

## **DIVISION 2**

### **SITE CONSTRUCTION**



## **SECTION 02200**

### **EARTHWORK**

#### **PART 1 - GENERAL**

##### **1.01 DESCRIPTION OF WORK**

- A. This Section of the specifications details requirements of work and materials to be used in connection with all clearing and grubbing; excavation, including borrow excavation; construction of embankments; preparation of subgrade, including spot reinforcement; grading; all hauling, wetting, rolling, compacting; and all other operations of incidental work for the construction of the roads, pipelines, ditches, ponds, canals, crossings, etc. to the lines and grades as established by the Engineer; all in accordance with the items of work shown on the Drawings and contained in the Proposal Form.

##### **1.02 REFERENCED STANDARDS**

- A. All work in this Section shall be in accordance with "Louisiana Standard Specifications for Roads and Bridges", latest edition with revisions. This standard specification will hereinafter be referred to a "LA DOTD Standards".

#### **PART 2 - PRODUCTS**

##### **2.01 BORROW (USABLE SOILS) MATERIAL**

- A. Borrow is defined as usable soils required for construction of embankments or other portions of the work in excess of usable materials available from required excavation and obtained from an approved source. Borrow may be required even though not shown on the Plans. Usable soil is defined as soil material whose composition is designated satisfactory for use in embankment construction. Moisture content has no bearing upon such determination. Compaction to conform to 90% modified Standard Proctor Density.

##### **2.02 NONPLASTIC EMBANKMENT**

- A. Nonplastic embankment materials shall be sand or shell or a sand-shell mixture and shall be in accordance with Subsection 203.09 of LA DOTD Standards.

##### **2.03 SHEETING AND BRACING**

- A. Furnish, put in place, and maintain such sheeting and bracing as may be required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect adjacent structures from undermining or other damage. Such support shall consist of braced steel sheet piling, braced wood lagging and solid beams or other approved methods. If the Engineer is of the opinion that any points sufficient or proper supports have not been provided, he may order additional supports put in at the expense of the Contractor, and compliance with such order shall not relieve or release the Contractor from his responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the

sheeting, but if voids are formed, they shall be immediately filled and rammed. Where soil cannot be properly compacted to fill a void, lean concrete shall be used as backfill at no additional expense to the Owner.

B. The Contractor shall construct the sheeting outside the neat lines of the foundation unless indicated otherwise to the extent he deems it desirable for his method of operation. Sheeting shall be plumb and securely braced and tied in position. Sheeting and bracing shall be adequate to withstand all pressures to which the structure or trench will be subjected. Any movement or bulging which may occur shall be corrected by the contractor at his own expense so as to provide the necessary clearances and dimensions.

C. Where sheeting and bracing is required to support the sides of excavations for structures, the Contractor shall engage a Professional Geotechnical Engineer, registered in the State to design the sheeting and bracing. The sheeting and bracing installed shall be in conformity with the design, and certification of these designs shall be provided by the Professional Geotechnical Engineer.

D. The Contractor shall leave in place to be embedded in the backfill all sheeting and bracing not shown on the Drawings but which the Engineer may direct him in writing to leave in place at any time during the progress of the work for the purpose of preventing injury to structures, utilities, or property, whether public or private. The Engineer may direct that timber used for sheeting and bracing be cut off at any specified elevation.

E. All sheeting and bracing not left in place shall be carefully removed in such manner as not to endanger the construction or other structures, utilities, or property. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, or otherwise as may be directed by the Engineer.

F. The right of the Engineer to order sheeting and bracing left in place shall not be construed as creating any obligation on his part to issue such orders, and his failure to exercise his right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.

G. No wood sheeting is to be withdrawn if driven below mid-diameter of any pipe, and under no circumstances shall any wood sheeting be cut off at a level lower than 1 foot above the top of any pipe.

## **PART 3 - EXECUTION**

### **3-01 CLEARING AND GRUBBING**

A. This work consists of required clearing, grubbing, removing and disposing of vegetation and debris within the limits of the right-of-way and easement areas, except such objects that are designated to remain or to be removed as shown on the plans.

B. Clearing and grubbing shall be in accordance with Section 201 of LA DOTD Standards.

### **3-02 REMOVAL OF STRUCTURES AND OBSTRUCTIONS**

A. This work consists of removal and satisfactory disposal of all buildings, septic tanks, fences,

culverts, structures, pavements, abandoned pipelines, and other obstructions not designated or permitted to remain, except obstructions to be removed under other contract items. It shall also include salvaging of designated materials and backfilling resulting trenches, holes, and pits.

- B. Removal of structures and obstructions shall be in accordance with Section 202 of LA DOTD Standards.

### **3.03 EXCAVATION, EMBANKMENT, AND BACKFILL**

- A. This work consists of excavation, disposal, placement and compaction of all materials that are not provided under other Sections of these Specifications, including excavation and embankment construction for roadways and other structures, excavation for ditches and channels, and all other grading operations necessary for the work in accordance with these Specifications and in conformity with the lines, grades, thicknesses, and typical cross sections shown on the Plans or established by the Engineer.
- B. The Plans may include data regarding the boring and classification of existing materials. The Owner does not guarantee the accuracy of such information and bidders should make, at their own expense, such additional investigations as they consider necessary. No additional payment will be made for any increased costs due to inaccuracy of soil boring data shown on the Plans.

### **3.04 TEMPORARY EROSION CONTROL**

- A. This work consists of providing temporary erosion control measures on the project and in areas outside the right-of-way where work is accomplished in conjunction with the project, to prevent pollution of water, detrimental effects to property adjacent to the right-of-way and damage to work on the project. These measures shall consist of construction and maintenance of temporary erosion control features shown on the Plans or as directed.
- B. Installation of temporary erosion control features shall be coordinated with construction of permanent erosion control features to the extent necessary to assure economical, effective and continuous control of erosion and water pollution throughout the life of the contract.
- C. Temporary erosion control shall be in accordance with Section 2.04 of LA DOTD Standards.

### **3.09 EXCAVATION AND TRENCHING FOR PIPEWORK**

- A. All excavation necessary for laying pipe and construction appurtenances shall be made in line and grade and to provide cover as indicated on the Plans and as specified for the type of pipe being laid.
- B. All excavation shall be open cuts with vertical sides, except in special cases where the Engineer may permit sloping sides or tunnels. If tunnels are authorized by the Engineer, they shall be of the same width throughout as open cutting and of sufficient height to allow the establishment of grades if required.
- C. The Engineer shall have the authority, at any time, to require the Contractor to discontinue the use of any excavating machine or other appliance which, in the Engineer's judgement is not adapted to the purpose for which it is used. In order to protect trees, buildings, or structures, excavation by completely manual means may be required.
- D. The Contractor shall leave a berm of at least two feet (2') in width on one side if the trench

between the trench and the spoil bank to allow free passage of the Engineer and to permit the Engineer to perform work in an expeditious and satisfactory manner.

E. No greater length of trench shall be opened in advance of the completed structure or left unfilled to the rear thereof than deemed proper by the Engineer.

F. Where roadways, paving, or sidewalks are required to be broken in order to properly lay the pipe, then such breaking and removal shall be done in accordance with the Plans, Specifications, or Engineer's direction, and such work required shall be included in other pay items. If no specific pay item is provided, no additional compensation will be made.

G. The width of the trench to a point two feet (2') above the top of the pipe installation shall not exceed the external diameter plus 18" maximum. Additional cost for special foundation and backfill material and requirements as a result of failure to confine the excavation to this width shall be borne by the Contractor.

H. Unless specifically directed by the Engineer, the mechanical excavation shall be stopped above the final invert grade elevations so that the pipe may be laid on a firm, undisturbed, native earth bed. Just prior to laying the pipe, so as not to disturb subgrade, a continuous trough shall be manually excavated and accurately graded to provide uniform bedding for the bottom quadrant (90 degrees) of the pipe barrel. In addition, bell holes shall be excavated so that the bell will not come in contact with the bottom of the hole, so that the full length of the barrel be bedded as required and to allow for joints being properly made.

I. If overdigging occurs, all loosened earth must be removed and the trench bottom brought back to grade with granular material or lean concrete without additional compensation therefore. Recompaction of overdigging shall be 92% of modified proctor maximum dry density.

J. Where the bottom of the trench is rock, waterbearing soil, or unstable material, the Engineer may direct that the pipe be bedded in granular material or a concrete cradle and paid for as separate items. The pipe shall be bedded in a trough as provided above, but in no case shall the thickness of the bedding material be less than four inches (4") below the bottom of the pipe barrel.

K. Granular material, where required, shall be well-graded crushed stone or graded river gravel, in accordance with A.S.T.M. Designation C-33, Gradation No. 67.

L. Concrete for pipe foundations, where required, shall be high-early-strength proportioned to develop not less than 2,000 psi in 28 days.

M. Other excavation and trenching requirements as specified herein before in Section 2 of these Specifications, shall be complied with.

### **3.10 BACKFILLING OF PIPE TRENCHES**

#### **A. GENERAL**

No backfilling of underground lines or conduit shall occur until all dimensions and elevations as required for as-built documentation has been performed.

All trenches and excavations shall be backfilled as specified for the type of pipe being laid. No backfilling shall commence until the Engineer has inspected the pipework and until the joints are

reasonably cured, if the type of work requires. No material shall be used for backfilling that contains stone having any dimension greater than six (6") inches, frozen earth, debris, or sod.

Where any sheeting or bracing is withdrawn as backfilling progresses, all voids or spaces left thereby shall be carefully and thoroughly filled and compacted with shaped tools. The Engineer shall have the right to forbid the use of any compacting tools or machines that he so considers dangerous to the pipe or incapable of compacting the backfill properly.

Backfill and fill methods shall meet the approval of the State Highway Department where within State Highway rights-of-way and the approval of the owning railroad where within railroad rights-of-way. The requirements of the approving agency shall govern over specified requirements for backfill of pipe trenches, except in cases where the governing agency's requirements are inferior to those cited above.

The Contractor shall go over all trenches and refill all sunken trenches after every rain. Before final acceptance of the work where paving is not to be replaced over the trench, the Contractor shall go over the entire system and refill all sunken trenches, compact trenches by rolling and leave the surface of the trench slightly mounded and in a condition satisfactory to the Engineer. Any deficiency in the quantity of materials for backfilling the trenches, or for filling depressions caused by settlement, shall be supplied by the Contractor at no additional payment.

Upon completion of backfilling, all excavated material and surplus soil shall be cleared from adjacent street surfaces, gutters, sidewalks parkways, grass plots, etc. and shall be removed. The whole area affected shall be left in a tidy and acceptable condition.

The initial backfill shall be manually placed completely under the pipe haunches and around the pipe in uniform layers not exceeding six (6") inches in depth. Each layer shall then be carefully and uniformly tamped so as not to displace the pipe. The utmost care shall be taken not to disturb the pipe by stepping on them, throwing earth on them from the bank above, unequal backfilling, or unsilled compacting. There shall not be less than one man tamping to each two men shoveling for the initial backfill.

Where the Contractor uses a trenching machine for the excavation, then the initial backfill shall be brought to not less than six (6) inches above the top of the pipe, as hereinafter specified. Should the Contractor elect to use a backhoe, dragline, clam-shell bucket, or equipment other than a trenching machine, then the initial backfill shall be brought to not less than two (2) feet above the top of the pipe.

Upon written permission, and at the direction of the Engineer puddling, jetting, or flooding of porous sand or gravel may be permitted during warm weather for the intermediate backfill.

#### B. COMPACTION

1. General: Control soil compaction during construction providing maximum percentage of density specified on the structural drawings for each area classification. It shall be the Contractor's responsibility to notify the Engineer in writing that penetration tests can be performed. Written notice from the Contractor shall precede completion of compaction operations by at least two working days.
2. Percentage of Maximum Density Requirements:
  - A. Compact soil to not less than the following percentages of maximum dry density in accordance with AASHTO T-180 (modified proctor).

1. Structures and 5-foot 0-inches around Perimeter of Building: Compact top 36-inches of subgrade and each layer of backfill or fill material at 92 percent modified proctor maximum dry density except where pavement will be installed.
2. Building Slabs: Compact top 12-inches of subgrade and each layer of backfill or fill material at 95 percent maximum dry density.
3. Lawn or Unpaved Areas: Compact top 6-inches subgrade and each layer of backfill or fill to the extent required to obtain a stable fill.
4. Walkways: Compact top 6-inches of subgrade 95 percent maximum dry density.
5. Pavements and Steps: Compact top 24-inches of subgrade at 95 percent maximum dry density.
3. Moisture Control: Condition subgrade or layer material correcting moisture content:
  - a. When the material is too dry and before compaction, uniformly apply water to surface of subgrade or layer of soil material to prevent free water appearing on surface during or subsequent to compaction operations.
  - b. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
  - c. Soil material that has been removed because it is too wet to permit compaction but is otherwise satisfactory may be stock-piled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.
4. Structural fill and base course in open areas, shall be placed in layers not to exceed eight inches in depth as measured before compaction. Each layer shall be compacted to the minimum dry density as stated above. Incidental compaction due to traffic by construction equipment will not be credited toward the required minimum four coverages.
5. Common fill shall be placed and compacted in a manner similar to that described above for structural fill, with the following exceptions:
  - a. Layer thickness prior to compaction may be increased to 10-inches in open areas.
  - b. Common fill, except dike fill required below water level in peat excavation areas, may be placed as one lift, in-the-wet, to an elevation one foot above the water level at the time of filling.
6. Compaction equipment in open areas shall consist of medium-heavy vibrator rollers with a minimum static weight of 10 tons or other compaction equipment as approved by the Engineer.
7. Areas adjacent to structures and other confined areas inaccessible to the vibratory roller shall be compacted with approved hand guided mechanical compaction equipment. The Contractor shall also conform to additional backfilling requirements

at structures as specified in Paragraph 3.04. Compaction of the fill by such means shall be to the same degree of compaction as obtained by the rubber-tired equipment and the Engineer may make the necessary tests to determine the amount of compactive effort necessary to obtain compaction. Unless such tests indicate that modifications may be made, the fill compacted by mechanical compactors shall be placed in 6-inch layers and thoroughly tamped over the entire surface. Compaction equipment is subject to approval by the Engineer.

8. It is the intention that the fill materials with respect to moisture be used in the conditions they are excavated insofar as this is practicable. Material which is too wet shall be spread and permitted to dry, assisted by harrowing if necessary, until the moisture content is reduced to allowable limits.

9. If the Engineer determines that added moisture is required, water shall be applied by sprinkler tanks or other sprinkler systems, which will insure uniform distribution of the water over the area to be treated, and give complete and accurate control of the amount of water to be used. If too much water is added the area shall be permitted to dry before the compaction is continued.

10. The Contractor shall supply all hose, piping, valves, sprinklers, pumps, sprinkler tanks, hauling equipment, and all other materials and equipment necessary to place the water in the fill in the manner specified.

### C. BACKFILL AND FILL

1. Backfill methods for gravity sewer trenches, as shown on the Drawings, are classified into three (3) zones; bedding, initial backfill, and final backfill.

a. **Bedding** is the material a minimum of six inches (6") under the pipe up to a level four inches (4') above the pipe. Bedding material shall be well graded crushed stone meeting the requirements of ASTM Designation C-33, Gradation No. 67.

b. **Initial backfill** is the material above the bedding material to a distance of twelve inches (12") above the pipe. Acceptable initial backfill material is useable excavated soil unless otherwise directed by the Engineer to be select earth backfill, except under paved areas where only select earth backfill shall be accepted.

c. **Final backfill** is the material placed above the initial backfill extending up the final grade (except under paved surfaced where crushed #610 stone shall be placed on the last 12" of the trench). Acceptable final backfill materials are useable excavated soils, unless otherwise directed by the Engineer to be select earth backfill, except under paved areas where only select earth backfill shall be accepted.

### 2. Definition of Acceptable Soils

a. **Usable Soils** shall be defined as having a PI of 25 or less, an organic content of 5 percent or less and a maximum silt content of 65 percent.

b. **Select Earth Backfill** shall be defined as natural soils with a maximum PI of 20, maximum Liquid Limit of 35, a maximum organic content of 5 percent, and a maximum silt content of 65 percent.

3. Backfill excavations as promptly as work permits, but not until completion of the following:
  - a. Acceptance by engineer of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
  - b. Inspection, testing, approval, and recording locations of underground utilities.
  - c. Removal of concrete formwork.
  - d. Removal of shoring and bracing, and filling of voids with satisfactory materials.
  - e. Removal of trash and debris.
  - f. Placement of permanent or temporary horizontal bracing has been completed on horizontally supported walls. Layout and location of bracing shall consider loads of the structure as well as the effects of the soil and groundwater.
4. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface. When existing ground surface has a density less than that specified under "Compaction" for the particular area classification, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.
5. Placement and Compaction: Place backfill and fill materials in layers not more than 9-inches loose depth for material compacted by heavy compaction equipment, and not more than 6-inches loose depth for material compacted by hand-operated tampers.
  - a. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
  - b. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately same elevation in each lift.
  - c. Large compaction equipment shall not be used within 5 feet of walls.

### **3.11 HANDLING AND DISPOSAL OF WATER**

- A. The Contractor shall pump, bail, well point, or otherwise remove any water which may be found or may accumulate in the excavations, and shall perform all work necessary to keep the excavations clear of water while the work is in progress. The cost of removing water by

pumping or otherwise shall be included in the prices bid for various items of the work, it will not be paid for as separate pay item.

- B. Gutters and drains parallel with the trench must be maintained unobstructed. When necessary a proper platform shall be built over them and the excavated dirt placed thereon so as to permit the free passage of all drainage water.

**3.12 CROSSINGS OF CANALS, TRACKS, ETC. - PERMITS, CHARGES, PAYMENTS, ETC.**

- A. No additional compensation will be paid for the construction of any pipe line because of its crossing under or over a drainage canal (either open or covered), a natural or artificial stream or lagoon, a railroad track, or a conduit or any such structure provided the route of the pipe line as bid on has not been changed so as to produce a crossing not to be anticipated by the Bidder. All additional compensation required because of the crossing will be paid for items entering into the construction.
- B. Natural or artificial streams or lagoons, drainage, or navigation canals, gutters or culverts, shall not be unreasonably blocked or obstructed or prevented from carrying their customary drainage or traffic, and shall be replaced by the Contractor in as good condition as they were originally, without charge.
- C. The Owner will secure the permits for crossing railroads, highways, canals, or other waterways or appurtenances, but the Contractor will be held to a strict compliance with the terms under which such permits may be issued.
- D. The Owner will pay all fees and charges of railroad companies for their supervision, their labor, and their material and services required by the railroad company in effecting the various crossing of tracks set up in the Contract.
- E. When any railway tracks are encountered in the course of the work, the Contractor shall take utmost precautions to avoid any unnecessary delays or interruptions of traffic and to avoid injury to the roadbed or tracks of such railroads. The Engineer shall have the right to forbid the use of any methods or details of construction that may be considered unsafe or unwise, but the Contractor shall be held fully responsible for all risks and damages attending such work. The Contractor shall notify the Owner or lessee of any railroad track or switch track, or any street railway track of any contemplated crossing of the track at least forty-eight (48) hours in advance.
- F. The Contractor shall receive no extra compensation for the work done crossing under tracks above the prices bid for the items entering into the construction.

**3.13 LOCATION OF PIPE LINES**

- A. The appropriate location of the proposed lines has been indicated on the Plans. Final location of the pipe lines shall be made by the Engineer at the time of construction.
- B. It shall be the responsibility of the Contractor to locate or cause to be located, all subsurface obstructions within the trench and also underground structures which are adjacent to but outside the trench.

**3.14 SITE GRADING**

- A. Site of all structures, embankments, ditches, streets, and roads shall be graded within the areas and to the elevations as shown on the Plans or as specified. Grading operations shall be so conducted that material shall not be removed or loosened beyond the required limits.

Slopes and ditches shall be neatly trimmed and finished to conform to the slope lines shown on the Plans, or as directed by the Engineer.

**3.15 MAINTENANCE**

- A. All areas of excavation, backfill, embankments, trenches, ditches, roadways and parking area grading shall be maintained by the Contractor in good condition and provide for proper drainage of the work site and adjoining properties at all times until final acceptance. The Engineer may require the use of gravel or other granular material for trench maintenance. All areas of the project will be seeded as directed by the Engineer.

END OF SECTION

## SECTION 02221

### MODIFICATIONS TO EXISTING STRUCTURES, PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals to modify, alter and/or convert existing structures as shown or specified and as required for the installation of new mechanical equipment, piping, structures, and appurtenances.

#### PART 2 - PRODUCTS (NOT USED)

#### PART 3 - EXECUTION

##### 3.01 GENERAL

- A. The Contractor shall cut, repair, excavate, demolish, or otherwise remove parts of the existing structures or appurtenances, as indicated on the Contract Drawings, herein specified, or necessary to permit completion of the work under this Contract. He shall dispose of surplus materials resulting from the above work in an approved manner. The work shall include all necessary cutting and bending of reinforcing steel, structural steel, or miscellaneous metal work found embedded in the existing structures.
- B. The Contractor shall dismantle and remove all existing equipment, piping, and other appurtenances required for the completion of the work. Where called for or required, the Contractor shall cut existing pipelines for the purpose of making connections thereto. Anchor bolts for equipment and structural steel removed shall be cut off one inch below the concrete surface. Surface shall be finished as specified in Division 3.
- C. At the time that a new connection is made to an existing pipeline, additional new piping, extending to and including a new valve, shall be installed.
- D. No existing structure, equipment, or appurtenances shall be shifted, cut, removed, or otherwise altered except with the express approval of and to the extend approved by the Engineer.
- E. When removing materials or portions of existing structures and when making openings in walls and portions, the Contractor shall take all precautions and use all necessary barriers and other protective devices so as not to damage the structures beyond the limits necessary for the new work and not to damage the structures or contents by falling or flying debris. Unless otherwise permitted, line drilling will be required in cutting existing concrete.
- F. Materials and equipment removed in the course of making alterations and additions shall remain the property of the Owner, except that items not salvageable, as determined by the Engineer and the Owner shall become the property of the Contractor to be disposed of by him off the work site at his own place of disposal. Operating equipment shall be thoroughly cleaned, lubricated, and greased for protection during prolonged storage.
- G. All alterations to existing structures shall be done at such time and in such manner as will comply with the approved time schedule. So far as possible before any part of the work is

started all tools, equipment, and materials shall be assembled and made ready so that the work can be completed without delay.

- H. All workmanship and new materials involved in constructing the alterations shall conform to the General Specifications for the classes of work insofar as such specifications are applicable.
- I. All cutting of existing concrete or other materials to provide suitable bonding to new work shall be done in a manner to meet the requirements of the respective section of these Specifications covering the new work. When not covered, the work shall be carried on in the manner and to the extent directed by the Engineer.
- J. Surface of seals visible in the completed work shall be made to match as nearly as possible the adjacent surfaces.
- K. Non-shrink grout shall be used for setting wall castings, sleeves, leveling pump bases, doweling anchors into existing concrete and elsewhere as shown.
- L. Where necessary or required for the purpose of making connections, the Contractor shall cut existing pipelines in a manner to provide an approved joint. Where required, he shall weld beads, flanges, or provide Dresser Couplings, all as required.
- M. The Contractor shall provide flumes, hoses, piping, and other related items to divert or provide suitable plugs, bulkheads, or other means to hold back the flow of wastewater, water, or other liquids, all as required in the performance of the work under this Contract.
- N. Blasting will not be permitted.

### **3.02 CLEANING EXISTING STRUCTURES**

- A. After dewatering by Contractor and before commencing work on any structures, the Contractor shall remove and dispose of the debris and other solids remaining in such structures.

### **3.03 CONNECTING TO EXISTING PIPING AND EQUIPMENT**

- A. The Contractor shall verify exact location, material, alignment, joint, etc. of existing piping and equipment prior to making the connections called out in the Drawings. The verifications shall be performed with adequate time to correct any potential alignment or other problems prior to the actual time of connection.
- B. The Contractor shall dismantle and remove all existing equipment, piping and other appurtenances required for the completion of the work. Where called for or required, Contractor shall cut existing pipelines for the purpose of making connections thereto. Anchor bolts for equipment and structural steel removed shall be cut off one inch below the concrete surface. Surface shall be finished as specified in Division 3.
- C. At the time that a new connection is made to an existing pipeline, additional new piping, extending to and including the most convenient new valve, shall be installed.

END OF SECTION

## SECTION 02230

### CLEARING AND GRUBBING

#### PART 1 -- GENERAL

##### 1.01 DESCRIPTION OF WORK

- A. The work covered under this section includes clearing and grubbing, removal of all stumps, limbs, roots, and tree debris as necessary to construct the facilities shown on the drawings or as specified herein.

##### 1.02 PROTECTION OF ADJACENT SURFACES

- A. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation designated by the CITY to remain in place against unnecessary cutting, breaking or skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line. Provide temporary guards to protect trees and vegetation to be left standing.
- B. Construction Limits: All construction limits shall be strictly adhered to during construction. The preservation and protection of wetlands shall be strictly followed, including restoration of the construction area and sedimentation control measures during construction.
- C. Sedimentation Control Measures: Sedimentation control measures (bales, screens, etc.) shall be placed at the construction limits prior to any physical work activities. These control measures shall be carefully maintained during initial clearing activities and throughout the duration of construction and startup activities.

#### PART 2 - PRODUCTS (Not Used)

#### PART 3 - EXECUTION

##### 3.01 CLEARING

- A. Clearing shall consist of the removal of all natural growth, trees, down timber, logs, stumps, branches, and any other objects deemed detrimental or in the way of construction. Over-cutting and over-cleaning shall be the sole responsibility of the CONTRACTOR and all costs to correct over-cutting and over-clearing shall be borne by CONTRACTOR.
- B. Protect existing trees and vegetation and other growth which does not interfere with construction for use as part of the landscape treatment and buffer zone. Do not damage root systems.
- C. Maintain all bench marks, monuments, and other reference points. If disturbed or destroyed, restore as directed by ENGINEER.
- D. Construction Limits: The project construction limits must be clearly marked and approved for all impacted areas before any physical work is done on this site. This work site is environmentally sensitive and all measures must be taken to eliminate construction encroachment outside predetermined boundaries. Marking system (stakes, flags, etc.) shall

### **3.02 GRUBBING**

- A. Grubbing shall consist of the removal and disposal of stumps, roots, logs, and other organic metallic debris not suitable for foundation purposes, below the original surface level of the ground. Depressions made by grubbing shall be filled with suitable material and compacted as specified in Section 02330, Embankment and Backfilling, so that the surface conforms with the adjacent ground surface. Earth material of topsoil quality shall be stockpiled for placement on exposed embankments or other designated surfaces.

### **3.03 STRUCTURAL CONSTRUCTION**

- A. Remove all vegetation, topsoil, debris, organic material, and otherwise objectionable materials which are not suitable for use as fill for support of structural loads or slabs from within the designated area. Remove all roots and matted root systems. Extended clearing and grubbing at least 10 feet beyond structure lines or as shown on drawing. Unless further excavation is required, fill all depressions made by grubbing and compact to 95% of the modified Proctor (ASTM D 1557) maximum dry density before placing subsequent embankment material.

### **3.04 DISPOSAL OF CLEARED AND GRUBBED MATERIALS**

- A. Remove from the construction area all logs, stumps, roots, branches, rotten wood, branches, and other refuse which are the products of clearing and grubbing operations. Remove the products of clearing and grubbing operations from the construction area, and dispose of the materials in approved waste areas. Disposal of cleared and grubbed material in adjacent streams, drainage channels, or on the banks thereof, other than the areas designated, will not be allowed.
- B. Abandoned pipelines, structures, existing fences, or other improvements encountered within the limits of the work, shall become the property of the CONTRACTOR and shall be removed from the site and disposed of in areas arranged for, by and at the expense of the CONTRACTOR.

END OF SECTION

## SECTION 02315

### EXCAVATION, BACKFILLING, AND COMPACTION

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

The CONTRACTOR shall furnish all labor, materials, equipment, and incidentals necessary to perform all excavation, backfill, grading, and wall protection required to complete the work shown on the Drawings and specified herein. The work shall include, but not necessarily be limited to, excavation, filling and grading under and around precast and cast in place structures to attain the subgrades and grades indicated on the Drawings, trenching operations to install pipe, manholes, vaults, electrical duct conduit, and other structures, including all backfilling, grading, disposal of surplus and unsuitable materials, and all related work such as sheeting, bracing and water handling.

##### 1.02 QUALITY ASSURANCE

- A. The CONTRACTOR shall perform excavation work in compliance with applicable requirement codes and standards of governing authorities having jurisdiction.
- B. Follow the requirements of Louisiana Standard Specifications for Roads and Bridges, latest edition, where they are not superceded by this specification.

##### 1.03 JOB CONDITIONS

- A. The CONTRACTOR shall examine the site and review all available information prior to submitting his bid, taking into consideration all conditions that may affect his work. The OWNER and ENGINEER will not assume responsibility for subsurface conditions.
- B. Existing Utilities: Locate existing underground utilities in the areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.
  - 1. The location of pipes, ducts, or underground structures is not warranted to be exact, nor is it warranted that all underground pipes, ducts, or structures are shown. The CONTRACTOR shall contact Louisiana One Call and any other appropriate utility company for location of their underground service a minimum of 48 hours prior to beginning construction in each area. It is the CONTRACTOR's responsibility to verify and locate all utilities in the field at no cost to the OWNER.
  - 2. Cooperate with OWNER and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility OWNER or make the site available to the utility OWNER for his work crews to make the necessary repairs at no additional cost to the OWNER.
  - 3. Demolish and completely remove from site any existing underground utilities indicated on the Drawings to be removed.
  - 4. Examine the areas and conditions under which excavating, filling, and grading are to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected.

5. Examine existing grades prior to commencement of work and report to ENGINEER if elevations of existing subgrade vary from elevations shown on Drawings.
6. If it is determined that existing utilities are to be relocated by OWNER of those utilities, the CONTRACTOR shall be responsible for that coordination. The CONTRACTOR shall notify the utility OWNER in sufficient time as to avoid any delays to the CONTRACTOR's schedule. The CONTRACTOR is solely responsible for this coordination, and no delay or extension of time will be allowed as a result of or the cause of inaction by the CONTRACTOR or utility OWNER.

#### **1.04 PROTECTION**

- A. Slope sides of excavations to comply with OSHA regulation and any applicable local codes and ordinances. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
- B. Sheeting and Bracing in Excavations:
  1. In connection with construction of below grade structures and piping, the CONTRACTOR shall construct, brace, and maintain cofferdams consisting of sheeting and bracing as required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect adjacent structures, existing yard piping and/or foundation material from disturbance, undermining, or other damage. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed they shall be immediately filled and rammed.
  2. Trench sheeting for pipes is not to be withdrawn when driven below mid-diameter of any pipe, and no wood sheeting shall be cut off at a level lower than 1 foot above the top of any pipe unless otherwise directed by the ENGINEER. If during the progress of the work the ENGINEER decides that additional wood sheeting should be left in place, he may direct the CONTRACTOR in writing and the CONTRACTOR shall be reimbursed in accordance with the Bid Documents. If steel sheeting is used for trench sheeting, removal shall be as specified above, unless written approval is given for an alternate method of removal.
  3. All sheeting and bracing not left in place shall be carefully removed in such a manner as not to endanger the construction or other structures, existing utilities, existing piping, or personnel and property. Unless otherwise approved or indicated on the Drawings or in the Specifications, all sheeting and bracing may be carefully removed after completion of the substructure. Care shall be taken not to disturb or otherwise injure any finished masonry. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, by hydraulic compaction or otherwise as may be directed.
  4. The right of the ENGINEER to order sheeting and bracing left in place shall not be construed as creating any obligation on his part to issue such orders, and his failure to exercise his right to do so shall not relieve the CONTRACTOR from liability for damages to persons or property occurring from or on the work occasioned by negligence or other cause, growing out of a failure on the part of the CONTRACTOR to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.

