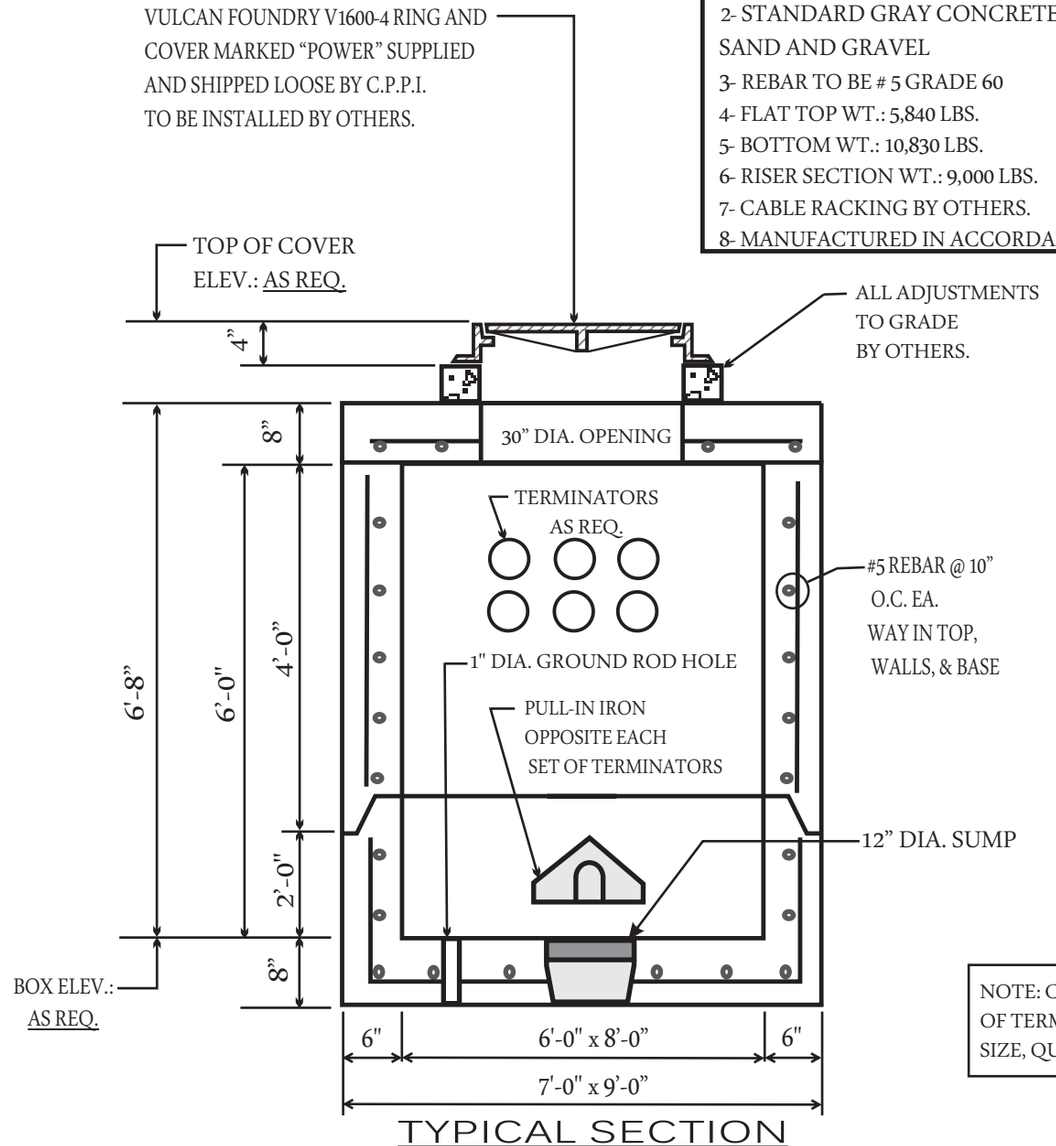
6'-0" X 12'-0" PRECAST COMMUNICATION MANHOLE (QTY: 6 REQ.)


CUSTOM PRECAST PRODUCTS INC.
P.O. DRAWER #242 LUMBERTON, MS. 39455 (601) 796-8531

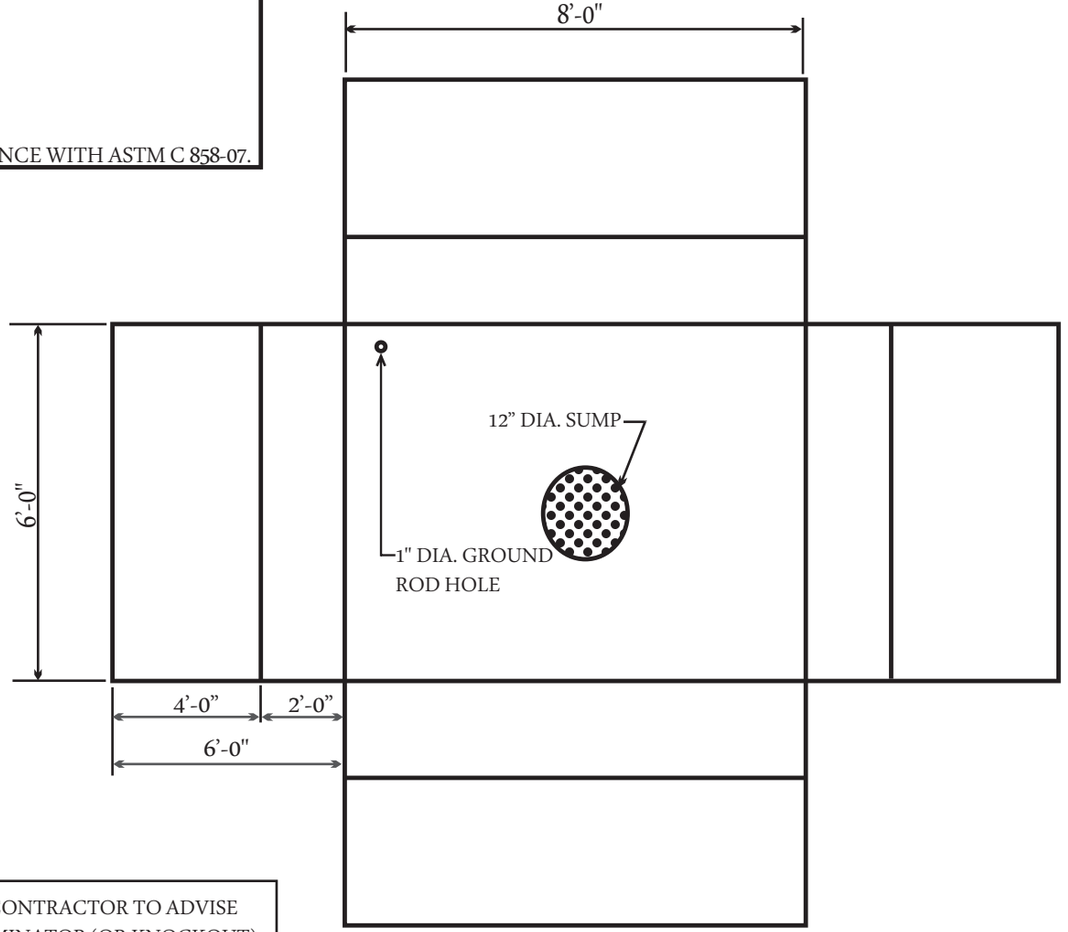
## NOTES

1- CONCRETE TO BE 4,000 PSI IN 28 DAYS.
2- STANDARD GRAY CONCRETE WITH RIVER RUN SAND AND GRAVEL
3- REBAR TO BE # 5 GRADE 60
4- FLAT TOP WT.: 5,840 LBS.
5- BOTTOM WT.: 10,830 LBS.
6- RISER SECTION WT.: 9,000 LBS.
7- CABLE RACKING BY OTHERS.
8- MANUFACTURED IN ACCORDANCE WITH ASTM C 858-07.

☐ NO EXCEPTIONS TAKEN
☐ APPROVED WITH CHANGES
☐ RESUBMIT
APPROVED BY:




TYPICAL SECTION




NOTE: CONTRACTOR TO ADVISE OF TERMINATOR (OR KNOCKOUT) SIZE, QUANTITIES, AND LOCATIONS.

## FOLD OUT VIEW

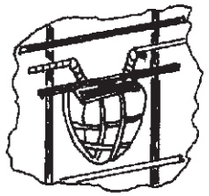
LOOKING DOWN ON BOX WITH SIDES FOLDED OUT
(FLAT TOP & RING/COVER REMOVED FOR CLARITY)

(NO SCALE)

JOB: STENNIS SPACE CENTER / PICAYUNE, MS.
CONTR.: H.T.E.

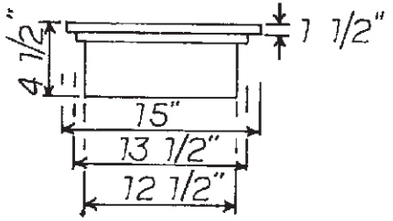
6'-0" X 8'-0" PRECAST POWER MANHOLE
(QTY: 1 REQ.)

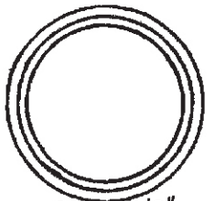

CUSTOM PRECAST PRODUCTS INC.
P.O. DRAWER #242 LUMBERTON, MS. 39455 (601) 796-8531

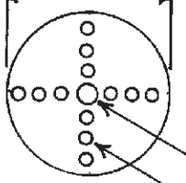


RECESSED PULLING IRON DETAIL
AS MANF. BY PENNSYLVANIA INSERT CORP.

DETAIL 'A'



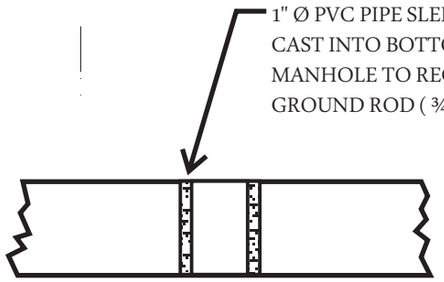





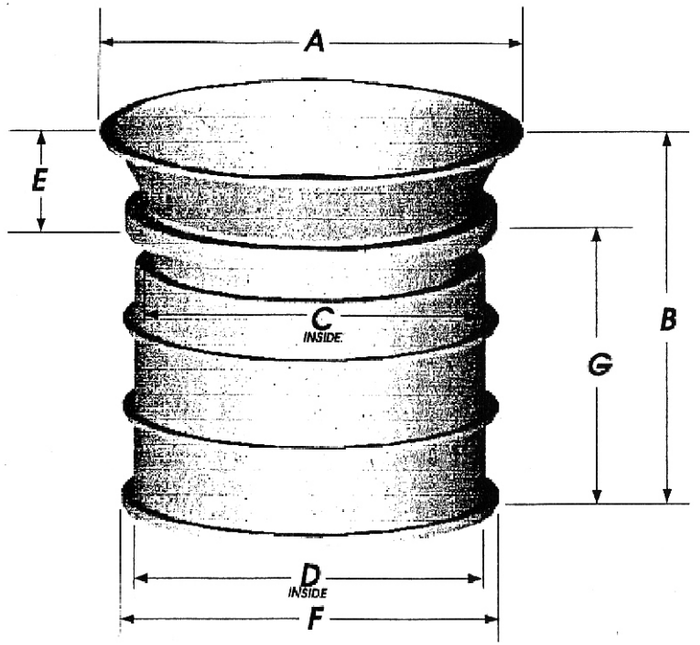

LID

PLASTIC SUMP DETAIL
AS MANF. BY PENNSYLVANIA INSERT CORP.

DETAIL 'B'




DETAIL 'E'




| SIZE | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 2 INCH | —— | —— | 2 1/4" | 2 3/8" | —— | 3" | 3 1/2" |
| 4.50 INCH | 5 1/4" | 4 3/8" | 4 3/8" | 4 1/2" | 1 1/4" | 4 15/16" | 3 3/8" |
| 4.35 INCH | 5 1/4" | 4 3/8" | 4 1/4" | 4 3/8" | 1 1/4" | 4 13/16" | 3 3/8" |
| 4 INCH STEP DOWN | 5 1/4" | 4 3/8" | 4 1/4" | 4 1/2" | 1 1/4" | 4 15/16" | 3 3/8" |
| 5 INCH | 6 5/8" | 4 3/8" | 5 1/2" | 5 5/8" | 1 1/4" | 6 1/4" | 3 3/8" |
| 6 INCH | 7 5/8" | 4 3/8" | 6 1/2" | 6 5/8" | 1 1/4" | 7 1/4" | 3 3/8" |

| SIZE | GLUE SURFACE |
|---|---|
| 2 INCH | 2 3/4 INCH |
| 4.50 INCH | 2 5/8 INCH |
| 4.35 INCH | 2 5/8 INCH |
| 4 INCH STEP DOWN | 1 5/16 INCH EACH STEP |
| 5 INCH | 2 3/4 INCH |
| 6 INCH | 2 3/4 INCH |

1. CONCRETE TO BE 4000 PSI IN 28 DAYS.
2. JOINTS TO BE SEALED WITH BIDCO C-56 JOINT SEALANT.
3. RACKING PACKAGE TO BE SUPPLIED AND INSTALLED BY CONTRACTORS.

JOB: STENNIS SPACE CENTER / PICAYUNE, MS.
CONTR.: H.T.E.