5. The CONTRACTOR may construct the cofferdams and sheeting outside the neat lines of the foundation for pipes and manholes, unless indicated otherwise, to the extent he deems it desirable for his method of operation. Sheeting shall be plumb and securely braced and tied in position. Sheeting, bracing, and cofferdams shall be adequate to withstand all pressures to which the existing or new structure will be subjected. Pumping, bracing, and other work within the cofferdam shall be done in a manner to avoid disturbing any completed construction or personnel injury. Any movement or bulging which may occur shall be corrected by the CONTRACTOR so as to provide the necessary clearances and dimensions.
6. The CONTRACTOR is fully responsible for any sheeting, bracing and cofferdams that are required to perform any of the Work under the contract. As part of his submittal of schedules and other data indicating his planning of the Work, the CONTRACTOR shall provide drawings of the planned supporting system, not for review by the ENGINEER but for informational purposes only and use by the ENGINEER in tracking the progress of the Work. Such drawings shall be of sufficient detail to adequately disclose the method of operation that the CONTRACTOR plans to use for each of the various stages of construction. The Work shall not be started until such drawings are received.
7. Establish requirements for trench shoring and bracing to comply with OSHA regulations and any applicable local codes and ordinances.
8. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.
9. As an alternate to sheeting, the CONTRACTOR is authorized to utilize a mechanical trench box, the size and construction of which shall be submitted to the ENGINEER for review.

C. Dewatering, Drainage and Flotation:

1. The CONTRACTOR shall furnish all materials and equipment and perform all work required to install and maintain the drainage systems he proposes for handling groundwater and surface water encountered during construction of structures, pipelines, and compacted fills.
2. The CONTRACTOR shall construct and place all pipelines, concrete work, structural fill, bedding, and base course, in-the-dry. In addition, the CONTRACTOR shall make the final 24-inches of excavation for this work in-the-dry, and not until the water level is a minimum of twelve (12) inches below proposed bottom of excavation.
3. The CONTRACTOR shall, at all times during construction, provide and maintain proper equipment and facilities to promptly remove and dispose of all water entering excavations and keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition, until the fill, structure, or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.
4. Dewatering shall at all times be conducted in such a manner as to preserve the natural undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.
5. Wellpoints may be required for predrainage of the soils prior to final excavation for

deeper below ground structures or piping, and for maintaining the lowered groundwater level, until construction has been completed to such an extent that the structure, pipeline, or fill will not be floated or otherwise damaged. Wellpoints shall be surrounded by suitable filter sand and no fines shall be removed by pumping. Pumping from wellpoints shall be continuous and standby pumps shall be provided. Correction of any damages caused to the structures being constructed or to any existing structures due to failure of the dewatering equipment shall be the Contractor's full responsibility.

6. If requested by the ENGINEER, the CONTRACTOR's proposed method of dewatering shall include a minimum of two (2) 4-inch, Schedule 40, operating groundwater observation wells at each structure to be used to determine the water level during construction of the structure. Locations of the observations wells shall be at structures and along pipelines as approved by the ENGINEER prior to their installation.
7. Prior to excavation, the CONTRACTOR shall submit his proposed method of dewatering and maintaining dry conditions to the ENGINEER. The CONTRACTOR shall be responsible for the satisfactory performance of the system. The CONTRACTOR shall be responsible for correcting any disturbance or natural bearing of soils or damage to structures caused by an inadequate dewatering system or by interruption of the continuous operation of the system as specified.
8. As part of the submittal of his dewatering system, the CONTRACTOR may be required to demonstrate the adequacy of the proposed system and wellpoint filter sand by means of a test installation. Discharge water shall be clear, with no visible soil particles in a one quart sample.
9. During backfilling and construction, water levels shall be measured in observation wells located as directed by the ENGINEER.
10. Continuous pumping will be required as long as water levels are required to be below natural levels.
11. While dewatering for new construction in the vicinity of the existing structures, depletion of the groundwater level underneath these existing structures may cause settlement. To avoid this settlement, the groundwater level under these structures shall be maintained by appropriate methods of construction.

D. Protection of Persons and Property:

1. Barricade open excavations occurring as part of this work and post with warning lights in accordance with local requirements. Operate warning lights as recommended by authorities having jurisdiction.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

## **PART 2 - PRODUCTS**

### **2.01 SOIL MATERIALS**

#### **A. Definitions:**

1. Select Material - Select fill shall conform to Louisiana DOTD designation TR 423 Classes A-I-a, A-I-b, A-3, A-2-4, A-2-6, A-4 or A-6 having a maximum liquid limit of 35, a maximum plasticity index of 15, a maximum organic content of 2%, and a maximum silt content of 60%. This material is referred to as "selected soils" in the Louisiana DOTD Specifications. Based on an approved geotechnical engineering report, particularly A-6 soils, a higher elasticity index of up to 25 will be considered. These materials can be used for backfill in over-excavated areas, for backfill from 12 inches above the top of the pipe to the top of the subgrade and as structural fill/backfill.
2. Bedding Materials - Bedding materials shall conform to Louisiana DOTD Specifications 1003.08, however, shell will not be allowed as bedding material. These materials shall be used for placement under the pipes in the trench and as a bedding material as defined on the Drawings and shall have a minimum thickness of 6 inches; these materials shall also be used for backfill in over-excavated trench areas and may be used for backfill from above the top of the pipe to the top of subgrade and as structural fill/backfill.
3. Stabilization Materials - Stabilization materials shall be a blended, manufactured aggregate conforming to the requirements for concrete aggregate as stated in ASTM C33 except for gradation which shall be between sizes 78 and 57 (inclusive) as specified in ASTM D448.
4. Granular Materials Granular materials shall conform to Louisiana DOTD Specifications 1003.07. These materials shall be used for backfilling around the pipes from the bedding material up to at least 12 inches above the top of the pipes or to subgrade and in confined areas around structures; these materials may also be used as structural fill/backfill.
5. Usable Excavated Soils - Usable excavated soils, referred to as "usable soils" in Louisiana DOTD specifications, shall conform to Classes A-I-a, A-I-b, A-2-4, A-2-5, A-2-6, A-2-7, A-3, A-4, A-5, A-6, A-7-5, and/or A-7-6, except that soils in Classes A-5, A-6, A-7-5 and A-7-6 which are considered unusable by the ENGINEER and any soil with a plasticity index exceeding 60 will not be accepted in accordance with paragraph 203.06 in the Louisiana DOTD specifications. These materials can be used for backfill from 12 inches above the top of the pipe up to the surface in unimproved areas.
6. Soil classifications used herein are to be in accordance with the AASHTO table for "Classification of Soils and Soil-Aggregate Mixtures (With Suggested Subgroups )" as shown on LADOTD designation TR423.

#### **B. General:**

1. Materials for use as fill and backfill shall be as described above. The CONTRACTOR shall notify the ENGINEER of the source of each material and shall furnish to the ENGINEER for testing and approval, a representative sample of each material

weighing approximately 50 pounds, at least ten (10) calendar days prior to the date of anticipated use of such material.

2. Additional materials shall be furnished as required from off-site sources and hauled to the site.
3. Disposal of unsuitable material is specified in this Section, see Paragraph 3.07.

C. Structural Fill:

1. Structural fill shall consist of select fill and shall be used below spread footing foundations, slab-on-grade floors, and other structures and as backfill within three (3) feet of the below grade portions of structures, except that, when stabilization layers of courses are shown on the Drawings, stabilization material shall be placed and compacted over the structural fill material in accordance with the requirements for the structural fill.
2. Material falling within the above specification, encountered during the excavation, may be stored in segregated stockpiles for reuse. All material which, in the opinion of the ENGINEER, is not suitable for reuse shall be spoiled as specified herein for disposal of unsuitable materials.

## **PART 3 - EXECUTION**

### **3.01 EXCAVATION**

A. General:

Excavation consists of removal and disposal of material encountered when establishing required grade elevations and in accordance with the Drawings.

B. Excavation Classifications:

The following classifications of excavation will be made when unclassified excavation is encountered in the work. Do not perform such work until material to be excavated has been cross-sectioned and classified by ENGINEER or specialized geotechnical consultant.

1. Authorized earth excavation includes removal and disposal of pavements and other obstructions visible on ground surface, underground structures and utilities indicated in soil boring data to be removed, and other materials encountered that are not classified but are to be removed.
2. Unauthorized excavation consists of removal of material beyond the limits needed to establish required grade and subgrade elevations without specific direction of ENGINEER. Unauthorized excavation, as well as remedial work directed by the ENGINEER, shall be at no additional expense to the OWNER. Backfill and compact unauthorized excavations as specified for authorized excavations, except that bedding material as specified above shall be used for backfill under footings, foundations bases, or retaining walls unless otherwise directed by the ENGINEER. The ENGINEER may approve the use of lean concrete fill, reinforced or unreinforced as required by the site conditions and as required by the ENGINEER, if soil conditions allow the extra loading.

C. Additional Structural Excavation:

When excavation has reached required subgrade elevations, notify the ENGINEER who will make an inspection of conditions or contact a geotechnical consultant to do so.

1. If unsuitable, unsatisfactory bearing materials are encountered at the required subgrade elevation, carry excavation deeper and replace the excavated material as directed by the ENGINEER.
2. Removal of unsuitable material and its replacement as directed beyond the authorized limits will be paid on the basis of contract conditions relative to changes in the Work as provided in the General Conditions.

D. Excavation for Structures:

Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 feet, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete framework, installation of services, other construction, and for inspection, or as shown on the Drawings.

1. In excavation for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive any required stabilization material or concrete.
2. In the event that excavations subsequent to the placement of the fill are performed by the CONTRACTOR to install piping, conduit, or other appurtenances, any fill placed above the level of the planned excavation shall be fully compacted in accordance with the requirements of this specification prior to beginning the excavation.

**3.02 FILL PLACEMENT**

A. General:

1. Material placed in fill areas under and around structures or within the pipe trench limits shall be deposited within the lines and to the grades shown on the Drawings or as directed by the ENGINEER, making due allowance for settlement of the material. Fill shall be placed only on properly prepared surfaces which have been inspected and approved by the ENGINEER. If sufficient fill material is not available from excavation on site, the CONTRACTOR shall provide borrows as may be required.
2. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.
3. Fill shall be brought up in substantially level lifts throughout the site, starting in the deepest portion of the fill. The entire surface of the work shall be maintained free from ruts, and in such condition that construction equipment can readily travel over any section. Fill shall not be placed against concrete structures until they have attained sufficient strength.

4. Fill shall be dumped and spread in layers by a bulldozer or other approved method. During the process of dumping and spreading, all roots, debris, and other objectionable material shall be removed from the fill areas, and the CONTRACTOR shall assign a sufficient number of men to this work to insure satisfactory compliance with these requirements.
5. If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layer, it shall be loosened by harrowing or by an other approved method before the succeeding layer is placed.
6. All fill materials shall be placed and compacted in dry conditions. The CONTRACTOR shall dewater excavated areas and is required to perform the work in such manner as to preserve the undisturbed state of the natural inorganic soils.

### 3.03 COMPACTION

#### A. General:

1. CONTRACTOR shall control soil compaction during construction and obtain the minimum required percentage of the total maximum dry densities as specified herein and as shown on the structural or civil drawings. The CONTRACTOR shall maintain the backfill for a period of one (1) year after final acceptance and shall restore any backfill that fails and repair any pavement or other structures which may be damaged as a result of backfill failure. It shall be the CONTRACTOR's responsibility to notify the ENGINEER in writing that compaction tests of either the nuclear gauge, sand-cone, or other method as required can be performed.
  2. The frequency for density tests will be a minimum of one (1) test per lift per 1,000 linear feet under pavements, within street and highway rights-of-way, and under building slabs and one (1) randomly selected test per 2,500 linear feet for open areas (testing of each lift in open areas is not required). If the density tests indicate that the work does not meet specified density requirements, the ENGINEER may require additional density tests to determine the extent of the deficient Work. The CONTRACTOR will not be allowed an extension of contract time as a result of any density testing.
  3. It is the CONTRACTOR's responsibility to provide equipment and labor as needed to achieve the required compaction as specified herein. Should the rates of compaction fall below the values specified herein, the ENGINEER has the right to instruct the CONTRACTOR to alter his work to assure that the required backfill quality is consistently achieved. Any decision by the ENGINEER to forgo such instructions shall in no way relieve the CONTRACTOR of his responsibility to provide backfill of the specified quality.
- B. Percentage of Maximum Density Requirements:
1. Compact soil to not less than the following percentages of maximum dry density as determined in accordance with AASHTO T-180 (ASTM D1557) or seventy-five percent (75%) relative density as determined by ASTM D2049 as applicable.
    - a. Building Slabs: Compact top 12-inches of subgrade and each layer of backfill or fill material to a minimum of ninety-five percent (95%) of the maximum dry density.

b. Compaction of Backfill near Highways or Streets: Where the trench limit falls under the roadway pavement or within two (2) feet of the edge of the pavement, requiring granular backfill and in other areas designated on the plans where future roadways are to be constructed, backfill for the balance of the trench above a point one (1) foot above the top of the pipe shall be placed in layers of not more than 6-inch compacted thickness and compacted with mechanical tampers or by any satisfactory method or methods that will obtain the density hereinafter specified. The density of compacted material in each layer of backfill shall not be less than ninety-five percent (95%) of the maximum dry density.

c. Walkways: Compact top 6-inches of subgrade to a minimum of ninety-five percent (95%) of the maximum dry density.

d. Pavements and Steps: Compact top 24-inches of subgrade to a minimum of ninety-five percent (95%) of the maximum dry density.

e. Bedding Material: Shall be compacted to a minimum of ninety-two percent (92%) of the maximum dry density.

f. Compaction of all other Backfill: Where a trench is in open ground and the backfill is not influenced by the loading conditions as described in the other listed backfilling requirements, the balance of the trench above a point one (1) foot above the top of the pipe may be filled and compacted in layers of not more than 12 inches to obtain a minimum density of the measured in-situ condition prior to excavation. If the CONTRACTOR has to dry the excavated soil to a moisture content below the insitu moisture content in order to achieve the required rate of compaction, he shall do so at no additional expense to the OWNER. The final surface shall be left in a condition equal to that originally found at the start of the work.

C. Moisture Control: Condition subgrade or layer material correcting moisture content:

1. When the material is too dry to be compacted efficiently, the CONTRACTOR shall uniformly apply water to surface of subgrade or layer of soil material and thoroughly mix the soil to achieve a moisture content near the optimum level to facilitate compaction.

2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

3. Soil material that has been removed because it is too wet to permit compaction but is otherwise satisfactory may be stockpiled or spread and allowed to dry. The CONTRACTOR may assist the drying process by discing, harrowing or pulverizing to reduce the moisture content to a satisfactory value.

D. Structural fill and base course in open areas shall be placed in layers not to exceed the thicknesses specified above. Each layer shall be compacted to the minimum dry density as stated herein. Incidental compaction due to traffic by construction equipment will not be credited toward the required minimum compaction as required for any material.

E. All other fill shall be placed and compacted in a manner similar to that described above for structural fill except that dike or levee fill required below water level in peat excavation areas, may be placed as one lift, in-the-wet, to an elevation one (1) foot above the water

level at the time of filling.

- F. Areas adjacent to structures and other confined areas inaccessible to roller type equipment shall be compacted with approved hand guided mechanical compaction equipment. The CONTRACTOR shall also conform to additional backfilling requirements at structures as specified elsewhere in these specifications. Compaction of the fill by such means shall be to the same degree of compaction as obtained by roller type equipment and the ENGINEER may make the necessary tests to determine the amount of compactive effort necessary to obtain compaction. Unless such tests indicate that modifications may be made, the fill compacted by mechanical compactors shall be placed in 6-inch layers and thoroughly tamped over the entire surface. Compaction equipment is subject to approval by the ENGINEER.

### **3.04 PIPE EXCAVATION AND BACKFILLING**

- A. Excavation for all trenches required for the installation of pipes and electrical ducts shall be made to the depths indicated on the Drawings and in such manner and to such widths as will give suitable room for laying the pipe or installing the ducts within the trenches, for bracing and supporting and for pumping and drainage facilities. The bottom of the excavations shall be firm and dry, and in all respects acceptable to the ENGINEER.
- B. Where pipes or ducts are to be laid in bedding or encased in concrete, the trench may be excavated by machinery to or just below the designated subgrade provided that the material remaining in the bottom of the trench is no more than slightly disturbed.
- C. Where the pipes or ducts are to be laid directly on the trench bottom, the lower part of the trenches shall be excavated to grade by machinery. The material being excavated shall be done in such a manner that will give a flat bottom true to grade so that pipe or duct can be evenly supported on undisturbed material. Bell holes shall be made as required.
- D. Backfilling over pipes shall begin as soon as practicable after the pipe has been laid, jointed, and inspected and the trench filled with suitable compacted bedding material up to a level even with six-tenths of the outside diameter of the pipe or as otherwise required on the Drawings.
- E. Backfilling over ducts shall begin not less than three (3) days after placing concrete encasement.
- F. All backfilling shall be prosecuted expeditiously and as detailed on the Drawings and specified herein.
- G. Any space remaining between the pipe and sides of the trench shall be packed full by hand shovel with bedding material and thoroughly compacted with a tamper. Material shall be placed in lifts no greater than 6-inches in thickness, up to a level even with six-tenths of the outside diameter of the pipe.
- H. The backfilling shall be carried up evenly on both sides of the pipe with at least one man tamping for each man shoveling material into the trench.
- I. Granular material shall then be placed and compacted from the top of the bedding material to a minimum depth of one (1) foot above the top of the pipe.
- J. The remainder of the trench above the compacted granular material as just described above shall be filled and thoroughly compacted to the required density by rolling, ramming, or

puddling to prevent subsequent settling.

K. The width of the trench at the top of the pipe for water pipe installation shall not exceed the external diameter of the barrel of the pipe plus nine inches (9") on each side.

Trenches for water lines shall be of a depth to provide a thirty-inch (30") minimum cover over the top of the pipe.

Where sanitary sewer, storm sewer, or other subsurface utilities are encountered in trenching for water lines, it will be permitted to lay pipe above the obstruction if a minimum cover of twenty-four inches (24") can be obtained while providing a cushion between the bottom of the pipe and the top of the obstruction of at least six inches (6") in thickness. Otherwise, the obstruction will have to be by-passed or tunneled under. Approval must be sought by the Department of Health in these situations.

### **3.05 BACKFILLING AROUND STRUCTURES**

A. Fill shall be placed in layers having a maximum thickness of eight (8) inches in loose state and shall be compacted sufficiently to prevent settlement. If compaction is by rolling or ramming, material shall be wet down as required. Where material can be suitably compacted by flooding, the CONTRACTOR may use this method.

B. The final finished surface of filled areas shall be graded to smooth true lines, strictly conforming to grades indicated on the plans, and no soft spots or uncompacted areas will be allowed in the work.

C. Temporary bracing shall be provided as required during construction of all structures to protect partially completed structures against all construction loads, hydraulic pressure, and earth pressure. The bracing shall be capable of resisting all loads applied to the walls as a result of backfilling.

### **3.06 GRADING**

A. General: Uniformly grade areas within limits of grading under this Section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades as are required or shown on the Drawings.

B. Compaction: After grading, compact subgrade surfaces to the depth and percentage of maximum dry density for each area classification.

C. Grading shall be performed at such places as are indicated on the Drawings, to the lines, grades, and elevations shown or as directed by the ENGINEER and shall be made in such a manner that the requirements for formation of embankments can be followed. All unacceptable material encountered, of whatever nature within the limits indicated, shall be removed and disposed of in accordance with Paragraph 3.07. During the process of excavation, the grade shall be maintained in such condition that it will be well drained at all times. When directed, temporary drains and drainage ditches shall be installed to intercept or divert surface water which may affect the prosecution or condition of the work.

D. If at the time of excavation it is not possible to place any material in its proper section of the permanent structure, it shall be stockpiled in approved areas for later

use. No additional cost is allowed for the stockpiling or double handling of excavated material.

- E. The right is reserved to make adjustments or revisions in lines or grades if found necessary as the work progresses, in order to obtain satisfactory construction.
- F. All fill slopes shall be uniformly dressed to the slope, cross section and alignment shown on the Drawings, or as directed by the ENGINEER.
- G. In cuts, all loose material on the back slopes shall be barred loose or otherwise removed to line or finished grade of slope. All cut and fill slopes shall be uniformly dressed to the slope, cross section and alignment shown on the Drawings or as directed by the ENGINEER.
- H. No grading is to be done in areas where there are existing pipelines that may be uncovered or damaged until such lines, which must be maintained, are relocated, or where lines are to be abandoned, all required valves are closed and drains plugged at manholes.

### **3.07 DISPOSAL OF UNSUITABLE AND SURPLUS MATERIAL**

- A. Unsuitable and surplus excavated materials, unless specified otherwise below, and pavement shall become the property of the CONTRACTOR and shall be removed and disposed of by the CONTRACTOR off the project site.
- B. Usable, excavated material may be used for fill or backfill if it meets the specifications and is approved by the ENGINEER. Excavated material so approved may be neatly stockpiled at the site where designated by the ENGINEER provided there is an area available that will not interfere with the OWNER's access nor inconvenience traffic or adjoining property OWNERS.
- C. Surplus suitable excavated material may be used to fill depressions as the ENGINEER may direct.
- D. In instances where the OWNER can use surplus excavated materials and so desires to retain possession of the material, the CONTRACTOR will be directed to stockpile the material on site.

### **3.08 SPECIAL FOUNDATIONS**

- A. The CONTRACTOR shall furnish and install a special foundation for sewer pipe, water pipe, and manholes or other pipes as shown on the Drawings.
- B. All piping shall be installed on the special bedding foundation and the prices for laying pipe shall include this cost. This bedding shall be as previously specified and placed in the trench to the proposed elevation prior to any pipe laying. This bedding shall not be used under any circumstances as a drain for groundwater. The CONTRACTOR shall take all precautions necessary to maintain the bedding in a compacted state and to prevent washing erosion or loosening of this bed.

### **3.09 MAINTENANCE**

- A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep areas free of trash and debris and repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape and compact to required density prior to further construction.

END OF SECTION

## SECTION 02510

### WATER PIPING, MATERIALS AND STRUCTURES

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION OF WORK

- A. The work covered by this section consists of all labor, materials, equipment, and incidentals necessary to completely furnish, install, test, and clean all water piping, valves, fittings, hydrants, services and accessories indicated on the drawings and/or specified herein including all appurtenances necessary to make the water system complete and fully operational.

##### 1.02 REFERENCED STANDARDS

- A. American Petroleum Institute (API), 5L Specification for Line Pipe.
- B. American Railroad Engineering Association Manual for Railroad Engineering.
- C. American Standards Association
- D.
1. ASA B16.1, American National Standard for Cast Iron Flanged Fittings and Flanges.
  - American Society of Testing Materials
  1. ASTM A120, Standard Specification for Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses.
  2. ASTM A338, Standard Specification for Malleable Iron Flanges, Pipe Fittings and Valve Parts for Railroad, Marine, and other Heavy Duty Service at Temperatures up to 650 Degrees F.
  3. ASTM B88, Standard Specification for Seamless Copper Water Tube.
  4. ASTM C127, Standard Test for Thermal Conductivity of materials by Means of the Guarded Hot Plate.
  5. ASTM D256, Standard Test for Impact Resistance of Plastics and Electrical Insulating Materials.
  6. ASTM D635, Standard Test for Flammability of Self-Supporting Plastics.
  7. ASTM D638, Standard Test for Tensile Properties of Plastic.
  8. ASTM D648, Standard Test Deflection Temperature of Plastics under Flexural Load.
  9. ASTM D696, Standard Test for Coefficient of Linear Thermal Expansion of Plastics.
  10. ASTM D746, Standard Test of Brittleness Temperature of Plastics by Means of a Cantilever Beam.

11. ASTM D792, Standard Test for Specific Gravity and Density of Plastics by Displacement.
  12. ASTM D1238, Measuring Flow Rates of Thermoplastics by Extrusion Platometer.
  13. ASTM D1248, Standard Specification for Polyethylene Plastic Molding and Extrusion Materials.
  14. ASTM D1525, Standard Test for Vicat Softening Point of Plastics.
  15. ASTM D1693, Standard Test for Environmental Stress Cracking of Ethylene Plastic.
  16. ASTM D1784, Standard Specification for Rigid Poly (Vinyl Chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds.
  17. ASTM D2240, Standard Test for Indentation Hardness of Rubber and Plastics by Means of a Durometer.
  18. ASTM D2241, Standard Specification for Poly (Vinyl Chloride)(CPVC) Plastic Pipe (SDR-PR).
  19. ASTM D2837, Obtaining Hydrostatic Design Basis for ThermoPlastic Pipe Materials.
- E. American Water Works Association
1. AWWA C101, American National Standard for Thickness Design of Cast Iron Pipe (ASA 21.1).
  2. AWWA C104, American National Standard for Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water (ASA 21.4).
  3. AWWA C106, American National Standard for Gray-Iron Pipe Centrifugally Cast in Metal Molds, for Water and Other Liquids (ASA 21.6).
  4. AWWA C108, American National Standard for Cast Iron Pipe Centrifugally Cast in Sand-lined Molds, for Water or Other Liquids (ASA 21.8).
  5. AWWA C110, American National Standard for Gray-Iron and Ductile Iron Fittings 3" through 48", for Water and Other Liquids (ASA A21.10)
  6. AWWA C111, American National Standard for Rubber Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings (ASA A21.11).
  7. AWWA C150, American National Standard for the Thickness Design of Ductile Iron Pipe (ASA A21.50).
  8. AWWA C151, American National Standard for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-lined Molds, for Water or Other Liquids (ASA A21.51).
  9. AWWA C153, Short Body Full Flow Ductile Iron Fittings 3" through 24" for Water and Other Liquids (AAS A21.10).
  10. AWWA C500, Standard for Gate Valves, 3" through 48" NPS, for Water and Sewage

Systems.

11. AWWA C502, Standard for Dry-Barrel Fire Hydrants.
  12. AWWA C504, Standard for Rubber-seated Butterfly Valves.
  13. AWWA C600, American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances.
  14. AWWA C601, Standard for Disinfecting Water Mains.
  15. AWWA C700, Standard for Cold-water Meters - Displacement Type.
  16. AWWA C800, Standard for Threads for Underground Service Line Fittings with Appendix on Collected Standards for Service Line Material.
  17. AWWA C900, Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4" through 12", for Water.
  18. AWWA C901, Standard for Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, 2" through 3", for Water.
  19. AWWA C905, Standard for Polyvinyl Chloride (PVC) Pressure Pipe 14" through 36".
- F. National Fire Protection Association
- NFPA No. 194, Standard for Screw Threads and Gasket for Fire Hose Couplings.
- G. Louisiana Standard Specification for Roads and Bridges
- H. American National Standards/National Sanitation Foundation Standard for Drinking Water System Components (ANSI/NSF 61)

**1.03 GENERAL**

- A. Contract Drawings: The contract drawings indicate the general design, arrangement and extent of the piping system. It is desired that the indicated positions be followed as closely as possible. Do not scale drawings for roughing in measurements nor use as shop drawings. Prepare shop drawings per Paragraph 1.04, Submittals, herein. The exact location of the various items is subject to construction, and the actual materials and equipment furnished by the Contractor. The Contractor shall verify the location of all items furnished, installed, or connected to by him. Coordinate work with other specification divisions.
1. Piping systems shall be located from dimensions given on drawings or all implied locations shall be determined after field measurements have been taken.
  2. Should interferences or discrepancies prevent the installation of any part of the work, the Engineer shall be notified and he will determine the steps necessary to complete the true development of the intent of the drawings and specifications.
- B. Materials
1. General

- a. Unless otherwise specified or shown, pipe, fittings, and general purpose valves for each piping system shall be as shown in the drawings.
- b. If there are any conflicts in the specifications, use the stronger pipe class. Contractor shall submit calculations with shop drawings where specified.
- c. All piping shall have a minimum cover of 30 inches unless otherwise shown on the drawings.

#### **1.04 SUBMITTALS**

- A. General: Shop drawings and product data shall be submitted in accordance with the General Requirements.
- B. Product data shall include all manufacturer's literature, catalog cuts and other descriptive literature to fully substantiate the conformance with specifications of materials and equipment submitted. Mark product-data to indicate exactly those items that are to be provided and cross out unrelated or nonapplicable items.
- C. Shop drawings shall include Contractor prepared plans, sections and details fully dimensioned showing all piping systems and appurtenances to be installed and with system designations as indicated herein. Show all equipment connection details.

#### **1.05 JOB CONDITIONS**

- A. Schedule Of Work: Arrange work to comply with schedule of construction. In scheduling, anticipate means of installing equipment through available openings in structure.
- B. Coordination Of Work: The Contractor shall coordinate all trades whose work is adjacent, in order to avoid field interference and delay in execution of the work of all trades. Furnish detailed advance information regarding all requirements related to work by others. Furnish sizes and accurate data and location of any and all foundations, pits, chases, holes through beams, floors, walls, ceilings and roof, and other special openings required for this contract work.
- C. Inserts: Prior to the execution of each step in the general construction work, determine that all chases and holes required for the specified work are properly located and sized and supervise the setting of all sleeves, inserts and other required build-in items. If this preliminary work is not properly performed and should cutting be required to install the specified work, the Contractor shall bear all expense of cutting and restoring the construction to its original condition.
- D. Cutting: The work shall be carefully laid out in advance and any cutting of construction shall be done only with the written permission of the Engineer. Cutting shall be carefully done, and any damage to the building, piping, wiring and equipment as a result of the cutting shall be repaired by persons skilled in the particular trade.

#### **1.06 MANUFACTURER**

- A. Pipe and fittings shall be manufactured by a firm regularly engaged in the successful manufacture of the type of pipe furnished. All water piping specified shall be NSF approved and all piping shall bear the NSF stamp of approval. (ANSI/NSF 61)

## 1.07 HANDLING OF PIPE

- A. The pipe shall not be dropped or subjected to any unnecessary jar, impact or other treatment that might damage the pipe. Any unit of pipe that in the opinion of the Engineer is damaged beyond repair by the Contractor shall be replaced by another unit. Any pipe that is damaged and repairable shall be repaired in the field, or at the direction of the Engineer shall be returned to the manufacturing plant for repair.

## PART 2 - PRODUCTS

### 2.01 DUCTILE IRON PIPE AND FITTINGS

- A. **Manufacture.** Ductile Iron pipe shall be manufactured in the U.S.A. in accordance with the latest revision of ANSI/AWWA C151/A21.51. All ductile iron pipe shall be hydrostatic pressure tested at the plant of the manufacturer to 500 psi.
- B. **Design.** Ductile Iron Pipe shall be designed in accordance with the latest revision of ANSI/AWWA C150/A21.50. The design shall include a minimum working pressure of 150 psi plus a 150 psi surge allowance. A two to one safety factor shall be applied to the sum of the working pressure plus the surge allowance. A two to one safety factor shall also be applied to the bending stress and deflection design for a Type 3 to Type 5 laying condition with the depth of cover as required per the plans.  
  
Unless noted otherwise on the plans, the minimum pressure classes for ductile iron pipe shall be as follows: PC 350 for 8" - 12" pipe, PC 250 for 14" - 20" pipe, PC 200 for 24" pipe and PC 150 for 30" and larger pipe.
- C. **Coating and Lining.** Pipe shall have a standard asphaltic coating on the exterior. Pipe shall have a cement mortar lining on the interior in accordance with the latest revision of ANSI/AWWA C104/A21.4.
- D. **Joints.** All in plant ductile iron piping shall be restrained joint. "Fast-Grip", "Flex-Grip", "Field Flex-Ring", "Lok-Ring" or approved equal shall be used.
- E. **Ductile Iron Fittings.** Ductile Iron Fittings shall conform to the latest revisions of either ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53. Linings and coatings for fittings shall be the same as specified for ductile iron pipe.
- F. **Flanged Pipe.** All above ground or exposed pipe shall be ductile iron and shall comply with ANSI/AWWA C115/A21.15. The pipe barrel shall be made in accordance with ANSI/AWWA C151/A21.51, and shall have a thickness of no less than special thickness Class 53. All flanges shall be ductile iron and rated for a working pressure of 250 psi. Flange pipe and fittings shall be cement lined as specified above and shall be shop primed on the outside diameter with either TNEMEC 37H77 Chem Primer for an alkyl-phenolic primer or TNEMEC 140-1211 Pota-1211 Pota-Pox Plus for high solids epoxy primer, carboline, or approved equal.
- G. **Outlets.** Welded on outlets may be provided in lieu of trees and crosses. Outlets shall be fabricated from centrifugally cast ductile iron pipe, manufactured and tested in accordance with the latest revision of ANSI/AWWA C151/A21.51, using a high nickel content weld such as NI-Rod #55. Welding shall be performed in the pipe manufacturer's shop only. Outlets shall not be more than 70% of the size of the parent pipe. Minimum walls for the parent and outlet pipes shall be as published by American Ductile Iron Pipe, Tyler Pipe or other

approved manufacturer.

## 2.02 POLYVINYL CHLORIDE (PVC) PIPING:

All PVC piping shall meet the requirements of ASTM D2241 and conform to one of the paragraphs as designated on the Drawings.

- A. AWWA C900, Plastic pipe designated as C900 shall be made of rigid polyvinyl chloride (PVC) compounds conforming to ASTM D1784 for Type 1, Grade 1 (PVC 1120). The pipe shall be standard sizes 4" through 12" in pressure class 100, 150 and 200 conforming with the outside diameter (OD) of cast-iron (CI) and with the wall thickness of dimension ratio DR series 25, 18 and 14 as indicated on the Drawings. Standard laying lengths shall be twenty feet (20').
- B. AWWA C905, plastic pipe designated as C905 shall be made of rigid polyvinyl chloride (PVC) compounds conforming to ASTM D1784 for Type 1, Grade 1 (PVC 1120). The pipe shall be the standard sizes 14" through 36" conforming with the outside diameter (OD) for cast iron (CI) and with the wall thickness of dimension ratio DR series 25 and 18 as indicated in the Plans. Standard laying lengths shall be twenty feet (20') laying length. Sizes and pressures are as follows:

<u>Size</u>	<u>DR</u>	<u>Pressure</u>	<u>DR</u>	<u>Pressure</u>
14	25	165	18	237
16	25	165	18	237
18	25	165	18	237
20	25	165	NA	---
24	25	165	NA	---
30	25	165	NA	---
36	25	165	NA	---

- C. SDR 21 and 26. Plastic pipe designated as SDR 21 or 26 shall be made of rigid polyvinyl chloride (PVC) compounds conforming to ASTM D1784 for Type 1, Grade 1 (PVC 1120). The pipe shall be standard sizes 4" through 12" in pressure classes 160 (SDR-26) and 200 (SDR-21). The standard length shall be twenty feet (20') or forty feet (40').
- D. Polyvinylchloride (PVC) material for pipe, fittings, and couplings shall conform to ASTM D1784, Type 1, Grade 1, with 2,000 psi design stress. Pipe shall be Schedule 40 or 80 and shall be in accordance with ASTM D1785. Thickness schedule shall be as specified on pipe specifications sheets. PVC fittings shall be socket type conforming to ASTM D2466/2467. Solvent cement shall comply with ASTM D2564.
- E. Joints:  
Joints shall be rubber ring and made to manufacturer's specifications. Rubber rings shall be securely locked into the bell.
- F. Fittings:  
Fittings shall be the same type and grade, pressure rating and manufacturer of the pipe, and conform to the pipe specifications AWWA 900 or AWWA 905; or shall be ductile iron as specified herein under ductile iron pipe, except that fittings shall have all connections of standard AWWA dimensions or dimensions as required or with adapters of the proper class for the size of plastic pipe laid. Fittings 3" and smaller shall be PVC equal. Fittings 4"

through 36" shall be ductile iron meeting C-153 specifications of AWWA. Where new water main is being cut into existing water main, only ductile iron fittings, all sizes, will be accepted.

G. Manufacturer's Representative:

The pipe manufacturer must furnish a trained representative for not less than one (1) eight (8) hour day on the job site to instruct and supervise the contractor in the proper method for installation of pipe and pipe fittings.

## **2.03 HIGH DENSITY POLYETHYLENE PRESSURE PIPE**

- A. High density polyethylene pipe shall be made from polyethylene resin compound that meet the requirements for Type III, Category 5, Class C, Grade P34 as defined in ASTM D1248.
- B. The pipe produced from this resin shall have a classification of 345434C in accordance with ASTM D 3350 and shall have a Plastic Pipe Institute (PPI) rating of PE 3408.
- C. The material shall be of virgin quality and contain a minimum of 2% well dispersed carbon black. The workmanship shall be of the highest level compatible with current commercial practice. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification and from the same raw material supplier. The polyethylene pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other injurious defects. It shall be uniform in color, opacity, density and other physical properties.
- D. The pipe shall have a manufacturer's recommended hydrostatic design stress rating of 800 psi based on a material with a 1,600 psi design basis determined in accordance with ASTM D2837. The pipe shall conform to the dimensions, wall thickness, testing, marking and all other provisions of ASTM F 714 for the dimension ratios as shown on the drawings or on the bid form.
- E. Pipe shall be marked at 5-foot intervals with a coded number which identifies the manufacturer, SDR, size, PPI rating, manufacturing standard reference and production code form which date and place of manufacture can be determined.
- F. Flange adaptors shall be manufactured by the same manufacturer as the pipe using the same resin as the pipe. Each flange adaptor shall be furnished with a ductile iron convoluted backup ring drilled to match a standard ANSI bolt pattern for welded steel pipe.
- G. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other injurious defects. It shall be uniform in color, opacity, density and other physical properties.
- H. Butt fusion of the pipe and fittings shall be performed by the thermal butt fusion system. Polyethylene pipe lengths, fittings and flange adaptor connections to be fused shall be of the same type, grade and class of polyethylene compound and supplied by the same raw material supplier.

## **2.04 STEEL PIPE AND FITTINGS**

- A. Steel pipe shall meet the requirements of ASTM A 53 Grade B and shall be standard weight. Steel pipe specified to meet the requirements of AWWA C200 shall be designed to the maximum internal pressure given in the specifications.

- B. The minimum wall thickness for steel pipe 4 inches and up to and including 36 inches shall be 1/4 inch.
- C. Exposed pipe shall have grooved or shoulder type joints complying with AWWA C606 unless flanged ends or plain ends for flexible couplings are shown on the drawings are required. Flanged ends shall conform to AWWA C207 Class B with rubber gaskets.

Pipe used with groove and couplings shall be not less than standard weight and at least as thick as the minimum recommended by the coupling manufacturer or shall be provided with double fillet or butt welded collared ends to meet requirements. Laying length shall be as specified by the Contractor. Bends, fittings, and special fittings for pipe 14 inches and larger shall meet the requirements of AWWA C 208 and the same stress and load conditions required for pipe meeting the requirements of AWWA C 200 specified above. The Contractor shall determine and provide reinforcements or additional shell thickness as required to keep the combined stresses within the specified maximum.
- D. Coatings for steel pipe and fittings shall be hot applied coal tar enamel with kraft paper wrap in accordance with AWWA C203, or coal tar epoxy per AWWA C210 or fusion epoxy coating per AWWA C213. Other steel pipe and fittings shall be factory cleaned and primed and field painted.
  - 1. Lining for steel pipe and fittings shall be cement mortar lining per AWWA C205.
  - 2. All field repair work shall conform to one of the following as applicable. Welding per AWWA C206, cement mortar lining per AWWA C602, and cold applied coal tar coating per AWWA C209.
- E. The manufacturer shall provide an affidavit of compliance as described in AWWA C200. Shop hydrostatic tests of steel pipe and fittings, as specified in AWWA C200, are required.

## **2.05 GALVANIZED PIPE**

- A. Pipe:

Galvanized steel pipe shall conform to A.S.T.M. A120, standard weight (unless designated otherwise), with hot-dip galvanizing.
- B. Joints:

Joints shall be threaded or screwed and shall utilize iron pipe threads. Only joint compounds that are suitable and AWWA approved for use in potable water systems shall be used.

## **2.06 CASING PIPE**

- A. Pipe:

Casing pipe shall be steel having a minimum yield strength of 35,000 psi, conforming to A.P.I. Specification 5L. Casings shall have the following minimum wall thicknesses:

<u>Size</u> <u>(Non. Diam., In.)</u>	<u>Thickness</u> <u>(Inches)</u>
Under 12" I.D.	0.250
14 and 16 O.D.	0.281
18 O.D.	0.313
20 O.D.	0.344
24 O.D.	0.375
26 O.D.	0.438
28 and 30 O.D.	0.469
32 O.D.	0.500
34 and 36 O.D.	0.532
38, 40 and 42 O.D.	0.563

Both the interior and exterior of the pipe shall have a bituminous coating.

- B. Joints:
  - Joints shall be butt welded. Coatings shall be continuous at the joints.
- C. Carrier Runners:
  - The carrier pipe shall be supported by utilizing three way to concentric casing cradle as manufactured by T. D. Williamson, Inc., Pipeline Seal and Insulator Company, APS Casing Spacers or approved equal.
- D. Casing Seal:
  - Casing seals, which seals the annulus between the casing and carrier pipe, shall be made of cement grout or bituminous material.

## **2.07 PLASTIC SERVICE PIPE**

- A. Polyethylene Pipe:
  - Polyethylene service pipe shall conform to AWWA Standard C901 and be approved by the National Sanitation Foundation. The pipe shall have a standard dimension ration (SDR) of 9, and pipe shall conform to PE 3306, Type III, Grade 3, Class C.
- B. Service Pipe Connections:
  - Only compression type couplings with inserts or flared couplings will be acceptable. Hot flared or hose connections are not permitted. The pipe must be continuous from water main to meter.

## **2.08 MECHANICAL COUPLINGS**

- A. Flexible Couplings: Flexible (sleeve) couplings shall be of the full sleeve type, split sleeve type, or flanged adaptor type, as shown on the Drawings, specified herein, or as otherwise permitted by the Engineer. The coupling shall provide the requisite pipe flexibility without jeopardizing pipe joint integrity due to hydraulic thrust, and shall have the same pressure-rating as the pipe. Couplings shall have all metal bearing surfaces and shall be provided with galvanized steel bolts and nuts. Flexible couplings shall be restrained unless the Engineer

has given his approval to omit this feature for specific cases.

1. Full Sleeve Type Couplings shall be properly gasketed and shall be of a diameter to fit the pipe. Each coupling shall consist of a steel middle ring, 2 steel followers, 2 gaskets and the necessary steel bolts and nuts to compress the gaskets. The couplings shall be Dresser Style 38, Smith-Blair Type 411, or equal. Couplings to be installed underground shall have a hot-dipped galvanized sleeve with corrosion resistant bolts conforming to AWWA C-111 (type 316 stainless steel).
2. Split Sleeve Type Couplings shall consist of one gasket, 2 housing clamps, and 2 bolts and nuts to obtain the flexibility for connecting the piping. Steel shoulders shall be provided and welded to the pipe ends to accommodate the couplings. The couplings shall be Kuhns, Ductile Iron Pipe Lock Coupling; M.B. Skinner Seal; or equal.
3. Flexible Flanged Coupling Adaptors shall be of the sleeve type, consisting of steel middle ring, steel followers, gaskets, and steel bolts and nuts to compress the gaskets. The couplings shall contain anchor studs of strength adequate to hold the pipe together under a pull equal to the longitudinal strength of the pipe at a tensile stress of 20,000 psi, and shall be Smith-Blair No. 913, Dresser Style 128, or equal. Couplings to be installed underground shall have a hot-dipped galvanized steel with corrosion resistant bolts conforming to AWWA C-111 (type 316 stainless steel).

## **2.09 GATE VALVES (2-IN AND LARGER)**

### **A. General Requirements:**

1. Unless otherwise specified below, these requirements shall apply to all gate valves.
2. Gate valves shall meet the requirements of AWWA C500 and AWWA C509 as applicable to the type of valve specified.
3. Buried and submerged valves shall be furnished with mechanical joints and stainless steel hardware; non-rising stem design.
4. Exposed valves shall be furnished with Class 125 flanged ends; provided valves with outside screw and yoke.
5. All metal valves shall be manufactured of ASTM A126 Cast Iron, Class B, with bronze mounting design.
6. Rising stem valves shall be sealed with adjustable and replaceable packing; valve design must permit packing replacement under operation system pressures with only moderate leakage.
7. Non-rising stem valves shall use a double O-ring stem seal, except that packing shall be used where geared operators are required.
8. Except as otherwise specified, valves shall be rated for the following working water pressures:



2. Resilient Seated.

- a. Conform to AWWA C509. Also UF and FM approved.
- b. Internal and external epoxy coating of valve body, including bonnet, per AWWA C550.
- c. Gate shall be encapsulated with synthetic rubber. It shall be bonded and vulcanized in accordance with ASTM B429, Method B.
- d. No recesses in valve body.

D. Buried Valves:

1. Conform to the requirements above, except restrained mechanical joint bell ends per AWWA C111. Exposed valve hardware (nuts, bolts, washers, etc.) including bonnet, bonnet cover, stuffing box, gear adaptor and joints shall be Type 304 stainless steel.
2. Non-rising stem design, double O-ring seals for non-gear valves and shall incorporate packing for geared valves.

**2.10 CHECK VALVES**

- A. Check valves for metallic lines of 2-in to 20-in diameter shall be swing type and shall meet the requirements of AWWA C508. The valves shall be iron body, bronze mounted, single disc, 150 psi working water pressure, nonshock and hydrostatically tested at 300 psi.
  1. When there is no flow through the line, the disc shall hang lightly against its seat in practically a vertical position. When open, the disc shall swing clear of the waterway.
  2. Check valves shall have bronze seat and body rings, extended bronze hinge pins and bronze nuts on the bolts of bolted covers.
  3. Valves shall be so constructed that disc and body seat may easily be removed and replaced without removing the valve from the line. Valves shall be fitted with an extended hinge arm with outside lever and weight. The position of the weight shall be adjustable. Various weights shall be provided and installation approved by the Engineer. Lever shall be installed to the horizontal in the closed position, for both horizontal and vertical pipeline installations.
  4. Air Cushion type check valves shall be provided for all check valves 10 inches and larger and shall be Golden Anderson Figure 250-D, or equal.
  5. Check valves shall be by American-Darling; APCO; M&H; Golden Anderson; McWayne or equal.
- B. Check valves 2-in and smaller for installation in copper and steel pipes shall be bronze, swing type, 125 lb with solder or screwed ends.
- C. Check valves for PVC or CPVC pipe shall be of the ball check valve type, and of same material as the pipe, with solder or screwed ends. Valve bodies shall be union type. Valves shall be as manufactured by Plastic Piping Systems Inc., or Equal.

- D. Wafer style check valves shall be of the dual disc type with bodies constructed of cast iron, ASTM A126, Class B. Disc shall be fabricated of ductile iron, ASTM A536 and shall be electroless nickel plated. Body seat material shall be Buna-N. Spring material shall be Type 316 stainless steel. The ends shall be plain. The valve shall be of APCO; Val-Matic; GA; Keystone or equal.

## **2.11 PRESSURE REGULATING VALVES**

- A. Pressure regulating valves shall be factory tested. Outlet pressure shall be easily field adjustable over the pressure ranges and meet the criteria noted on the Drawing.
- B. Pressure regulating valves shall have flanged connections, or shall have unions mounted in the pipe on each side of the valve.
- C. Strainers for installation upstream of pressure regulating valves are specified elsewhere. The pressure regulating valve manufacturer shall specify the screen mesh or size or perforations that are required to protect the regulating valve. The supplier shall furnish both valve and strainer.
- D. Pressure Regulating Valves - 3-in and larger.
  - 1. Valves 3-in and larger and for pressure regulating shall be flanged with globe body, full bronze mounted, external pilot operated, diaphragm type single seat with seat base equal to size of valve and shall be equal to the Figure 4500D Pressure Reducing Valve as manufactured by GA Industries, Inc; Clayton Model 90 by Cla-Val Company, Bailey, similar models by Ross; OCV; Watts/Muesco or equal.
  - 2. The valve shall be packed with leather material acceptable to the Engineer to ensure tight closure and prevent metal to metal friction and sticking. The valve shall be furnished with indicator rod, to show position of opening of the piston, and pet cocks for attachment to valve body for receiving gauges for testing purposes.
  - 3. The pilot valve, controlling operation of the main valve, shall be easily accessible and so arranged to allow for its removal from the main valve, while the valve is under pressure. The pilot valve shall be easily adjustable without removal of the springs, weights or use of special tools. The control piping on the valves shall have strainers to prevent plugging of control mechanisms.
  - 4. The design shall be such that repairs and dismantling internally of main valve may be made without its removal from the line.
  - 5. The unit shall be flanged. The valve body shall be constructed of cast iron.
  - 6. The valve shall maintain pre-adjusted downstream pressure for varying rates of flow through the positioning of the piston by the pilot without causing; water hammer or waste of water and without cavitation.

## **2.12 AIR RELEASE VALVES**

- A. Air release valves shall be installed to release any small accumulations of air which may collect while pipe is in operation and under pressure.
- B. The small orifice assembly air release valve shall automatically release air accumulations from the pipe while under positive pressure. When the valve body fills with air, the float ball

shall fall to open the small orifice and exhaust the air to atmosphere. When the air has been exhausted, the float ball shall be buoyed up and tightly close the small orifice.

- C. The small orifice assembly shall be furnished with cast iron body and cover (ASTM A126-B). The float ball shall be constructed of stainless steel and attached to a stainless steel lever mechanism. A resilient, Buna-N seat shall be attached to the lever mechanism for drop-tight closure.

### 2.13 BUTTERFLY VALVES

- A. Butterfly valves for above ground service, where required on the Plans, shall be Allis-Chambers, Henry Pratt, B.I.F. Industries, Darling, or approved equal.
- B. Valves shall be rubber seated and have rated working pressures of 150 psi. Valves shall be flangeless or shall employ narrow face to face dimensions for A.S.A. B16.1 flanges (Class 125). Packing shall preferably be rubber "O" rings and shall be replaceable without disassembling the valve stem and discs. Operators shall be of the manual sidewinder type, with indicator, unless designated otherwise on the Plans.
- C. Rubber seated butterfly valves shall equal or exceed the requirements of the latest revision of A.W.W.A. Standard C504, Class 125-16, -and the requirements specified above shall govern.

### 2.14 VALVE BOXES

- A. Valve boxes shall be provided for all below ground valves. Valve boxes in non-traffic areas shall be of the two-piece sliding or threaded type, equal to Mueller H-10364. For traffic areas, boxes shall be of the three-piece sliding type with the appropriate base, equal to Mueller H-10380, Tyler 6800 series or approved equal.

### 2.15 FIRE HYDRANTS

- A. Fire Hydrants:

Fire hydrants shall be cast iron bodies, full bronze mounted, suitable for a working pressure of one hundred fifty pounds (150#) per square inch, and shall meet all requirements of the latest AWWA Standard C-502. Hydrants shall be Mueller improved, M&H, Darling, or approved equal. Hydrants shall have double "O-Rings" seals and dry bonnets. Each hydrant shall be given a 300 psi hydrostatic test in the shop.

Hose Nozzles	2-2 1/2"	2-2 1/2"
Pump Nozzle	None	1-4 1/2"
Main Lead Diameter	6"	6"
Min Opening Diameter	4 1/2"	5 1/4"
Min. Barrel Diameter	6 1/2"	7 1/4"

Nozzles shall be bronze.

Unless noted otherwise on the Plans and specified in the special conditions, nozzle thread and operating nuts shall be as follows: Threads for nozzle connections shall conform to NFPA No. 194, and shall be opened by turning in a counter clockwise direction. The operating nut at the top of the hydrant and cap nuts shall be one and one-half inch pentagon nut (measured point to flat) and shall open counter-clockwise. The Contractor shall verify all pertinent hydrant features and dimensions with both the Engineer and the Owner adapt to

the Owner's standards shall be made at no additional cost to the Owner.

The hydrant main valve shall be of the compression type closing with pressure. The valve shall be faced with heavy impregnated water-proof balata, or other approved material. Hydrants shall have a safety "Breakable" section located above the ground line. The minimum distance from the ground line to the top of the hydrant lead (cover) and from ground line to bottom of hydrant lead (bury) shall be thirty inch (30") cover. After installation, exposed surfaces of hydrants shall be painted with one (1) finish coat of red enamel (Alkyd paint), unless otherwise directed by the Engineer. The Contractor shall provide the Owner with two (2) cartons of collision breakage repair parts for the hydrants.

Fire hydrants shall be AWWA C503 with a 6-inch inlet and threaded for two (2) 2-1/2" inch outlets (National Standard Hose Threads).

**B. Wrenches and Keys for Hydrants:**

The Owner shall be furnished one (1) key wrench for each ten (10) hydrants, or a minimum of one (1) for ten (10) or less hydrants.

**C. Manufacturer:**

Provide hydrants by Mueller, Centurion, M&H, Darling or approved equal.

**2.16 PRESSURE GAUGES**

Pressure gauges, where called for on the Plans or specified elsewhere, shall be bronze bourdon tube; movements mounted on socket independent of case; steel, aluminum alloy or phenol cased; long life plastic face; heavy glass or unbreakable plastic face; accuracy 1/2"; 1/4" N.P.T. connection. Gauges shall be equal to Hellcoid as manufactured by American Chain and Cable Co., Bridgeport, Conn., or Ashcroft as manufactured by Manning, Maxwell, and Moore, Stratford, Conn., a division of Dresser Industries or equal.

Gauges for clear water service shall be compound 4-1/2" dials with a range of 0 to twice the anticipated operating pressure, reading in psig and feet of water.

All gauges shall employ valves or gauge cocks to facilitate cleaning and changing.

**2.17 NEW SERVICE ASSEMBLY WITH METER SETTING**

New water service assemblies with meter setting where called for on the Plans or in the Proposal, shall each include a plastic meter box with cast iron reading lid, service tap clamps or fittings, curb stop, corporation stop, and the required connectors and service pipe. All equipment shall be bronze. Water meters shall be furnished by the Contractor, except in the case where it is designated on the Plans or in the Special Conditions that meters will be purchased by the Owner, and furnished to the Contractor, in which case the Contractor will set the meters. These items, in place and accepted, shall together form a pay item for service assemblies of the various sizes. All connectors shall comply with A.W.W.A. Standard C800.

**A. Service Assembly and Corresponding Service Pipe Size:**

SERVICE ASSEMBLY SERVICE PIPE SIZE

5/8" x 3/4" small res. & comm. (up to 2 baths) 3/4"

5/8" x 3/4" large res. & comm. (more than 2 baths)  
3/4" or 2-5/8" x 3/4"  
1" or 2-3/4"  
1 1/4" or 2-3/4"  
1 1/2" or 2-1"  
2"  
3"  
4"

1"  
1 1/2"  
1 1/2"  
2"  
2 1/2"  
3"  
4"

B. Water Meters:

Water meters shall be cold water rotating disc type with hermetically sealed and magnetically driven registers as manufactured by Sensus Technology, Precision or an approved equal. Meters shall be first line quality of the manufacturer. The latest specifications of the A.W.W.A. Standard C700 shall be complied with, except in cases of conflict with these Specifications.

1. Main Cases:

The main case shall be high grade waterworks bronze with hinged single lid cover and raised characters cast on them to indicate the direction of number stamped on the lid. The working pressure shall be 150 psi. Standard, Southern or non-frost proof bottoms shall be furnished unless noted otherwise on the Plans or in the Special Conditions. Non-ferrous strainers shall be provided which fit tightly against the main case. Meters 1 1/2" and larger shall be flanged.

2. Measuring Chamber:

The measuring chamber shall be of 85-5-5-5 bronze alloy composition and stainless steel or monel trimmed. The moving unit shall be of hard rubber rotating disc type. The disc shall be preferably the three-piece and the chamber shall be the two-piece type employing a thrust roller and insert.

3. Register:

The register shall be straight reading in gallons. The unit shall be completely encased, hermetically sealed, and driven by permanent magnets. There shall be a test index circle which shall be divided into one hundred (100) equal parts and red test hand.

C. Corporation stops shall be of bronze or brass and shall be designed and manufactured in accordance with AWWA C800, except as modified herein.

Corporation stops shall have Mueller inlet threads except that corporation stops for use with service clamps shall have IPS threads. Where corporation stops are used with plastic pipe, a brass companion flange shall be provided on the outlet of each corporation stop.

D. Curb stops shall be similar to corporation stops as manufactured by Crane; Ford; McDonald or equal.

E. All service taps shall be threaded couplings or strap clamps for A.W.W.A threads. Thread couplings for galvanized pipe shall not be permitted.

Maximum Size Threaded Coupling Permitted in Ductile Iron Pipe

<u>Pipe Size</u>	<u>Tap Size</u>	<u>Pipe Size</u>	<u>Tap Size</u>
2"	1/2"	8"	1 1/4"
3"	1/2"	10"	1 1/2"
4"	3/4"	12"	2"
6"	1"		

Where it is necessary to provide a service larger than the allowable ductile tap size, multiple taps shall be employed by staggering the taps around the pipe and spacing the taps at least twelve (12) inches apart and twelve (12) inches from the end of the pipe length, or service clamps shall be used.

Service strap clamps shall be galvanized malleable or ductile iron or bronze with rubber gasket. Clamps shall be Smith-Blair, Mueller, Dresser, Nappco or approved equal.

Maximum Size Service Clamp Permitted

<u>Pipe Size (Inches)</u>	<u>Ductile Iron Size</u>	<u>Plastic and Galvanized Size</u>
2	1"	3/4"
2 1/2	1 1/4"	1"
3	1 1/2"	1 1/2"
4	2"	1 1/2"
6	2"	1 1/2"
8	3"	1 1/2"
10	3"	1 1/2"
12	4"	1 1/2"

**2.18 THRUST BLOCKS AND ANCHORS**

A. For all water lines, at 1/8 bends or greater, and at tees, caps, plugs, and other fittings, concrete thrust blocks or anchor rods shall be provided by the Contractor to firmly secure these fittings. Anchor blocks and straps shall be used under valves and hydrants and plastic pipe in accordance with the manufacturer's standards or recommendation. Thrust blocks shall be of such size and dimensions as detailed on the plans. Concrete for thrust blocks shall be not leaner than one (1) cement to two and one-half (2 1/2) sand to five (5) aggregate, and having a compressive strength of not less than 2,000 psi at 28 days. Otherwise, concrete shall be in strict conformance with the applicable section on concrete in these Specifications. Restrainer devices such as Uni-Flange or an approved equal shall be acceptable.

B. Restrained Joints:

1. Restrained joints may be considered by the Engineer in lieu of thrust blocks if they meet the requirements of the section. Restrained joints shall be constructed using pipe and fittings with restrained "Lock-type" joints. The joints shall be capable of holding against withdrawal and no axial movement for line pressures 50 percent above the normal working pressure but not less than 100 psi. The pipe and fittings

shall be as shown for restrained push-on joints or restrained mechanical joints in the Handbook of Cast Iron Pipe, 4th Edition, except that mechanical joint ductile iron pipe retainer glands will not be permitted.

2. Restrained pipe joints that achieve restraint by incorporating cut out sections in the wall of the pipe shall have a minimum wall thickness at the point of cut out that corresponds with the minimum specified wall thickness for the rest of the pipe.
3. The minimum number of restrained joints required for resisting forces at fittings and changes in direction of pipe shall be determined from the length of restrained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil. The formula and parameters given below shall be used to determine the minimum requirements:

$$L = \frac{1.5PA(1-\cos X)}{fw}$$

Where

- L = length of pipe on each side of fitting or change in direction  
P = 50 percent above the normal working pressure  
A = cross-sectional area in square inches based on outside diameter (O.D.) of pipe  
X = angle of bend or change in direction in degrees  
f = coefficient of friction = 0.4 (maximum)  
w = earth + pipe + water in pipe

earth = (density of soil\*) (depth of cover in feet) (O.D. in feet) (2)

\* maximum 120 lbs/ft above maximum water table elevation  
and 60 lbs/ft below maximum water table elevation

4. Bolts and nuts for restrained joints shall be corten, low alloy, high strength steel.
5. Restrained joints shall be "TR-Flex" as manufactured by the U.S. Pipe and Foundry Company, "Super-Lock" as manufactured by the Clow Corporation, or equal.

### **PART 3 - EXECUTION**

#### **3.01 LAYING WATER PIPE**

- A. General:

Grading, excavation, and earthwork required in laying water pipe shall conform to Section 02315 of these Specifications. Installation of water pipe shall be in conformance with provisions of A.W.W.A. Standard C605, Installation of PVC pressure pipe for water mains, except in cases of conflict with these Specifications, in which case these Specifications will govern.

When work is suspended either for the night or for any other reason, open ends of the pipe shall be securely capped or plugged to prevent the entrance of mud, water, animals, or any obstruction.

Dead ends of pipe and unused branches of crosses, tees, valves, etc., shall be closed with a plug suitable to the type of pipe used.

Proper and suitable tools and appliances for the safe and convenient handling and laying of pipe shall be used, and care shall be taken to prevent damage to pipe coating. If required by the size pipe being used, mechanical pullers (or spreaders) shall be used in conformance with the pipe manufacturer' instructions.

While pipe laying is in progress, the trench shall be kept free of water.

While suspended in the sling and before lowering in the trench, the pipe shall be swabbed clean and inspected for defects and tapped with a light hammer to detect cracks. Defective, damaged, or unsound pipe shall not be used.

**B. Excavation and Bedding:**

The width of the trench at the top of the pipe for water pipe installation shall not exceed the external diameter of the barrel of the pipe plus nine inches (9") on each side.

Trenches for water lines shall be of a depth to provide a thirty inch (30") minimum cover over the top of the pipe.

Where sanitary sewer, storm sewer, or other subsurface utilities are encountered in trenching for water lines, it will be permitted to lay pipe above the obstruction if a minimum cover of twenty-four inches (24") can be obtained while providing a cushion between the bottom of the pipe and the top of the obstruction of at least six inches (18") in thickness. Otherwise, the obstruction will have to be by-passed or tunneled under. Approval must be sought by the Department of Health in these situations.

Mechanical excavation shall be stopped so that the pipe may be laid on a firm, undisturbed, continuous native earth bed. Prior to laying the pipe, the trench shall be manually excavated so that it is flat, true to grade, and provides continuous contact with the pipe barrel. Bell holes shall be spaced as required providing two inches (2") minimum between earth and the pipe coupling.

If over digging occurs, the trench bottom must be brought back to grade with compacted select material, and the cost borne by the Contractor.

Where the bottom of the trench is rock, water bearing soil, or unstable material, the Resident Project Representative may direct that the pipe be bedded in granular material, a concrete cradle, or granular material on timber runners, and paid for as separate items. The pipe shall be bedded as provided above, but in no case shall the bedding provide less than eighteen inch (18") cushion below and at the sides of any part of the pipe.

Granular material, where required, shall be sand, crushed stone, or gravel, and shall not exceed 3/4 inch maximum size.

Concrete for pipe foundations, where required, shall be proportioned a required hereinbefore for thrust blocking concrete. Other excavation and trenching requirements as specified hereinbefore (Section 2) shall be complied with.

**C. Backfilling:**

The initial backfill under the pipe haunches, around the pipe, and over the top of the pipe shall be manually placed in layers, each layer being thoroughly hand tamped. The thickness of each layer, prior to compaction, shall be six inches (6"). Special laying instructions of any pipe manufacturer shall be rigidly followed.

Where the Contractor uses a trenching machine for the excavation, the initial backfill shall be brought to not less than one foot (1') above the top of the pipe, as hereinafter specified. Should the Contractor elect to use a backhoe, dragline clam - shell bucket or equipment other than a trenching machine, then the initial backfill shall be brought to not less than two feet (2') above the top of the pipe.

Other backfill requirements as specified hereinbefore in Section 2 of the Specifications shall be complied with.

### **3.02 PLACING VALVES AND FITTINGS**

- A. Valves and fittings shall be placed in the location indicated on the Plans and as directed by the ENGINEER.
- All underground valves shall be set vertically. Boxes shall be set with covers flush with the surface.
- Before being placed in the trenches, all valves, meters, fittings, etc., shall be carefully examined to see that they are in good working order and are clean.

### **3.03 JACKING AND BORING PIPE**

- A. General:

Where pipe is to be laid beneath railroads, Federal Highways, State Highways, and concrete pavement, jacking and boring is required. The Contractor will not be permitted to open cut.

The requirements of the approving agency, such as railroad or State Highway Department, shall govern over these Specifications and Plans.

Sub-surface operations resulting in damage to the tracks or pavement, shall be the responsibility of the Contractor and shall be repaired at no cost to the OWNER.

- B. Jacking and Boring Casing Pipe:

Installing of steel casing pipe shall conform to the A.R.E.A. Manual for Railway Engineering and Louisiana Standard Specifications for Roads and Bridges, Sections 7 and 8, latest edition.

Where the ends of pipe used as casing for other pipe are below ground, the ends shall be sealed.

The barrel of the carrier pipe shall be supported within the casing. Supports or carrier runners shall be spaced as recommended by the manufacturer, or as directed by the ENGINEER.

3/4" diameter service lines not permitted to be jack and bored. Contractor must use 1" minimum service line.