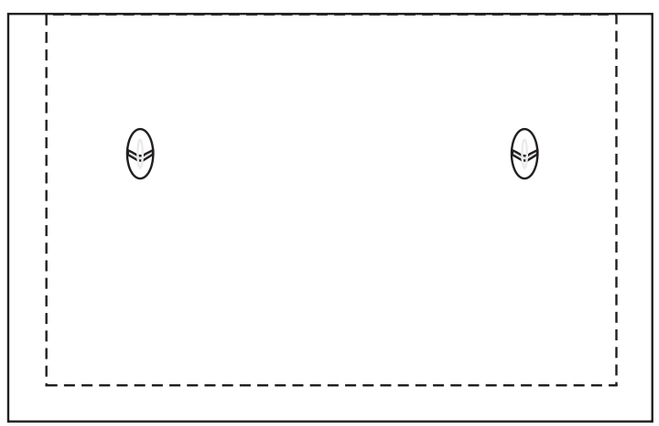
ELECTRICAL MANHOLE
DETAIL SHEET

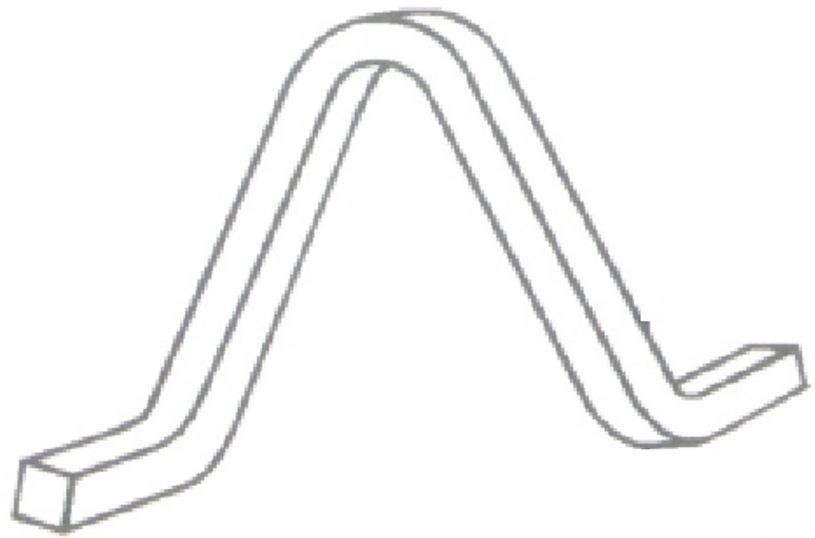
CUSTOM PRECAST PRODUCTS INC.
P.O. DRAWER #242 LUMBERTON, MS. 39455 (601) 796-8531

General Price List January 2, 2004' Precast Products

# HOOK-LIFT UTILITY ANCHOR

| ITEM NUMBER | DESCRIPTION | FINISH | UNIT WEIGHT (LBS) | TYPE | QTY. | WEIGHT (LBS) |
|---|---|---|---|---|---|---|
| 79U55 | UTILITY ANCHOR 5 ½" SLAB | MILL | 1.25 | DRUM | 550 | 688 |





JOB: STENNIS SPACE CENTER / PICAYUNE, MS.
CONTR.: H.T.E.

HOOK LIFT UTILITY ANCHOR DETAIL

CUSTOM PRECAST PRODUCTS INC.
P.O. DRAWER #242 LUMBERTON, MS. 39455 (601) 796-8531

# BIDCO C-56 PRE-FORMED BUTYL MASTIC JOINT SEALANT

C-56 BUTYL JOINT SEALANT IS DESIGNED TO FULLY COMPLY WITH CURRENT ASTM STANDARDS AND SPECIFICATIONS AS REQUIRED BY FEDERAL, STATE, AND LOCAL AGENCIES FOR USE BY THE PRECAST CONCRETE INDUSTRY AND CONTRACTORS.

C-56 REMAINS FLEXIBLE AND FORMS A PERMANENT BOND TO A WIDE VARIETY OF SUBSTRATES INCLUDING CONCRETE, METALS, AND PLASTICS. ADHESION AND COHESION AT THE TIME OF INSTALLATION ARE EXCELLENT, AND ACTUALLY IMPROVE AFTER THE JOINT HAS BEEN FORMED AND PLACED IN SERVICE. THIS SEALANT IS DESIGNED NOT TO SHRINK, OXIDIZE OR HARDEN AND HAS EXCELLENT RESISTANCE TO TEMPERATURE EXTREMES, ACID AND ALKALINE ENVIRONMENTS.

## PRODUCT FEATURES:

1. AVAILABLE IN STRIP OR COIL FORM
2. NEW, CRUSH PROOF PACKAGE
3. NON-STICK, NON-TEAR PLASTIC BACKING

| CHEMICAL COMPOSITION | SPECIFICATION | REQUIREMENTS | C-56 |
|---|---|---|---|
| CONTENT OF HYDROCARBON - % BY WT. | ASTM D4-86 | 50-70 | 56.0 |
| INERT MINERAL FILLER - % BY WT. | AASHTO T III | 30-50 | 44.0 |
| VOLATILE MATTER - % BY WT. | ASTM D-6 | 2.0 MAX | BELOW 1 |

## CHEMICAL RESISTANCE ( TOTAL IMMERSION - 30 DAYS )

5% SULFURIC ACID - NO VISIBLE DETERIORATION
5% HYDROCHLORIC ACID - NO VISIBLE DETERIORATION
5% POTASSIUM HYDROXIDE - NO VISIBLE DETERIORATION
SATURATED HYDROGEN SULFIDE SOLUTION - NO VISIBLE DETERIORATION

## PHYSICAL PROPERTIES:

SPECIFIC GRAVITY - 77°F ASTM D-71 1.2-1.35 1.27
DUCTILITY - 77°F ASTM D-113 5.0 MIN. 10.00
SOFTENING POINT - °F ASTM D-36 320 MIN 380
PENETRATION - 77°F ASTM D-217 50 - 120 85
ACCELERATED AGING ( MECHANICAL OVEN 4 HOURS @ 212°F )
MAINTAINED 99+% SOLIDS ( FLEXIBILITY NOT EFFECTED )
ELONGATION INITIAL 77°F - 330% MIN
TWO WEEKS - TOTAL WATER IMMERSION - 330% MIN
FLOW RESISTANCE ( 1" WIDE OVERHEAD JOINT EXPOSED TO 135°F FOR 7 DAYS - NO FLOW
STORAGE LIFE - INDEFINITE
APPLICATION TEMPERATURE RANGE - 10 TO 125°F
SERVICE TEMPERATURE RANGE - NEGATIVE 20 TO 200°F

## PRIMARY APPLICATIONS:

- ○ CONCRETE PIPE
- ○ BOX CULVERTS
- ○ UTILITY VAULTS
- ○ BURIAL VAULTS
- ○ SEPTIC TANKS
- ○ WET WELLS
- ○ SANITARY & STORM SEWER MANHOLES
- ○ CONCRETE WALL PANEL SYSTEMS

## AVAILABLE SIZE: BIDCO C-56

| JOINT STRIPS SIZE X LENGTH | STRIP PER CONTAINER |
|---|---|
| 1 ¼" X 42" | 28 |

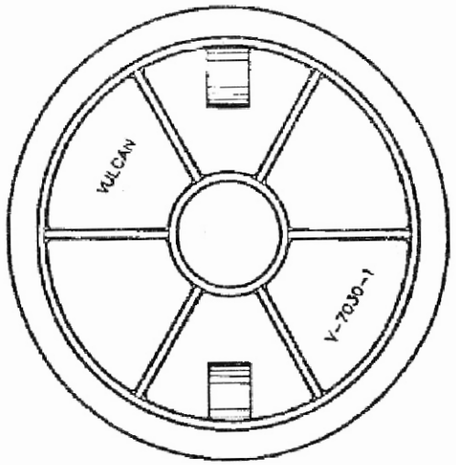
CONFORMS TO AASHTO M-198B
SS-S210A - ASTM C 900

NPC
ST. JOE DR. & LEWIS ST.
PARK HILLS, MO 63601
TELEPHONE: 1-800-442-0141
FAX: 573-431-1035

JOB: STENNIS SPACE CENTER / PICAYUNE, MS.
CONTR.: H.T.E.

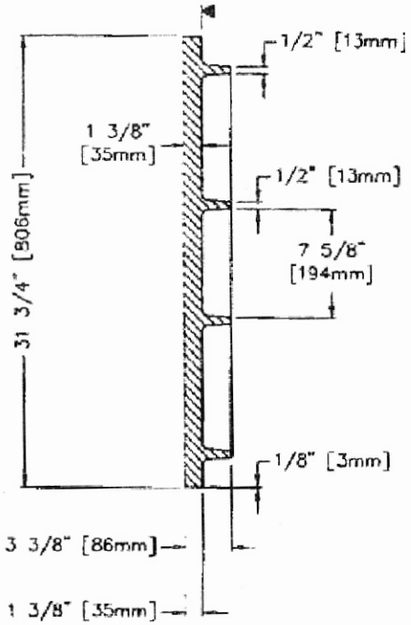
BIDCO C-56 BUTYL
MASTIC JOINT SEALANT

CUSTOM PRECAST PRODUCTS INC.
P.O. DRAWER #242 LUMBERTON, MS. 39455 (601) 796-8531

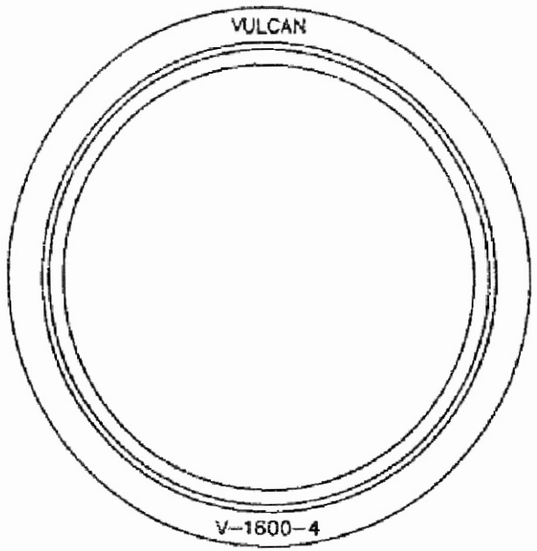



COVER BACK

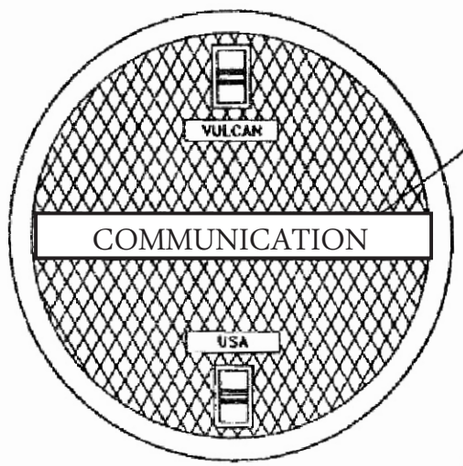
COVER MARKED AS REQUIRED




COVER SECTION



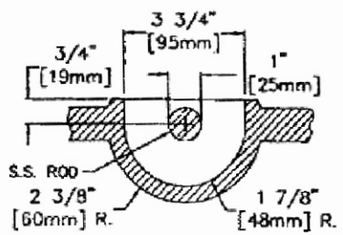

REVERSIBLE RING TOP VIEW




COVER FACE

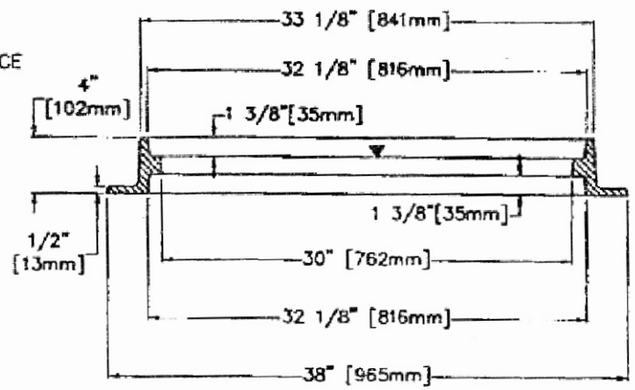
▼ MACHINED BEARING SURFACE

2" BLOCK LETTERING




(2) TYPE 4 STAINLESS STEEL PICKBARS

PICKBAR DETAIL




REVERSIBLE RING SECTION

NOTE: FOR TOP FLANGE ORDER NUMBER V-1800-4.
FOR BOTTOM FLANGE ORDER NUMBER V-1600-4.

**Vulcan Foundry Corp.**
POST OFFICE BOX 905
DENHAM SPRINGS, LA 70727
WATS No. 1-800-MANHOLE
LOCAL No. 1-225-665-6151
FAX No. 1-225-665-4306

DRAWN BY: DHV DATE:10/12/98

REVISION: UPDATED

LOAD RATING
HEAVY DUTY

MATERIAL SPECIFICATION
ASTM A48 CLASS 30

OPEN AREA - sq.in [sq.cm]
N/A

ESTIMATED WEIGHT - lbs.[kg]
COVER 310 [145kg]
RING 145 [66kg]
TOTAL 455 [207kg]

PATTERN BREAKDOWN
V-7030-1 COVER
V-1600-4 RING

CATALOG NUMBER
**V-1600-4**

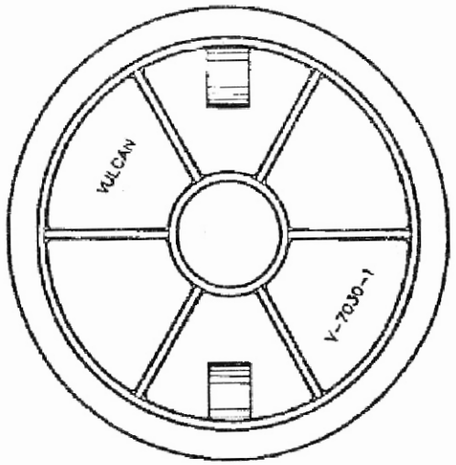
PRODUCT NUMBER
**41600466**

V-1600-4

JOB: STENNIS SPACE CENTER / PICAYUNE, MS.
CONTR.: H.T.E.