### **3.04 INSTALLING FIRE HYDRANTS**

- A. Each hydrant and flush hydrant shall be placed vertically on a concrete base, and shall be secured against dislocation as shown on the Plans. Unless otherwise directed by the ENGINEER, hydrants shall be placed as shown on the Plans and as follows:

- B. Flush hydrants shall be located at high or low points and at the ends of lines in the approximate locations shown on the Plans. Fire hydrants placed behind curbs shall be set so that no portion of the hydrant of nozzle caps shall be less than six (6) nor more than twelve (12) inches from the vertical face of the curb. Hydrants shall not be placed within twenty (20) feet of the intersection of curb lines at street corners.
- C. Vertical off-sets or hydrant extensions shall be used as required in the hydrant lead so that the bury line of the hydrant will be flush with the natural ground and the specified cover will be maintained on the main and the hydrant lead.
- D. Hydrants shall be secured in place by hydrant valve anchoring tee with hydrant anchoring connection pieces, concrete thrust blocks, or socket clamps and tie rods. Tie rods shall extend from hydrant to tee fitting in main. Clamps shall be of either wrought iron or steel, and not less than two (2) inches wide and three-eighth (3/8) inches thick. Bolts used shall be not less than three-quarter (3/4) inches in diameter, material shall be wrought iron steel. Wrought iron and steel shall be protected against corrosion by painting with tar, asphaltic, or other suitable and approved material.

### 3.05 CONNECTING EXISTING PIPE LINES TO NEW WATER MAINS

- A. On 3" and smaller water mains these connections shall be made each with the required number and size of corporation cocks, goosenecks, and branch connection. Valves and cast iron fittings and pipe shall be paid for separately and in addition to this item. On 4" and larger water mains, tapping valves and tees will be required. These shall be a separate pay item.

### 3.06 TESTING WATER PIPING

- A. No pressure tests shall be made until all concrete thrust blocks are at least forty-eight (48) hours old.
- B. Before any water lines will be accepted by the Engineer, all lines shall be subjected to a hydrostatic pressure of 1.5 times the working pressure and shall not exceed the pressure rating of the pipe for a period not less than two (2) hours and any defective work revealed by the test shall be repaired or replaced by the Contractor and the system re-tested.
- C. After the pressure test, a separate 24-hour leakage test shall be conducted. Leakage shall not exceed  $L = \frac{SD\sqrt{P}}{133,200}$

L = allowance in gallons per hour

S = length of pipe tested in feet

D = nominal diameter of the pipe in inches

P = average test pressure during the hydrostatic test in lbs/in<sup>2</sup> (gauge).

- All visible leaks shall be stopped, defects connected, and pipe shall be re-tested. The Contractor shall submit to the Engineer test results in a neat, tabular form.
- D. The Contractor shall furnish all taps, pumps, piping, gauges, and measuring devices for performing all pressure and leakage tests.
- E. Where cement lined ductile iron pipe is used, the pipe shall be filled twenty-four (24) hours in advance of the pressure test.

### **3.07 STERILIZATION**

- A. Following the pressure and leakage tests, all lines shall be flushed at a velocity of not less than 2.5 FPS and sterilized in accordance with A.W.W.A. Standard C601.
- B. All new potable water lines, including pipe, valves, etc. shall be sterilized prior to being placed in use with a solution of HTH Liquid Chlorine, or other approved disinfectant containing no less than fifty (50) parts per million of available chlorine.
- C. For this work, the Contractor shall furnish suitable plugs or caps for the pipe, injection pumps, pipe connections, and other equipment together with all labor required.
- D. While the disinfectant is being applied to any section of the system, the water shall be allowed to escape at all extremities of this section until an orthotolidin test shows a deep orange color. The disinfectant shall be allowed to remain in the pipe for twenty-four (24) hours, after which the lines shall be thoroughly flushed. Each section of the system shall be sterilized and re-sterilized until bacteriological approval has been obtained from the appropriate health agency.

### **3.08 INTERRUPTION OF WATER SERVICE**

- A. The attention of the Contractor is directed to the fact that some of the alterations in the water system may require cutting into existing water mains.
- B. Valving of new water lines shall be as shown on the Plans. Testing and sterilizing of the new lines shall be done by utilizing existing and new valves and temporarily plugging the line if necessary. Where no existing services occur on a short length of existing line, the Resident Project Representative may direct that this existing line be tested and sterilized in conjunction with the new line, at no additional cost to the Owner.
- C. Water service can be interrupted under the following conditions and subject to all other provisions herein contained:
  - 1. Where interruption of service will be along a main serving not more than fifty (50) customers, who will be affected by said interruption, and where the duration of said interruption is to be four (4) hours or less, interruption will be permitted, provided Contractor has notified both the Resident Project Representative and the Owner at least seventy-two (72) hours in advance of the contemplated interruption of service.
  - 2. Where interruption of service shall affect more than fifty (50) customers, or shall affect the main business district, or shall be of greater duration than four (4) hours, or a combination of the above conditions, interruption of service will be permitted only after both the Resident Project Representative and the Owner have received a seventy-two hours notice and have approved such cases. Owner reserves the right to require the Contractor to perform such work between the hours of 11:30 p.m. and 6:00 a.m. Any overtime pay required to be disbursed by the Contractor shall be included in his bid for the items of work involved.

The contract documents provide payment for ductile iron fittings and tapping valves and tees used to tie into existing lines on a pound and per each ton basis and provide payment for the additional work and extra cost of cutting into the existing lines. This additional work and cost shall be paid for separately, and shall be included in the prices bid for the items

applicable.

### **3.09 TRACERS FOR NON-METALLIC PIPE**

- A. A plastic bonded 12 gauge copper wire and/or a metallic tape strip (2" width) shall be laid one foot (1') above the top of the pipe. The wire shall be continuous along the entire length of the pipe and grounded to gate valves, fire hydrants, flush valves, and water meters.

### **3.10 HIGH DENSITY POLYETHYLENE (HDPE) PIPE INSTALLATION**

- A. Polyethylene pipe shall be joined by the method of thermal butt-fusion as outlined in ASTM D 2657 "Heat Joining Polyolefin Pipe and Fittings." All butt-fusion joining of pipe and fittings shall be performed in accordance with proven procedures and techniques recommended by manufacturer. Thermal butt-fusion of the pipe shall be performed by an experienced technician, certified in the jointing of high-density polyethylene pipe in accordance with Title 49 CFR 192.285. Written certification of the individual welders as per Attachments found at the end of this section shall be submitted to the Engineer prior to the performance of any welding.
- B. A minimum of two test joints shall be fused and cut from each pipe size and each SDR prior to beginning joining the pipe system. The test joints shall be visually examined in accordance with Title 49 CFT 192.285. The Engineer reserves the right to request that no more than 10 additional samples be cut from the pipe during the jointing process at no additional cost to the Owner, to document the integrity of the fusion process.
- C. All finished butt-fusion welds shall be ground out to the inside of joined pipe sections such that the maximum finished bead protrudes no more than 1/8-inch from the inside of the pipe wall at any given point.
- D. Where shown on the plans, the HDPE pipe shall be adapted to fittings and valves by means of an assembly consisting of polyethylene stub-ed, butt-fused to the pipe, a back-up flange of ductile iron, made to Class 140, ANSI B16.5 dimensional standard with exceptions, bolts of compatible material and a viton gasket to fill the joints. Bolts shall be drawn up evenly and in line.

### **3.11 STEEL PIPE FABRICATION AND INSTALLATION**

- A. The fabrication of the steel manifolds and piping shall be in accordance with these specifications and drawings and with the requirements of AWWA Standard C200.
  1. The outside surface of the steel manifold and piping sections, larger than 24 inches and joined by sleeve-type couplings shall be sufficiently free from indentations, projections, or roll marks for distance of 8 inches from the end of the steel manifold and piping sections to make a tight joint with the rubber-gasket type of coupling. The maximum permissible outside diameter shall permit passing a ring gage having 3/32-inch larger than the steel manifold and piping section for the same 8-inch length. The outside diameter shall not be more than 1/32-inch smaller than the nominal outside diameter for a distance of 8 inches from the end.
  2. Longitudinal joints shall be staggered. Longitudinal, girth, and spiral joints shall not intersect at outlet connections. All longitudinal, girth, and spiral joints shall be butt welded. All butt welds shall have complete penetration. Manual welding will be permitted for all welded joints. The ends of pipe sections shall lie in a plane normal to the longitudinal axis of the section within a maximum deviation of 1/16-inch on

either side of the plane. The radial offset of plate edges at the weld for pipe with wall thickness less than or equal to 0.500-inch shall not exceed 1/16-inch. For pipe with wall thickness greater than 0.500-inch the radial offset shall not exceed 0.125t or 1/8-inch whichever is less. Care shall be exercised in matching the edge and ends of the adjoining plates and courses to ensure that the inner surfaces of the plates to be joined by welding are in continuity within a maximum allowable offset at any point of 1/16-inch. Flange faces shall be sufficient true to provide a watertight joint.

3. Concave orientation of the flange face is not permissible. The flange thickness after machining shall not be reduced below the minimum thickness required in the appropriate flange specification.
  4. All joins of flange supports and pipe support shall be continuously welded so that no cracks will be left that could not be completely painted.
- B. Except as shown on the drawings all field joints for the 36-inch steel outlet piping shall be double-welded butt joints with complete penetration. Welding shall conform to AWWA Standard C206 except that testing of the field welds is not required.
- C. The Contractor shall furnish and install supports and bracing to hold the steel surface water connection piping in place and prevent distortion during erection, hydrostatic testing and backfilling.

### **3.12 CLEAN UP AND REPAIR**

- A. General: The Contractor shall maintain his operations in a neat and orderly manner causing as little inconvenience as possible. Within 10 working days from the time a trench is opened all roadside ditches, culverts, etc, shall be repaired and surfaces thoroughly cleaned. All excess excavation shall be removed from the trench side and disposed of at the Contractor expense. The work area shall be then thoroughly cleaned.
- B. Clean-up and repair shall conform to the applicable requirements of Section 02315, Excavation, Backfilling and Compacting.

### **3.13 ACCEPTANCE**

- A. Final acceptance of the project will not be made until the CONTRACTOR has completed the total project and all tests, restoration, and clean-up have been performed to the satisfaction of the ENGINEER.

END OF SECTION

## SECTION 02920

### LAWNS AND GRASS

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. Work to be performed under this section shall be either restoration or establishment of vegetative cover for aesthetic and erosion control purposes. This work shall be considered incidental to other work in the contract. The Contractor shall make investigations of the project to determine types of existing vegetative cover that will require restoration and shall take all measures necessary to restore the vegetative cover in like kind to that which existed prior to the beginning of the Work.
- B. Furnish all labor, materials, and equipment necessary to satisfactorily return all construction areas to their original conditions or better.
- C. Work includes furnishing and placing seed or sod, fertilizer, planting, watering, and maintenance until acceptance by the Owner.
- D. Reestablish vegetative cover in all areas where such cover existed prior to beginning of the Work.

##### 1.02 QUALITY ASSURANCE

- A. Requirements
  - It is the intent of this specification that the Contractor is obliged to deliver a satisfactory stand of grass as specified. If necessary, the Contractor shall repeat any or all of the work, including grading, fertilizing, watering, and seeding or sodding until a satisfactory stand is obtained.
- B. Satisfactory Stand
  - For purposes of grassing, a satisfactory stand of grass is herein defined as a full lawn cover of the predominant vegetative species existing prior to the beginning of the Work over areas to be seeded or sodded, with grass free of weeds, alive and growing, leaving no bare spots larger than 1 sq. yd. within a radius of 10 feet.
- C. If a satisfactory stand of grass has not been obtained within a reasonable period of time, the Engineer shall instruct the Contractor in writing that the vegetative cover is not adequate and that additional measures as determined by the Engineer, including installation of sodding on areas previously treated with seed applications, shall be undertaken by the Contractor to establish the required satisfactory stand of grass.

##### 1.03 REFERENCE

- A. All work shall conform to general requirements and references of the Louisiana Standard Specification for Roads and Bridges, latest edition.

## **PART 2 - MATERIALS**

### **2.01 MATERIALS**

#### **A. Fertilizer**

Fertilizer shall be in accordance with LADOTD Specifications latest revision, Section 718.

#### **B. Seeding**

1. The Contractor shall sow grass seed on all unpaved areas disturbed during construction which do not require sod. All seeding shall be completed in conformance with LADOTD Specifications latest revision, Section 717. The grassed areas shall be mulched and fertilized in accordance with LADOTD Specifications.
2. The following grass species may be established by seeding procedures.
  - a. Hulled Bermuda
  - b. Pensacola Bahia
  - c. Kentucky 31 Fescue
  - d. Crimson Clover

#### **C. Sodding**

1. Sod shall be provided as required in accordance with LADOTD Specifications latest revision, Section 714. The Contractor shall furnish sod equal to and similar in type as that disturbed. Placement and watering requirements shall be in accordance with LADOTD requirements.
2. The following grass species shall be established by sodding procedures:
  - a. Carpet
  - b. St. Augustine
  - c. Centipede
  - d. All other species not listed under Seeding
3. In addition to the above list, the following areas shall have vegetative cover restored by sodding procedures irrespective of the grass species.
  - a. Slopes steeper than four (4) horizontal and one (1) vertical.
  - b. Locations subject to concentrations of water flow or erosion including but not limited to roadway ditch bottoms and flume areas where storm water runoff is concentrated.
  - c. Repair of eroded areas within areas previously seeded.

D. Topsoil

Topsoil stockpiled during excavation may be used. If additional topsoil is required to replace topsoil removed during construction, it shall be obtained off site and provided by the Contractor. Topsoil shall be fertile, natural surface soil, capable of providing an adequate growing medium for all trees, plants, and grassing specified herein.

E. Mulch

Mulch shall be in accordance with LADOTD Specifications latest revision, Section 716.

F. Water

It is the Contractor's responsibility to supply all water to the site, as required during seeding and sodding operations and through the maintenance period and until the work is accepted. The Contractor shall make whatever arrangements may be necessary to ensure an adequate supply of water to meet the needs for his work. He shall also furnish all necessary hose, equipment, attachments, and accessories for the adequate irrigation of lawns and planted areas as may be required. Water shall be suitable for irrigation and free from ingredients harmful to plant life.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

A. Finish Grading

Areas to be seeded or sodded shall be finish graded, raked and debris removed. Soft spots and uneven grades shall be eliminated; the Engineer shall approve the finish grade of all areas to be seeded or sodded prior to application of seed or sod.

B. Time of Seeding and Sodding

When the trench backfill has stabilized sufficiently and for a period of time not to exceed sixty (60) days from the initial removal of the vegetative cover, the Contractor shall commence work on lawns and grassed areas, including fine grading as required and in accordance with the following:

1. Seed for specific grass species shall be placed in accordance with Table 1 of Section 717 of the LADOTD Specifications.
2. Sod may be placed during the period of January through October 20, but no sod shall be placed during the period of October 21 through December 31.

C. Watering

When necessary, additional water shall be applied to seeded and sodded areas, including those locations where trees, shrubs and other vegetative plantings have been replanted or replaced in accordance with the DOTD Standard Specifications, to supplement natural rainfall in accordance with Table A. Water shall be applied with approved sprinkling equipment that will spread the water evenly and in a manner that will not cause erosion of the soil surface. Application of water shall be suspended during any period when temperatures are expected to drop below thirty-five degrees Fahrenheit (35° F) and shall be resumed when the weather

moderates.

D. Protection

Seeded and sodded areas shall be protected against the traffic or other use by placing warnings signs or erecting barricades as necessary. Any areas damaged prior to actual acceptance by the Owner shall be repaired by the Contractor as directed by the Engineer.

**3.02 CLEANUP**

Soil, mulch, seed, or similar materials spilled onto paved areas shall be removed promptly, keeping those areas as clean as possible at all times. Upon completion of seeding and sodding operations, all excess soil, stones, and debris remaining shall be removed from the construction areas.

**3.03 LANDSCAPE MAINTENANCE**

A. Any existing landscape items damaged or altered during construction by the Contractor shall be restored or replaced as directed by the Engineer.

B. Maintain landscape work for a period of at least ninety (90) days immediately following complete installation of the Work or until Owner accepts project. Watering, weeding, cultivating, restoration of grade, mowing and trimming grass, protection from insects and diseases, fertilizing and similar operations as needed to ensure normal growth and good health for live plant material shall be the responsibility of the Contractor and at no additional cost to the Owner.

TABLE A  
WATER REQUIREMENTS FOR ESTABLISHMENT  
OF GROWTH OF GRASS

Vegetative Establishment Method	Growth Period	Amount of Water Required (Inches/Acre)*	Frequency and Duration of Application
Seeding	After Initial Planting	0.25	Daily for first two weeks after planting
Seeding	Establishment of Coverage	1.00	Twice weekly for growth period from fifteen to thirty days after planting
Sodding	March 1 through November 5	0.30	Every other day for the first two weeks after placement
Sodding	March 15 through November 20	0.50	Twice weekly for the growth period from fifteen to thirty days after placement
Sodding	Dormant Period January	1.00	Single application to set the

Seeding and Sodding	1 through last day of February	Maintenance of Growth	1.00	sod then proceed with other applications listed above beginning March 1
				Every other week after completion of above applications to maintain growth and coverage

\* Quality of water is to be measured by providing a rain gauge on the site mounted 6" above ground level and logging both natural rainfall and supplemental watering on at least a daily frequency.

**3.04 REPAIRS TO LAWN AREAS DISTURBED BY CONTRACTOR'S OPERATIONS**

Lawn areas planted under this Contract and all lawn areas damaged by the Contractor's operation shall be repaired at once by proper topsoil backfill, soil preparation, fertilizing, and reseeding or sodding, in accordance with the following:

- A. Areas damaged by placement of excavated material where existing grass is still living and more than fifty percent (50%) of the existing grass is left in place shall be repaired by filling depressions and scars created by equipment tires, tracks, or scarification teeth with topsoil, application of fertilizer over the entire area at the rates prescribed for other vegetative cover, hand raking soil to a uniform grade, and assure application of water at rates required for sodding until adequate regrowth of grass and coverage has been obtained.
- B. Areas damaged by placement of excavated material where existing grass has died or where fifty percent (50%) or more of the existing grass has been removed shall be repaired by excavating the dead and/or remaining material to a uniform grade, placing topsoil to regrade the area to its original topography upon placement where sod is required, preparing the ground surface as required including fertilizing, placing seed or sod as applicable under the above specifications, placing mulch as required, and watering as required for other vegetative cover.
- C. Areas damaged by other material or equipment storage or movement shall be repaired as applicable for areas described above for excavation storage.

END OF SECTION

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## **SECTION 02921**

### **SEEDING AND MULCHING**

#### **PART 1 - GENERAL**

##### **1.01 DESCRIPTION OF WORK**

- A. Work consists of providing all labor, material and equipment for installing grass seed and mulch as indicated below.
  1. The CONTRACTOR shall furnish and spread mulch and furnish and sow grass seed mixtures on miscellaneous fill areas, borrow areas, permanent cut slopes, roadways, trenches and ditches. The limits to which the above described surfaces are to be seeded shall be prescribed by the ENGINEER. Seeding shall include areas where construction operations have removed the existing grass cover, where such areas have otherwise been denuded of grass cover, or where due to other reasons grass seeding is determined to be necessary.
  2. The CONTRACTOR shall maintain the seeded areas until final acceptance thereof and any damage caused to the seeded area shall be repaired by and at the expense of the CONTRACTOR.
  3. Where the grass seed and mulch is intended to replace existing grass, the CONTRACTOR has the option of carefully removing the grass surface, keeping it alive during construction, and replacing it once construction is complete. Areas where the existing surface does not re-take shall be replaced by the CONTRACTOR at no additional cost.

##### **1.02 QUALIFICATIONS**

- A. Work performed as described in this section shall be done under the supervision of a CONTRACTOR having experience in landscape construction.

##### **1.03 REFERENCE STANDARDS**

- A. United States Department of Agriculture (USDA).
- B. State of Louisiana Standard Specifications for Roads and Bridges, 1992 Edition.

##### **1.04 SUBMITTALS**

- A. Guaranteed analysis of lawn seed mixture.
- B. Guaranteed analysis of field grass seed mixture.
- C. Samples of seed mixtures.

##### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver grass seed in original containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging and location of packaging.

Damaged packages are not acceptable.

### 1.06 JOB CONDITIONS

- A. Weather Conditions: Seeding is not permitted during the following conditions:
1. Cold Weather: When air or ground temperature is less than 32 degrees F.
  2. Hot Weather: When air temperatures is greater than 95 degrees F.
  3. Wet Weather: When ground becomes saturated.
  4. Windy Weather: When wind velocity is greater than 30 mph.

## PART 2 - PRODUCTS

### 2.01 SEED MIXTURE

A. Seed

1. Seeds shall be labeled in accordance with USDA Rules and Regulations under the Federal Seed Act.
2. Seed shall conform to requirements of Louisiana Law. The minimum percentage of pure live seed and the maximum percentage of weed seed permitted shall be in accordance with Section 2.01C.
3. Each variety of seed shall be furnished and delivered in separate bags or other containers. Each bag or container shall bear an analysis tag which is a minimum No. 6 standard shipping tag having all information required by the Louisiana Seed Law.

B. Field grass seed mixtures and application rates shall be:

<u>Seed Mixture</u>	<u>Pounds per Acre</u>	<u>Planting Dates</u>
Hulled Bermuda	30	March - September
Hulled Bermuda Crimson Clover	20 25	February - March
Kentucky 31 Fescue Unhulled Bermuda	25 20	September - February
Unhulled Bermuda Crimson Clover	20 40	September - February
Pensacola Bahia	25	March - September
Bald Clover Unhulled Bermuda	25 20	February - March
Vetch (Common)	40	September - October

Unhulled Bermuda	20	
Lespedeza	40	March - May

C. Seed Quality

- The minimum purity of grass seeds that will be acceptable are as follows:

<u>Variety</u>	<u>Minimum Percentage of Pure Live Seed (Purity Times Germination Including Hard Seed by Count)</u>	<u>Maximum Percentage of Weed Seed, by Count</u>
Hulled Bermuda	83	1
Pensacola Bahia	81	2
Crimson Clover	78	1
Kentucky 31 Fescue	80	1
Unhulled Bermuda	80	1
Balled Clover	80	1
Vetch (Common)	80	1
Lespedeza	80	1

- Noxious Weeds: Noxious weeds shall be interpreted to mean that list of weeds, except Bermuda, which has been adopted by the Louisiana Seed Commission as being noxious in Louisiana. Noxious weed seeds shall not exceed the limitations prescribed in the regulations and in no case shall they exceed 500 per pound.

Analysis tags shall be removed from each bag or container only by the ENGINEER or an authorized representative.

- The CONTRACTOR shall furnish suppliers certificate guaranteeing that the seed conforms to the above requirements and USDA certification. Seed shall be delivered to the contract site in unopened containers bearing the USDA and suppliers certificates.

**2.02 TEMPORARY SEEDING**

During construction, temporary seeding shall be placed as directed. Temporary seeding may be any of the types listed or rye grass. Rye grass is the only acceptable grass for winter cover.

**2.03 WATER**

- Water shall be free from oil, acid, alkali, salt and other substances harmful to growth of grass, and shall be from a source approved prior to use.

**2.04 VEGATIVE MULCH**

- Mulch shall consist of pine straw, stems or stalks of oats, rye, rice, or the approved straws. The CONTRACTOR may also use hay obtained from various legumes and greases such as lespedezas, vetches, soybeans, Bermuda, Dallis, carpet sedge, fescue or other approved legumes or grasses of any combination thereof. Straw or hay shall be reasonably dry and free from mold, Johnson grass or other noxious weeds.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Verify that grading has been completely correctly. Notify ENGINEER of any discrepancies; do not proceed with work until discrepancies have been resolved.
- B. Seedbed Preparation: Boulders brought to the surface by construction operations shall be buried at least 6 inches below the ground surface. After the seeding areas have been leveled and compacted to the required thickness, it shall be brought to a friable condition by harrowing or otherwise loosening and mixing to a depth of at least 3 inches.
- C. Notify ENGINEER at least 24 hours prior to planting or seeding operations.

### **3.02 SEEDING**

- A. Sowing Seed:
  - 1. Method: The mixture specified herein shall be sown by drilling with either an approved disc, shoe-type grass drill or by mechanical or hand broadcasting.
  - 2. Drilling Seeding: If the drill seeding method is used, the drill shall be regulated to uniformly distribute the seed at the rate specified herein on the areas to be seeded. Where possible to safely operate equipment as determined by the ENGINEER, drilling shall be done crosswise to the general slope. The drill shall be regulated so that the seed is properly placed in the soil and covered with soil to a depth of 1/2 to 3/4-inch.
  - 3. Broadcast Seeding: In areas inaccessible by methods prescribed in 2 above, the seed may be applied by either mechanical or hand broadcasting. When either of these methods are used, the seed shall be applied separately.
    - a. Mechanical Broadcasting: A mechanical broadcaster of either the centrifugal or pull type similar to fertilizer spreaders are acceptable. Any equipment of this type used for broadcast seeding shall be designed and regulated to ensure that the proper seeding rate per acre specified herein is uniformly applied on areas to be seeded.
    - b. Hand Broadcasting: Seed application may be performed by using an approved hand broadcaster or by broadcasting the seed by hand from a sack or other suitable container. Whichever means is used, the seed shall be uniformly applied at the rates specified herein.
  - 4. Immediately after broadcasting the seed they shall be properly covered with soil to the depths prescribed above by means of a hand rake or float. Covering broadcast seed by dragging a log chain or similar device will not be permitted.

### **3.03 MULCHING**

- A. The CONTRACTOR shall furnish and uniformly place after seeding a minimum of 4 tons per acre (1.6 pounds per square yard) of hay mulch on all seeded areas. Mulching material shall not be applied when in the judgement of the ENGINEER and wind velocity is such as to

prevent uniform distribution of the material. The mulch material shall be firmly anchored with a treader of by other approved methods. Threader shall be operated at a depth of 3 to 4 inches and crosswise to all slopes. Mulch shall be anchored at 6- to 12-inch intervals across the slope.

### **3.04 ESTABLISHMENT**

- A. General: The CONTRACTOR will be responsible for proper care of seeded areas while grass is becoming established for a maintenance period of 6 months after completion of treatment on entire project unless desired cover is established in a shorter period of time and the ENGINEER shortens the responsibility period.
- B. Reseeding: The ENGINEER will designate areas requiring reseeding at least 15 days before specified for reseeding. Reseeding shall occur as specified for original seeding unless written permission is obtained from the ENGINEER.
- C. Watering: Water to ensure uniform seed germination and to keep surface of soil damp. Avoid water puddling.

### **3.05 ACCEPTANCE**

- A. Seeded areas will be accepted at end of maintenance period when seeded areas are properly established and otherwise acceptable.

END OF SECTION

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**DIVISION 3**

**CONCRETE**



## SECTION 03100

### CONCRETE FORMWORK

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION OF WORK

- A. Formwork for cast-in-place concrete, complete with shoring, bracing, and anchorage.
- B. Coordinate installation of items supplied by other sections of work.

##### 1.02 RELATED SECTIONS

- A. Section 03200 - Concrete Reinforcement
- B. Section 03250 – Concrete Accessories
- B. Section 03300 - Cast-in-Place Concrete
- D. Section 03350 – Concrete Finishing

##### 1.03 QUALITY ASSURANCE

- A. Design, construct and erect concrete formwork in accordance with ACI 318 and ACI 347, and applicable construction safety regulations for place of work.

##### 1.04 REFERENCE STANDARDS

- A. American Concrete Institute (ACI)
  - 1. ACI 301 - Specification for Structural Concrete for Buildings.
  - 2. ACI 318 - Building Code Requirements for Reinforced Concrete.
  - 3. ACI 347 - Recommended Practice for Concrete Formwork.

##### 1.05 FALSEWORK, FORM, AND RELATED DRAWINGS

- A. Indicate pertinent dimensioning, methods of construction; materials; arrangement of joints, ties, and shores; location of bracing and temporary supports; schedule of erection; and stripping.
- B. When required by the Engineer, submit drawings and calculations for review. Such review shall not relieve the Contractor of his sole responsibility for form design and any damage due to insufficiency.

#### PART 2 - PRODUCTS

##### 2.01 MATERIALS

- A. Class I: For permanently exposed concrete surfaces, Class I forms shall be constructed with

particular care to assure a high quality type of Engineerural finish of uniform texture free from visible irregularities, patch marks and discolorations and shall be of waterproof synthetic resin bonded plywood, 3/4-inch minimum thickness, specially made for concrete work. The entire surface shall be lightly sanded, if necessary. Face and edges of forms shall be coated with a two-coat system of catalyzed polyurethane resin. Coating shall be applied by roller at the rate of 500 to 550 square feet per unit. Class I forms will be required for all exterior exposed concrete surfaces. Steel forms meeting the surface requirements are acceptable.

**B.** Class II: Formed surfaces not exposed to view such as footings and back-filled walls shall comply with ACI 10.2.1 rough form finish. These forms may be of metal or of smooth planed boards in good condition free from large or loose knots.

**C.** Form Ties:

1. Concealed Locations Where Concrete Is To Be Concealed With Subsequent Work: Snap ties with 1/2-minimum breakback.

2. Exposed Locations Where Concrete Is To Remain Exposed On Exterior Or Interior Spaces: Cone type snap ties with cone about 1-inch in diameter and 1 to 1-1/2 inches deep.

a. Ties shall not be pull out type which can be completely removed from the concrete leaving a hole through the concrete.

3. Submit details of proposed tie system to the Engineer for review prior to construction.

**D.** Miscellaneous:

1. Form Release Agent: Chemical agent guaranteed by manufacturer to be non-staining and not to impair bond of paint or other finish to be applied to concrete surface.

2. Chamfer Strip:

a. Wood: Clear with planed, 45 degree bevel; no defects on bevel surface.

b. Plastic or Rubber: Manufacturer's standard.

## **PART 3 - EXECUTION**

### **3.01 FORMWORK ERECTION**

**A.** Verify, levels, and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

**B.** Construct formwork, shoring, and bracing to meet design and code requirements, so that resultant finished concrete conforms to required shapes, lines, and dimensions. The sole responsibility for form design and for any resulting structural damage due to form failure rests with the Contractor.

- C. Arrange and assemble formwork to permit dismantling and stripping so that concrete is not damaged during its removal.
- D. Align joints and make watertight, to prevent leakage of mortar or disfigured appearance of concrete. Keep form joints to minimum.
- E. Arrange forms to allow stripping without removal of principal shores, where and when these are required to remain in place.
- F. Prior to framing structural members, obtain Engineer's review before framing any openings not indicated on the drawings.
- G. Apply form release agent on formwork in accordance with manufacturer's recommendations. Apply prior to placing reinforcing steel, anchoring devices, and embedded items.
- H. At construction joints, provide shear keys as shown on the drawings.
- I. Earth Forms: Side forms of footing may be omitted and concrete placed directly against excavations. When this is done, provide an additional 1-inch thickness on each side of the minimum design profiles and dimensions shown.

### **3.02 INSERTS, EMBEDDED PARTS, AND OPENINGS**

- A. Provide formed openings where required for pipes, conduits, sleeves, and other work to be embedded in and passing through concrete members.
- B. Locate and set in place items which will be cast directly into concrete.
- C. Coordinate work of other sections and cooperate with trade involved in forming and setting opening, recesses, bolts, anchors, and other inserts. Do not perform work unless specifically indicated on drawings or reviewed prior to installation.
- D. Install embedded items and concrete accessories in accordance with manufacturer's recommendations; straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain. Close temporary ports or openings with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be apparent in exposed concrete surfaces.

### **3.03 TOLERANCES**

- A. Tolerances for uniformity and plumbness are extremely critical to efficient flow control. Maximum variation from plumb shall conform to ACI 301 4.3.

### **3.04 FIELD QUALITY CONTROL**

- A. Inspect and check completed formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastening, wedges, ties, and parts are secure.
- B. Inform Engineer when formwork is complete and has been cleaned to allow for inspection. Obtain review prior to placing reinforcing.

### **3.05 CLEANING**

- A. Clean forms of foreign matter. Remove cuttings, shavings, and debris from within forms. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- B. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out completed forms, except when temperatures will remain above 40 degrees F during placing.

### **3.06 FORM REMOVAL**

- A. Notify Engineer prior to removing formwork.
- B. Do not remove forms, shores, and bracing until concrete has gained sufficient strength to carry its own weight and construction and design loads which are likely to be imposed upon it. Verify strength of concrete by test cylinder results. Forms shall remain in place for a minimum of 48 hours.
- C. Remove formwork progressively and in accordance with code requirements and so that no shock loads or unbalanced loads are imposed on structure.
- D. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against concrete surfaces.
- E. Leave forms loosely in place, against vertical surfaces, for protection until complete removal is reviewed by Engineer.
- F. Store removed forms in manner that surfaces of forms which are to be in contact with fresh concrete will not be damages. Marked or scored forms will be rejected.