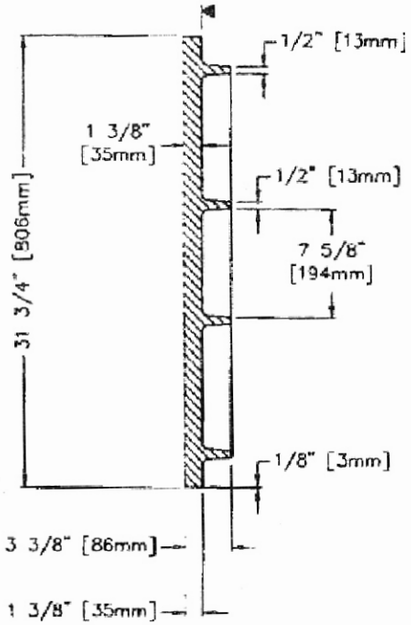
# V-1600-4 RING AND COVER DETAIL

CUSTOM PRECAST PRODUCTS INC.
P.O. DRAWER #242 LUMBERTON, MS. 39455 (601) 796-8531

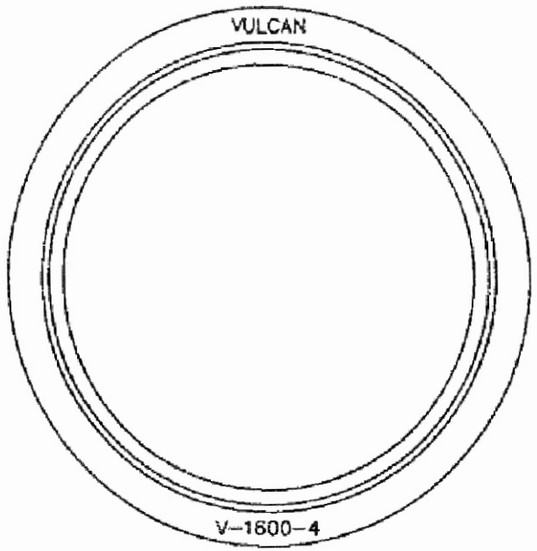



COVER BACK

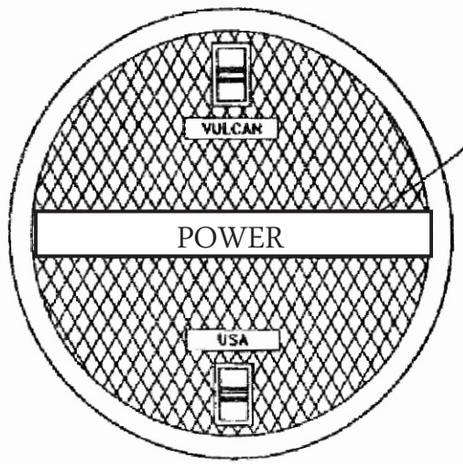
COVER MARKED AS REQUIRED




COVER SECTION



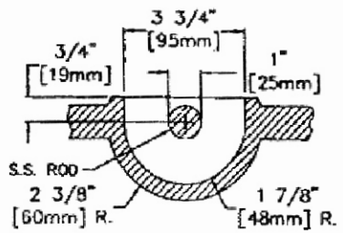

REVERSIBLE RING TOP VIEW




COVER FACE

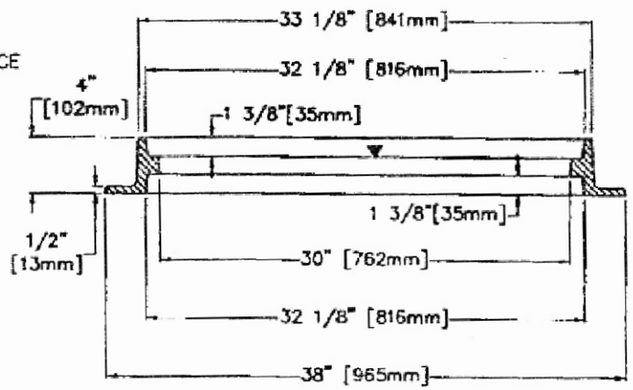
▼ MACHINED BEARING SURFACE

2" BLOCK LETTERING




(2) TYPE 4 STAINLESS STEEL PICKBARS

PICKBAR DETAIL




REVERSIBLE RING SECTION

NOTE: FOR TOP FLANGE ORDER NUMBER V-1800-4.
FOR BOTTOM FLANGE ORDER NUMBER V-1600-4.

**Vulcan Foundry Corp.**
POST OFFICE BOX 905
DENHAM SPRINGS, LA 70727
WATS No. 1-800-MANHOLE
LOCAL No. 1-225-665-6151
FAX No. 1-225-665-4306

DRAWN BY: DHV DATE:10/12/98

REVISION: UPDATED

LOAD RATING
HEAVY DUTY

MATERIAL SPECIFICATION
ASTM A48 CLASS 30

OPEN AREA - sq.in [sq.cm]
N/A

ESTIMATED WEIGHT - lbs.[kg]
COVER 310 [145kg]
RING 145 [66kg]
TOTAL 455 [207kg]

PATTERN BREAKDOWN
V-7030-1 COVER
V-1600-4 RING

CATALOG NUMBER
**V-1600-4**

PRODUCT NUMBER
**41600466**

V-1600-4

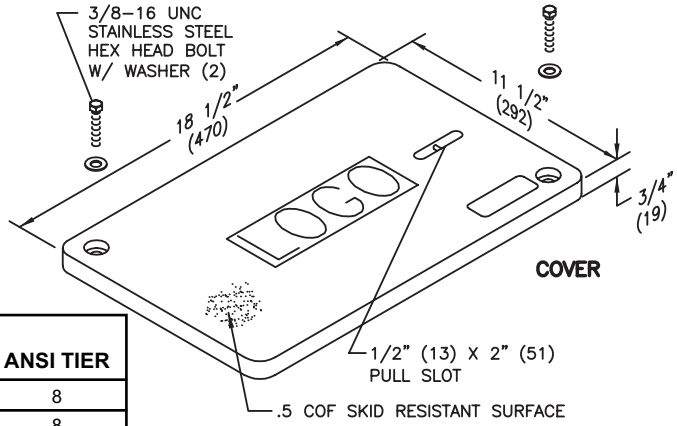
JOB: STENNIS SPACE CENTER / PICAYUNE, MS.
CONTR.: H.T.E.

# V-1600-4 RING AND COVER DETAIL

CUSTOM PRECAST PRODUCTS INC.
P.O. DRAWER #242 LUMBERTON, MS. 39455 (601) 796-8531

# SPECIFICATIONS/DATA

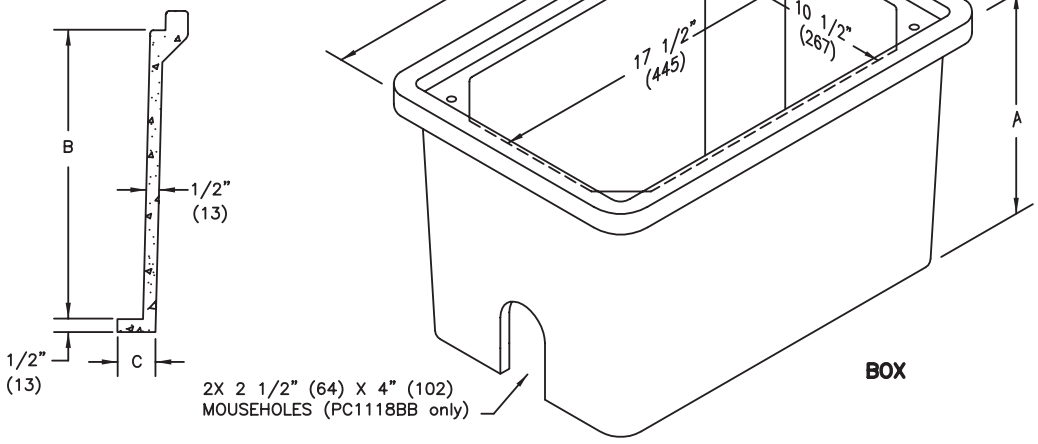
## 11” x 18” PC Style (Stackable) Assembly




### Covers (Blank unless logo is specified)

| | DESCRIPTION | PART NO. | WEIGHT # | DESIGN/TEST LOAD # | ANSI TIER |
|---|---|---|---|---|---|
| UL | W/2 Bolts | PC1118CA00 | 13 (5.9 kg) | 8,000 / 12,000 | 8 |
| UL | Gasketed w/4 Bolts | PC1118CG00 | 13 (5.9 kg) | 8,000 / 12,000 | 8 |
| UL | No Bolts | PC1118WA00 | 13 (5.9 kg) | 8,000 / 12,000 | 8 |
| UL | Heavy Duty w/2 Bolts | PC1118HA00 | 13 (5.9 kg) | 15,000 / 22,500 | 15 |
| UL | Gasketed Heavy Duty w/4 Bolts | PC1118HG00 | 13 (5.9 kg) | 15,000 / 22,500 | 15 |

- Gasketed covers and bolt grommets must be used with a gasketed box. Gaskets reduce the inflow of fluids but do not make the enclosure water tight.




### Boxes (Stackable with self-aligning, replaceable EZ-Nut)

| | DESCRIPTION | PART NO. | WEIGHT # | DIMENSION A | DIMENSION B | DIMENSION C | DESIGN/TEST LOAD # | ANSI TIER |
|---|---|---|---|---|---|---|---|---|
| UL | Open Bottom | PC1118BA12 | 37 (16.8 kg) | 12” (304.8 mm) | 11 1/4” (286 mm) | N/A | 15,000 / 22,500 | 15 |
| | | PC1118BA18 | 53 (24.0 kg) | 18” (457 mm) | 17 1/4” (438 mm) | N/A | 15,000 / 22,500 | 15 |
| UL | Open Bottom w/ Gasket | PC1118BG12 | 37 (16.8 kg) | 12” (304.8 mm) | 11 1/4” (286 mm) | N/A | 15,000 / 22,500 | 15 |
| | | PC1118BG18 | 53 (24.0 kg) | 18” (457 mm) | 17 1/4” (438 mm) | N/A | 15,000 / 22,500 | 15 |
| UL | Open Bottom w/ 2 Mouseholes | PC1118BB12 | 36 (16.3 kg) | 12” (304.8 mm) | 11 1/4” (286 mm) | N/A | 15,000 / 22,500 | 15 |
| | | PC1118BB18 | 52 (23.6 kg) | 18” (457 mm) | 17 1/4” (438 mm) | N/A | 15,000 / 22,500 | 15 |
| UL | Solid Bottom | PC1118DA12 | 45 (20.4 kg) | 12 1/2” (317.5 mm) | 11 1/4” (286 mm) | N/A | 15,000 / 22,500 | 15 |
| | | PC1118DA18 | 60 (27.2 kg) | 18 1/2” (470 mm) | 17 1/4” (438 mm) | N/A | 15,000 / 22,500 | 15 |
| UL | Solid Bottom w/ Gasket | PC1118DG12 | 45 (20.4 kg) | 12 1/2” (317.5 mm) | 11 1/4” (286 mm) | N/A | 15,000 / 22,500 | 15 |
| | | PC1118DG18 | 60 (27.2 kg) | 18 1/2” (470 mm) | 17 1/4” (438 mm) | N/A | 15,000 / 22,500 | 15 |
| UL | Footed Box | PC1118JA12 | 37 (16.8 kg) | 12 1/2” (317.5 mm) | 11 1/4” (286 mm) | 1 1/2” (38 mm) | 15,000 / 22,500 | 15 |
| | | PC1118JA18 | 56 (25.4 kg) | 18 1/2” (470 mm) | 17 1/4” (438 mm) | 1 1/2” (38 mm) | 15,000 / 22,500 | 15 |

Dimensions & weights in parentheses are metric equivalent.

SECTION 33 82 00

TELECOMMUNICATIONS OUTSIDE PLANT (OSP)
**04/06**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM B 1 | (2001; R 2007) Standard Specification for Hard-Drawn Copper Wire |
| ASTM B 8 | (2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft |
| ASTM D 709 | (2001; R 2007) Laminated Thermosetting Materials |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C2 | (2007; Errata 2007; INT 2008) National Electrical Safety Code |
| IEEE Std 100 | (2000) The Authoritative Dictionary of IEEE Standards Terms |

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

| | |
|---|---|
| ICEA S-87-640 | (2006) Fiber Optic Outside Plant Communications Cable |
| ICEA S-98-688 | (2006) Broadband Twisted Pair, Telecommunications Cable Aircore, Polyolefin Insulated Copper Conductors |
| ICEA S-99-689 | (2006) Broadband Twisted Pair Telecommunications Cable Filled, Polyolefin Insulated Copper Conductors |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2007; AMD 1 2008) National Electrical Code - 2008 Edition |

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

| | |
|---|---|
| TIA J-STD-607-A | (2002) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications |
| TIA TIA/EIA-455-204 | (2000) Standard for Measurement of |

| | |
|---|---|
| | Bandwidth on Multimode Fiber |
| TIA-455-78 | (2002B) FOTP-78 Optical Fibres - Part 1-40: Measurement Methods and Test Procedures - Attenuation |
| TIA-492CAAA | (1998; R 2002) Class IVA Dispersion-Unshifted Single-Mode Optical Fibers |
| TIA-492E000 | (1996; R 2002) Class IVd Nonzero-Dispersion Single-Mode Optical Fibers for the 1550 nm Window (ANSI/TIA/EIA-492E000) |
| TIA-526-14-A | (1998) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant |
| TIA-526-7 | (2002) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant OFSTP-7 |
| TIA-590-A | (1997) Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant |
| TIA-758-A | (2004) Customer-Owned Outside Plant Telecommunications Cabling Standard |
| TIA/EIA-455-B | (1998) Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components |
| TIA/EIA-568-B.1 | (2001 Addendums 2001, 2003, 2003, 2003, 2004, 2007) Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements |
| TIA/EIA-568-B.2 | (2001) Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cabling Components |
| TIA/EIA-568-B.3 | (2000; Addendum 2002) Optical Fiber Cabling Components Standard |
| TIA/EIA-569-A | (1998; Addenda 2000, 2001) Commercial Building Standards for Telecommunications Pathways and Spaces |
| TIA/EIA-598-B | (2001) Optical Fiber Cable Color Coding |
| TIA/EIA-606-A | (2002) Administration Standard for the Telecommunications Infrastructure |

U.S. DEPARTMENT OF AGRICULTURE (USDA)

| | |
|---|---|
| RUS 1755 | Telecommunications Standards and |

| | |
|---|---|
| | Specifications for Materials, Equipment and Construction |
| RUS Bull 1751F-643 | (2002) Underground Plant Design |
| RUS Bull 1751F-815 | (1979) Electrical Protection of Outside Plant |
| RUS Bull 1753F-201 | (1997) Acceptance Tests of Telecommunications Plant (PC-4) |
| RUS Bull 345-72 | (1985) Filled Splice Closures (PE-74) |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 497 | (2001; Rev thru Jun 2004) Protectors for Paired Conductor Communication Circuits |
| UL 510 | (2005; Rev thru Aug 2005) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape |
| UL 83 | (20086) Standard for Thermoplastic-Insulated Wires and Cables |

1.2 RELATED REQUIREMENTS

Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLING SYSTEM, and Section 33 71 02.00 20, UNDERGROUND TRANSMISSION AND DISTRIBUTION apply to this section with additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3, TIA/EIA-569-A, TIA/EIA-606-A, and IEEE Std 100 and herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect - (MC).)

1.3.2 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

1.3.3 Entrance Room (ER) (Telecommunications)

A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.4 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International

expression for intermediate cross-connect - (IC).)

1.3.5 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

The telecommunications outside plant consists of cable, conduit, manholes, poles, etc. required to provide signal paths from the closest point of presence to the new facility, including free standing frames or backboards, interconnecting hardware, terminating cables, lightning and surge protection modules at the entrance facility. The work consists of providing, testing and making operational cabling, interconnecting hardware and lightning and surge protection necessary to form a complete outside plant telecommunications system for continuous use.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telecommunications Outside Plant; G

Telecommunications Entrance Facility Drawings; G

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Wire and cable; G

Closures; G

Building protector assemblies; G

Protector modules; G

Spare Parts; G

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required for certificates in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Pre-installation tests; G

Acceptance tests; G

Outside Plant Test Plan; G

SD-07 Certificates

Telecommunications Contractor Qualifications; G

Key Personnel Qualifications; G

Minimum Manufacturer's Qualifications; G

SD-08 Manufacturer's Instructions

Building protector assembly installation; G

Cable tensions; G

Submit instructions prior to installation.

SD-09 Manufacturer's Field Reports

Factory Reel Test Data; G

SD-10 Operation and Maintenance Data

Telecommunications outside plant (OSP), Data Package 5; G

Commercial off-the-shelf manuals shall be provided for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications outside plant (OSP). Submit operations and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data package 5, include the requirements of paragraphs TELECOMMUNICATIONS OUTSIDE PLANT SHOP DRAWINGS and TELECOMMUNICATIONS ENTRANCE FACILITY DRAWINGS.

SD-11 Closeout Submittals

Record Documentation; G

In addition to other requirements, provide in accordance with paragraph RECORD DOCUMENTATION.

## 1.6 QUALITY ASSURANCE

### 1.6.1 Shop Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Outside Plant Shop Drawings

Provide Outside Plant Design in accordance with TIA-758-A, and RUS Bull 1751F-643 for underground system design. Provide T0 shop drawings that show the physical and logical connections from the perspective of an entire campus, such as actual building locations, exterior pathways and campus backbone cabling on plan view drawings, major system nodes, and related connections on the logical system drawings in accordance with TIA/EIA-606-A. Drawings shall include wiring and schematic diagrams for fiber optic and copper cabling and splices, copper conductor gauge and pair count, fiber pair count and type, pathway duct and innerduct arrangement, associated construction materials, and any details required to demonstrate that cable system has been coordinated and will properly support the switching and transmission system identified in specification and drawings. The telecommunications outside plant (OSP) shop drawings shall be included in the operation and maintenance manuals.

1.6.1.2 Telecommunications Entrance Facility Drawings

Provide T3 drawings for EF Telecommunications as specified in the paragraph TELECOMMUNICATIONS SPACE DRAWINGS of Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLING SYSTEMS. The telecommunications entrance facility shop drawings shall be included in the operation and maintenance manuals.

1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, the supervisor (if different from the installer), and the cable splicing and terminating personnel. A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.2.1 Telecommunications Contractor Qualifications

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems that include outside plant and broadband cabling within the past 3 years. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems in accordance with TIA-758-A within the past 3 years.

1.6.2.2 Key Personnel Qualifications

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications

systems within the past 3 years.

Cable splicing and terminating personnel assigned to the installation of this system or any of its components shall have training in the proper techniques and have a minimum of 3 years experience in splicing and terminating the specified cables. Modular splices shall be performed by factory certified personnel or under direct supervision of factory trained personnel for products used.

Supervisors and installers assigned to the installation of this system or any of its components shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products.

Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications outside plant systems, including broadband cabling, and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The Contracting Officer.

1.6.2.3 Minimum Manufacturer's Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with, TIA/EIA-568-B.1, TIA/EIA-568-B.2 and TIA/EIA-568-B.3. In addition, cabling manufacturers shall have a minimum of 3 years experience in the manufacturing and factory testing of cabling which comply with ICEA S-87-640, ICEA S-98-688, and ICEA S-99-689.

1.6.3 Outside Plant Test Plan

Prepare and provide a complete and detailed test plan for field tests of the outside plant including a complete list of test equipment for the copper conductor and optical fiber cables, components, and accessories for approval by the Contracting Officer. Include a cut-over plan with procedures and schedules for relocation of facility station numbers without interrupting service to any active location. Submit the plan at least 30 days prior to tests for Contracting Officer approval. Provide outside plant testing and performance measurement criteria in accordance with TIA/EIA-568-B.1 and RUS Bull 1753F-201. Include procedures for certification, validation, and testing that includes fiber optic link performance criteria.

1.6.4 Standard Products

Provide materials and equipment that are standard products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and shall be the manufacturer's latest standard design that has been in satisfactory commercial or industrial use for at least 1 year prior to bid opening. The 1-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 1-year period. Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.4.1 Alternative Qualifications

Products having less than a 1-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 3000 hours, exclusive of the manufacturers' factory or laboratory tests, is provided.

1.6.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6.5 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.5.1 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been

tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

## 1.7 DELIVERY, STORAGE, AND HANDLING

Ship cable on reels in 1000 feet length with a minimum overage of 10 percent. Radius of the reel drum shall not be smaller than the minimum bend radius of the cable. Wind cable on the reel so that unwinding can be done without kinking the cable. Two meters of cable at both ends of the cable shall be accessible for testing. Attach permanent label on each reel showing length, cable identification number, cable size, cable type, and date of manufacture. Provide water resistant label and the indelible writing on the labels. Apply end seals to each end of the cables to prevent moisture from entering the cable. Reels with cable shall be suitable for outside storage conditions when temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent. Equipment, other than cable, delivered and placed in storage shall be stored with protection from weather, humidity and temperature variation, dirt and dust, or other contaminants in accordance with manufacturer's requirements.

## 1.8 MAINTENANCE

### 1.8.1 Record Documentation

Provide the activity responsible for telecommunications system maintenance and administration a single complete and accurate set of record documentation for the entire telecommunications system with respect to this project.

Update existing record documentation to reflect campus distribution T0 drawings and T3 drawing schedule information modified, deleted or added as a result of this installation. Provide the following T5 drawing documentation as a minimum:

a. Cables - A record of installed cable shall be provided in accordance with TIA/EIA-606-A. The cable records shall include only the required data fields in accordance with TIA/EIA-606-A. Include manufacture date of cable with submittal.

b. Termination Hardware - Provide a record of installed patch panels, cross-connect points, campus distributor and terminating block arrangements and type in accordance with TIA/EIA-606-A. Documentation shall include the required data fields as a minimum in accordance with TIA/EIA-606-A.

Provide record documentation as specified in Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

### 1.8.2 Spare Parts

In addition to the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA, provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking. Spare parts shall be provided no later than the start of field testing.

1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems.

2.2 TELECOMMUNICATIONS ENTRANCE FACILITY

2.2.1 Building Protector Assemblies

Provide self-contained 5 pin unit supplied with a field cable stub factory connected to protector socket blocks to terminate and accept protector modules for 25 pairs of outside cable. Building protector assembly shall have interconnecting hardware for connection to interior cabling at full capacity. Provide manufacturers instructions for building protector assembly installation. Provide copper cable interconnecting hardware as specified in Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.2.2 Protector Modules

Provide in accordance with UL 497 solid state type 5 pin rated for the application. Provide the number of surge protection modules equal to the number of pairs of exterior cable of the building protector assembly.

2.2.3 Fiber Optic Terminations

Provide fiber optic cable terminations as specified in Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.3 CLOSURES

2.3.1 Copper Conductor Closures

2.3.1.1 Underground Cable Closures

c. In vault or manhole: Provide underground closure suitable to house a straight, butt, and branch splice in a protective housing into which can be poured an encapsulating compound. Closure shall be of suitable thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure. Provide filled splice cases in accordance with RUS Bull 345-72.

2.3.2 Fiber Optic Closures

2.3.2.1 In Vault or Manhole

Provide underground closure suitable to house splice organizer in a protective housing into which can be poured an encapsulating compound.

Closure shall be of thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure.

## 2.4 CONDUIT

Provide conduit as specified in Section 33 71 02.00 20, UNDERGROUND TRANSMISSION AND DISTRIBUTION.

## 2.5 PLASTIC INSULATING TAPE

UL 510.

## 2.6 WIRE AND CABLE

### 2.6.1 Copper Conductor Cable

Solid copper conductors, covered with an extruded solid insulating compound. Insulated conductors shall be twisted into pairs which are then stranded or oscillated to form a cylindrical core. For special high frequency applications, the cable core shall be separated into compartments. Cable shall be completed by the application of a suitable core wrapping material, a corrugated copper or plastic coated aluminum shield, and an overall extruded jacket. Telecommunications contractor shall verify distances between splice points prior to ordering cable in specific cut lengths. Gauge of conductor shall determine the range of numbers of pairs specified; 19 gauge (6 to 400 pairs), 22 gauge (6 to 1200 pairs), 24 gauge (6 to 2100 pairs), and 26 gauge (6 to 3000 pairs). Copper conductor shall conform to the following:

#### 2.6.1.1 Underground

Provide filled cable meeting the requirements of ICEA S-99-689 and RUS 1755.890.

### 2.6.2 Fiber Optic Cable

Provide single-mode, 8/125-um, 0.10 aperture 1310/1550 nm fiber optic cable in accordance with TIA-492CAAA and TIA-492E000, including any special requirements made necessary by a specialized design. Provide 24 optical fiber strands and 48 optical fiber strands as indicated on the drawings. Fiber optic cable shall be specifically designed for outside use with loose buffer construction. Provide fiber optic color code in accordance with TIA/EIA-598-B.

#### 2.6.2.1 Strength Members

Provide non-central, non-metallic strength members with sufficient tensile strength for installation and residual rated loads to meet the applicable performance requirements in accordance with ICEA S-87-640. The strength member is included to serve as a cable core foundation to reduce strain on the fibers, and shall not serve as a pulling strength member.

#### 2.6.2.2 Performance Requirements

Provide fiber optic cable with optical and mechanical performance requirements in accordance with ICEA S-87-640.

### 2.6.3 Grounding and Bonding Conductors

Provide grounding and bonding conductors in accordance with RUS 1755.200, TIA J-STD-607-A, IEEE C2, and NFPA 70. Solid bare copper wire meeting the requirements of ASTM B 1 for sizes No. 8 AWG and smaller and stranded bare copper wire meeting the requirements of ASTM B 8, for sizes No. 6 AWG and larger. Insulated conductors shall have 600-volt, Type TW insulation meeting the requirements of UL 83.

## 2.7 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS

Provide tags for each telecommunications cable or wire located in manholes, handholes, and vaults. Cable tags shall be polyethylene and labeled as in accordance with TIA/EIA-606-A. Handwritten labeling is unacceptable.

### 2.7.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

## 2.8 BURIED WARNING AND IDENTIFICATION TAPE

Provide fiber optic media marking and protection in accordance with TIA-590-A. Provide color, type and depth of tape as specified in paragraph BURIED WARNING AND IDENTIFICATION TAPE in Section 31 00 00, EARTHWORK.

## 2.9 GROUNDING BRAID

Provide grounding braid that provides low electrical impedance connections for dependable shield bonding in accordance with RUS 1755.200. Braid shall be made from flat tin-plated copper.

## 2.10 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

## 2.11 FIELD FABRICATED NAMEPLATES

Provide laminated plastic nameplates in accordance with ASTM D 709 for each patch panel, protector assembly, rack, cabinet and other equipment or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

## 2.12 TESTS, INSPECTIONS, AND VERIFICATIONS

### 2.12.1 Factory Reel Test Data

Test 100 percent OTDR test of FO media at the factory in accordance with TIA/EIA-568-B.1 and TIA/EIA-568-B.3. Use TIA-526-7 for single mode fiber and TIA-526-14-A Method B for multi mode fiber measurements. Calibrate OTDR to show anomalies of 0.2 dB minimum. Enhanced performance filled OSP copper cables, referred to as Broadband Outside Plant (BBOSP), shall meet the requirements of ICEA S-99-689. Enhanced performance air core OSP copper cables shall meet the requirements of ICEA S-98-688. Submit test reports, including manufacture date for each cable reel and receive approval before delivery of cable to the project site.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Install all system components and appurtenances in accordance with manufacturer's instructions IEEE C2, NFPA 70, and as indicated. Provide all necessary interconnections, services, and adjustments required for a complete and operable telecommunications system.

### 3.1.1 Contractor Damage

Promptly repair indicated utility lines or systems damaged during site preparation and construction. Damages to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the Contract Clauses. When Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In every event, immediately notify the Contracting Officer of damage.

### 3.1.2 Cable Inspection and Repair

Handle cable and wire provided in the construction of this project with care. Inspect cable reels for cuts, nicks or other damage. Damaged cable shall be replaced or repaired to the satisfaction of the Contracting Officer. Reel wraps shall remain intact on the reel until the cable is ready for placement.