END OF SECTION

## SECTION 03200

### CONCRETE REINFORCEMENT

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install all concrete reinforcement including reinforcing steel bars, welded steel wire fabric, support chairs, bolsters, bar supports and spacers as shown on the Drawings and specified herein.

##### 1.02 REFERENCE STANDARDS

- A. CRSI Document 63 – Recommended Practice for Placing Reinforcement Bars.
- B. CRSI Document 65 – Recommended Practice for Placing Bar Supports
- C. ASTM A 185 – Welded Steel Wire Fabric for Concrete Reinforcement
- D. ASTM A 615 – Deformed and Plain Billet – Steel Bars for Concrete Reinforcement
- E. ACI 315 – Manual of Standard Practice for Detailing Reinforced Concrete Structures.

##### 1.03 QUALITY ASSURANCE

- A. All concrete reinforcement work shall be performed in accordance with Concrete Reinforcement Steel Institute (CRSI) Manual of Standard Practice, CRSI Document 63 – Recommended Practice for Placing Reinforcing Bars, and CRSI Document 65 – Recommended Practice for Placing Bar Supports.

##### 1.04 SUBMITTALS

- A. Submit copies of a reinforcing steel placement plan for all structures where reinforcing steel is involved.
- B. Prepare placement plans in accordance with ACI 315.
- C. Indicate reinforcement sizes, spacings, locations, quantities of reinforcing steel, bending schedules, splicing, supporting and spacing devices.
- D. Before placing reinforcing steel, copies of a list of all reinforcing steel showing the location, mark number, size and type bend shall be furnished to the Engineer at the site for his use in administering the contract. Furnishing such lists to the Engineer shall not be construed to mean that the lists will be reviewed for accuracy. The Contractor shall be responsible for the accuracy of the lists and for furnishing and placing all bar reinforcing steel in accordance with the details shown on the Drawings and as specified.
- E. A certified copy of the mill test on each heat number of reinforcing steel used for fabrication showing physical and chemical analysis shall be submitted to the Engineer at the time of shipment.

## **1.05 PRODUCT DELIVERY AND HANDLING**

- A. Reinforcing shall be substantially free from mill scale, rust, dirt, grease, or other foreign matter.
- B. Reinforcement shall be shipped and stored with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same designations as shown on the submitted placing drawings. All in accordance with the Code of Standard Practice of the Concrete Reinforcement Steel Institute (CRSI).
- C. Reinforcing steel shall be stored off the ground and shall be protected from moisture and kept free from dirt, oil, or other injurious contaminants.
- D. Coated reinforcing steel shall be stored on padded wooden or steel cribbing. Coatings damaged by fabrication, handling or installation shall be repaired to conform to the applicable coating specification.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS**

- A. Materials shall be new, be of domestic manufacture and shall conform to the following material specifications.
  - 1. Deformed concrete reinforcing bars: ASTM A 615, Grade 60 or ASTM A 615 Grade 60 supplementary requirement S1 deformed bars as required.
  - 2. Concrete reinforcing bars required on the Drawings to be welded: ASTM A 706.
  - 3. Spiral reinforcement for columns: ASTM A 82 or ASTM A 615, Grade 60.
  - 4. Welded steel wire fabric: ASTM A 185.
  - 5. Welded deformed steel wire fabric: ASTM A 497.
  - 6. Welded plain bar mats: ASTM A 704, Grade 60.
  - 7. Fabricated deformed steel bar mats: ASTM A 184 and ASTM A 615, Grade 60 deformed bars.
  - 8. Galvanized reinforcing bars: ASTM A 767 and ASTM A 615, Grade 60.
  - 9. Plastic protected bar supports: CRSI Bar Support Specifications, Class 1 - Maximum Protection.
  - 10. Stainless steel protected bar supports: CRSI Bar Support Specifications, Class 2 - Moderate Protection.
  - 11. Precast concrete block bar supports: CRSI Bar Support Specifications, precast Blocks with Wires.

12. Tie wires for reinforcement: 16-gauge or heavier, black annealed wire.
  13. Ferrous supports and ties for galvanized reinforcing steel shall be zinc coated.
- B. The following alternate materials are allowed:
1. ASTM A 616 (Rail-steel), Grade 60 deformed bars for ASTM A 615 (Billet-steel), Grade 60 deformed bars.
  2. ASTM A 617 (Axle-steel) Grade 60 deformed bars for ASTM A 615 (Billet-steel), Grade 60 deformed bars.
  3. Selected heats of ASTM A 615, Grade 60 including supplementary requirement S1 deformed bars with a carbon equivalency (C.E.) of 0.55 or less for ASTM A 706.
- C. Mechanical reinforcing steel butt splices if approved by the Engineer shall be positive connecting taper threaded type employing a hexagonal coupler. They shall meet all ACI 318 Building Code requirements. Bar ends must be taper threaded with coupler manufacturer's bar threader to ensure proper taper and thread engagement. Bars shall be to required to manufacturer's recommended value.

Approved connectors are Lenton rebar splices as manufactured by Erico Products, Inc., 34600 Solon Road, Solon, Ohio 44139, (216) 248-0100.

1. Mechanical tension splices shall be designed to produce a splice strength of not less than one hundred twenty-five percent (125%) of the ASTM MJ specified minimum yield strength of the reinforcing.
2. Compression type mechanical splices shall provide concentric bearing from one bar to the other bar and shall be capable of developing the ultimate strength of the reinforcement in compression.

## **2.02 FABRICATION OF REINFORCEMENT**

- A. Fabrication tolerances shall be in accordance with the CRSI, Code of Standard Practice-Fabrication.
- B. Bars shall be cold bent.
- C. Bars shall be bent around a revolving collar having a diameter of not less than that recommended by the CRSI, Code of Standard Practice-Detailing. Hooks shall conform to the same Code.
- D. Bars that are to be butt spliced, placed through limited diameter holes in metal or have a threaded end shall have the applicable end(s) saw-cut.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Surface condition, bending, spacing, and tolerances of placement of reinforcement shall conform to the CRSI, Code of Standard Practice-Field Erection.

B. Except as otherwise indicated on the Drawings, the minimum concrete cover of reinforcement shall be as follows:

1. Concrete cast against and permanently exposed to earth; 3-in.
2. Concrete surfaces in contact with soil, water, sewage, sludge or exposed to the weather; 2-in.
3. Concrete surfaces not in contact with soil, water, sewage, sludge or exposed to the weather:
  - a. Beams, girders, columns: principal reinforcement, ties, stirrups or spirals - 1-1/2-inches
  - b. Walls and bottom steel of slabs - 1-inch
  - c. Shells and top steel of slabs - 3/4-inch

C. Reinforcement which is to be exposed for a considerable length of time after being placed shall be painted with a heavy coat of neat cement slurry, if required by the Engineer.

D. No reinforcing bars shall be welded either during fabrication or erection unless specifically called for on the Drawings, specified herein, or approved in writing by the Engineer. All bars that have been welded, including tack welds, without such approval shall be immediately removed from the work. When welding of reinforcement is approved or called for, it shall conform to the AWS Structural welding Code-Reinforcing Steel, AWS D1.4.

### **3.02 REINFORCEMENT AROUND OPENINGS**

A. Place an equivalent area of steel to that interrupted by an opening, pipe penetration, electrical conduit group or duct penetration around the opening or penetration. The bars shall have sufficient length to develop bond at each end beyond the opening or penetration.

### **3.03 SPLICING OF REINFORCEMENT**

A. Except as otherwise indicated on the Drawings, compression embedment and lap splices shall be minimum 30 diameters, but not less than 12 inches. The lap splice length for column vertical bars shall be based on the smaller bar size.

B. Except as otherwise indicated on the Drawings, tension lap splices shall be in accordance with the applicable tables in the ACI 315 Detailing Manual. Class B splices shall be used when fifty percent (50%) or less of the bars are spliced within the required lap length, otherwise Class C splices shall be used.

C. Except as otherwise indicated on the Drawings, splices in circumferential reinforcement in circular walls shall be Class C splices. Adjacent bars shall not be spliced within the required lap length.

D. Splices in reinforcement for tension tie members and hangers shall be welded to develop, in tension, at least one-hundred-twenty-five percent (125%) of the specified yield strength of the bar. Splices in adjacent bars shall be offset the distance of a Class C splice. Splicing of bars in tension tie members and hangers shall be avoided whenever possible.

- E. Compression type mechanical connectors may be used for No. 9 or larger reinforcing bars in compression if approved in writing by the Engineer. The splice shall include concentric bearing from one bar to the other bar and shall be capable of developing one-hundred-twenty-five percent (125%) of specified yield strength . Splices in adjacent bars shall be offset at least 30 bar diameters.
- F. Splices in welded wire fabric shall be lapped not less than 1-1/2 courses or 12-inches. The spliced fabrics shall be tied together with wire ties at least 24-inches on center.

### **3.04 ACCESSORIES**

- A. The Contractor is solely responsible for determining, providing and installing accessories such as chairs, chair bars, and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the steel and the placement of concrete and to provide spacings of bars with adequate cover as shown on the Drawings or specified herein.
- B. Precast concrete blocks with wires shall be used where the reinforcing steel is to be supported over soil.
- C. Stainless steel protected bar supports shall be used to firmly hold vertical reinforcement in position.
- D. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if accepted by the Engineer.

### **3.05 INSPECTION**

- A. In no case shall any reinforcing steel be covered with concrete until the amount and position of the reinforcement has been observed by the Engineer and his permission given to proceed with placement of the concrete. The Engineer shall be given ample prior notice of the availability of set reinforcement for his review.

END OF SECTION

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## SECTION 03250

### CONCRETE ACCESSORIES

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required to make all joints tight in the concrete as detailed on the Drawings and as specified herein.

##### 1.02 RELATED SECTIONS

- A. Section 03100 – Formwork
- B. Section 03200 – Concrete Reinforcement
- C. Section 03300 – Cast-in-place Concrete
- D. Section 03350 – Concrete Finishing

##### 1.03 SUBMITTALS

- A. Manufacturer's product data for all materials required to establish compliance with these Specifications shall be submitted for review and approval of the Engineer.

#### PART 2 - PRODUCTS

##### 2.01 MATERIALS

- A. Waterstops shall be of the highest grade virgin polyvinyl chloride (PVC) meeting the latest revision of Corps of Engineers' Specification CRD-C-572. No scrap or reclaimed PVC shall be used in the compound. Waterstops required for expansion joints shall be 9 inches in width, 3/8-inch in web thickness dumbbell type with 3/4-inch I.D. center bulb, capable of withstanding a hydrostatic pressure of 150 feet. Waterstops required for all other joint conditions shall be 6-inches in width, 3/8-inch in web thickness, dumbbell type capable of withstanding a hydrostatic pressure of 125 feet. Manufacturers meeting the geometry and specifications are: Greenstreak Plastic Products, Box 7139, St. Louis, Missouri 63177, (314) 225-9400, Style No. 748 for the 6-inch by 3/8-inch and style 753 for the 9-inch by 3/8-inch; Vinylex Corporation, P.O. Box 7187, Knoxville, Tennessee 37921, (615) 690-2211, Catalog No. D6-38 for the 6-inch by 3/8-inch and DB9-38 for the 9-inch by 3/8-inch or equal. Other products shall not be used without prior review and acceptance by the Engineer. Rubber waterstops meeting the latest revision of Corps of Engineers' Specification CRD-C-513 will be considered equal.
- B. Premolded joint filler (PJF) for interior expansion joints shall be self-expanding cork consisting of preformed strips that have been formed from clean granulated cork particles securely bound together by a synthetic resin of an insoluble nature. The PJF shall be capable of expanding 140 percent of its original thickness, which shall be 3/4-inch unless shown otherwise on the Drawings. The PJF shall meet the specification requirements of the

latest revision of Corps of Engineers' Specification CRD-C-509, Type III and ASTM D 1752 Type III. Manufacturers meeting the specification requirements are: Sealtight Projects by W. R. Meadows, Inc., P.O. Box 543, Elgin, Illinois 60120, (312) 683-4500 and Tex-Mastic Products by J & P Petroleum Products, Inc., P.O. Box 4206, Dallas Texas 75208, (214) 331-5401 or equal. Other products shall not be used without prior review and acceptance by the Engineer.

- C. Premolded joint filler (PJF) for exterior expansion joints between concrete slabs and structural walls, where specifically shown on the Drawings shall be asphalt impregnated fiberboard conforming to the latest revision of ASTM D 1751. Thickness of the PJF shall be 3/4-inch unless otherwise shown on the Drawings. Manufacturers meeting the specification requirements are: Sealtight Products by W. R. Meadows, Inc., P.O. Box 543, Elgin, Illinois 60120, (312) 683-4500 and Tex-Mastic Products by J & P Petroleum Products, Inc., P.O. Box 4206, Dallas Texas 75208, (214) 331-5401 or equal. Other products shall not be used without prior review and acceptance by the Engineer.
- D. Backer-rod shall be high-grade extruded closed-cell polyethylene foam that is completely compatible with polysulfide and urethane type sealants. Backer-rod shall also be ultraviolet stable, resistant to oils, chemicals, ozone and weathering. The size of the rod shall be 1-inch diameter for 3/4-inch wide joints. To the extent possible only full length rods shall be used; splices shall be minimized. Acceptable manufacturers are: Sonofoam by Sonneborn Building Products, 7711 Computer Avenue, Minneapolis, Minnesota 55435, (612) 835-3434 and Tex-Mastic Products by J & P Petroleum Products, Inc., P.O. Box 4206, Dallas, Texas 75208, (214) 331-5401. Other products shall not be used without prior review and acceptance by the Engineer.
- E. Mastic used to prevent bond at joints indicated on the Drawings shall be by Sika Corporation, Box 297, Lyndhurst, New Jersey 07071, (201) 933-8801, Five Star, or approved equal. Primer shall be as recommended by the manufacturer.
- F. Materials for forming joints and load transfer devices for installation in street and roadway pavement slabs shall be in accordance with LADOTD Specifications, Section 601.10.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install waterstops for all joints indicated on the Drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided. Splices shall be made by welding in accordance with the manufacturer's recommendations, subject to acceptance of the Engineer. The finished splices shall provide a cross-section that is dense and free of porosity. If rubber waterstops are used, provide factory formed corners, intersection pieces, splicing unions and approved joint cementing compounds.
- B. To properly secure waterstops before concrete is poured, drill holes in waterstops just below the bulb and center the waterstop in the joint. Tie to reinforcing steel with 16 gauge black annealed steel tying wire as specified in Section 03200 and secure in place so that the waterstop will be normal to the joint.
- C. The spacing of the ties shall match the spacing of the reinforcing, but need not be spaced less than 12 inches on center. The ties shall be secured to the reinforcing such that the waterstops will remain in the required position during concrete placement.

- D. Premolded joint fillers shall be installed at all locations shown on the Drawings. Exterior asphalt impregnated fiberboard expansion joints do not require a joint sealer, but shall stop 3/4-inch from the concrete surface. Interior expansion joints shall be sealed.
- E. All control joints shall be coated with mastic to prevent bond. Mastic shall be applied in strict compliance with the manufacturer's instructions.
- F. Joints, joint forming devices, and load transfer devices for street and roadway pavement shall be installed in accordance with the requirements of LADOTD Specifications, Section 601.10, and the typical details required in the LADOTD Standard Plans.

END OF SECTION

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## SECTION 03300

### CAST-IN-PLACE CONCRETE

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required to place all cast-in-place concrete, reinforcing steel, forms, waterstops and miscellaneous related items, including sleeves, reglets, anchor bolts, inserts and embedded items, as shown on the Drawings and as specified.

##### 1.02 GENERAL DESCRIPTION

- A. Concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, water and admixtures as specified and shall be ready-mixed concrete produced by a plant acceptable to the Engineer. All constituents, including admixtures, shall be batched at the central batch plant.
- B. All work shall comply with the latest edition of ACI Specifications 301, 318 and 350.
- C. All testing and inspection services required shall be provided by the Owner. The cost of such work, except as specifically stated otherwise, shall be paid for by the Owner. Methods of testing shall comply in detail with the latest applicable ASTM Methods.
- D. Samples of constituents and of concrete as-placed will be subjected to laboratory tests. All materials incorporated in the Work shall conform to accepted samples.
- E. Under special circumstances, the Engineer may allow minor deviations from the material requirements specified, provided that the resulting concrete quality is not adversely affected or that a suitable adjustment in cement content is made to compensate for such deviations

##### 1.04 REFERENCED STANDARDS

- A. ACI 301 – Structural Concrete for Buildings
- B. ACI 318 – Building Code Requirements for Reinforced Concrete
- C. ACI 350R – Environmental Engineering Structures
- D. ASTM C33 – Concrete Aggregates
- E. ASTM C150 – Portland Cement
- F. ASTM C260 – Air Entraining Admixtures for Concrete

##### 1.05 SUBMITTALS

- A. The Contractor shall submit to the Engineer for approval a proposed design mix for each concrete strength and type required by these specifications. Information to be submitted for each type and strength shall include the following items:

1. Sources of concrete mix design components including coarse aggregate, fine aggregate, cement, water, admixtures, and pozzolans where included.
  2. Concrete mix design
    - a. Constituent quantities per cubic yard.
    - b. Water content: gallons/100 pounds cementitious materials.
    - c. Cement: type, manufacturer, and chemical analysis.
    - d. Mix design slump.
    - e. Average laboratory cylinder strength test results at 28-days for concrete mix design (include standard deviation). Provide results of seven and 14 day tests if available.
  3. Laboratory sieve analysis and mechanical properties for coarse and fine aggregate.
  4. Admixture types and chemical compositions. (Include certification of compliance with ASTM reference standards and confirmation of any supplementary requirements included in these Specifications.)
- B. An additional mix design for each type and strength of concrete to be placed by pumping shall be submitted to the Engineer for approval.
- C. Failure to include any item of information noted in Article 1.04 A for a given concrete strength or type shall be cause for requirement of a resubmittal by the Engineer.
- D. The Contractor shall submit to the Engineer for acceptance, as provided in Section 01340, shop drawings showing placement of all joints of plywood forms, and rustications.
- E. Concrete mix designs including fly-ash will not be acceptable.

### 1.06 QUALITY ASSURANCE

- A. The actual acceptance of aggregates and development of mix proportions to produce concrete complying with the specific requirements of this Section shall be determined by means of prior laboratory tests made with the constituents to be used on the Work.
- B. Well in advance of placing concrete, the Contractor shall discuss with the Engineer the proposed source of materials and concrete mixture which he proposes to use. He shall furnish samples of aggregate and cement for testing, deliver them to the laboratory designated by the Engineer, and permit ample time for the laboratory to develop a proposed design mix or to modify the design of the mix within the limits of these Specifications.
- C. The following limiting strengths, water contents and cement factors shall apply.

Table 03300-1

Minimum Compressive Strength, f'c (psi at 28 days)	Maximum Water Content* (gals./100 lbs.)	Net Minimum Cement Factor** (100 lbs./c.y.)
2500	7.4	4.30

3000	6.2	5.64
4000	5.9	5.64
4000 @ 7 days	4.5	6.58

\* Maximum: decrease if possible. This represents total water in mix at time of mixing, including free water on aggregates and water in admixture solutions.

\*\* Minimum: increase as necessary to meet other requirements. These cement factors apply to "controlled" concrete subject to specific inspection.

1. Minimum cement content shall be as shown in Table 03300-1. The Contractor shall increase cement content as required to meet strength requirements.
2. When high early-strength Portland cement is permitted, the same strength requirements shall apply except that the indicated strengths shall be attained at seven days instead of 28 days.
- D. If, during the progress of the work, it is impossible to secure concrete of the required workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the desired properties. All changes so ordered shall be made by the Contractor.
- E. If, during the progress of the work, the Contractor desires to use materials other than those originally accepted or if the materials from the sources originally accepted change in characteristics, the Contractor shall make new acceptance tests of aggregates and establish new design mixes. Such testing and design shall be accomplished with the assistance of a testing laboratory acceptable to the Engineer.
- F.. Consistency of the concrete as measured by the ASTM C 143, shall be as shown in Table 03300-2.

Table 03300-2

Portion of Structure	Recommended	Slump (inches) Range
Pavement and slabs on ground	2	1-3
Plain footings, gravity walls, slabs and beams	2-3	1-4
Heavy reinforced foundation walls and footings	3-4	2-5
Thin reinforced walls and columns	4	3-5

Concrete shall be of a consistency which can be readily worked into the corners and angles of the forms and around the reinforcement, inserts, and wall castings without permitting materials to segregate or free water to collect on the surface. Consideration shall be given to the proposed methods of placing and compacting in establishing the consistency of the concrete.

- G. Entrained air as measured by ASTM C 231 shall be as indicated in Table 03300-3.

Table 03300-3

Concrete Placement	Total Air Measured at Discharge from Truck (%)
Finished slabs	3.0 maximum
All other	3.5 - 5.0

If the air entraining agent proposed for use in the mix requires testing methods other than ASTM C 231 to accurately determine air content, make special note of this requirement in the admixture submittal required under Article 1.04.

**1.07 ACCEPTANCE TESTS**

- A. The actual proportioning of cement, aggregates, and water necessary to produce concrete complying with the requirements of Table 03300-1, shall be determined by tests made with representative samples of the materials to be used for the Work. Tests shall be made by a testing laboratory selected by the Owner and approved by the Engineer. Testing shall comply with ASTM C 39.
- B. Cement shall be tested to certify compliance with the requirements of this Specification. Methods of testing shall comply with the appropriate Specifications, but the place, time, frequency, and method of sampling will be determined by the Engineer in accordance with the particular need.
- C. Samples of fine and coarse aggregates shall be furnished for examination and testing at least three weeks before the Contractor proposes to use them in the work.
- D. Water content of the concrete shall be based on a curve showing the relation between water content and seven and 28-day compressive strengths of concrete made using the proposed

materials. The curves shall be determined by four or more points, each representing an average value of at least three test specimens at each age, and shall have a range of values sufficient to yield the desired data, including all the compressive strengths called for on the Drawings, without extrapolation. The water content of the concrete to be used, as determined from the curve, shall correspond to the following test strengths of the laboratory trial mixtures:

Table 03300-4

Design strength**	7 Days*	Min. Lab. Strength 28 Days
2500 psi	2000 psi	2900 psi
3000 psi	2500 psi	3400 psi
4000 psi	3500 psi	4600 psi
4000 psi @ 7 days	4000 psi	5600 psi

\* May be employed for preliminary designs

\*\* To be used for final designs

- E. In no case, however, shall the resulting mix conflict with the limiting values for maximum water content and net minimum cement factor as specified in Table 03300-1.
- F. Testing under Section 1.05 to establish conformity of the various concrete mix components and the mix design with the provisions of this Specification shall be at the Contractor's expense.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Materials shall comply with these Specifications and any State or local specification requirements.
- B. Cement for all cast-in-place concrete shall be domestic Portland cement (ASTM C 150, Type II) or high early strength Portland cement (ASTM C 150, Type III). Air entraining cements shall not be used. Cement brands shall be subject to approval by the Engineer.
  1. For all hydraulic and below grade structures use Type II cement.
  2. High early strength cement shall be used only after obtaining written approval from the Engineer.
  3. Use only Portland cement produced at locations approved and listed in the Qualified Products List of LADOTD.
- C. Aggregates
  1. Fine aggregate shall consist of washed inert natural sand conforming to the requirements of LADOTD Specifications, Section 1003.02, and the following detailed requirements:

a. Gradation:

Sieve (ASTM Specification E11)	Percentage Passing
3/8 inch	100%
No. 4	95 - 100%
No. 16	45 - 90%
No. 50	7 - 30%
No. 100	0 - 7%
No. 200	0 - 3%
Fineness Modulus	2.60 - 3.00
Organic	See ASTM C 33
Silt	2.0% maximum
Mortar Strength Section 10	95% minimum as per ASTM C 87
Soundness	8% maximum loss, using magnesium sulfate, subjected to 5 cycles

2. Coarse aggregate shall consist of well-graded crushed stone or washed gravel conforming to the requirements of LADOTD Specifications Section 1003.02, and the following detailed requirements.

Organic	See ASTM C 33
Silt	1.0% maximum
Soundness	8% maximum loss, using magnesium sulfate, subjected to 5 cycles

3. Maximum coarse aggregate size shall be:

- 2-inch for mass concrete
- 1-inch for reinforced section 10-inches and over in thickness
- 3/4-inch for reinforced sections less than 10-inch thickness

The "Designated Size" and the corresponding gradations shown represent the end or combined gradation of the coarse aggregate to be used in the final concrete.

D. Water

1. Water shall be clean and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.
2. Mortar specimens made with the water under examination and normal Portland cement shall have at least one-hundred percent (100%) of the strength of similar specimens made with distilled water when tested for 28-day strength in accordance with ASTM C 87.
3. Potable tap water will normally fulfill the requirements noted. Water from all other sources shall be tested and approved before use and shall not contain impurities in excess of the following limits:
  - a. Acidity or alkalinity calculated in terms of calcium carbonate: 0.05%

b. Total organic solids: 0.05%

c. Total inorganic solids: 0.08%

d. Total chlorides as sodium chloride: 0.05%

**E. Admixtures**

1. A water reducing agent such as Pozzolith, WRDA or approved equal shall be used in all concrete. The admixture shall comply with ASTM Specification C 494, Type A or Type D, shall contain no chlorides, shall be non-toxic after thirty (30) days, and shall be compatible with the air entraining admixtures. Proportioning and mixing shall be as recommended by the manufacturer.

2. Admixtures causing accelerated setting of cement in concrete shall not be used.

3. Air entraining admixtures compatible with the concrete mix shall be used in moderation along with the water reducing agent to obtain the specified percent air in the resultant concrete.

F. Non-Shrink Cement Grout: Non-shrink cement grout shall consist of cement, aggregate and additives formulated to meet the following volume change requirements. Early volume change (within 24 hours) as tested by ASTM C 827 shall be limited to zero percent (0%) shrinkage and four percent (4%) maximum expansion. Long term volume change of hardened non-shrink cement grout (after 1 day of cure) shall conform to the Corps of Engineers' Specification for Non-Shrink Grout, CRD-C621-82B. Shrinkage shall be zero percent (0%) and expansion limited to a maximum of 0.4 percent volume change. Cement additives required to meet this specification shall be recommended by the grout manufacturer, but shall be non-staining and non-metallic. Grout shall be equal to "Five Star" products by the U.S. Grout Corporation, Sika, or equal.

G. Non-Shrink Epoxy Grout: Non-shrink epoxy grout shall meet plastic volume changes within the first four hours of zero percent (0%) shrinkage and four percent (4%) maximum expansion as tested by ASTM C 827. Restrained hardened epoxy grout shall have 0 percent shrinkage as tested by ASTM C 531. Epoxy grout shall have zero percent (0%) expansion in volume change after set under constant temperature conditions. Epoxy grout shall be one-hundred percent (100%) solids formulated with resin, hardener and aggregate as recommended by the manufacturer. Epoxy grout shall be equal to "Five Star" Epoxy products manufactured by the U.S. Grout Corporation, Sika or equal.

H. Bonding agents shall conform to ASTM C 881, 2-component, 100% solids, moisture insensitive structural epoxy adhesive. Poly sulfide type epoxies are not acceptable. Acceptable products include "Sikadur 32 Hi-Mod" by Sika Corp, Five Star or equal.

**PART 3 - EXECUTION**

**3.01 MEASURING MATERIALS**

A. Measure materials by weighing except as otherwise specified or where other methods are specifically authorized by the Engineer. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. Scales shall have been certified by the local Sealer of Weights and Measures within one year of use and a copy

of the certification shall be delivered to the Engineer prior to beginning of placement of concrete. The accuracy of all weighing devices shall be such that successive quantities can be measured to within one percent (1%) of the desired amount.

- B. Cement and each type of aggregate shall be weighed separately. Cement in standard packages (sacks) need not be weighed, but bulk cement and fractional packages shall be weighed.
- C. Water shall be measured by volume or by weight. The water-measuring devices shall be capable of control to one-half (2%) percent accuracy. All measuring devices shall be subject to approval by the Engineer.
- D. Admixtures shall be dispensed either manually with use of calibrated containers or measuring tanks, or by means of an automatic dispenser approved by the manufacturer of the specific admixture.

### **3.02 MIXING**

- A. Concrete shall be ready-mixed concrete by equipment acceptable to the Engineer. No hand-mixing will be permitted. Adding water in controlled amounts during the mixing cycle shall be done only with the express approval of the Engineer and under his direction. The amount of water added shall be shown on each delivery invoice.
- B. Ready-mix concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of rated capacities for the respective conditions as stated on the name plate. Discharge at the site shall be within 1-1/2 hours after water was first introduced to the mix.
- C. Fill central plant and rolling stock equipment and methods shall comply with the latest Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers' Bureau of the National Ready-Mixed Concrete Association, as well as ACI Standard 318 Section 5.2, and ASTM C 94.
- D. Retempering of concrete or mortar which has partially hardened (that is, mixing with or without additional cement, aggregate, or water) will not be permitted.
- E. Attention is called to the importance of dispatching trucks from the batching plant so they arrive at the site of the work just before the concrete is required, thus avoiding excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms.

### **3.03 FIELD TESTS**

- A. Sets of three (3) field control cylinder specimens will be taken at random by the Engineer during the progress of the Work, in compliance with ASTM C 31; the total number of specimens taken on the project shall average one (1) set per 100 cubic yards, and not less than one (1) set of specimens shall be taken on any one day. When average 28-day compressive strength of control cylinders in any set falls below the required compressive strength or below proportional minimum seven-day strengths (where proper relation between seven and 28-day strengths have been established by tests), proportions, water content, or temperature conditions shall be changed to achieve the required strengths.
- B. The Contractor shall cooperate in the making of tests by allowing free access to the work for

the selection of samples, providing an insulated closed curing box for specimens, affording protection to the specimens against injury or loss through his operations, and furnishing material and labor required for the purpose of taking concrete cylinder samples. All shipping of specimens will be paid for by the Owner. Curing boxes shall be acceptable to the Engineer.

- C. Slump tests and concrete cylinders will be made in the field by the Owner's laboratory technician.
- D. Air entrainment shall be measured by the Owner's laboratory technician at the time of concrete deposit in compliance with ASTM C 231.

### **3.04 INSPECTION AND CONTROL**

- A. The preparation of forms, placing of reinforcing steel, conduits, pipes, and sleeves, batching, mixing, transporting, placing, and ring of concrete shall be all times under the inspection of the Engineer.
- B. The Contractor shall advise the Engineer of his readiness to proceed at least 24 hours prior to each concrete placement. The Engineer will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing and the alignment and tightness of formwork. No placement shall be made without the inspection and acceptance of the Engineer.

### **3.05 CONCRETE APPEARANCE**

- A. Concrete for the Work shall provide a homogeneous structure which, when hardened, will have the required strength, durability and appearance.
- B. Formwork, mixtures and workmanship shall be such that concrete surfaces, when exposed, will require no finishing.
- C. When concrete forms are stripped, the concrete surface when viewed in good lighting from 10-foot away shall be pleasing in appearance, and at 20-foot shall show no visible defects.

### **3.06 FORMS**

- A. Forms shall be used for all cast-in-place concrete, including footings. Forms shall be constructed and placed so the resulting hardened concrete will conform to the shape, lines, dimensions, appearance, and elevations indicated on the Drawings. The Engineer shall have the right to approve or reject material for use in the construction or fabrication of formwork.
- B. Forms for all exposed exterior and interior concrete walls shall be Type A-C exterior grade plywood with the "A" veneer turned to the casting side. Rustications shall be as located and detailed on the Drawings. Moldings for chamfers and rustications shall be milled and planed smooth.
- C. Forms for all other cast-in-place concrete shall be made of wood, metal, or other acceptable material. Wood forms shall be constructed of sound lumber or plywood of suitable dimensions, free from knotholes and loose knots. where used for exposed surfaces, boards shall be dressed and matched. Plywood shall be sanded smooth and fitted with tight joints between panels. Metal forms shall be of an acceptable type for the class of work involved

and of the thickness and design required for rigid construction.