### 3.1.3 Cable Protection

Galvanized conduits which penetrate concrete (slabs, pavement, and walls) shall be wrapped and shall extend from the first coupling or fitting outside either side of the concrete minimum of 6 inches per 12 inches burial depth beyond the edge of the surface where cable protection is required; all conduits shall be sealed on each end. Where additional protection is required, cable may be placed in galvanized iron pipe (GIP) sized on a maximum fill of 40% of cross-sectional area, or in concrete encased 4 inches PVC pipe. Conduit may be installed by jacking or trenching. Trenches shall be backfilled with earth and mechanically tamped at 6 inches lift so that the earth is restored to the same density, grade and vegetation as adjacent undisturbed material.

#### 3.1.3.1 Cable End Caps

Cable ends shall be sealed at all times with coated heat shrinkable end

caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.1.4 Underground Duct

Provide underground duct and connections to existing manholes, as specified in Section 33 71 02.00 20, UNDERGROUND UNDERGROUND TRANSMISSION AND DISTRIBUTION with any additional requirements as specified herein.

3.1.5 Reconditioning of Surfaces

Provide reconditioning of surfaces as specified in Section 33 71 02.00 20, UNDERGROUND TRANSMISSION AND DISTRIBUTION.

3.1.6 Penetrations

Caulk and seal cable access penetrations in walls, ceilings and other parts of the building. Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings in accordance with Section 07 84 00, FIRESTOPPING.

3.1.7 Cable Pulling

Test duct lines with a mandrel and swab out to remove foreign material before the pulling of cables. Avoid damage to cables in setting up pulling apparatus or in placing tools or hardware. Do not step on cables when entering or leaving the manhole. Do not place cables in ducts other than those shown without prior written approval of the Contracting Officer. Roll cable reels in the direction indicated by the arrows painted on the reel flanges. Set up cable reels on the same side of the manhole as the conduit section in which the cable is to be placed. Level the reel and bring into proper alignment with the conduit section so that the cable pays off from the top of the reel in a long smooth bend into the duct without twisting. Under no circumstances shall the cable be paid off from the bottom of a reel. Check the equipment set up prior to beginning the cable pulling to avoid an interruption once pulling has started. Use a cable feeder guide of suitable dimensions between cable reel and face of duct to protect cable and guide cable into the duct as it is paid off the reel. As cable is paid off the reel, lubricate and inspect cable for sheath defects. When defects are noticed, stop pulling operations and notify the Contracting Officer to determine required corrective action. Cable pulling shall also be stopped when reel binds or does not pay off freely. Rectify cause of binding before resuming pulling operations. Provide cable lubricants recommended by the cable manufacturer. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.

3.1.7.1 Cable Tensions

Obtain from the cable manufacturer and provide to the Contracting Officer, the maximum allowable pulling tension. This tension shall not be exceeded.

3.1.7.2 Pulling Eyes

Equip cables 1.25 inches in diameter and larger with cable manufacturer's

factory installed pulling-in eyes. Provide cables with diameter smaller than 1.25 inches with heat shrinkable type end caps or seals on cable ends when using cable pulling grips. Rings to prevent grip from slipping shall not be beaten into the cable sheath. Use a swivel of 3/4 inch links between pulling-in eyes or grips and pulling strand.

3.1.7.3 Installation of Cables in Manholes, Handholes, and Vaults

Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support cables on brackets and cable insulators at a maximum of 4 feet. In existing manholes, handholes, and vaults where new ducts are to be terminated, or where new cables are to be installed, modify the existing installation of cables, cable supports, and grounding as required with cables arranged and supported as specified for new cables. Identify each cable with corrosion-resistant embossed metal tags.

3.1.8 Surge Protection

All cables and conductors, except fiber optic cable, which serve as communication lines through off-premise lines, shall have surge protection installed at each end which meet the requirements of RUS Bull 1751F-815.

3.1.9 Grounding

Provide grounding and bonding in accordance with RUS 1755.200, TIA J-STD-607-A, IEEE C2, and NFPA 70. Ground exposed noncurrent carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals.

3.1.9.1 Telecommunications Master Ground Bar (TMGB)

The TMGB is the hub of the basic telecommunications grounding system providing a common point of connection for ground from outside cable, CD, and equipment. Establish a TMGB for connection point for cable stub shields to connector blocks and CD protector assemblies as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEMS.

3.1.9.2 Incoming Cable Shields

Shields shall not be bonded across the splice to the cable stubs. Ground shields of incoming cables in the EF Telecommunications to the TMGB.

3.1.9.3 Campus Distributor Grounding

a. Protection assemblies: Mount CD protector assemblies directly on the telecommunications backboard. Connect assemblies mounted on each vertical frame with No. 6 AWG copper conductor to provide a low resistance path to TMGB.

b. TMGB connection: Connect TMGB to TGB with copper conductor with a total resistance of less than 0.01 ohms.

3.2 LABELING

3.2.1 Labels

Provide labeling for new cabling and termination hardware located within

the facility in accordance with TIA/EIA-606-A. Handwritten labeling is unacceptable. Stenciled lettering for cable and termination hardware shall be provided using laser printer.

3.2.2 Cable Tag Installation

Install cable tags for each telecommunications cable or wire located in manholes, handholes, and vaults including each splice. Tag only new wire and cable provided by this contract. The labeling of telecommunications cable tag identifiers shall be in accordance with TIA/EIA-606-A. Do not provide handwritten letters. Install cable tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

3.2.3 Termination Hardware

Label patch panels, distribution panels, connector blocks and protection modules using color coded labels with identifiers in accordance with TIA/EIA-606-A.

3.3 FIELD APPLIED PAINTING

Provide ferrous metallic enclosure finishes as specified in Section 09 90 00, PAINTS AND COATINGS.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 FIELD QUALITY CONTROL

Provide the Contracting Officer 30 working days notice prior to each test. Provide labor, equipment, and incidentals required for testing. Correct defective material and workmanship disclosed as the results of the tests. Furnish a signed copy of the test results to the Contracting Officer within 3 working days after the tests for each segment of construction are completed. Perform testing as construction progresses and do not wait until all construction is complete before starting field tests.

3.5.1 Pre-Installation Tests

Perform the following tests on cable at the job site before it is removed from the cable reel. For cables with factory installed pulling eyes, these tests shall be performed at the factory and certified test results shall accompany the cable.

3.5.1.1 Cable Capacitance

Perform capacitance tests on at least 10 percent of the pairs within a cable to determine if cable capacitance is within the limits specified.

3.5.1.2 Loop Resistance

Perform DC-loop resistance on at least 10 percent of the pairs within a cable to determine if DC-loop resistance is within the manufacturer's calculated resistance.

3.5.1.3 Pre-Installation Test Results

Provide results of pre-installation tests to the Contracting Officer at least 10 working days before installation is to start. Results shall indicate reel number of the cable, manufacturer, size of cable, pairs tested, and recorded readings. When pre-installation tests indicate that cable does not meet specifications, remove cable from the job site.

3.5.2 Acceptance Tests

Perform acceptance testing in accordance with RUS Bull 1753F-201 and as further specified in this section. Provide personnel, equipment, instrumentation, and supplies necessary to perform required testing. Notification of any planned testing shall be given to the Contracting Officer at least 14 days prior to any test unless specified otherwise. Testing shall not proceed until after the Contractor has received written Contracting Officer's approval of the test plans as specified. Test plans shall define the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested. Provide test reports in booklet form showing all field tests performed, upon completion and testing of the installed system. Measurements shall be tabulated on a pair by pair or strand by strand basis.

3.5.2.1 Copper Conductor Cable

Perform the following acceptance tests in accordance with TIA-758-A:

a. Wire map (pin to pin continuity)

b. Continuity to remote end

c. Crossed pairs

d. Reversed pairs

e. Split pairs

f. Shorts between two or more conductors

3.5.2.2 Fiber Optic Cable

Test fiber optic cable in accordance with TIA/EIA-455-B and as further specified in this section. Two optical tests shall be performed on all optical fibers: Optical Time Domain Reflectometry (OTDR) Test, and Attenuation Test. In addition, a Bandwidth Test shall be performed on all multimode optical fibers. These tests shall be performed on the completed end-to-end spans which include the near-end pre-connectorized single fiber cable assembly, outside plant as specified, and the far-end pre-connectorized single fiber cable assembly.

a. OTDR Test: The OTDR test shall be used to determine the adequacy of the cable installations by showing any irregularities, such as discontinuities, micro-bendings or improper splices for the cable span under test. Hard copy fiber signature records shall be obtained from the OTDR for each fiber in each span and shall be included in the test results. The OTDR test shall be measured in

both directions. A reference length of fiber, 66 feet minimum, used as the delay line shall be placed before the new end connector and after the far end patch panel connectors for inspection of connector signature. Conduct OTDR test and provide calculation or interpretation of results in accordance with TIA-526-7 for single-mode fiber. Splice losses shall not exceed 0.3 db.

b. Attenuation Test: End-to-end attenuation measurements shall be made on all fibers, in both directions, using a 1310 or 1550 nanometer light source at one end and the optical power meter on the other end to verify that the cable system attenuation requirements are met in accordance with TIA-526-7 for single-mode fiber optic cables. The measurement method shall be in accordance with TIA-455-78. Attenuation losses shall not exceed 0.5 db/km at 1310 nm and 1550 nm for single-mode fiber.

c. Bandwidth Test: The end-to-end bandwidth of all multimode fiber span links shall be measured by the frequency domain method. The bandwidth shall be measured in both directions on all fibers. The bandwidth measurements shall be in accordance with TIA TIA/EIA-455-204.

-- End of Section --

# ALTOS® Gel-Free, All-Dielectric Cables 12-288 Fibers

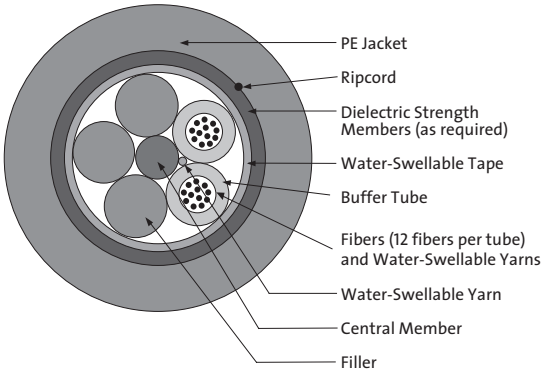
An Evolant® Solutions Product

## Description

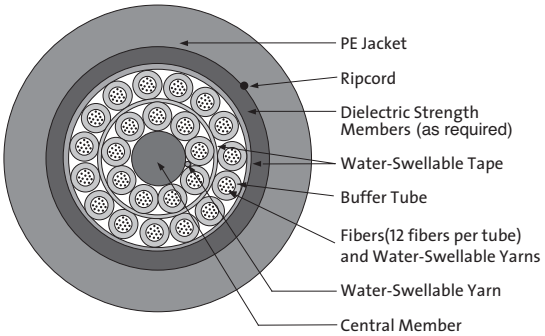
ALTOS® All-Dielectric Gel-Free Cables are lightweight cables designed for duct and aerial (lashed) installation. The loose tube design provides stable performance over a wide temperature range and is compatible with any telecommunications-grade optical fiber.

## Features / Benefits

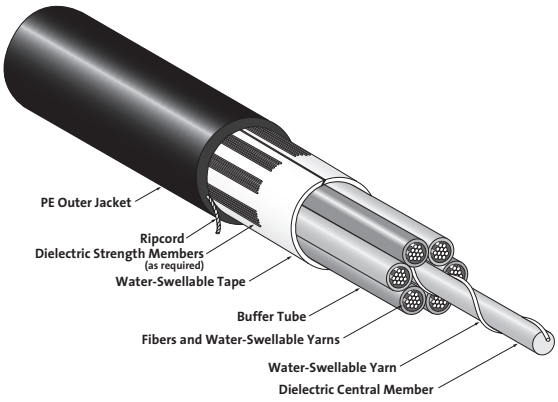
- Gel-free design is fully waterblocked using craft-friendly water-swellable yarns and tapes, making cable access simple and requiring no clean up
- Flexible, craft-friendly buffer tubes are easy to route in closures
- Standard buffer tube size reduces the number of access tools required by craft personnel
- S-Z stranded, loose tube design isolates fibers from installation and environmental rigors and facilitates midspan access
- Dielectric strength members have no preferential bend and require no bonding or grounding
- Medium-density PE jacket is rugged, durable and easy to strip
- Meets industry standards and specifications including ICEA-640 and Telcordia GR-20
- RDUP (formerly RUS) listed, 7 CFR 1755.900




**ALTOS Gel-Free, All-Dielectric Cable, 24-Fiber** | Drawing ZA-2747




**ALTOS Gel-Free, All-Dielectric Cable, 288-Fiber** | Drawing ZA-2749




**ALTOS All-Dielectric Cable** | Drawing ZA-2750

CORNING
Evolant® Solutions

Product Specifications

# ALTOS® Gel-Free, All-Dielectric Cables
# 12-288 Fibers

An Evolant® Solutions Product

## Specifications

| | |
|---|---|
| **Maximum Tensile Loads** | Short-Term: 2700 N (600 lbf)<br>Long-Term: 890 N (200 lbf) |
| **Storage Temperature** | -40° to +70°C (-40° to +158°F) |
| **Installation Temperature** | -30° to +70°C (-22° to +158°F) |
| **Operating Temperature** | -40° to +70°C (-40° to +158°F) |

| Fiber Count | Maximum Fibers per Tube | Number of Tube Positions | Number of Active Tubes | Central Member | Nominal Weight kg/km (lb/1000 ft) | Nominal Outer Diameter mm (in)[1] | Minimum Bend Radius Loaded cm (in) | Minimum Bend Radius Installed cm (in) |
|---|---|---|---|---|---|---|---|---|
| 12-60 | 12 | 5 | 3-5 | Dielectric | 78 (52) | 11.3 (0.44) | 17.0 (6.7) | 11.3 (4.4) |
| 72 | 12 | 6 | 6 | Dielectric | 91 (61) | 12.0 (0.47) | 18.0 (7.1) | 12.0 (4.7) |
| 84-96 | 12 | 8 | 7-8 | Dielectric | 120 (80) | 13.9 (0.55) | 20.9 (8.2) | 13.9 (5.5) |
| 108-120 | 12 | 10 | 9-10 | Dielectric | 157 (105) | 15.9 (0.63) | 23.9 (9.4) | 15.9 (6.3) |
| 132-192 | 12 | 16 | 11-16 | Dielectric | 159 (107) | 17.4 (0.69) | 26.1 (10.3) | 17.4 (6.9) |
| 204-216 | 12 | 18 | 17-18 | Dielectric | 178 (119) | 18.2 (0.72) | 27.3 (10.7) | 18.2 (7.2) |
| 228-240 | 12 | 20 | 19-20 | Dielectric | 197 (132) | 19.1 (0.75) | 28.7 (11.3) | 19.1 (7.5) |
| 252-288 | 12 | 24 | 21-24 | Dielectric | 246 (165) | 21.3 (0.84) | 32.0 (12.6) | 21.3 (8.4) |

# ALTOS® Gel-Free, All-Dielectric Cables
# 12-288 Fibers

An Evolant® Solutions Product

## Transmission Performance Table

| Fiber Code | K | C | E | E |
|---|---|---|---|---|
| **Performance Option Code** | **30** | **31** | **01** | **00** |
| **Fiber Type** | 62.5/125 µm (850/1300 nm) | 50/125 µm (850/1300 nm) | Single-mode (1310/1383/1550 nm) | Single-mode (1310/1383/1550 nm) |
| **Maximum Attenuation (dB/km)** | 3.5/1.0 | 3.5/1.5 | 0.4/0.4/0.3 | 0.35/0.35/0.25 |
| **Minimum LED Bandwidth (MHz•km)** | 200/500 | 500/500 | – / – / – | – / – / – |
| **Minimum Effective Modal Bandwidth (MHz•km)** | 220/ –* | 510/ –* | – / – / – | – / – / – |
| **Serial Gigabit Ethernet Distance (m)** | 300/550 | 600/600 | 5000/ – / – | 5000/ – / – |
| **Serial 10 Gigabit Ethernet Distance (m)** | 33/ – | 82/ – | 10000/ – /40000 | 10000/ – /40000 |

** EMB when deployed with 850 nm, 1 Gb/s VCSELs as predicted by RML Bandwidth using FOTP-204.*

## Ordering Information

Contact Customer Service for other options.