- D. Edges of all form panels in contact with concrete shall be flush within 1/32-inch and forms for plane surfaces shall be such that the concrete will be plane within 1/16-inch in four (4) feet. Forms shall be tight to prevent the passage of mortar, water and grout.
- E. Forms for walls shall have removable panels at the bottom for cleaning, inspecting, and scrubbing-in of bonding paste. Forms for walls of considerable height shall be arranged with tremies and hoppers for placing concrete in a manner that will prevent segregation and accumulation of hardened concrete on the forms or reinforcing above the fresh concrete.
- F. Molding or bevels shall be placed to produce a 3/4-inch chamfer on all exposed projecting corners, unless otherwise noted on the Drawings. Provide similar chamfer strips at horizontal and vertical extremities of all wall placements to produce "clean" separation between successive placements as called for on the Drawings.
- G. Forms shall be sufficiently rigid to withstand vibration and to prevent displacement or sagging between supports. Forms shall be constructed so that the concrete will not be damaged by their removal. The Contractor shall be entirely responsible for the adequacy of the forming system.
- H. Forms, including new pre-oiled forms, shall be oiled before reinforcement is placed, with an approved nonstaining oil or liquid form coating not having a paraffin base.
- I. Before form material is reused, all surfaces in contact with concrete shall be thoroughly cleaned; all damaged places repaired; all projecting nails withdrawn; and all protrusions smoothed. Wood forms shall be pre-oiled before reuse.
- J. Form ties encased in concrete other than those specified in the following paragraph shall be designed so that after removal of the projecting part, no metal shall be within one-inch of the face of the concrete. That part of the tie to be removed shall be at least 2-inch diameter or be provided with a wood or metal cone at least 2-inch diameter and one inch long. Form ties in concrete exposed to view shall be the cone-washer type equal to the Richmond "Tyscru". Throughbolts or common wire shall not be used for form ties.
- K. Form ties for exposed exterior and interior walls shall be as specified in the preceding paragraph except that the cones shall be of approved wood or plastic conforming with the preceding dimensions or as otherwise shown on the Drawings.

### **3.07 PLACING AND COMPACTING**

- A. Unless otherwise permitted, concrete placement begun on any day shall be completed, including finishing, in daylight of the same day.
- B. Place no concrete until reinforcing steel, pipes, conduits, sleeves, hangers, anchors, and other work required to be built into concrete have been inspected and approved by the Engineer. Remove water and foreign matter from forms and excavation. Place no concrete on frozen soil, and provide adequate protection against frost action during freezing weather. All soil preparation below slabs and footings shall be approved by the Engineer before placing concrete.
- C. Transport concrete from mixer to place of final deposit as rapidly as possible by methods

which prevent separation of ingredients and displacement of reinforcement, and which avoid rehandling. Deposit no partially hardened concrete.

- D. "Cold joints" are to be avoided unless called for on the Drawings. If they occur, they are to be treated as bonded construction joints.
- E. At construction joints, the surfaces of the concrete already placed, including vertical and inclined surfaces, shall be thoroughly cleaned of foreign materials, laitance, and weak concrete and roughened with suitable tools to expose a fresh face. At least two hours before and again shortly before the new concrete is deposited, the joints shall be saturated with water. After glistening water disappears, the joints shall be given a thorough coating of neat cement slurry mixed to the consistency of very heavy paste. The surfaces shall receive a coating at least 1/8-inch thick, well scrubbed-in by means of stiff bristle brushes whenever possible. New concrete shall be deposited before the neat cement dries.
- F. Deposit concrete to maintain a horizontal plastic surface. Vertical lifts shall not exceed 24-inches. Vertical lifts of 18 inches are preferable.
- G. Chutes for conveying concrete shall be of U-shaped design sized to insure a continuous flow of concrete. Do not use flat (coal) chutes. Chutes shall be metal or metal-lined and each section shall have approximately the same slope. The slope shall be not less than 25 nor more than 45 degrees and shall be such as to prevent the segregation of the ingredients. The discharge end of the chute shall be provided with a baffle plate or spout to prevent segregation. If the discharge end of the chute is more than five (5) feet above the surface of the concrete in the forms, a spout shall be used, and the lower end maintained as near the surface of deposit as practicable. When the operation is intermittent, the chute shall discharge into a hopper. Chutes shall be thoroughly cleaned before and after each delivery or separate, continuous pour. Debris and any water generated by the cleaning of chutes shall be discharged outside the forms. Concrete shall not be allowed to flow horizontally over distances exceeding five (5) feet.
- H. Pumping of concrete is an acceptable method of placement. The proposed pumping equipment and concrete mix shall be submitted to the Engineer prior to usage for approval.
- I. In thin sections of considerable height, concrete shall be placed using suitable hoppers, spouts with restricted outlets, or other approved methods.
- J. Concrete shall be thoroughly compacted during and immediately after placement using suitable tools. Internal type mechanical vibrators shall be employed to produce the required quality of finish. vibration shall be done by experienced operators under close supervision and shall be of the duration required to produce homogeneity and optimum consolidation without permitting segregation of the solid constituents or "pumping" or migration of air. All vibrators shall be supplemented by proper wooden spades to prevent puddling adjacent to forms and to remove bubbles and honeycomb, especially for the top lifts of walls. All vibrators shall operate at minimum 10,000 rpm. At least one vibrator shall be used for every 10 cubic yards of concrete placed per hour. In addition, one spare vibrator in operating condition shall be on the site.
- K. Concrete slabs on the ground shall be well-tamped into place. Foundation materials shall be wet, tamped, and rolled until thoroughly compacted prior to placing concrete.
- L. Concrete shall be deposited continuously in layers of such thickness that no concrete will be

deposited on concrete which has sufficiently hardened to cause the formation of seams and planes of weakness within the section. If a section cannot be placed continuously, construction joints may be located at points as provided for in the Drawings or as acceptable to the Engineer.

### **3.08 CURING AND PROTECTION**

- A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.
- B. All concrete shall be treated immediately after concrete placing or finishing is completed to provide continuous moist curing above 50° F for at least seven (7) days (fourteen (14) days minimum for water-retaining structures), regardless of the ambient air temperature. Absorptive wood forms remaining in place will not be considered as a satisfactory means of curing. Forms and vertical surfaces shall be covered and kept moist with three layers of continuously saturated burlap, or by other approved means. Horizontal surfaces, slabs, etc. shall be ponded to a depth of 2-inch or kept continuously wet by use of sprinklers. Street pavement, driveways, and sidewalks shall be cured by application of a white pigmented liquid-membrane forming compound applied in strict conformance with LADOTD Specifications , Section 601.12. Liquid-membrane forming compounds shall conform to LADOTD Specifications Section 1011.01.
- C. Cured surfaces and slabs shall be protected from the direct rays of the sun to prevent checking and crazing until the concrete is 28 days old.
- D. Cold Weather Concreting:
  - 1. Concrete placed at air temperature below 40° F shall have a minimum temperature of 60° F. When the air temperature is below 40° F or near 40° F and falling, the water and aggregates shall be heated before mixing. Concrete shall be protected so the temperature at the surface will not fall below 50° F for at least seven (7) days after placing. No salt, manure, or other chemicals shall be used for protection. Overheating or non-uniformity of heating shall be prevented. The surface temperature of the concrete shall not exceed 95° F during heating operations.
  - 2. In cold weather, continuous warm curing (with supplementary heat when required) shall provide a total of 350 day-degrees (i.e., 5 days at 70° F, etc.) of heat.
  - 3. The Contractor shall submit for acceptance by the Engineer a Work Plan describing the methods and procedures he proposes to use for concrete placement and curing during periods with temperatures below 40° F.
- E. Hot Weather Concreting
  - 1. For this Specification, "hot weather" is defined as any combination of high air temperatures, low relative humidity, and wind velocity which produces a rate of evaporation as estimated by Figure 2.1.5 of ACI 305R approaching or exceeding 0.2 lb/ft<sup>2</sup> /hr.
  - 2. Concrete placed during hot weather shall be batched, delivered, placed, cured and protected in compliance with the recommendations of the latest ACI Committee 305 Report and the additional requirements of this Specification.

- a. Temperature of concrete being placed shall not exceed 90 ° F and every effort shall be made to maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall be such that it will cause no difficulties from loss of slump, flash set or cold joints.
  - b. All necessary precautions shall be taken to promptly deliver and place the concrete upon its arrival at the job and to provide vibration immediately after placement.
  - c. The Engineer may direct the Contractor to immediately cover plastic concrete with polyethylene.
3. The Contractor shall submit for acceptance by the Engineer a work Plan describing the methods and procedures he proposes to use for concrete mixing, including cooling or addition of ice to the aggregates, placement, finishing and curing during hot weather periods.

**3.09 REMOVAL OF FORMS**

- A. Except as otherwise specifically authorized by the Engineer, forms shall not be removed before the concrete has cured as specified above in subparagraph 3.08.C and the concrete has attained a strength of at least 30 percent of the ultimate strength prescribed by the design, and not before reaching the following number of day-degrees (whichever is the longer):

Forms For:	Day Degree*
Beams and slabs (spanning or self supporting)	500
walls and vertical surfaces (non-water retaining)	100
walls and vertical surfaces (water retaining)	150
Beams and slabs on grade	50

\*Day-Degree : Total number of days times average daily air temperature at surface of concrete. For example, 5 days at a daily weighted average temperature of 60° F equal 300 day-degrees. Temperatures below 50° F not to be included.

- B. Shores shall not be removed until the concrete has attained at least seventy-five percent (75%) of the specified strength and also sufficient strength to support safely its own weight and any construction live loads that may be placed upon it.

**3.10 FAILURE TO MEET REQUIREMENTS**

- A. Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 03300-1, the Engineer shall have the right to require changes in proportions outlined to apply on the remainder of the Work. Furthermore, the Engineer shall have the right to require additional curing on those portions of the structure represented by the test specimens which failed. The cost of such additional curing shall be at the Contractor's expense. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, the Engineer shall have the right to require strengthening or replacement of those portions of the structure which fail to develop the required strength. The cost of all such core borings and/or load tests and any

strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be entirely at the expense of the Contractor. In such cases of failure to meet strength requirements, the Contractor and Engineer shall confer to determine what adjustment, if any, can be made in compliance with Sections 15 and 17 of ASTM C 94.

- B. When the tests on control specimens of concrete fall below the required strength, the Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C 42 and C 39. In case of failure of the latter, the Engineer, in addition to other recourses, may require, at the Contractor's expense, load tests on any one of the slabs, beams, piles, caps, and columns in which such concrete was used. Test need not be made until concrete has aged 60 days.
- C. Slabs or beams, under load test, shall be loaded with their own weights plus a superimposed load of 2 times design live load. The load shall be applied uniformly over portion being tested in an acceptable manner, and left in position for 24 hours. The structure shall be considered satisfactory if deflection "D" in feet, at end of 24-hour period does not exceed value:  $D = 0.001 L^2/t$  in which "L" is span in feet, "t" is depth of slab or beam in inches.
- D. If deflection exceeds "D" in the above formula, the concrete shall be considered faulty unless within 24 hours after removal of the load, slab or beam under test recovers at least seventy-five percent (75%) of observed deflection.
- E. Should the strength of test cylinders fall below sixty percent (60%) of the required minimum 28-day strength, the concrete shall be rejected and shall be removed and replaced.

### 3.11 PATCHING AND REPAIRS

- A. It is the intent of these Specification to require forms, mixture of concrete and workmanship so concrete surfaces, when exposed, will require no patching.
- B. As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed, recesses left by the removal of form ties shall be filled, and surface defects which do not impair structural strength shall be repaired. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to approval of the Engineer.
- C. Immediately after removal of forms remove plugs and break off metal ties as required by Article 3.06. Holes are then to be promptly filled upon stripping as follows: Moisten the hole with water, followed by a 1/16-inch brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1-1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "bailing"). Hammer the grout into the hole until dense, and an excess of paste appears on the surface in the form of a spiderweb. Trowel smooth with heavy pressure. Avoid burnishing.
- D. When patching or repairing exposed surfaces, the same source of cement and sand as used in the parent concrete shall be employed. Adjust color if necessary by addition of proper amounts of white cement. Rub lightly with a fine Carborundum stone at an age of one to five days if necessary to bring the surface down with the parent concrete. Exercise care to avoid damaging or staining the virgin skin of the surrounding parent concrete. Wash thoroughly to remove all rubbed matter.
- E. Defective concrete and honeycombed areas as determined by the Engineer shall be chipped



Cement 1.0  
Sand 2.0  
Water = 5 gals/200 lbs. cement

- b. Greater than 2-inches to 12-inches in depth

Material Volume

Cement 1.0  
Pea Gravel 2.5  
Sand 2.0  
Water = 5 gals/100 lbs. cement

- c. Greater than 12-inch in depth

Material

Concrete as specified under  
2.01 MATERIALS in this Section

2. Non-shrink Cement Grout - As specified in Articles 2.01 F and 3.11 F in this Section.

3. Epoxy Bonding Agent

- a. Epoxy bonding agent shall be a two component epoxy adhesive specifically formulated for bonding old concrete to new (plastic) concrete. Component A shall be an epoxy resin and Component B shall be epoxy hardener. The epoxy bonding agent shall be "Sikdador 32, Hi-Mod", by Sika Corporation, Lyndhurst, NJ; "Pro Bond 821 or 822" by Protex Industries, Denver CO; "Concrete 1170" by Adhesive Engineering Company, San Carlos, CA; or equal.
- b. The mixing ratio shall be as recommended by the manufacturer for the ambient temperature when placed. Furnish manufacturer's specific instruction for specific job application and obtain Engineer's review prior to purchase.

- c. Epoxy bonding agent shall conform to ASTM C 881 and corresponding tests for bond strength and shrinkage as specified in ASTM C 882, C 883, and C 884.

- d. The properties of the cured material shall meet the following:

Compressive Strength (ASTM D-695)  
48 hour - 1000 psi  
28 day - 7000 psi

Tensile Strength (ASTM D-638)  
7 day - 4000 psi

Bond Strength (ASTM C-882 or C-884) - 1500 psi

- e. Approval requirements The Contractor must furnish notarized certification that the material proposed for use meets all of the above requirements and that the material has been previously used successfully for the purpose describe.
- 4. Non-shrink epoxy grout, when specifically called for on the Drawings, shall be as specified in Article 2.01 F. Proportions of aggregate shall be as recommended by the grout manufacturer for the specific installation.
- C. Demolition of Existing Concrete  
Concrete shown to be removed on the Drawings shall be done by line drilling at limits followed by jack-hammering in areas where concrete is to be taken out. The Contractor shall be responsible for removing concrete in such a manner that surrounding concrete or existing reinforcing to be left in place and existing in place equipment is not damaged. Sawcutting at limits of concrete to be removed shall be done where indicated on the Drawings.
- D. Connection to Existing Concrete
  - 1. Roughen surface of existing concrete to be connected to new materials by sand-blasting, chipping, or scarifying. Thoroughly clean area of concrete to receive new materials of loose particles and dust or other contaminating objects.
  - 2. Existing reinforcing to be left in place as shown on the Drawings shall be wire brushed to remove rust or concrete. The existing reinforcing shall be cut, bent, or lapped to new reinforcing as shown on the Drawings and provided with a minimum of one inch of cover all around and at ends of the bar. The reinforcing shall be thoroughly cleaned of loose particles and dust before incorporating in new materials.
  - 3. Connection Methods
    - a. Method A. After existing concrete surface at connection has been roughened and cleaned as specified above, thoroughly saturate and maintain saturation for a period of at least 12 hours. Brush on a 1/16-inch layer of cement and water mixed to the consistency of a heavy paste. Immediately after application of cement paste, place new concrete or group mixture as detailed on the Drawings.
    - b. Method B. After existing concrete surface has been roughened and cleaned as specified above, apply epoxy bonding agent at connection surface. The field preparation and application of the epoxy bonding agent shall comply strictly with the manufacturer's recommendations. Place new concrete or non-shrink grout to limits shown on the Drawings within time constraints recommended by the manufacturer.
    - c. Method C for Dowels. Drill hole 1-1/2 times the diameter of the dowel. The drilled hole shall first be filled with non-shrink epoxy grout, then dowels shall be inserted by tapping. These holes shall be blown clear of loose particles and dust prior to installing epoxy. Place new epoxy grout mixture to depth shown on the Drawings.
    - d. Method D for Dowels. Dowels and anchor bolts shall be set in existing

concrete by the use of non-shrink cement grout in drilled holes. The diameter of the drilled hole shall be two inches larger than the diameter of the dowel or anchor bolt. The hole shall be thoroughly cleaned and non-shrink cement grout shall be placed in the bottom of hole. The dowel or anchor bolt is then inserted into place and the remaining void is filled by ramming in non-shrink cement grout. The dowel or anchor bolt shall have a minimum of 3/4-inches of grout between it and the drilled side of the hole. If the surface of the grout is to be exposed, the non-shrink grout shall be discontinued 2-inches from the surface and the remaining void filled with mortar matching the existing concrete as near as practical.

- e. Method E. Non-expanding polyester resin/aggregate glass capsule anchor system shall be set in existing concrete by drilling holes to the required depth to develop the full tensile and shear strengths of the anchor material being used. The anchor bolts system shall be installed per the manufacturer's recommendation in holes sized as required. The capsule anchor system shall be equal to Molly Parabond two part stud and capsule system by Emhart, 504 Mt. Laurel Avenue, Temple, PA, or the HVA Adhesive Anchoring System by Ave . Hilti Fastening Systems, Tulsa, OK. The capsule shall consist of a sealed glass capsule containing premeasured amounts of a polyester or vinyl ester resin, quartz sand aggregate, and a hardener contained in a separate vial within the capsule. The anchor stud bolt, rebar or other embedment item shall be tipped with a double 45 degree chamfered point, securely fastened into the chuck of a rotary percussion hammer drill, and drilled into the capsule filled hole. The anchor may be installed in horizontal, vertical and overhead positions.

#### E. Waterstops Set into Existing Concrete

Where waterstops are required to be set into existing concrete, reglets shall be cut as shown on the Drawings. The surface shall be thoroughly cleaned of all debris. The roughened surface shall be kept wet for at least 12 hours in an acceptable manner before pouring new concrete. All free water shall be removed and a layer of cement and water mixed to the consistency of a heavy paste shall be placed to coat the existing concrete. The waterstop shall be bedded in the reglet with non-shrink cement grout prior to placing the new concrete. Where waterstops are called to be placed laying flat against existing concrete, the concrete surface shall be thoroughly cleaned of all debris and the waterstop bonded to the concrete using the epoxy bonding compound specified in Method B above.

- F. Where existing reinforcing is exposed due to saw cutting and removal of existing concrete, a coating or surface treatment of epoxy protectant shall be applied to the entire cut surface. The epoxy manufacturer shall submit to the Engineer for review specifications for the epoxy mortar material to be used. The epoxy protectant shall be formulated for the intended application.

### 3.13 INSTALLATION SCHEDULE

- A. Concrete for structures shall have minimum 28 day compressive strength of 4,000 psi unless noted otherwise on the Drawings or in these specifications.
- B. Concrete fill and duct encasement shall have a minimum compressive strength at twenty-eight (28) days of 2,500 psi.

C. Concrete for street or roadway pavement replacement shall have a minimum compressive strength at seven (7) days of 4,000 psi.

D. Concrete for sidewalks and miscellaneous slabs shall have a minimum compressive 28 day strength of 3,000 psi.

### **3.14 FINISHING OF FORMED SURFACES**

#### **A. General:**

1. After removal of forms, the surfaces of concrete shall be given one or more of the finishes specified below in locations designated by the contract documents.
2. When finishing is required to match a small sample furnished to the contractor, the sample finish shall be reproduced on an area at least 100 sq.ft. in an inconspicuous location designated by the architect/engineer before proceeding with the finish in the specified location.

#### **B. As-Cast Finishes:**

1. Rough Form Finish - No selected form facing materials shall be specified for rough form finish surfaces. Tie holes and defects shall be patched. Fins exceeding **1/4** inch in height shall be chipped off or rubbed off. Otherwise, surfaces shall be left with the texture imparted by the forms.
2. Smooth Form Finish - The form facing material shall produce a smooth, hard, uniform texture on the concrete. It may be plywood, tempered concrete-form-grade hardboard, metal, plastic, paper, or other approved material capable of producing the desired finish. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. It shall be supported by studs or other backing capable of preventing excessive deflection. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface shall not be used. Tie holes and defects shall be patched. All fins shall be completely removed.

#### **C. Rubbed Finishes:**

1. General - The following finishes shall be produced on concrete with a smooth form finish. Where smooth rubbed finish is to be applied, the forms shall have been removed and necessary patching completed as soon after placement as possible without jeopardizing the structure.
2. Smooth Rubbed Finish - Smooth rubbed finish shall be produced on newly hardened concrete no later than the day following form removal. Surfaces shall be wetted and rubbed with carborundum brick or other abrasive until uniform color and texture are produced. No cement grout shall be used other than the cement paste drawn from the concrete itself by the rubbing process.
3. Grout Cleaned Finish - No cleaning operations shall be undertaken until all contiguous surfaces to be cleaned are completed and accessible. Cleaning as the work progresses shall not be permitted. Mix 1 part portland cement and 1 1/2 parts

fine sand with sufficient water to produce a grout having the consistency of thick paint. White portland cement shall be substituted for a part of the gray portland cement in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch. Wet the surface of the concrete sufficiently to prevent absorption of water from the grout and apply the grout uniformly with brushes or a spray gun. Immediately after applying the grout, scrub the surface vigorously with a cork float or stone to coat the surface and fill all air bubbles and holes. While the grout is still plastic, remove all excess grout by working the surface with a rubber float, sack, or other means. After the surface whitens from drying (about thirty minutes at normal temperatures), rub vigorously with clean burlap. The finish shall be kept damp for at least 36 hours after final rubbing.

**D. Unspecified Finish:**

1. General - If the finish is not designated in the contract documents, the following finishes shall be used as applicable.
2. Rough Form Finish - For all concrete surfaces not exposed to public view.
3. Smooth Form Finish - For all concrete surfaces exposed to public view.

**E. Related Unformed Surfaces:**

1. Tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture reasonably consistent with that of the formed surfaces. Final treatment on formed surfaces shall continue uniformly across the unformed surfaces.

**3.15 FINISH OF FLOORS AND SLABS**

- A. Scratched Finish - After the concrete has been placed, consolidated, struck off, and leveled, the surface shall be roughened with stiff brushes or rakes before final set.
- B. Floated Finish - After the concrete has been placed, consolidated, struck off, and leveled, the concrete shall not be worked further until ready for floating. Floating with a hand float or with a bladed power trowel equipped with float shoes, or with a powered disc float shall begin when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation. During or after the first floating, planeness of surface shall be checked with a 10 foot straightedge applied at not less than two different angles. All high spots shall be cut down and all low spots filled during this procedure. The slab shall then be refloated immediately to a uniform sandy texture.
- C. Troweled Finish - The surface shall first be float-finished as specified. It shall next be power troweled, and finally hand troweled. The first troweling after power floating shall produce a smooth surface which is relative free of defects by which may still show some trowel marks. Additional trowelings shall be done by hand after the surface has hardened sufficiently. The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The surface shall be thoroughly Consolidated by the hand troweling operations. The finished surface shall be essentially free of trowel marks and uniform in texture and appearance. On surfaces intended to support floor coverings, any defects of sufficient magnitude to show through the floor covering shall be removed by grinding.

D. Broom or Belt Finish - Immediately after the concrete has received a float finish, it shall be given a coarse transverse scored texture by drawing a broom or burlap belt across the surface.

E. Unspecified Finish:

1. When type of finish is not specified in the contract documents, the following finishes shall be used as applicable:
  - a. Scratched Finish - For surfaces intended to receive bonded applied cementitious applications.
  - b. Floated Finish - For surfaces intended to receive roofing, waterproofing membranes, or sand bed terrazzo.
  - c. Troweled Finish - For floors intended as walking surfaces or for reception of floor coverings.
  - d. Broom or Belt Finish - For sidewalks and garage floors and ramps.

### 3.16 SCHEDULE OF FINISHES

- A. Concrete not exposed to view and not scheduled to receive additional applied finish: Rough Form Finish.
- B. Exterior vertical concrete exposed to view: Smooth Rubbed Finish.
- C. Interior vertical concrete exposed to view except water containment structures: Smooth Rubbed Finish.
- D. Interior vertical concrete in water containment structures: Smooth Form Finish.
- E. Interior and exterior underside of concrete exposed to view: Smooth Rubbed Finish.
- F. Surface of exterior walkways and miscellaneous slabs: Broom Finish.
- O. Surface of water containment slabs which will receive grout topping: Scratched Finish.
- H. Interior concrete floors of sludge dewatering building and office/storage building: Troweled Finish with a light broom texture.

### 3.17 FIELD CONTROL

- A. The Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete quality. The results of tests on such cores shall be the basis for acceptance, ejection or determining the continuation of concrete work.
- B. The Contractor shall cooperate in obtaining cores by allowing free access to the Work and permitting the use of ladders, scaffolding and such incidental equipment as may be required. The Contractor shall repair all core holes. The work of cutting and testing the cores will be at the expense of the Owner, if the cores show that the concrete meets the specified requirements, and at the expense of the Contractor, if the cores show the concrete to be substandard.

### **3.18 LEAKAGE TESTING OF WATER-RETAINING STRUCTURES**

- A. The Contractor will be allowed to use plant effluent water for leakage testing and shall make necessary provisions for routing the water for testing from the chlorine contact basin to the structure being tested.
- B. Testing shall not begin until the structure has been cleaned, all concrete components have attained full design strength, and in no case less than 14 days after all concrete pouring operations for the structure are complete.
- C. Fill structure to maximum operating level and maintain this water surface elevation for a period of 3 days prior to testing. The rate of filling shall be approved by the Engineer.
- D. Delay backfilling of the structure until testing is complete.
- E. Water-Retaining Structures are considered acceptable if:
  - 1. There are no visible leakage or visible damp areas.
  - 2. The volume of leakage rate does not exceed 0.1 percent of tank volume in any 24 hour period.
- F. Structures which fail the leakage test shall be repaired as approved by the Engineer prior to retesting. Repairs and retesting shall be at no additional cost to the Owner.

END OF SECTION

## SECTION 03350

### CONCRETE FINISHING

#### PART1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required to finish cast-in-place concrete surfaces as specified herein.

##### 1.02 RELATED SECTIONS

- A. Section 03100 – Concrete Formwork
- B. Section 03200 – Concrete Reinforcement
- C. Section 03250 – Concrete Accessories
- D. Section 03300 – Cast-In-Place Concrete

##### 1.03 REFERENCED STANDARDS

- A. ACI 301 – Structural Concrete for Building
- B. ACI 318 – Building Code Requirements for Concrete

##### 1.04 SCHEDULE OF FINISHES

- A. Concrete for the project shall be finished in the various specified manners either to remain as natural concrete or to receive an additional applied finish or material under another section.
- B. The base concrete for the following conditions shall be finished as noted and as further specified herein:
  1. Concrete to receive damproofing - Off-form finish, See Article 3.01.D.
  2. Concrete where not exposed in the finished work and not scheduled to receive an additional applied finish or material - Off-form finish. See Article 3.01.D.
  3. Exposed exterior vertical concrete including above grade tank walls and beams - Rubbed finish. See Article 3.01.E.
  4. Interior or exterior horizontal concrete not requiring floor hardener or sealer - Floated finish. See Article 3.02.A.
  5. Concrete for exterior walks, interior and exterior stairs - Broomed finish perpendicular to direction of traffic. See Article 3.02.B.
  6. Concrete on which process liquids flow or in contact with sludge - Steel trowel finish. See Article 3.02.C.
  7. Concrete to receive roofing Steel trowel finish. See Article 3.02.C.

8. Concrete to receive hardener - Wood float finish, non-slip. See Article 3.02.D.
9. Interior horizontal concrete to receive floor sealer - Wood float finish. See Article 3.02.E.
10. Streets and Roadway pavement concrete to receive a drag finish in accordance with LADOTD specifications, Section 601.11, Paragraph G.

#### **1.05 RESPONSIBILITY FOR CHANGING FINISHES**

- A. The surface finishes specified for concrete to receive additional applied finishes or materials are the finishes required for the proper application of the actual products specified. Where, different products are approved for use, it shall be the Contractor's responsibility to determine if changes in finishes are required and to provide the proper finishes to receive these products.
- B. Changes in finishes made to accommodate products different from those specified shall be performed at no additional cost to the Owner. Submit the proposed new finishes and their construction methods to the Engineer for acceptance.

#### **1.06 MANUFACTURER'S SUPERVISION**

The manufacturer of curing compound, sealer or hardener shall make available at no extra cost, upon 72 hours notification, the services of a qualified field representative to make clear to the user the application of the product under prevailing job conditions.

### **PART 2 - PRODUCTS**

#### **2.01 MATERIALS**

Floor hardener shall be FRICTEX H aluminum oxide abrasive aggregate by Sonneborn, Minneapolis, Minnesota or equal as accepted by the Engineer. Floor sealer shall be Kure-N-Seal, acrylic-based, transparent polymer by Sonneborn, Minneapolis, Minnesota or approved equal by W.R. Grace or equal.

### **PART 3 - EXECUTION**

#### **3.01 FORMED SURFACES**

- A. Forms shall not be removed before the requirements of Section 03300, Article 3.09.A have been met.
- B. Care shall be exercised to prevent damaging edges or obliterating the lines of chambers, rustications or corners when removing the forms or doing any other work adjacent thereto.
- C. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to the satisfaction of the Engineer.
- D. Concrete to receive dampproofing, tank interiors, and concrete not exposed in the finished work shall have off-form finish with fins and other projections removed and tie cones and defects filled as specified under Section 03300.

E. Rubbed Finish

1. Immediately upon stripping forms and before concrete has changed in color, all fins shall be carefully removed with a hammer. While the wall is still damp apply a thin coat of medium consistency neat cement slurry by means of bristle brushes to provide a bonding coat within all pits, air holes or blemishes in the parent concrete; avoid coating large areas of the finished surface with this slurry.
2. Before the slurry has dried or changed color, apply a dry (almost crumbly) grout consisting of one part by volume cement to 1-1/2 parts by volume of clean masonry sand having a fineness modulus of approximately 225 and complying with the gradation requirements of the ASTM C-404. Grout shall be uniformly applied by means of damp (neither dripping wet nor dry) pads of coarse burlap approximately, 6-inch square, used as a float. Grout shall be well scrubbed into the pits and air holes to provide a dense mortar in the imperfections to be patched.
3. Allow the mortar to partially harden for one or two hours depending upon the weather. If the air is hot and dry, keep the wall damp during this period using a fine, fog spray. when the grout has hardened sufficiently so it can be scraped from the surface with the perpendicular edge of a steel trowel without damaging the grout in the small pits or holes, cut off all that can be removed with a trowel. Grout allowed to remain on the wall too long will get too hard and will be difficult to remove.
4. Allow the surface to dry thoroughly and rub it vigorously with clean dry burlap to completely remove any dried grout. No visible film of grout should remain after this rubbing. The entire cleaning operation for any area must be completed the day it is started. Do not leave grout on surfaces overnight. Allow sufficient time for grout to dry after it has been cut with the trowel so it can be wiped off clean with the burlap.
5. On the day following the repair of pits, air holes and blemishes, the walls again shall be wiped off clean with dry, used pieces of burlap containing old hardened mortar which will act as a mild abrasive. After this treatment, there shall be no built-up film remaining on the parent surface. If, however, such is present, a fine abrasive stone shall be used to remove all such material without breaking through the surface film of the original concrete. Such scrubbing shall be light and sufficient only to remove excess material without working up a lather or mortar or change the texture of the concrete.
6. A thorough wash-down with stiff bristle brushes shall follow the final bagging or stoning operation in order that no extraneous materials remain on the surface of the wall. The wall shall be sprayed with a fine fog spray periodically to maintain a continually damp condition for at least three (3) days after the application of the repair grout.

**3.02 FLOORS AND SLABS (EXCEPTING STREET PAVEMENT)**

A. Floated Finish:

1. Machine Floating:

Screed floors and slabs with straightedges to the established grades shown on the plans. Immediately after final screening, a dry cement/sand shake in the proportion

of two (2) sacks of Portland cement to 350 pounds of coarse natural concrete sand shall be sprinkled evenly over the surface at the rate of approximately 500 pounds per 1,000 square feet of floor. Neat, dry cement shall not be sprinkled on the surface. When the concrete has hardened sufficiently to support the weight of the power float used without digging in or disrupting the level surface, the shake shall be thoroughly floated into the surface with a heavy revolving disc type power compacting machine capable of providing a 200 pound compaction force distributed over a 24-inch diameter disc. This compacting machine shall be the "Kelly Power Float with Compaction Control" as manufactured by Kelley Industries of SSP Construction Equipment, Inc.; P.O. Box 2038, Pomona, CA 91766; (714) 623-6184, or equal acceptable to the Engineer. Troweling machines equipped with float (shoe) blades that are slipped over the trowel blades may be used for floating. Floating with a troweling machine equipped with normal trowel blades shall not be permitted. The use of any floating or troweling machine which has a water attachment for wetting the concrete surface during finishing of a floor shall act as a mild abrasive. After this treatment, there shall be no not be permitted. Floating should start along walls and around columns and then move systematically across the surface leaving a matte finish.

NOTE: This operation (application of the cement/sand shake) may be eliminated at the discretion of the Engineer if the base slab concrete exhibits adequate fattiness and homogeneity, and the need is not indicated.

2. Hand Floating:

In lieu of power floating, small areas as defined by the Engineer may be compacted by hand floating. The dry cement/sand shake specified in Subparagraph 1 above shall be used unless eliminated by the Engineer. Scream the floors and slabs with straightedges to the established grades shown on the plans. While the concrete is still green, but sufficiently hardened to support a finisher and kneeboards with no more than 1/4-inch indentation, wood float to a true, even plane with no coarse aggregate visible. Sufficient pressure shall be used on the wood floats to bring moisture to the surface.

3. Finishing Tolerances:

Floors and slabs shall be level with a tolerance of 1/8-inch when checked with a 10-foot straightedge placed anywhere on the slab in any direction, except where drains occur, in which case floors shall be pitched to drains such that there are no high spots left undrained. Failure to meet either of the above requirements shall be cause for removal, grinding, or other correction as directed by the Engineer.

B. Broom Finish:

Finish concrete as specified in Article 3.02A and, if required, 3.02D. Then draw a stiff bristle broom lightly across the surface in the direction of drainage, or in the case of walks and stairs, perpendicular to the direction of traffic to provide a non-slip surface.

C. Steel Trowel Finish:

Finish concrete as specified in Article 3.02A and, if required, 3.02D. Then hand steel trowel to a smooth hard even finish free from high or low spots or other defects.

### **3.03 STREET AND ROTARY PAVEMENT SLABS**

Final strike-off, consolidation and finishing of street and roadway pavement slabs shall be performed in accordance with LADOTD specifications, Section 601.11.

### **3.04 APPROVAL OF FINISHES**

- A. All concrete surfaces, when finished, will be inspected by the Engineer.
- B. Surfaces which, in the opinion of the Engineer, are unsatisfactory shall be refinished or reworked until accepted by the Engineer.
- C. After finishing horizontal surfaces, regardless of the finishing procedure specified, the concrete shall be cured in accordance with Section 03300, unless otherwise directed by the Engineer.

END OF SECTION

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# **DIVISION 9**

# **FINISHES**



## SECTION 09900

### PAINTING

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. The work of this section consists of furnishing all materials, labor, equipment and incidentals required and performing all the painting necessary. This section does not cover certain coatings specified for certain materials or surfaces specified elsewhere.
- B. It is the intent of these Specifications to clean, perform surface preparation, and paint all new and existing concrete, exposed miscellaneous metal, doors, frames, transoms, pipe, fittings, valves, new equipment, existing equipment to remain, and all other exposed and submerged work customarily painted unless otherwise clearly specified in the drawings. Priming of equipment and piping is included in the respective equipment and piping sections. All parts of existing structures to remain (ceiling, floor, walls, etc.) are to be cleaned even if these surfaces are otherwise specified to not be painted.
- C. The following surfaces or items will not be painted:
1. Portions of metal, other than aluminum, embedded in concrete. This does not apply to the back face of items mounted to concrete or masonry surfaces which shall be painted before erection. Aluminum to be embedded in concrete shall be coated to prevent electrolysis.
  2. Aluminum hatches, handrails, and toeboards.
  3. Stainless steel, brass, bronze, and aluminum other than exposed tubing.
  4. Piping buried in the ground (except for air piping) or embedded in concrete.
  5. Ducts, pipes, and other miscellaneous items covered with insulation or plastic coated.
  6. Concealed surfaces of pipe or crawl spaces.
  7. Finish hardware.
  8. Manhole frames and covers.
  9. Nonferrous architectural metals, unless specifically noted otherwise.
  10. Electrical switchgear and motor control centers except for touch-up and recoating where factory coatings are unsatisfactory.
  11. Packing glands and other adjustable parts and nameplates of mechanical equipment.
  12. Floors of wet wells and other water holding structures unless specified elsewhere or shown on the drawings.

13. Slabs on grade.
14. Exposed concrete tops of wet wells and valve pits unless otherwise specified elsewhere or shown on the drawings.

### **1.02 QUALITY ASSURANCE**

#### **A. Include on label of paint containers:**

1. Manufacturer's name
2. Type of paint
3. Manufacturer's stock number and batch code
4. Color
5. Instructions for reducing, where applicable
6. Label analysis
7. Federal specification number, if applicable

#### **B. Sampling of Materials**

When requested by the Engineer, obtain test samples of paint material stored at project site or source of supply:

1. 1 qt. - From batches of 50 gallons or less.
2. 2 qts. - From batches over 50 gallons.
3. Select samples at random from sealed containers.

### **1.03 SUBMITTALS**

- A. The Contractor shall submit to the Engineer, as provided in the General Conditions, manufacturers' specifications and printed technical data on the proposed paint systems and detailed surface preparation, mixing, thinning application procedures, and dry film thickness.
- B. Schedule of painting Operations: The Contractor shall submit for approval a complete Schedule of Painting Operations within thirty (30) days after the Notice to Proceed. This Schedule is imperative so that the various fabricators may be notified of the proper shop prime coat to apply. It shall be the Contractor's responsibility to properly notify and coordinate the fabricators' surface preparation and painting operations with these Specifications. This Schedule shall include, for each surface to be painted, the brand name, the volume of solids, the coverage and the number of coats the Contractor proposes to use in order to achieve the specified dry film thickness, and color charts. When the Schedule has been approved, the Contractor shall apply all material in strict accordance with the approved Schedule and the manufacturer's instructions. Wet and dry paint film gauges may be utilized by the Engineer to verify the proper application while work is in progress.
- C. The Contractor shall have available, at all times at the work site, a Nordson Dry Film gauge

or other Engineer approved dry film thickness gauge to be used to inspect the coating thickness by the Contractor during the progress of the work. The gauge shall be made available to the Engineer upon request for dry film thickness inspection.

#### **1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING**

##### **A. Delivery of Materials**

1. Deliver sealed containers with labels legible and intact and with batch codes indicating when the coating was manufactured.
2. Deliver to project site or segregate at source of supply in advance of need so as to allow fifteen (15) days for testing.

##### **B. Storage Materials**

1. Store only acceptable project materials on project site.
2. Store in a protected location at temperatures printed on the container's label.
3. Restrict storage to paint materials and related equipment.
4. Comply with all applicable Federal, state, and local health and fire regulations.
5. No paint shall be stored on site or applied which exceeds the product shelf life at time of application.

#### **1.05 JOB CONDITIONS**

##### **A. Environmental Requirements**

1. Comply with manufacturer's recommendations as to environmental conditions under which painting systems can be applied.
2. Do not apply finish in areas where dust is being generated.

##### **B. Protection**

Cover or otherwise protect finished work of other trades or surfaces not being painted concurrently or not to be painted.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS**

- A. All painting materials shall be fully the equal to those manufactured by the Themec Co.; Carboline, Sherwin Williams Industrial & Marine Coating Division, Ameron or equal. The painting schedule has been prepared on the basis of Themec products (unless otherwise noted) and Themec recommendations for applications. No brand other than those named will be considered for approval, unless the brand and type of paint proposed for each item in the following schedule together with product data is furnished to demonstrate its equality to the paint(s) named submittal shall be in writing to the Engineer for approval within 30 days after

signing the Notice to Proceed. The type and number of tests performed shall be subject to the Engineer's approval.

Minimum standards for testing shall be in accordance with the applicable test methods of the American Society for Testing and Material (ASTM) and Federal Standard No. 141 or other approved methods when not covered by the preceding. All coatings shall meet or exceed NSF Standard 61.

- B. All painting materials shall be delivered to the job site in unbroken packages, bearing the manufacturer's brand and name. They shall be used without adulteration and mixed, thinned, and applied in strict accordance with manufacturer's directions for the applicable materials and surface and with the Engineer's approval before using.
- C. Shop priming shall be done with primers that are specified by the manufacturer to be compatible with the finish paints to be used.
- D. No paint containing lead will be allowed. All thinners used shall be from the coating manufacturer.
- E. Work areas will be designated by the Engineer for storage and mixing of all painting materials. Materials shall be in full compliance with the requirements of pertinent codes and fire regulations. Proper containers outside of the buildings shall be provided and used for painting wastes, and no plumbing fixture shall be used for this purpose.
- F. All recommendations of the paint manufacturer in regard to the health and safety of workers shall be followed.

## **2.02 COLOR CODING FOR PIPES AND EQUIPMENT**

- A. Color coding shall consist of color code painting of all exposed conduits, trough items and pipelines for the transport of gases, liquid and semi-liquids including all accessories such as valves, insulated pipe coverings, fittings, junction boxes, bus bars, connectors and all operating accessories which are integral to the whole functional mechanical pipe and electrical conduit system Color code shall be in accordance with OSHA Standards and as selected by the Owner when OSHA Standards do not govern.
- B. All hangers and pipe support floor stands shall be painted. The system shall be painted up to but not including the flanges attached to the mechanical equipment nor the flexible conduit connected to electrical motors. Colors shall be as referenced above.
- C. All systems which are an integral part of the equipment, that is originating from the equipment and returning to the same piece of equipment, shall be painted between and up to, but not including, the fixed flanges or connections on the equipment.
- D. Once established, a color code defines, and assigns a definite color for each category of pipe. Pipelines, which are not assigned a color under the requirements stated above, shall be assigned a color by the Engineer and shall be treated as an integral part of the Contract.
- E. All pipes, equipment, and accessories shall be painted according to the color codes established by the above listed requirements.

## **2.03 FABRICATED EQUIPMENT**

- A. Unless otherwise indicated below, all fabricated equipment shall be shop primed and field

finished.

- B. All items to be shop primed shall be prepared and primed in accordance with Section 09910. If, in the opinion of the Engineer, any prime coating shall have been improperly applied or if material contrary to these Specifications shall have been used, that coating shall be removed by sandblasting to white metal and reprimed in accordance with these Specifications.
- C. Shop primed surfaces shall be cleaned thoroughly and retouched with the specified primer before the application of successive paint coats in the field.
- D. Shop finish coats may be the standard finish as ordinarily applied by the manufacturer when approved by the Engineer. All pumps, motors, and blowers shall be repainted after installation.
- E. The Contractor shall be responsible for and take whatever steps are necessary to properly protect the shop prime and finish coats against damage from weather or any other cause.
- F. If, in the opinion of the Engineer, a shop finish coat does not give the protection quality of other work of similar nature, the Contractor shall apply additional coats of paint as directed by the Engineer to accomplish the desired protection quality.
- G. Wherever fabricated equipment is required to be sandblasted, the Contractor shall protect all motors, drives, bearings, gears, and related equipment, from the entry of grit. Any equipment found to contain grit shall be promptly and thoroughly cleaned by the Contractor.
- H. Engineer may request proof of purchase of specified materials by the Contractor and/or fabricator if the need arises.

## **2.04 EXTRA PAINT**

- A. Furnish one clearly marked unopened gallon can or equivalent kit, if coating is a catalyzed type coating, of each type and each color of paint used.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION OF SURFACES**

- A. All surfaces to be painted shall be prepared as specified herein and shall be dry and clean and free from all traces of oil, grease, mud, dirt, unspecified paint, and any other foreign substance before painting. Cleaning shall be accomplished by the use of solvents, water, sanding, and wire brushing as appropriate.
- B. All metal welds, blisters, and other defects shall be ground and sanded smooth in accordance with SSPC-SP-3 or in difficult and otherwise inaccessible areas by hand cleaning in accordance with SSPC-SP-2. All Pits and dents shall be filled, and all imperfections shall be corrected so as to provide a smooth surface for painting. All rust and loose scale shall be removed prior to cleaning.
- C. Concrete surfaces shall be finished as specified in Division 3. Unsatisfactory surfaces shall be repaired to the satisfaction of the Engineer. Concrete shall be cleaned to be free of dust, oil, curing compounds, and other foreign matter. Concrete surfaces that will be coated for immersion service shall be brush blasted to uniformly profile the concrete and open bugholes

and voids.

- D. All nonferrous metals specified not to be coated shall be cleaned. This cleaning shall be done in accordance with SSPC-SP-1, Solvent Cleaning.
- E. Concrete block surface shall be smooth and cleaned of all dust, efflorescence, chalk, loose mortar, dirt, grease, oil, tar and other foreign matter.
- F. All plastic pipe surfaces shall be cleaned and lightly sanded before painting.
- G. Exposed Pipe: Bituminous coated pipe shall not be used in exposed locations. Pipe which shall be exposed after project completion shall be primed in accordance with the requirements herein. Any bituminous coated pipe which is inadvertently installed in exposed locations shall be sandblasted clean before priming and painting. After installation, all exterior exposed flanged joints shall have the gap between adjoining flanges sealed with a single component Thiokol caulking prior to priming to prevent rust stains on the finish paint.
- H. Primed or Coated Surfaces: All primed and coated surfaces shall be cleaned prior to application of successive coats.
- I. Shop-Finished Surfaces: All shop-finished painted surfaces shall be protected from damage and corrosion before and after installation by treating damaged areas immediately upon detection. Abraded or corroded spots on shop finished surfaces shall be cleaned in accordance with SSPC-SP-2, Hand Tool Cleaning, and then touched up with the same materials as the shop coat. All shop coated surfaces which are faded, discolored, or which require more than minor touch-up shall be repainted at the direction of the Engineer.
- J. Cut Edges of Galvanized Steel: Cut edges of galvanized sheets and exposed threads and cut ends of galvanized steel piping, electrical conduit, and pipe sleeves shall be solvent cleaned and primed with Themec Series 90-97 Themec-Zinc per manufacturers' directions.
- K. Galvanized and Zinc-Copper Alloy Surfaces: Surfaces shall be solvent cleaned in accordance with SSPC-SP-1. Such surfaces specified not to be painted shall be solvent cleaned only. All non-ferrous metal that will be coated shall be treated with Oakite 747 in accordance with manufacturer's written instructions.

### **3.02 PAINTING SYSTEMS**

- A. All colors will be selected by the Engineer or Owner based on the color numbers contained in the finish schedule and sample color charts to be furnished by the Contractor.
- B. The following types of paints have been used as basis for the paint schedule:
  - 1. Hi-Build Epoxoline (Series 66) - polyamide cured epoxy.
  - 2. Themec -Tar (Series 46-H-413) – coal tar epoxy.
  - 3. Enviro-Fill (Series 130) – cementitious acrylic.
  - 4. H.S. Epoxy (Series 104) – cycloaliphatic amine epoxy.
  - 5. W. B. Themec crate (Series 181) – acrylic emulsion.
  - 6. Endura-Shield (Series 74) aliphatic acrylic urethane.

- 7. Enviro-Crete (Series 156) styrenated acrylate.
- 8. Vinester (Series 120) vinyl ester.
- 9. Pota Pox (Series 20) polyamide epoxy.

C. The following surfaces shall have the types of paint schedule below applied at the dry film thickness in mils per coat (DFM) noted:

1. Exterior non-submerged ferrous metals:

1 Coat	No. 66 Hi-Build Epoxoline	(4 - 6 DFM)
2 Coats	No. 74 Endura-Shield	(2.0 -- 3.0 DFM/coat)

2. Interior non-submerged concrete:

2 Coats	No. 66 Hi-Build Epoxoline	(4.0 - 6.0 DFM/coat)
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3. Interior concrete masonry units:

1 Coat	No. 130	(60-80 sq. ft/gallon)
2 Coats	No. 66 Hi-Build Epoxoline	(4.0 - 6.0 DFM/coat)

4. Interior non-submerged ferrous metals:

2 Coats	No. 66 Hi-Build Epoxoline	(3.0 - 5.0 DFM/coat)
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5. Submerged ferrous metals and ferrous metals subject to submersion or splashing:

1 Coat	No. 46-H-413 Hi Build Tneme Tar	(16.0 - 20.0 DFM/coat)
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NOTE: For potable water, use the following system:

2 Coats	No. 20 Pota Pox	(4.0-6.0 DFM/coat)
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6. Concrete in wet well, influent channels, walkways, stairs and stairwell area:

2 Coats	No. 104 H.S. Epoxoline	(8.0 - 10.0 DFM/coat)
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1 Coat No. 120-5002 Vinester (15.0 – 18.0 DFM/coat)

1 Coat No. 120-5003 Vinester (As required to fill voids)

1 Coat No. 120-5001 Vinester (15.0 – 18.0 DFM/coat)

7. Plastic Piping:

2 Coats	No. 66 Hi-Build Epoxoline	(2.0 - 3.0 DFM/coat)
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8. Copper Pipe:

2 Coats	No. 66 Hi-Build Epoxoline	(2.0 - 3.0 DFM/coat)
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9. Galvanized metals:

Apply a passivator to all surfaces.

Interior - non-submerged

2 Coats	No. 66 Hi-Build Epoxoline	(2.0 - 3.0 DFM/coat)
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Exterior - non-submerged

1 Coat	No. 66 Hi-Build Epoxoline	(2.0 - 3.0 DFM/coat)
1 Coat	No. 74 Endura-Shield	(2.0 - 3.0 DFM/coat)

10. Stainless steel:

Not painted.

11. Pipe insulation:

2 Coats	No. 66 Hi-Build Epoxoline	(3.0 - 5.0 DFM/coat)
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Plastic or metal-sheathed insulation: Paint as scheduled for appropriate substrate.

12. Aluminum (only coat in locations indicated on the Drawings):

Interior - non-submerged

2 Coats	No. 66 Hi-Build Epoxoline	(2.0 - 3.0 DFM/coat)
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Exterior - non-submerged

1 Coat	No. 66 Hi-Build Epoxoline	(2.0 - 3.0 DFM/coat)
1 Coat	No. 74 Endura-Shield-Gloss	(3.0 - 4.0 DFM/coat)

13. Exterior non-submerged concrete:

2 Coats	No. 156 Enviro-Crete	(6 - 8 DFM/coat)
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14. Concrete - Immersion

1 Coat	Xypex concentrate	1.5 lbs/sq.yard
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1 Coat	Xypex modified	1.5 lbs/sq.yard
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### 3.03 WORKMANSHIP

#### A. General:

1. Primer (spot) and paint used for repainting surfaces shall, in general, be as scheduled for that type of new surface. Confirm with the paint manufacturer that the paint proposed for a particular repaint condition will be compatible with the existing painted surface. Sample repainted areas on the actual site will be required to ensure this compatibility. Finished repainted areas shall be covered by the same guarantee specified for remainder of work.
2. At the request of the Engineer, samples of the finished work prepared in accordance with these Specifications shall be furnished, and all painting shall be equal in quality to the approved samples. Finished areas shall be adequate for the purpose of determining the quality of workmanship. Experimentation with color tints shall be performed to the satisfaction of the Engineer where standard chart colors are not satisfactory.
3. Protection of furniture and other movable objects, equipment, fittings and accessories shall be provided throughout the painting operations. Canopies of lighting fixtures shall be loosened and removed from contact with surface, covered and protected and reset upon completion. Remove all electric plates, surface hardware, and related materials before painting, and protect and replace them when completed. Mask all machinery name plates and all machinery parts not to receive a paint finish. Dripped or spattered paint shall be promptly removed. Lay drop cloths in all areas where painting is being done to adequately protect flooring and other work from paint and damage during the operation and until the finished job is accepted.
4. On metal surfaces, apply each coat of paint at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. One gallon of paint as originally furnished by the manufacturer shall not cover a greater area when applied by spray gun than when applied unthinned by brush. Deficiencies in film thickness shall be corrected by the application of additional coats. On masonry, application rates will vary according to surface texture; however, in no case shall manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the Contractor's responsibility to achieve a protective and decorative finish either by decreasing the coverage rate or by applying additional coats of paint.
5. All safety equipment shall be maintained in accordance with OSHA Standards as approved.
6. Paints shall be mixed in proper containers of adequate capacity. All paints shall be thoroughly stirred before use and shall be kept stirred while using. No unauthorized thinners or other materials shall be added to any paint.
7. Only skilled painters shall be used on the work, and specialists shall be employed where required.

B. Field Priming:

1. Steel members, metal castings, mechanical and electrical equipment, and other metals which are shop primed before delivery at the site shall be touched up, prepared, and reprimed to obtain complete primary coverage satisfactory to the Engineer. All piping and other bare metals to be painted shall receive one coat of primer before exposure to the weather, and this prime coat shall be prepared and reprimed as directed by the Engineer.
2. Equipment which has been specified to have a baked-on enamel shop finish or a standard factory finish shall not be field painted unless the finish has been damaged in transit or during installation. Surfaces that have been shop primed and have been damaged or where the shop prime coats or coats of paint have deteriorated shall be properly cleaned and reprimed and/or repainted as directed by the Engineer.

C. Field Painting:

1. All paint shall be applied in environmental conditions that are in accordance with the manufacturers written instructions when the air and surface temperatures are between 60-100 degrees F for epoxies, 50-100 degrees F for acrylic emulsions and 32-100 degrees F for all other coating systems applied, unless coating manufacturer's technical information states otherwise. No paint shall be applied unless the surface and air temperature is 5 degrees above the dew point and rising.
2. Successive coats of paint shall be tinted so as to make each coat easily distinguishable from each other with the final undercoat tinted to the approximate shade of the finished coat.
3. Finish surfaces shall not show brush marks or other irregularities. Undercoats shall be thoroughly and uniformly sanded with No. 00 sandpaper or equal to remove defects and provide a smooth, even surface. Top and bottom edges of doors shall be painted, and all exterior trim shall be back-primed before installation.
4. Painting shall be continuous and shall be accomplished in an orderly manner so as to facilitate inspection. All exterior concrete and masonry painting shall be performed in a continuous manner structure by structure. Materials subject to weathering shall be prime coated as quickly as possible. Surfaces of exposed members that will be inaccessible after erection shall be cleaned and painted before erection.
5. All surfaces shall be brush painted unless spray painting is specifically approved by the Engineer for specific cases in writing.
6. All surfaces to be painted, as well as the atmosphere in which painting is to be done, shall be kept at the above temperatures and dry by heating and ventilation, if necessary, until each coat of paint has hardened. Any defective paint shall be removed and the surface repainted in accordance with the Engineer's direction.
7. Before final acceptance of the work, all damaged surfaces of paint shall be cleaned and repainted as directed by the Engineer.
8. Valves and fittings shall be painted the same color as the pipe.

9. The Contractor shall arrange a meeting at the site prior to the start of painting between the Contractor, his painter, the paint manufacturers, and the Engineer. All aspects of surface preparation and application of the specific paint systems shall be fully reviewed at the meeting.
10. The paint manufacturers shall provide a representative to provide onsite technical assistance to the Engineer and Contractor and to report the findings from the onsite inspection as to surface preparation, application procedures, and dry film thickness to the Engineer on a timely basis unless deemed unnecessary by the Engineer.

#### **3.04 CLEAN-UP**

- A. The premises shall at all times be kept free from accumulation of waste material and rubbish caused by employees or work. At the completion of the painting remove all tools, scaffolding, surplus materials, and all rubbish from and about the work and leave work "broom clean" unless more exactly specified.
- B. Upon completion, remove all paint where it has been spilled, splashed, or splattered on floors, fixtures, equipment, furniture, and all other surfaces, leaving the work ready for inspection.

END OF SECTION

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## SECTION 09910

### SURFACE PREPARATION AND SHOP PRIME PAINTING

#### PART 1- GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required for the surface preparation and application of shop primers on ferrous metals, excluding stainless steels, as specified herein.
- B. This specification does not apply to equipment specified to have shop-finished painting, in which case the manufacturer shall use primers fully compatible with the service environment and finish coats.

##### 1.02 SUBMITTALS

- A. Submit to the ENGINEER for approval manufacturers' specifications and data on the proposed primers and detailed surface preparation, application procedures and dry film thickness.
- B. Submit representative physical samples of the proposed primers, if required by the ENGINEER.

#### PART 2- PRODUCTS

##### 2.01 MATERIALS

- A. All painting materials shall be fully equal to those manufactured by the Inemec Co.; Sherwin-Williams, Ameron or equal. The priming requirements below have been prepared on the basis of Inemec products and the manufacturer's recommendations for applications. No brand other than those named will be considered for approval, unless the brand and type of paint proposed for each item in the following schedule together with product data is sufficient to demonstrate its equality to the paint(s) named submittal shall be in writing to the Engineer for approval within 30 days of the signing of the Notice to Proceed. The type and number of test performed shall be subject to the Engineer's approval. Minimum standards for testing shall be in accordance with the applicable test methods of the American Society for Testing Material (ASTM) and Federal Standard No. 141 or other approved methods when not covered by the preceding.
- B. Submerged Services: Shop primer for ferrous metals which will be submerged or which are subject to splash action or which are specified to be considered submerged service shall be given one coat of Inemec 66-1211 dry film thickness 3.0 to 5.0 mils. Note: For potable water service, the Series 91 H20 Hydrozinc 2000, at a dry film thickness of 2.5 to 3.5 mils shall be used in place of Series 66-1211.
- C. Non-submerged Services: Shop primer for ferrous metals other than those covered by paragraph 2.01B shall be given one coat of Inemec 90-97, dry film thickness 2.5 to 3.5 mils.
- D. Nonprimed Surfaces: Gears, bearings surfaces, and other similar surfaces obviously not to be

painting shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating shall be maintained as necessary to prevent corrosion during all periods of storage and erection and shall be satisfactory to the Engineer up to time of the final acceptance test.

- E. Compatibility of Coating Systems: Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with their corresponding primers and finish coats.

## **PART 3 - EXECUTION**

### **3.01 APPLICATION**

Surface preparation and priming shall be performed as follows:

1. Non-submerged components shall be sandblasted clean in accordance with SSFC-SP-6, Commercial Grade, immediately prior to priming. Submerged components shall be sandblasted clean in accordance with SSPC-SP-10, Near White, immediately prior to priming.
2. Surfaces shall be dry and free of dust, oil grease, dirt, rust, loose mill scale, and other foreign material before priming.
3. Shop prime in accordance with approved paint manufacturer's recommendations.
4. Priming shall follow sandblasting before any evidence of corrosion has occurred and within 24 hours.

END OF SECTION

**DIVISION 13**

**SPECIAL CONSTRUCTION**



## SECTION 13205

### GROUND STORAGE TANK

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION OF WORK

- A. This section of the specifications covers ground storage tanks used for water storage including all appurtenances required to construct a 64,300 gallon ground storage water tank for the Village of Montpelier.

##### 1.02 REFERENCED STANDARDS

The latest revision of the following publications apply to this project.

- A. American Society of Testing Materials
1. ASTM A36, Standard Specification for Structured Steel
  2. ASTM A123, Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel, Shapes, Plates, Bars and Strip
  3. ASTM A153, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality
  4. ASTM A283, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality
  5. ASTM A307, Standard Specification for Carbon Steel Externally and Internally Threaded Standard Fasteners
  6. ASTM A569, Standard Specification for Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial Quality
- B. American Water Works Association
1. AWWA D100, Standard for Welded Steel Tanks for Water Storage
  2. AWWA D102, Standard for Painting Steel Water Storage Tanks
  3. AWWA D103, Standard for Factory-Coated Bolted Steel Tanks for Water Storage
  4. AWWA D105, Standard for Disinfection of Water Storage Facilities
- C. United States Department of Health, Education and Welfare. Public Health Service
1. List of Accepted Equipment for Interstate Carriers Use
- D. American Petroleum Institute
1. API 12B Specifications for Bolted Tanks for Storage of Productions of Liquids

### **1.03 INSPECTION AND REJECTION**

A. Inspection:

The inspector and resident engineer shall have free entry, at all times while work on the contract is being performed, to all parts of the manufacturer's shops which will concern the manufacture of the material ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the material is being manufactured in accordance with this specification.

B. Rejection:

Material which shows injurious defects on mill inspection or subsequent to acceptance at manufacturer's shop or which proves defective when properly applied in service, may be rejected, and the manufacturer so notified.

### **PART 2 - PRODUCT**

#### **2.01 DESCRIPTION**

- A. The work shall consist of the furnishing of all materials, tools, equipment and necessary labor for the design, manufacture, delivery, erection and painting a 64,300 gallon bolted galvanized ground storage water tank of the height and capacity hereinafter specified, complete with appurtenances listed, erected on foundations constructed under this same contract.

#### **2.02 QUALIFICATIONS OF BIDDERS**

- A. Contractors bidding on this work must give evidence of their experience in the class of work involved or must show evidence of experience in similar, though smaller work, together with evidence of financial ability to successfully prosecute the work. This evidence must be in writing and attached to the contractor's proposal. Failure to submit such evidence may be considered as cause for rejection of the proposal.

#### **2.03 MATERIAL**

A. Sheets:

Steel Sheets shall conform to, or shall be at least equal to, hot-rolled commercial quality per ASTM A569, and with a minimum yield strength of 33,000 psi.

B. Plate:

Steel Plates shall conform to, or at least be equal to, the requirements of ASTM A281, grade C and with a minimum yield strength of 33,000 psi.

C. Flanges:

Flanges shall be cast iron or steel, and to Specification API 12B.

D. Rolled Structural Shapes:

Rolled Structural Shapes shall conform to ASTM A36.

E. Bolts:

Bolts used in tank joints shall be 1/2" diameter and shall meet the minimum requirements of API 12B except bolt heads and nuts may be other than square at the option of tank manufacturer. Other bolts shall conform to, or at least be equal to the requirements of ASTM A107.

**2.04 GALVANIZING**

A. Hot-Dip Galvanizing:

Zinc-Coating shall be applied to the tank components, after fabrication, in accordance with ASTM A123 or ASTM A153.

**2.05 GASKETS AND SEALANTS**

A. The gaskets and sealants shall be among those listed under Category 14 of the "List of Accepted Equipment for Interstate Carriers Use" as published by the Public Health Service.

**2.06 DESIGN**

A. Component Parts:

Component parts of tanks such as bottom sections, wall sections, and roof sections shall conform to the dimensional standards of the American Petroleum Institute Standard for Bolted Production Tanks, API 12B, with walls composed of standard side sheets (staves) having nominal dimensions of 5' wide by 8' high. Special height or width side sheets may be used with API as B standard joint details.

B. Tank Bottoms:

Minimum thickness of tank bottoms shall be 12 gauge. Tank bottom and tank roof plates shall be pie-shaped.

C. Tank Walls:

Tank walls shall be properly designed to resist the maximum anticipated dead and live loads, both when the tank is empty and when filled with water having a specific gravity of 1.0. Snow and earthquake live loads may be neglected due to the location. Wind loads will be in accordance to AWWA D103 standards.

D. Tank Roofs:

Minimum thickness of tank roof sheets shall be in accordance with AWWA D103. Tank bottom and tank roof plates shall be pie-shaped.

E. Roof Supports:

Roof structures shall be designed to support the minimum design loads as specified in AWWA D103.

F. Foundations:

The tank foundation shall consist of 18" of pea gravel enclosed by a galvanized steel retainer ring

as shown on the drawing. Subgrade shall be graded level and compacted to 95% Standard Proctor Density.

G. Shell Manways:

A shell manway shall be installed so that manway cover plates may be removed and replaced without entering the tank.

H. Inlet and Outlet Connections:

Inlet and outlet connections shall be as shown on the drawing.

I. Overflow:

The tank shall be equipped with an overflow as shown on the drawing. The overflow shall be brought down the outside of the tank wall supported at proper intervals by suitable brackets. The overflow pipe shall terminate at the bottom with a base elbow. The overflow shall end with a hinged flap valve and insect proof screen.

J. Vent:

A suitable vent shall be furnished, above the maximum water level, or sufficient capacity to pass air so that, at the maximum possible rate of the water either entering or leaving the tank, pressures will not be developed which will exceed the roof design loads. The overflow pipe shall not be considered a tank vent. The vent shall be so designed and constructed as to prevent the entrance of birds, animals or insects.

K. Roof Manway:

A roof hatch shall be included which shall be paced near the outside ladder and which shall be provided with hinges and hasp for locking. The hatch shall have a minimum opening dimension of 24" by 24". The hatch shall be raised 2" to prevent seepage of rainwater.

L. Outside Tank Ladder:

The ladder shall begin at ground level of the tank bottom to the top of the tank and at the location shown on the drawing. A fixed ladder shall be provided from the top of tank to the bottom inside of the tank. All ladders to be OSHA approved.

M. Water Level Indicator:

A suitable telltale showing water level in the tank shall be furnished. The indicators shall be marked to clearly indicate water level at empty, full and the quarter points between.

## **PART 3 - EXECUTION**

### **3.01 TESTING**

A. Upon completion of the tank, it shall be filled with water furnished at the tank site by the Owner at proper pressure to fill the tank to the maximum working water level. Any leaks or other defects which are disclosed in this test shall be repaired by the Contractor. The test water shall be disposed of by the Contractor.