□ □ □ □ W 4 - T □ 1 □ □ D 2 0
1 2 3 4 5 6 7 8 9 10 11 12 13 14

024EW4-T101D20
048EW4-T101D20

**1 - 3 Select fiber count (012 to 288, increments of 12).**

**4 Select fiber code (see Transmission Performance Table).**

**5 / 12 Defines cable type.**
W/D = ALTOS® Gel-Free Cable

**6 Defines jacket.**
4 = Dielectric

**7 Defines fiber placement.**
T = 12 fiber/buffer tube (standard)

**8 Select length markings.**
4 = Markings in feet (standard)
3 = Markings in meters

**9 Defines tensile strength.**
1 = 2700 N/600 lb (standard)

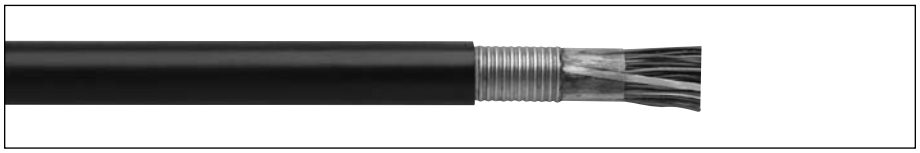
**10 - 11 Select performance option code. (see Transmission Performance Table).**

**13 - 14 Defines special requirements.**
20 = No special requirements

# Filled Foam Skin Cable

RDUP (RUS) PE-89 AL

# Spec. 2007



**Nominal Cable Data**

| CATALOG NUMBER | PAIRS AWG | O.D. (INCHES) | WEIGHT (LBS/MFT) | STANDARD LENGTH (FT) |
|---|---|---|---|---|
| **7525504** | 6/19 | 0.57 | 155 | 5000 |
| **7525512** | 12/19 | 0.66 | 230 | 5000 |
| **7525538** | 25/19 | 0.87 | 415 | 5000 |
| **7525595** | 6/22 | 0.47 | 100 | 5000 |
| **7525603** | 12/22 | 0.54 | 140 | 5000 |
| **7525629** | 25/22 | 0.65 | 230 | 5000 |
| **7525637** | 50/22 | 0.83 | 400 | 5000 |
| **7525652** | 100/22 | 1.10 | 725 | 2500 |
| **7525678** | 200/22 | 1.40 | 1330 | 2500 |
| **7525686** | 300/22 | 1.70 | 1950 | 1250 |
| **7525694** | 400/22 | 2.00 | 2570 | 1250 |
| **7525702** | 600/22 | 2.40 | 3900 | 1250 |
| **7525751** | 6/24 | 0.40 | 70 | 5000 |
| **7525769** | 12/24 | 0.46 | 100 | 5000 |
| **7525785** | 25/24 | 0.59 | 175 | 5000 |
| **7525793** | 50/24 | 0.72 | 290 | 5000 |
| **7525819** | 100/24 | 0.90 | 490 | 5000 |
| **7525827** | 150/24 | 1.10 | 690 | 5000 |
| **7525835** | 200/24 | 1.20 | 900 | 2500 |
| **7525843** | 300/24 | 1.40 | 1290 | 2500 |
| **7525850** | 400/24 | 1.60 | 1700 | 2500 |
| **7525868** | 600/24 | 1.90 | 2440 | 1250 |
| **7525876** | 900/24 | 2.30 | 3620 | 1250 |
| **7526973** | 1200/24 | 2.60 | 4720 | 1000 |
| **7526981** | 1500/24 | 2.90 | 5850 | 1000 |
| **7526999** | 1800/24 | 3.20 | 7040 | 1000 |

Data subject to change without notice. Contact your Customer Service Representative for latest information.

## Core Construction:

### Conductors:

- Solid, annealed copper; sizes 19, 22 and 24 AWG

### Insulation:

- Dual insulation consisting of an inner layer of foamed polyolefin surrounded by a solid polyolefin skin, color-coded in accordance with telephone industry standards

### Twisted Pairs:

- Insulated conductors are twisted into pairs with varying lay lengths to minimize crosstalk

### Core Assembly:

- 25 pairs and less: pairs are assembled together in a single group
- More than 25 pairs: pairs are arranged in groups, each group having a color-coded unit binder

### Filling Compound:

- The entire core assembly is completely filled with ETPR compound, filling the interstices between the pairs and under the core tape

### Core Wrap:

- Non-hygroscopic dielectric tape applied longitudinally with an overlap

## Sheath:

### Aluminum Shield:

- Corrugated, copolymer-coated, 0.008" aluminum tape applied longitudinally with an overlap
- The sheath interfaces are flooded with an adhesive water-blocking compound

### Jacket:

- Black, linear low density polyethylene

## Application(s):

- Intended for duct and direct buried installations where protection against water and moisture entry is required and may also be installed aerially

## Compliance:

- Rural Development Utility Program (RDUP) 7 CFR 1755.890 (RUS PE-89)

## Packaging:

- Standard lengths are shipped on non-returnable wood reels
- Non-standard packaging is available upon request

RDUP Listed

General Cable

## 5-Pin Building Entrance Protectors (cont'd)

## Model 525 & 1525 - 25 Pair Building Entrance Protector

**ORDERING INFORMATION:**

| PAIRS | TERM. | BLOCK ONLY | 230V GAS TUBE PROTECTORS | 240V SOLID STATE PROTECTORS | 230V DELTA PROTECTORS | 75V DELTA PROTECTORS |
|---|---|---|---|---|---|---|
| 25 | 66 | 525 | 525GT | 525SS | 525D | 525D75 |
| 25 | 110 | 1525 | 1525GT | 1525SS | 1525D | 1525D75 |

**DIMENSIONS:**

| Model # | Dimensions (height x width x depth) |
|---|---|
| 525 & 1525 | 10" x 3.4" x 3.5" (25.4 cm x 11.7 cm x 8.2 cm) |

525 1525

# Closet Connector Housings (CCH-04U & CCH-03U)

A LANscape® Solutions Product

Corning
Cable Systems

## Applications

Corning Cable Systems Closet Connector Housings (CCHs) provide interconnect or cross-connect capabilities between the outside plant, riser, or distribution cables, and the opto-electronics.

## Description

The units can be rack-mounted in 19-in (48 cm) racks or an optional 23-in (58 cm) equipment rack (1.75-in EIA hole spacing) and are available in three-rack-space (6 panels) or four-rack-space (12 panels) versions. For installations requiring 144 fibers, the capacity can be achieved using SC simplex, SC duplex, LC and MT-RJ connectors for 12 fibers per panel in conjunction with the 4-rack-space housing. For installations requiring up to 288 fibers, the capacity can be achieved using LC and MT-RJ connectors for 24 fibers per panel in conjunction with the 4-rack-space housing.

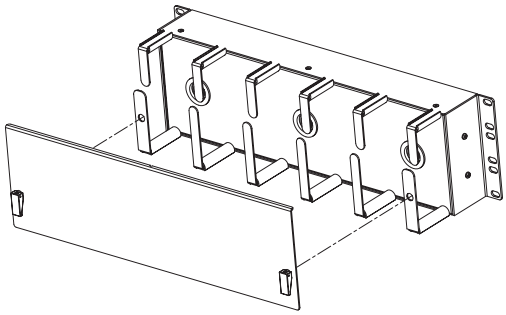
Closet connector housings can be ordered with connector panels for multimode and single-mode applications. Connector panels are offered in 6-, 8-, 12-, 16- and 24-fiber configurations. Documentation labels are provided and units or components can be added as needed to construct a fiber distribution frame for any application.

The 3- and 4-rack-space versions of the CCH have been designed with an open top, located in the front of the housing. The opening, when used in conjunction with the closet jumper management panel (CJP), facilitates jumper routing.

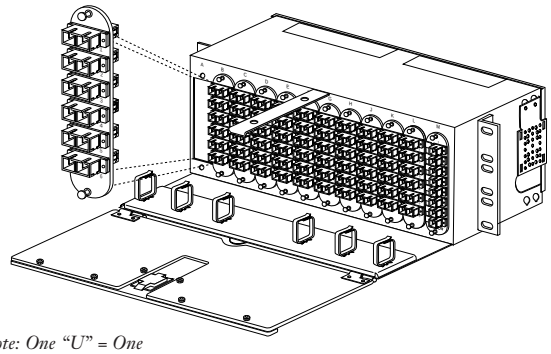
## Features / Benefits

- Ideal for field connectorization
- Includes mounting provisions for buffer tube fan-out kits
- Suitable for loose tube, tight-buffered and optical fiber ribbon cables
- Mounting configurations include standard 4.5-in (11.4 cm) frontal projection, partially flush and fully flush (with optional kit)
- Multiple locations for jumper egress

**CCH-04U (open)** | Photo LAN209

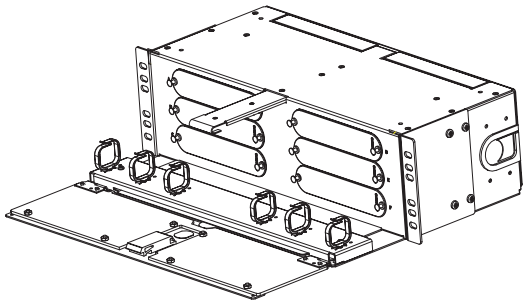


**CJP-02U** | Drawing ZA-2812



*Note: One "U" = One industry-standard rack space of 1.75 inches.*

**CCH-04U (up to 288 fibers)** | Drawing CPC-220/5/1



**CCH-03U (up to 144 fibers)** | Drawing ZA-2799

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Product Specifications

# Closet Connector Housings (CCH-04U & CCH-03U)

A LANscape® Solutions Product

Corning Cable Systems

## Features / Benefits (continued)

- Removable, durable, clear polycarbonate-tinted front door
- Lock can be field-installed
- Accepts CCH connector panels and modules
- Open top of housing for vertical pigtail or jumper exiting
- Optional top and side covers available
- Meets requirements of ANSI/TIA/EIA-568A and 606
- Brackets included for rack mounting in 19-in equipment racks; 23-in rack-mount brackets sold separately

## Specifications

| Part Number | Dimensions (H x W x D) cm (in) | Shipping Weight kg (lb) |
|---|---|---|
| **CCH-03U** | 13.3 x 43.2 x 30.5 (5.25 x 17 x 12) | 2.7 (6) |
| **CCH-04U** | 17.8 x 43.2 x 30.5 (7 x 17 x 12) | 3.6 (8) |

## Ordering Information

| Part Number | Description |
|---|---|
| **CCH-03U** | Closet Connector Housing that will accept up to six CCH panels or modules;<br>comes with blank panels and hardware to strain-relieve one cable with the<br>Universal Cable Clamp (UCC) or up to five 0.4-in or smaller cables with the UCC insert;<br>six 6-fiber panels = 36 fiber total capacity;<br>six 8-fiber panels = 48 fiber total capacity;<br>six 12-fiber panels = 72 fiber total capacity;<br>six 16-fiber panels = 96 fiber total capacity;<br>six 24-fiber panels = 144 fiber total capacity (MT-RJ and LC) |
| **CCH-04U** | Closet Connector Housing that will accept up to 12 CCH panels or modules;<br>comes with blank panels and hardware to strain-relieve one cable with the<br>Universal Cable Clamp (UCC) or up to five 0.4-in or smaller cables with the UCC insert;<br>twelve 6-fiber panels = 72 fiber total capacity;<br>twelve 8-fiber panels = 96 fiber total capacity;<br>twelve 12-fiber panels = 144 fiber total capacity;<br>twelve 16-fiber panels = 192 fiber total capacity;<br>twelve 24-fiber panels = 288 fiber total capacity (MT-RJ and LC) |
| ***Pre-Loaded Housings*** | |
| **CCH-04U-E491** | CCH-04U preloaded with 72 568SC (SC duplex) adapters (12 CCH panels), 62.5 µm MM, composite insert, composite housing |
| **CCH-04U-7291** | CCH-04U preloaded with 36 568SC (SC duplex) adapters (six CCH panels), 62.5 µm MM, composite insert, composite housing |
| **CCH-04U-E497** | CCH-04U preloaded with 72 MT-RJ adapters (12 CCH panels), 62.5 µm MM, composite housing |
| **CCH-04U-7297** | CCH-04U preloaded with 36 MT-RJ adapters (six CCH panels), 62.5 µm MM, composite housing |
| **CCH-04U-7215T** | CCH-04U preloaded with 72 ST® compatible connector adapters (12 CCH panels), 62.5 µm MM, ceramic insert, composite housing |

# Buffer Tube Fan-Out Kits

A LANscape® Solutions Product

Corning
Cable Systems

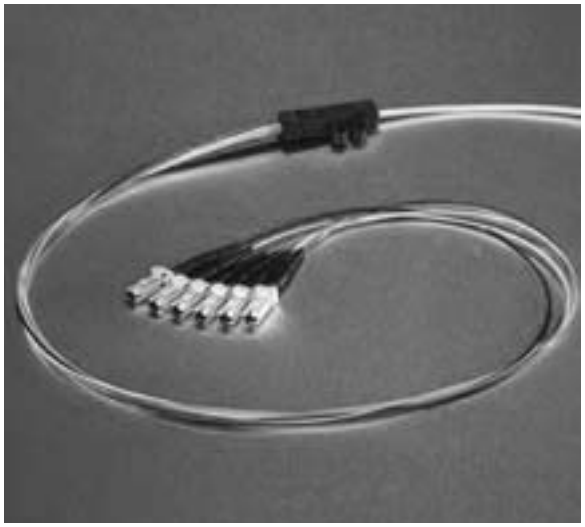
## Applications

- Field termination of loose tube cables at indoor or outdoor cross-connects

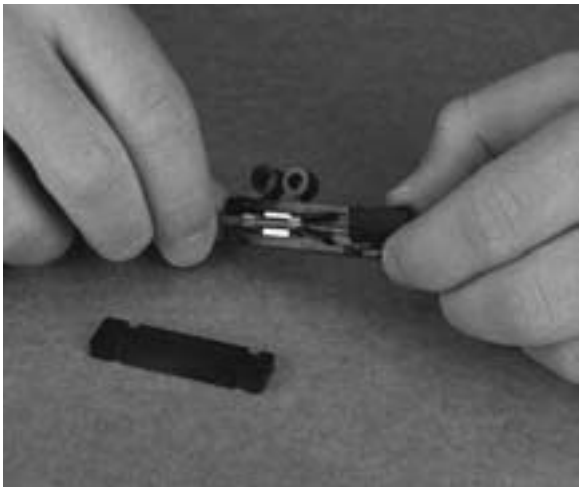
## Description

Corning Cable Systems Indoor and Outdoor Buffer Tube Fan-Out Kits are specifically designed for the termination of 6- and 12-fiber buffer tubes. These buffer tube fan-out kits provide the ultimate solution for those users who want to field-install connectors. The kits provide the most compact, easy-to-install fan-out solution requiring no additional hardware or space than that required for terminating tight-buffered cables.

Indoor and outdoor kits feature a 900 µm fan-out assembly that is color-coded to match the fiber color scheme. The fan-out assembly is available with 6- or 12-fiber units in lengths of 25 or 47 inches. These different lengths provide the installer the flexibility needed for a variety of hardware options.



**Buffer Tube Fan-Out Kit** | Photo LAN365



**Buffer Tube Fan-Out Kit** | Photo LAN49

## Features / Benefits

- Eliminates strain on fibers by isolating them from tensile forces
- Colored fan-out tubing
- Snap-together furcation unit eliminates epoxy for indoor kits
- Compact design
- Quick and easy to install
- Optimized for field termination of cables
- Excellent fiber routing capabilities
- Bend radius protection designed into each unit
- Outdoor kits include additional elements that compensate for wider temperature fluctuations common in outdoor environments
- Indoor temperature range 0° to +70°C
  Outdoor temperature range -40° to +70°C

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# Buffer Tube Fan-Out Kits

A LANscape® Solutions Product

Corning
Cable Systems

## Ordering Information

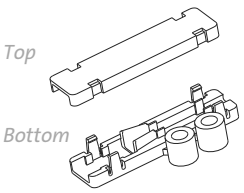
To order a buffer tube fan-out kit, first determine the length of tubing required for connector termination, either 25 or 47 inches. Next, determine the number of fibers to furcate.

| Part Number | Length of Tubing | Number of Fibers per Buffer Tube[1] |
|---|---|---|
| ***Indoor Buffer Tube Fan-Out Kits*** | | |
| **FAN-BT25-06** | 25 inches | 6 |
| **FAN-BT47-06** | 47 inches | 6 |
| **FAN-BT25-12** | 25 inches | 12 |
| **FAN-BT47-12** | 47 inches | 12 |
| ***Outdoor Buffer Tube Fan-Out Kits*** | | |
| **FAN-OD25-06** | 25 inches | 6 |
| **FAN-OD47-06** | 47 inches | 6 |
| **FAN-OD25-12** | 25 inches | 12 |
| **FAN-OD47-12** | 47 inches | 12 |

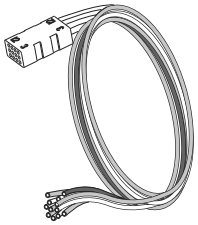
*Notes*
[1]*Refer to cable specifications.*

### *Tool Kit and Tool Kit Consumables*

| Part Number | Description |
|---|---|
| **TKT-FANBT-A** | Buffer Tube Fan-Out Assembly Tool Kit includes buffer tube fan-out assembly fixture and buffer tube fan-out kit instructions |
| **TKT-FANBT-C** | Buffer Tube Fan-Out Assembly Consumables Kit includes buffer tube fan-out procedure instructions, buffer tube fan-out clamp, MSDS 411 adhesive, Loctite 411 adhesive, Kimwipes, alcohol wipes, and MSDS alcohol wipes |

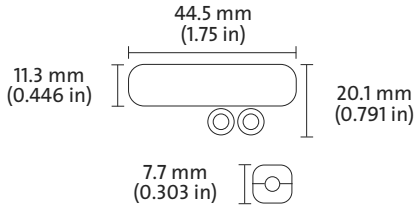



Furcation Unit



Fan-Out Assembly

**Kit Components** | Drawing CPC-220/2/1




**Completed Kit Dimensions** | Drawing CPC-220/2/2

**Corning Cable Systems LLC • PO Box 489 • Hickory, NC 28603-0489 USA**
**1-800-743-2675 • FAX: +1-828-901-5973 • International: +1-828-901-5000 • http://www.corning.com/cablesystems**

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LANscape®
Fiber Cabling Solutions for Premises Networks

# Closet Connector Housing Panels (CCH-CP)

A LANscape® Solutions Product

Corning
Cable Systems

## Applications

- The panels are used with field-installable connectors or in applications where the preconnectorized cables are routed directly from the equipment to the piece of interconnect hardware
- Provides an efficient way to securely mate two or more connectors

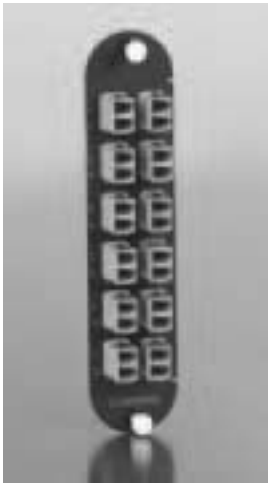
## Description

Closet connector housing panels are offered in a wide variety of fiber counts for use with the LANscape® Solutions hardware products. The panels are used with field-installable connectors or in applications where the preconnectorized cables are routed directly from the equipment to the interconnect hardware.

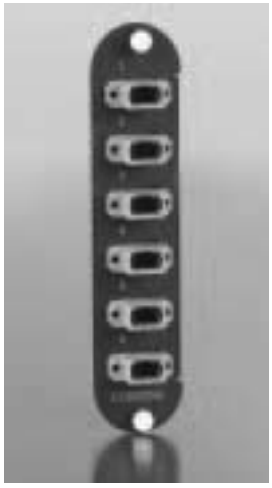
The panels are available with a variety of industry-standard adapter types. In most applications, the closet connector housing panels are designed for applications where specified labeling and connector identification are required. This is accomplished by the use of colored icons, which come standard on panels as space allows.

## Features / Benefits

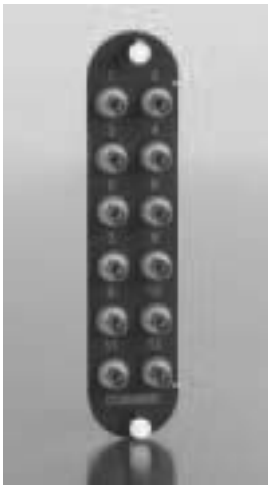
- Designed to accommodate all industry-standard adapter types
- Universal approach is used; one panel size fits in all standard LANscape Solutions hardware (for example, CCH, PCH, CCS, WCH, ICH,EDC, FZB)
- Available in 6-, 8- and 12-fiber count options in most adapter styles; 16- and 24-fiber count options available in MT-RJ and LC duplex styles
- Unique color-coded connector labeling system (space permitting)



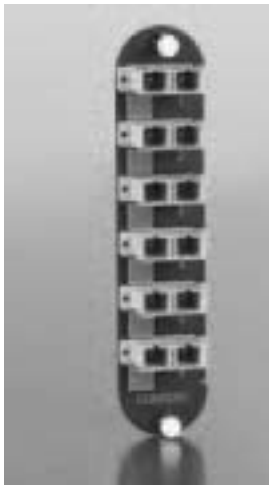
**24-Fiber LC Duplex Connector** | Photo LAN661



**72-Fiber MTP® Connector Panel** | Photo LAN659



**12-Fiber ST® Compatible Connector Panel** | Photo LAN662



**12-Fiber SC Duplex Connector Panel** | Photo LAN658

CORNING
Discovering Beyond Imagination

# Closet Connector Housing Panels (CCH-CP)

A LANscape® Solutions Product

Corning Cable Systems

## Ordering Information

| Adapter Code | Fiber Type | Alignment | Housing | UPC/ APC | Fibers/ Adapter | Available Fibers/Panel Counts 6 | 8 | 12 | 16 | 24 | 36 | 72 | 144 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LC Duplex** | | | | | | | | | | | | | |
| A8 | 62.5 µm Multimode | Ceramic | Composite | UPC | 2 | | X | X | X | X | | | |
| D3 | 50 µm Multimode | Ceramic | Composite | UPC | 2 | | X | X | X | X | | | |
| E4 | LOMMF* | Ceramic | Composite | UPC | 2 | | X | X | X | X | | | |
| A9 | Single-mode | Ceramic | Composite | UPC | 2 | | X | X | X | X | | | |
| **SC Duplex** | | | | | | | | | | | | | |
| 91 | 62.5 µm Multimode | Composite | Composite | UPC | 2 | | X | X | | | | | |
| G7 | 50 µm Multimode | Ceramic | Composite | UPC | 2 | | X | X | | | | | |
| E7 | LOMMF | Ceramic | Composite | UPC | 2 | | X | X | | | | | |
| 59 | Single-mode | Ceramic | Composite | UPC | 2 | | X | X | | | | | |
| **MT-RJ** | | | | | | | | | | | | | |
| 97 | 62.5 µm Multimode | N/A | Composite | UPC | 2 | | X | X | X | X | | | |
| G1 | 50 µm Multimode | N/A | Composite | UPC | 2 | | X | X | X | X | | | |
| E1 | LOMMF | N/A | Composite | UPC | 2 | | X | X | X | X | | | |
| 98 | Single-mode | N/A | Composite | UPC | 2 | | X | X | X | X | | | |
| **SC** | | | | | | | | | | | | | |
| 56 | 62.5 µm Multimode | Composite | Composite | UPC | 1 | X | X | X | | | | | |
| G6 | 50 µm Multimode | Ceramic | Composite | UPC | 1 | X | X | X | | | | | |
| E6 | LOMMF | Ceramic | Composite | UPC | 1 | X | X | X | | | | | |
| 3C | Single-mode | Ceramic | Composite | UPC | 1 | X | X | X | | | | | |
| 6C | Single-mode | Ceramic | Composite | APC | 1 | X | X | X | | | | | |
| **ST® Compatible Connector** | | | | | | | | | | | | | |
| 25T | 62.5 µm Multimode | Composite | Composite | UPC | 1 | X | X | X | | | | | |
| 15T | 62.5 µm Multimode | Ceramic | Composite | UPC | 1 | X | X | X | | | | | |
| G5 | 50 µm Multimode | Ceramic | Composite | UPC | 1 | X | X | X | | | | | |
| E5 | LOMMF | Ceramic | Composite | UPC | 1 | X | X | X | | | | | |
| 19T | Single-mode | Ceramic | Composite | UPC | 1 | X | X | X | | | | | |
| **FC** | | | | | | | | | | | | | |
| 11 | Single-mode | Metal | Metal | UPC | 1 | X | X | X | | | | | |
| 21 | Single-mode | Metal | Metal | APC | 1 | X | X | X | | | | | |
| **MTP® Connector** | | | | | | | | | | | | | |
| 69 | 62.5 µm Multimode | N/A | Composite | UPC | 12 | | | | | | X | X | X |
| G3 | 50 µm | N/A | Composite | UPC | 12 | | | | | | X | X | X |
| E3 | LOMMF | N/A | Composite | UPC | 12 | | | | | | X | X | X |
| 89 | Single-mode | N/A | Composite | UPC | 12 | | | | | | X | X | X |
| 90 | Single-mode | N/A | Composite | APC | 12 | | | | | | X | X | X |

| Fiber Type | Housing Color |
|---|---|
| 62.5 µm Multimode | Beige |
| 50 µm Multimode | Black |
| 50 µm LOMMF | Aqua |
| Single-mode | Blue |
| Single-mode APC | Green |

**LOMMF = Laser-Optimized Multimode Fiber*

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LANscape®
Fiber Cabling Solutions for Premises Networks

## Ordering Information *(continued)*

### *Closet Connector Panels*

**CCH - CP ☐☐ - ☐☐** ← CCH-CP12-59

**1** **2**

Use the following options to construct the part number:

**1 Select fiber count.**

06 = 6 fibers
08 = 8 fibers
12 = 12 fibers
16 = 16 fibers
24 = 24 fibers
36 = 36 fibers
72 = 72 fibers
E4 = 144 fibers

*Confirm fiber count for desired adapter is available in preceding chart.*

**2 Select adapter code from chart on previous page.**

---

### *Pigtailed Closet Connector Panels (pigtail is 3 m long)*

**CCH - CP ☐☐ - ☐☐ - P03 ☐☐**

**1** **2** **3**

Use the following options to construct the part number:

**1 Select fiber count.**

06 = 6 fibers
08 = 8 fibers
12 = 12 fibers
16 = 16 fibers
24 = 24 fibers
36 = 36 fibers
72 = 72 fibers
E4 = 144 fibers

*Confirm fiber count for desired adapter is available in preceeding chart*

**2 Select adapter code.**

*From chart on previous page.*

**3 Select fiber type.**

***MIC® Subunit (Standard Fiber Cable Option)***

CH = Standard multimode (50/125 µm)
SH = Laser-optimized multimode (50/125 µm) Sx +
KH = Multimode (62.5/125 µm)
RH = Single-mode

***Ribbon Fiber***

CJ = Standard multimode (50/125 µm)
SJ = Laser-optimized multimode (50/125 µm) Sx +
KJ = Multimode (62.5/125 µm)
RJ = Single-mode

***OptiStrip™ Buffered Fiber***

KN = Multimode (62.5/125 µm)
RN = Single-mode

## Ordering Information *(continued)*

### *Colored Icons*

**Pack of 50 Colored Icons**

**ICN - □ □ □**
**1**

Use the following options to construct the part number:

**1 Select icons.**

### *Blank Icons*

YLB = Blank (Yellow)
RDB = Blank (Red)
GRB = Blank (Green)
BLB = Blank (Blue)
WTB = Blank (White)

### *Etched Icons*

BLP = Phone (Blue)

RDC = Computer (Red)

GRT = Cable TV (Green)

**Corning Cable Systems LLC • PO Box 489 • Hickory, NC 28603-0489 USA**
**1-800-743-2675 • FAX: +1-828-901-5973 • International: +1-828-901-5000 • http://www.corning.com/cablesystems**

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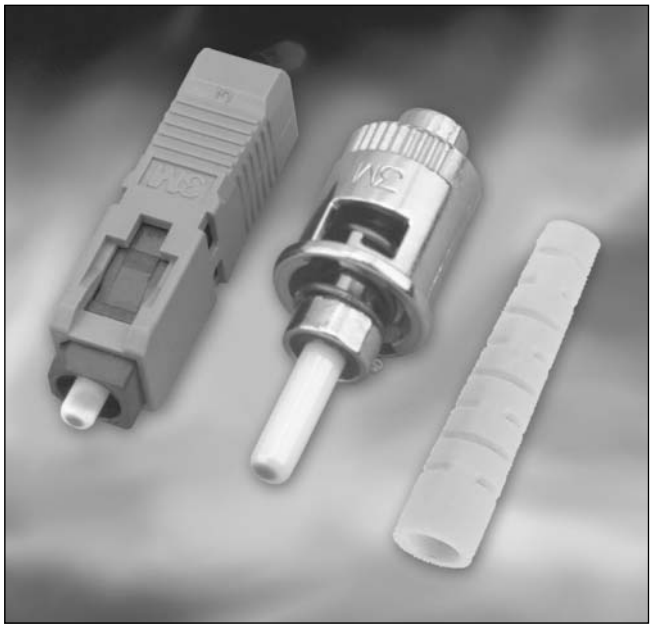
Fiber Cabling Solutions for Premises Networks

3M

# ST, FC, SC Hot Melt Connectors for Indoor/Outdoor Applications

## Single-mode and Multimode



### 3M Hot Melt Connectors can be used in high temperature environments.

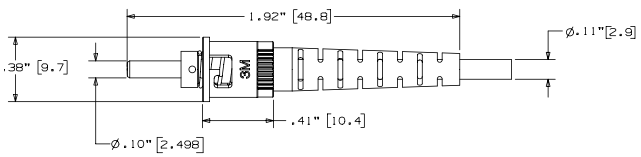
3M Hot Melt Connectors have a proven record of high performance and ease of use in local area networks around the world. These connectors are now qualified to TIA/EIA 568B standards for both indoor and outdoor use, including temperatures as high as 85°C (185°F). Drawing on 70 years of adhesive expertise and 40 years of experience in ceramic technology, 3M provides the most convenient, reliable and easy-to-install connectors on the market.

Preloaded adhesive means no syringe and no epoxy mixing is needed, saving installation time. The PC zirconia ceramic ferrule provides superior optical contact and durability. The ability to reheat and reposition fiber within the connector means virtually all connections are successful, saving time and money. And one kit provides everything needed to terminate ST, FC, and SC connectors for both single-mode and multimode applications.

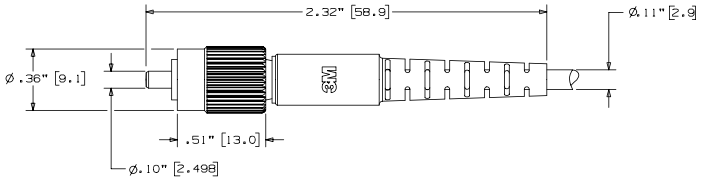
| Features | Benefits |
|---|---|
| Preloaded Hot Melt adhesive | Easy to use, no epoxy to mix, fewer consumables |
| Terminates in less than 2 minutes | Saves time and labor |
| Meets TIA/EIA 568B standards for indoor and outdoor applications | Reliable performance |
| Reheatable adhesive allows fiber repositioning | High yield reduces waste of connectors and time |
| Pre-radiused PC zirconia ceramic ferrule | Assures optical contact and stability up to 85°C (185°F) |
| Universal Kit contains consumables for up to 400 connectors* | Eliminates confusion and lost time |

*Alcohol is not included. Connectors are sold separately.

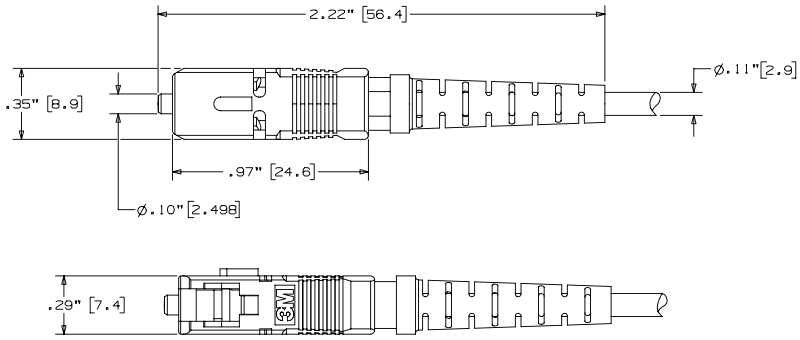
**ST Hot Melt Connector**




**FC Hot Melt Connector**




**SC Hot Melt Connector**




# Specifications

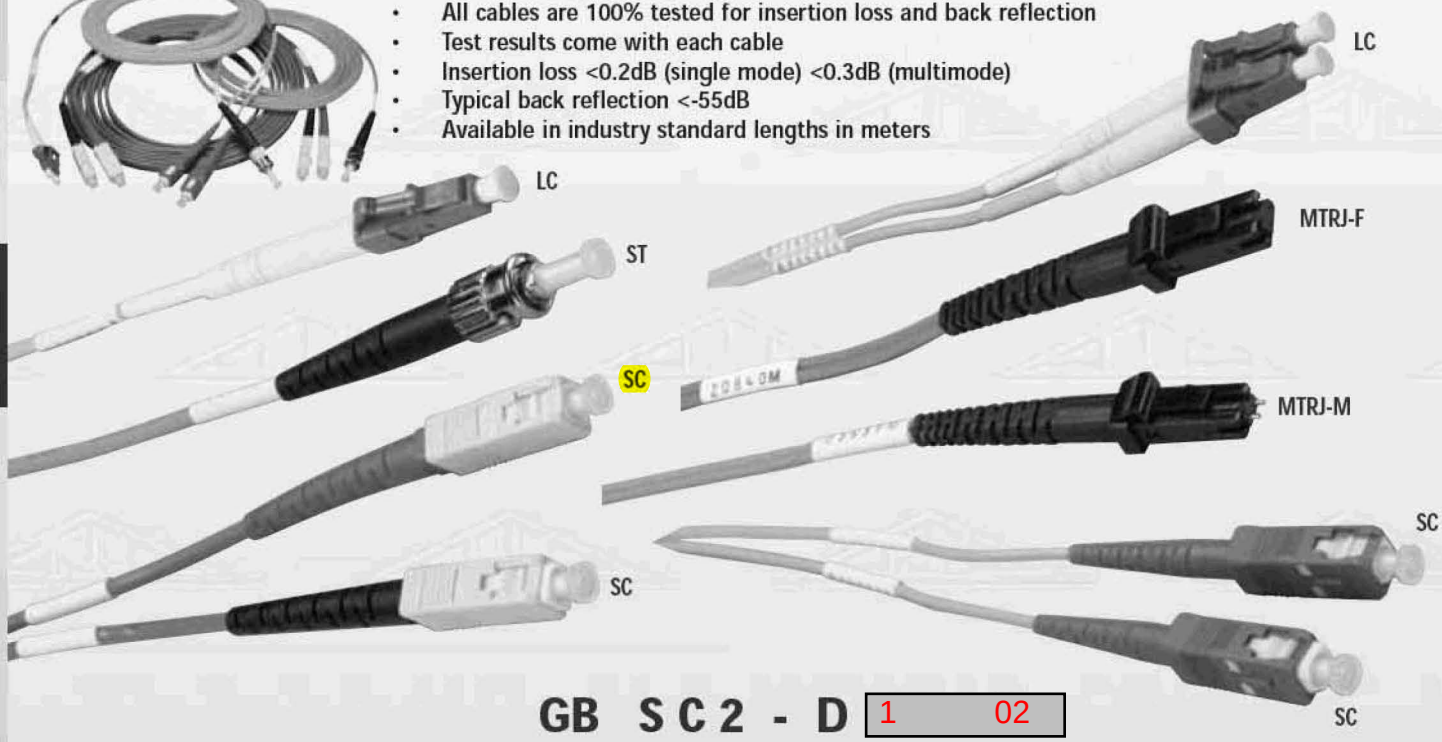
| Product Number | 6100 MM ST | 8100 SM ST | 6200 MM FC | 8200 SM FC | 6300 MM SC | 8300 SM SC |
|---|---|---|---|---|---|---|
| Operating Temperature | -40°C to +85°C (-40°F to +185°F) | | -40°C to +85°C (-40°F to +185°F) | | -40°C to +85°C (-40°F to +185°F) | |
| Attenuation* | <0.2dB typical | | <0.2dB typical | | <0.2dB typical | |
| Reflection* | -25dB typical | -40dB typical | -25dB typical | -40dB typical | -25dB typical | -40dB typical |
| Mating Durability (500 matings) | <0.2dB change | | <0.2dB change | | <0.2dB change | |
| Storage Temperature | -40°C to +85°C (-40°F to +185°F) | | -40°C to + 85°C (-40°F to + 185°F) | | -40°C to +85°C (-40°F to +185°F) | |
| Testing Specification | TIA/EIA 568B | | TIA/EIA 568B | | TIA/EIA 568B | |
| **Materials and Identification** | | | | | | |
| Ferrule | Zirconia Ceramic | | Zirconia Ceramic | | Zirconia Ceramic | |
| Housing Body | Nickel plated zinc | | Engineered resin | | Engineered resin | |
| Boot | Thermoplastic elastomer | | Thermoplastic elastomer | | Thermoplastic elastomer | |
| Flame Retardancy | UL-94 V-0 | | UL-94 V-0 | | UL-94 V-0 | |
| Adhesive | Blue dot on ferrule | | Blue dot on ferrule | | Blue dot on ferrule | |

*Multimode connectors tested at 850nm and 1300nm.
Single-mode connectors tested at 1310nm and 1550nm.

# Patch Cords

## Fiber Optic Cable Assemblies

- Full line of high quality single mode and multimode fiber optic cable assemblies
- All cables are 100% tested for insertion loss and back reflection
- Test results come with each cable
- Insertion loss <0.2dB (single mode) <0.3dB (multimode)
- Typical back reflection <-55dB
- Available in industry standard lengths in meters




**GB SC2 - D 1 02**

### Connector to Connector Configurations

| | |
|---|---|
| FC2 | FC to FC |
| FCC | FC to SC |
| FCT | FC to ST |
| LC2 | LC to LC |
| LCC | LC to SC |
| LCT | LC to ST |
| MF2 | MTRJ Female to MTRJ Female |
| MFC | MTRJ Female to SC |
| MFL | MTRJ Female to LC |
| MFT | MTRJ Female to ST |
| MM2 | MTRJ Male to MTRJ Male |
| MMC | MTRJ Male to SC |
| MMF | MTRJ Male to MTRJ Female |
| MMT | MTRJ Male to ST |
| SC2 | SC to SC |
| ST2 | ST to ST |
| STC | ST to SC |

### Length

| | |
|---|---|
| 01 - 1 Meter | 08 - 8 Meter |
| 02 - 2 Meter | 09 - 9 Meter |
| 03 - 3 Meter | 10 - 10 Meter |
| 04 - 4 Meter | 15 - 15 Meter |
| 05 - 5 Meter | 20 - 20 Meter |
| 06 - 6 Meter | 25 - 25 Meter |
| 07 - 7 Meter | 30 - 30 Meter |

### Fiber

1 - Single Mode 9/125 (Yellow Jacket)
2 - Multi Mode 62.5/125 (Orange Jacket)
3 - Multi Mode (Only) 50/125 (Blue Jacket)

### Cable Type

S - Simplex
D - Duplex

## Ordering Example

**GBSC2-D2-03**

SC to SC duplex 62.5/125 microns multimode - 3 Meters

Sold by:
TWAcommerce.com
http://www.TWAcomm.com
Toll Free: (877) 389-0000