**3.02 CLEANING AND PAINTING**

- A. The ground storage tank shall be cleaned and painted in accordance with ASTM A123 Standard Specification for Zinc (Hot Galvanized) Coatings on Products Fabricated From Rolled, Pressed or Forged Steel, Shapes, Plates, Bars and Strips.
- B. The proposed tank will be constructed adjacent to existing homes and businesses. The contractor shall provide containment of his sand blasting and painting operations at all times.

**3.03 DISINFECTION**

- A. The ground storage tank and connections to the water distribution system shall be thoroughly disinfected with a hypochlorite or chlorine solution before being placed into operation. The method and amount of disinfectant applied shall be in accordance with AWWA D105. "Standard for Disinfection of Water Storage Facilities." The Louisiana Department of Health shall be contacted and a water sample taken to determine if the water is free of any bacterial contamination.

**3.04 CLEANING UP**

- A. Upon completion of the erection, the Contractor will remove or dispose of all rubbish or other unsightly material caused by his operations and will leave the premises in as good of condition as he found them.

**3.05 INDEMNITY**

- A. The Contractor shall agree to indemnify the Owner from all claims and demands for damages or compensation from injuries to persons or property caused by negligence of Contractor in completing the requirements of this contract.

**3.06 GUARANTY**

- A. The Contractor must guarantee for a period of one year the structure he furnishes under these specifications, to the extent that he will repair any defects due to fault design, workmanship, or materials, which may appear in the structure during that period.

END OF SECTION

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## SECTION 13206

### PRESSURE TANK AND AIR COMPRESSOR

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION OF WORK

- A. This section of the specifications covers pressure tanks used for hydro-pneumatic pumping stations including all appurtenances required to construct a 5,000 gallon pressure tank for the Village of Montpeller.

##### 1.02 REFERENCED STANDARDS

The latest revision of the following publications apply to this project.

- A. American Society of Testing Materials
  1. ASTM A36, Standard Specification for Structured Steel
  2. ASTM A153, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality
  3. ASTM A283, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality
  4. ASTM A307, Standard Specification for Carbon Steel Externally and Internally Threaded Standard Fasteners
  5. ASTM A569, Standard Specification for Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial Quality
- B. American Water Works Association
  1. AWWA D100, Standard for Welded Steel Tanks for Water Storage
  2. AWWA D102, Standard for Painting Steel Water Storage Tanks
  3. AWWA D105, Standard for Disinfection of Water Storage Facilities

##### 1.03 INSPECTION AND REJECTION

- A. Inspection:

The inspector and resident engineer shall have free entry, at all times while work on the contract is being performed, to all parts of the manufacturer's shops which will concern the manufacture of the material ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the material is being manufactured in accordance with this specification.

- B. Rejection:

Material which shows injurious defects on mill inspection or subsequent to acceptance at manufacturer's shop or which proves defective when properly applied in service, may be rejected, and the manufacturer so notified.

## **PART 2 - PRODUCT**

### **2.01 DESCRIPTION**

- A. The work shall consist of the furnishing of all materials, tools, equipment and necessary labor for the design, manufacture, delivery, erection and painting of an all-welded pressure tank of the height and capacity hereinafter specified, complete with appurtenances listed, erected on foundations constructed under this same contract.

### **2.02 QUALIFICATIONS OF BIDDERS**

- A. Contractors bidding on this work must give evidence of their experience in the class of work involved or must show evidence of experience in similar, though smaller work, together with evidence of financial ability to successfully prosecute the work.

### **2.03 PNEUMATIC PRESSURE TANK**

- A. Each tank shall be constructed as indicated in the Plans and as hereinafter specified. Tank shall conform to the following design data:

Capacity	5,000 gallons
Design Working Pressure	100 psig
Design Temperature	600 degrees F.
Maximum Allowable Stress	13,750 psig
Hydro. Test Pressure	200 psig
Corrosion Allowance	0.004 inches
Eff. Shell	80 per cent
Eff. Head	100 per cent

- B. Tank material and construction shall conform to the following specifications:

Fusion Welded Steel	A.S.M.E. Section VIII
Flanges	A.S.T.M. A-285 Grade C
Couplings	150# A.S.A.
Head	3000# Hydrostatic
Stress Relieve	2:1 Ellipsoidal
Radiograph	No
	Spot only

### **2.04 PAINTING**

- A. All surfaces to be painted shall be FIELD cleaned by sandblasting in accordance with the Steel Surfaces Painting Councils Surfaces Preparation Specification. Refer to Section 09900 Painting of the specifications for the painting schedule.

## **2.05 OPERATION – HYDROPNEUMATIC PRESSURE SYSTEM**

The hydropneumatic system shall operate the existing two (2) – 250 gpm high service pumps and the existing 2 h.p. air compressor. Operation of the facility shall be as follows:

- A. Pump Station Site Controls:
  - 1. Pressure Tank – Control for High Service Pumps:
    - a. A high water level, 30" (36%) of the volume of the 84" diameter tank shall operate @ 70 psig, and stop the high service pump running by the water level probe.
    - b. A low water level, 15" (18%) of tank volume shall start the pump by a pressure switch set at 55 psi.
  - 2. Pressure Tank – Air Compressor:
    - a. Air compressor with dry air filter and 2 hp motor shall pump air into the hydropneumatic tank by an adjustable pressure switch set at 68 psi to add air to 72 psi.
    - b. The pressure switch shall read air pressure only at the high water level in the pressure tank.
    - c. The air compressor shall stop at 70 psig pressure and/or when the high service pump starts running.

## **2.06 PRESSURE TANK CONTROL SYSTEM**

- A. See Division 16 – Electrical and the Plans.

## **2.07 AIR COMPRESSOR**

- A. The air compressor shall be equivalent to a Kellog-American, Champion, Ingersoll Rand, or equal with a base mounted 2 HP motor, approved by the Engineer. The components of the compressor and design shall be as follows:

- 1. Air Filter:
  - Shall have removable and replaceable element dry air type.
- 2. Motor Drive:
  - Shall be TEFC type, 2 HP, 230/480 volt, 3 phase, 1.15 service factor motor.
- 3. Belts:
  - Shall be two belt drive, size A.
- 4. Compressor Base:
  - The motor and compressor shall be mounted on a steel base unit constructed for anchor bolt

mounting to concrete floor.

5. Compressor:
- |                            |              |
|----------------------------|--------------|
| Maximum Operating Pressure | 125 psig     |
| H.P. Size                  | 2            |
| Pump R.P.M.                | 823          |
| Piston Displacement        | 11.9 cu. in. |
| Free Air                   | 8.8 cu. in.  |
| Pistons                    | 2            |
6. Accessories:
- a.) Automatic Drain Trap on discharge pipe.
  - b.) Two check valves on air discharge pipe.

### **PART 3 - EXECUTION**

#### **3.01 TESTING**

- A. Upon completion of erecting and painting the tank, it shall be filled with water furnished at the tank site by the Owner at proper pressure to fill the tank to the maximum working water level. Any leaks or other defects which are disclosed in this test shall be repaired by the Contractor. The test water shall be disposed of by the Contractor.

#### **3.02 CLEANING AND PAINTING**

- A. The pressure tank shall be cleaned and painted in accordance with Section 09900 of these Specifications.
- B. The name "MONTPELIER" shall be painted on the tank in one (1) place in bold type lettering. The paint used for the lettering shall be of the same type as specified for the exterior finish coat. Color of lettering to be selected by the Engineer.

#### **3.03 DISINFECTION**

- A. The pressure tank and connections to the water distribution system shall be thoroughly disinfected with a hypochlorite or chlorine solution before being placed into operation. The method and amount of disinfectant applied shall be in accordance with AWWA D105. "Standard for Disinfection of Water Storage Facilities." The contractor shall contact the Louisiana Department of Health and sample the water to determine if its is bacteria free.

#### **3.04 CLEANING UP**

- A. Upon completion of the erection, the Contractor will remove or dispose of all rubbish or other unsightly material caused by his operations and will leave the premises in as good of condition as he found them.

#### **3.05 INDEMNITY**

- A. The Contractor shall agree to indemnify the Owner from all claims and demands for

or compensation from injuries to persons or property caused by negligence of Contractor in completing the requirements of this contract.

### **3.06 GUARANTY**

- A. The Contractor must guarantee for a period of one year the structure he furnishes under these specifications, to the extent that he will repair any defects due to fault design, workmanship, or materials, which may appear in the structure during that period.

### **3.07 COORDINATION WITH ELECTRICAL REQUIREMENTS**

- A. Unless otherwise specified, the Contractor shall be responsible for furnishing all controls including magnetic starters with overload and under voltage protection, pushbutton stations, timers, limit switches, H-O-A switches, enclosures and other items as required by particular equipment in accordance with the manufacturer's recommendations and as shown on the Drawings.
- B. The vendors of the various pieces of equipment shall refer to the electrical specifications and the electrical drawings to supplement this section of the Specifications. Any additional equipment shown on the electrical plans or called for in the electrical specifications and not specifically specified in this section shall be furnished by the vendor. The plant electrical system is designed to the specific requirements of the Owner using a control system. The vendors shall design their electrical equipment and panels to match these electrical requirements. Shop drawings shall be submitted showing external wiring terminals and properly identifying the devices they are to be inter-connected with. Any drawings submitted where it is obvious that no effort was made to properly prepare them for checking by the Engineer will be rejected.
- C. The electrical contractor shall coordinate with the mechanical contractor and carefully review the mechanical packages proposed to be supplied. It shall be the electrical contractor's responsibility to insure that all wire and conduit needed for electrical appurtenances, associated with mechanical packages, are provided even if not specifically called for in the plans and specifications.

END OF SECTION

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100



**DIVISION 16**

**ELECTRICAL**





SECTION 16001

GENERAL ELECTRICAL/INSTRUMENTATION PROVISIONS

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to install a complete and operational electrical and instrumentation system as hereinafter specified and shown on the Drawings.

The work at the facility consists of the following areas:

Section Item

- 16001 General Electrical /Instrumentation Provisions
- 16002 Raceways, Fittings, and Boxes
- 16003 Underground Duct System
- 16004 Wires and Cables (Power and Control)
- 16005 Grounding System
- 16006 Motor Control Centers (MCC)
- 16007 Miscellaneous Electrical Equipment
- 16008 Lighting Fixtures and Accessories
- 16011 Motors

B. The proposed Division 15 Mechanical to Division 16013 Instrumentation interface shall be as follows:

1. It is recommended that the installation of all primary elements which required an insertion or tap into any of the process flow lines shall be the responsibility of personnel doing work under Division 15.
2. The instrumentation system Contractor shall bear the responsibility for providing elements to the Division 15 Contractor in a timely manner, coordinating size and material type when applicable, overseeing the actual installation and final element testing, calibrating and performance.

C. The proposed Division 16 Electrical (16001 - 16016) to Section 16013 Instrumentation interface shall be as follows:

Furnishing and installation of the following items shall be the responsibility of applicable portions of Division 16 exclusive of Section 16013 Instrumentation.

- a. Instrumentation, alarm and graphic display signal raceway and terminal cabinet system.
  - b. 120 Volt power branch circuits up to but not including the local instrumentation on-off switch at locations required by the various elements.
  - c. Wire and conduit to devices such as pressure switches, flow switches, control contacts, etc., (furnished by the instrumentation system supplier) which connect directly to motor starter control circuits.
2. Furnishing and installation of the following items shall be the responsibility of the instrumentation system supplier.
- a. Furnish and install all wire and cable required to interconnect the instrumentation, alarm and graphic systems specified under Section 16013 Instrumentation.
  - b. 120 volt power disconnect and 120 volt power wiring and conduit from the disconnect to the instrument.

- D. Furnish all conduit, wire, control equipment and field connections as required for all motors and process equipment furnished under other sections of these Specifications.
- E. Mount and wire speed, level, pressure and temperature measurement systems furnished under other Sections of these Specifications.
- F. Mount and wire isolation transformers, operator stations, and power conversion equipment for all variable speed drive systems furnished under other Sections of these Specifications.
- G. Mount and wire any power factor correction capacitors furnished under other Sections of these Specifications. Where capacitors are furnished with quick-release latched covers, furnish and install a bolt and nut on each latch.
- H. Make all field connections to process instrument panels and other control panels and devices furnished under other Sections of these Specifications.
- I. Mount and wire process instruments furnished under other Sections of these Specifications. Furnish and install all conduit, wire and interconnections between process instrumentation primary elements, transmitters, local indicators and receivers. Mount and wire all lightning and surge protection equipment at process instrumentation transmitters and receivers.
- J. Mount and make field connections to "packaged" equipment, process equipment, controls, and devices furnished under other Sections of these Specifications.
- K. Furnish and install all conduit and wire between motor operated doors and windows, HVAC units, hoists, and other non-process equipment, and their controls and devices furnished under other Sections of these Specifications.
- L. Install and wire all thermostats, aquastats and other devices furnished under other Sections of these Specifications directly controlling unit heater fan motors.
- M. Mount and wire electric heaters furnished under other Sections of these Specifications.
- N. It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material and all work which may be reasonably implied as being incidental to the work of this Section shall be furnished under the contract bid price.

#### 1.02 SERVICE AND METERING

- A. The power company serving this project is Gulf States Utilities:

#### 1.03 CODES AND STANDARDS

- A. The complete installation shall comply with all applicable requirements of the National Electrical Code, the Occupational Safety and Health Act of 1970, with additions and the requirements of any local codes effective at the site.
- B. Codes and standards referenced shall be considered minimum acceptable work.
- C. Referenced codes shall include the following:
  - American National Standards Institute, Inc. (ANSI)
  - Institute of Electrical and Electronics Engineers, Inc. (IEEE)
  - Instrument Society of America (ISA)
  - Insulated Cable Engineers' Association (ICEA)
  - Joint Industrial Council (JIC)
  - National Electrical Code (NEC)
  - National Electrical Manufacturers Association (NEMA)

1.04 PERMITS

- A. The Contractor shall pay for all permits, inspections and fees arising from the above referenced Codes and Ordinances.

1.05 INTERPRETATION OF DRAWINGS

- A. During the period of construction, the electrical plans will be complemented with detail drawings, as may be necessary in the opinion of the Engineer, to show the proper installation of various appliances or equipment with relation to the project.
- B. The drawings and specifications are intended to be descriptive only, and any error or omissions of detail in either shall not relieve the Contractor from the obligations thereunder to install in correct detail any and all materials necessary for complete and operating electrical systems to the extent shown on the Drawings and described in this Specification.
- C. The drawings are generally diagrammatic and the locations of equipment, fixtures, outlets, and similar devices shown on the Drawings are approximate only unless detailed or dimensioned. The exact locations and routing of cables and conduits shall be governed by structural conditions, physical interference, and the location of electrical terminations on equipment. Exact locations shall be as approved by the Engineer during construction. Obtain in the field all information relevant to the placing of electrical work, and, in case of any interference with other work, proceed as directed by the Engineer, and furnish all labor and materials necessary to complete the work in an approved manner.
- D. The Contractor shall examine the architectural, structural, mechanical, and instrumentation plans and shop drawings for the various equipment in order to determine exact routing and final terminations for all conduits and cables. Conduits shall be stubbed up as near as possible to equipment terminals.
- E. The Drawings are not intended to show exact locations of conduit runs. Each three-phase circuit shall be run in a separate conduit unless otherwise shown on the Drawings. Unless otherwise approved by the Engineer, conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed. Where circuits are shown as "home-runs", all necessary fittings and junction boxes shall be provided for a complete raceway installation. The Contractor shall coordinate and obtain approval from the Engineer during construction for the final routing of all "home-run" circuits. "Home-run" circuits shown concealed shall be run concealed unless approved otherwise by the Engineer.
- F. Verify with the Engineer the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.
- G. Any work installed contrary to or without approval by the Engineer shall be subject to change as directed by the Engineer at no additional cost to the Owner.
- H. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.
- I. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the equipment.
- J. All connections to equipment shall be made as required, and in accordance with the approved shop drawings.

1.06 SHOP OR ERECTION DRAWINGS

- A. This Contractor shall prepare shop drawings for all parts of his work. Before commencing any work or providing any material, the Contractor shall submit for review by the Engineer all drawings relating

to the construction, arrangement or disposition of the equipment entering into the contract, and show the complete equipment with manufacturer's specifications of same.

- B. Shop drawings of all switchgear, variable speed drive, motor control centers, panel, power and lighting systems, fixtures, wire, cables, devices, etc., shall be submitted for the Engineer's review, as well as complete details of all systems not shown in detail on the Drawings.
- C. Shop drawings shall be fully descriptive of all the materials and equipment to be incorporated into this project. The Contractor shall carefully check all his shop drawings making sure they are complete in all details and cover the specific items as hereinafter specified.
- D. Prior to submittal, all shop drawings shall be checked by the Contractor for accuracy and coordination with the respective associated electrical devices, and equipment and contract requirements. Shop drawings shall bear the date checked and shall be accompanied by a statement that the shop drawings have been examined for conformity to Specifications and Drawings. This statement shall also list all discrepancies with the Specifications and Drawings. Shop drawings not so checked and noted shall be returned.
- E. The Engineer's check shall be only for conformance with the design concept of the project and compliance with the Specifications and Drawings. The responsibility of, or the necessity of, furnishing materials and workmanship required by the Specifications and Drawings and coordination with associated devices and equipment which may not be indicated on the shop drawings is included under the work of this Section.
- F. The responsibility for all dimensions to be confirmed and correlated at the job site and for coordination of this work with the work of all other trades is also included under the work of this Section.
- G. No material or equipment shall be allowed at the site until shop drawings reviewed by the Engineer are received by the resident engineer at the site.
- H. It shall be the electrical contractor's responsibility to obtain copies of all mechanical shop drawings for verification and coordination of all electrical requirements for actual equipment furnished.  
  
The Contractor shall submit for approval, prior to installation, a final electrical equipment layout drawing at all buildings. This drawing shall show actual dimensions and locations of all electrical equipment.

#### 1.07 PURPOSE OF GENERAL ELECTRICAL/INSTRUMENTATION CONDITIONS

- A. The purpose of this Section (16001) is to tie together all of Section 16 into a meaningful unit. It prevents unnecessary repetition and adds supportive information to each of the following sections. Any specific statement in Section 16002 through 16016 overrides any statement in Section 16001.

#### PART 2: PRODUCTS (NOT USED)

#### PART 3: EXECUTION

#### 3.01 LABOR AND PROGRESS

- A. The Contractor shall employ a competent electrical foreman on the job throughout the entire period of construction to see that his work is carried on without delay and completed as rapidly as possible. Electrical foreman must be approved by the Engineer in writing. Delays in approval of the foreman will be the responsibility of the contractor.
- B. The foreman shall be empowered by the Contractor to make decisions relating to the electrical work proposed in this project.

#### 3.02 SLEEVES, FORMS, CUTTING AND PATCHING

- A. The Contractor shall be responsible for laying out and installing his work in advance of the pouring

- of pads, floors, walls, etc., and shall furnish and install all sleeves that may be required for the electrical work. Sleeves shall be provided for all conduits penetrating walls, partitions, and floors.
- B. Where required sleeves and inserts are not properly installed, the Contractor will be required to do the necessary cutting and patching later at his own expense to the Engineer's satisfaction.
- C. All forming for exterior lighting pole boxes, equipment pads, duct runs, etc., shall be furnished by the Contractor under applicable portions of Division 16.
- 3.03 EQUIPMENT MOUNTING**
- A. The Contractor shall be responsible for furnishing and setting all anchor bolts, channels, etc., required to install his equipment.
- B. Where electrical equipment is located on damp or wet walls, walls exposed to weather, or other locations as directed, it shall be 'stand-off' mounted 1/2-inch from the wall in a manner so that the rear of the equipment is freely exposed to air circulation. The method of mounting shall be approved by the Engineer before equipment is installed.
- C. All equipment enclosures shall be of the NEMA classification noted on the plan drawings for the area in which the device will be mounted.
- 3.04 EQUIPMENT STORAGE AND INSTALLATION**
- A. All electrical equipment entering into this contract including motor control center, starters, transformers, lighting fixtures, etc., shall be stored before installation in a warm dry indoor area adequately protected against mechanical injury or damage by water. Equipment stored outdoors under tarpaulins or plastic covers will not be considered as meeting this requirement. If any apparatus has been damaged, such damage will be repaired at no additional cost to the Owner. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried and put through such special tests as directed by the Engineer or shall be replaced at no additional cost to the Owner.
- B. The installation of electrical equipment shall not begin until the structures are complete enough to provide protection from weather and vandalism (i.e., walls, doors, windows, and roof installed).
- C. The Contractor shall investigate each space in the structure through which equipment must pass to reach its final location. If necessary, the manufacturer shall be required to ship his material in sections sized to permit passing through such restricted areas in the structure.
- 3.05 AS BUILT DRAWINGS**
- A. The Contractor shall maintain a neatly marked set of record drawings showing the installed location and/or routing of conduits, cables, pull boxes, junction boxes, and outlets. All deviations from the control schematics required by equipment actually utilized are to be kept current with the work and subject to inspection by the Engineer at any time. Two sets of marked final record drawings shall be delivered to the Engineer prior to final acceptance of the work.
- Particular care shall be given to describing the exact locations of all exterior conduit, duct banks, control circuits, conduit schedules, cable schedules, and single line modifications.
- 3.06 TEST AND REPORTS**
- A. The Contractor shall pay all costs of making the required tests and provide all meters, cable connections, equipment and/or apparatus for making same.
- B. All tests shall be made in the presence of the electrical job foreman and the Engineer.
- C. Motors: A test report and related data sheet shall be submitted to the Engineer for each motor supplied under this project.



D. Motor Control Centers: Before energizing any motor control centers, the Contractor shall make a megohmmeter test of all phase busing and check the results with typical manufacturer's data. Readings that fall below manufacturer's recommended values will not be acceptable and the Contractor shall be required to perform any necessary remedial action before energizing. A data sheet shall be submitted to the Engineer for each MCC supplied.

1. MCC Name and Number:
2. MCC Manufacturer:
3. MCC Nameplate Data:  
VOLTS:  
HORIZONTAL BUS AMPS:  
MAIN BREAKER AMPS:
4. Insulation Test (Measured):  
PHASE A - B:  
PHASE B - C:  
PHASE C - A:  
PHASE A - G:  
PHASE B - G:  
PHASE C - G:

5. Temperature of MCC During Test      deg. F):

6. Equipment Disconnected During Test:

7. Date of Test:

8. Tested By:

E. Contactors: After all wires and cables are in place but before connection to motors or devices, the electrical system shall be subjected to an insulation test with a 500 volt D.C. megger. Single conductor cables shall be replaced if the resistance to ground is less than 10 megohms. Tests conducted on wires serving loads of 50 hp or larger shall be recorded on the motor test data sheet.

F. 5 KV Cables: A D.C. High Pot and Megger test shall be performed on all 5 KV cable. Cable tests shall be done in accordance with ICEA Standards.

G. Electrical Apparatus, Fixtures and Wiring Devices: Any equipment, fixtures or device found to be grounded or shorted shall be removed and replaced.

H. Ground System: Each and all grounded cases and metal parts associated with electrical equipment shall be tested for continuity of connection with the ground bus system by the Contractor in the presence of the Engineer or his representatives.

I. Make all circuit breakers and protective relay settings. The Contractor shall test all protective relays and circuit breakers for calibration and proper operations. Test shall be by an independent testing firm, and a certified test report shall be submitted stating that the equipment meets and operates in accordance with the manufacturer and the job specifications, and that the equipment and installation conforms to all applicable standards and specifications.

J. Winding insulation resistance tests, tap changer operational tests, winding ratio tests, and oil dielectric tests shall be performed on all power transformers.

K. Field Documentation: The Electrical Contractor shall furnish and attach to all electrical equipment requiring test and documentation, a heavy duty weatherproof envelope. The envelope shall be suitable for protecting, for the duration of the project, all documentation required for electrical test associated with that specific equipment.

The Electrical Contractor shall submit copies of proposed documentation to the Engineer for approval, before installation at the equipment.

It shall be the responsibility of the Electrical Contractor to maintain all applicable documents in a clean and updated condition at their respective equipment. This will facilitate spot checks of documents by inspection and construction personnel to insure all tests and documentation have been performed prior to termination and energizing.

It is the purpose of this requirement and the responsibility of the Electrical Contractor to insure that all electrical tests and documentation required under this section and associated equipment sections are performed in a timely and professional manner to protect equipment and personnel.

L. Retesting: Where test reports show unsatisfactory results, the Engineer may require the removal of all defective or suspected materials, equipment and/or apparatus, and their replacement with new items, all at no cost to the Owner. All costs of the retesting shall be at the Contractor's expense.

M. Six (6) separately bound type written copies of all tests, reports, field documentation, and related manufacturer's data shall be submitted to the Engineer.

### 3.07 EQUIPMENT IDENTIFICATION

A. All equipment (disconnect switches, separately mounted motor starters, junction boxes, control stations, etc.) furnished under this Section shall be identified by the name of the process equipment or other facility component it serves. Motor control centers, control panels, panelboards, switchboards, switchgear, and other devices shall have nameplates describing respective equipment.

B. The identification method shall be laminated plastic nameplates. Nameplates shall be as detailed on the drawings.

C. Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be cemented to all other enclosure types using epoxy or other approved adhesive. Where the equipment size does not have space for mounting a nameplate, the nameplate shall be cemented to the adjacent mounting surface. Cemented nameplates shall not be drilled.

### 3.08 FINAL CLEAN UP

A. The Contractor shall be responsible for the removal and legal disposal of all debris and unused equipment which he introduces to the project site during the execution of his contract.

- B. The Contractor shall vacuum clean the interior of all motor control centers, panelboards, junction boxes, and other enclosures supplied under this project containing electrical equipment to remove all dirt, metal clips, stripped insulation, etc., from the enclosure.
- C. Motor Control Centers, starters, disconnects, panelboards, and other equipment which has factory baked enamel paint (or similar approved painting technique) will not be field painted with the exception of touch up paint to nicks and scratches caused during shipment or installation.

END OF SECTION

} ) | ] | } } } } } } } } } } } } } } } }

SECTION 16002

RACEWAYS, FITTINGS AND BOXES

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install complete and ready for use, the electrical raceways and fittings as shown on the Drawings and/or specified herein.

1.02 QUALIFICATIONS

A. All raceways and fittings of a given type shall be the product of one manufacturer.

1.03 SUBMITTALS

A. Submittals shall comply with Section 01340.

B. In addition the submittals shall contain the following:

1. Boxes.
2. Conduit.
3. Conduit Identification Band.

PART 2: PRODUCTS

2.01 STEEL RIGID CONDUIT (GRC)

A. Steel conduit shall be hot-dipped galvanized after threading as manufactured by the Triangle Conduit and Cable, Westmoreland Conduit Co., or equal.

2.02 PVC CONDUIT

A. The material shall be extruded from a polyvinyl chloride compound to form a Schedule 40 heavy wall conduit. The conduit shall comply with the wall and O.D. dimensions for standard sized steel conduit. The conduit shall be either a continuous length or joined into a continuous length by butt fusion or solvent welding in the field. The conduit shall be manufactured by Carlon, Phillips Petroleum Co., Triangle Pipe & Tube Co., or equal.

2.03 FLEXIBLE CONDUIT COUPLINGS AND FITTINGS

- A. Liquid-tight, flexible metal conduit shall be Sealite, Type UA manufactured by the Anaconda Metal Hose Division, American Brass Co., equal by American Flexible Conduit, or Universal Metal Hose Co., or equal.
- B. Fittings used with flexible conduit shall be of the screw-in type as manufactured by the Thomas and Betts Co., Triangle Conduit and Cable, Electrical Fittings, or equal.
- C. Flexible couplings shall be Crouse-Hinds Co., Appleton Electric Co., Thomas and Betts Co., or equal.

2.04 ALUMINUM RIGID CONDUIT (ARC)

A. Aluminum conduit shall be manufactured from copper free aluminum, alloy Grade 6063, and shall be suitable for use in corrosive environments.

2.05 PVC COATED RIGID STEEL CONDUIT

A. PVC coated rigid steel conduit shall utilize rigid steel conduit in accordance with the above paragraph and in addition shall have an outer jacket of 40 mil PVC permanently bonded to the outer surface.

B. Conduit shall be as manufactured by Robroy, Occential Coating Co., or equal.

2.06 BOXES AND FITTINGS (POWER & CONTROL)

A. Terminal boxes, junction boxes, pull boxes, etc., shall conform to the following Specifications dependent upon the area NEMA classifications as noted on the Drawings.

B. NEMA 1 areas surface mount: Boxes in NEMA 1 areas shall be sheet steel unless otherwise shown on the Drawings. Boxes shall be hot dipped galvanized and have continuously welded seams. Welds shall be ground smooth and galvanized. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be gasketed and fastened with stainless steel screws. Conduit connections shall be by conduit hubs only. Boxes shall be as manufactured by Hoffman Engineering Co. or equal.

C. NEMA 1 areas flush mount: Pressed steel switch and outlet boxes shall be hot-dipped galvanized as manufactured by the Adelet Co., O.Z. Manufacturing Co., or equal.

D. NEMA 4 areas: Boxes in NEMA 4 areas shall be of the cast aluminum or cast iron type. Cast aluminum boxes shall be manufactured from copper free aluminum and cast iron boxes shall be hot-dipped galvanized. Boxes shall be furnished with gasketed covers and corrosion resistant mounting hardware. Products shall be as manufactured by the Crouse-Hinds Co., Appleton Electric Co., Killark Electric Co., or equal.

E. NEMA 4x areas: Boxes in NEMA 4x areas shall be manufactured of a Type 316 stainless steel. Back and sides shall be welded to form a one piece construction. Doors or covers shall be attached with #316 stainless steel captive fasteners or hinges. The cover to box joints shall be made watertight with a mechanically retained gasket. Boxes shall be Krydon as manufactured by Nelson Electric, or equal. Cast aluminum boxes are approved for NEMA 4x areas.

F. NEMA 7 areas: Boxes in NEMA 7 areas shall be of the watertight (NEMA 4) explosion proof type. Body and covers shall be constructed of copper free cast aluminum with zinc plated steel attachment hardware and stainless steel hinges. Waterproof gasket shall be neoprene. Boxes shall be EJB series by Crouse-Hinds, Appleton Electric Co., or equal.

G. Cast or malleable iron device boxes shall be Type FD. Cast or malleable iron boxes and fittings shall have cadmium-zinc finish, threaded conduit connections, cast covers, and stainless steel screws as manufactured by the Crouse-Hinds Co. or equal.

H. Cast aluminum device boxes shall be Typed FD. All cast aluminum boxes and fittings shall be copper-free aluminum with threaded conduit connections, cast aluminum covers, and stainless steel screws as manufactured by the Killark Electric Co., Crouse-Hinds Co., L.E. Mason Co., or equal.

I. Conduit hubs shall be as manufactured by Myers Electric Products, Inc., Raco Div., Appleton Electric Co., or equal.

J. Conduit wall seals shall be Type WSK as manufactured by the O.Z. Electrical Mfg. Co., or equal.

- K. Combination expansion-deflection fittings shall be Type XD as manufactured by the Crouse-Hinds Co., or equal.
  - L. Explosion proof fittings shall be as manufactured by the Crouse-Hinds Co., Appleton Electric Co., O.Z. Electrical Manufacturing Co., or equal.
  - M. Conduit sealing bushings shall be O.Z. Gedney Type CSB or equal.
- 2.07 CONDUIT MOUNTING EQUIPMENT
- A. Hangers, rods, backplates, beam clamps, etc., shall be hot-dipped galvanized iron or steel. They shall be as manufactured by the Appleton Electric Co., Thomas and Betts Co., Unistrut Corp., or equal.
- 2.08 WALL AND FLOOR SLAB OPENING SEALS
- A. Wall and floor slab openings shall be sealed with "FLAME-SAFE" as manufactured by the Thomas and Betts Co. or equal.
- 2.09 JUNCTION AND TERMINAL BOXES (REMOTE ALARM AND TELEMETERING)
- A. The boxes furnished shall conform to the standards of Paragraph 2.06 "Boxes and Fittings (Power and Control)" and to the following additional requirements.
  - B. Each box shall be furnished with 15 amp, 300 volt terminal strips. The terminal strips shall be standard mounted from the box back and provide sufficient space for terminal identification.
  - C. A minimum of 25 percent spare terminals shall be provided in all terminal boxes.
  - D. NEMA 1 areas: Instrumentation/Alarm boxes for NEMA 1 areas shall use boxes rated NEMA 12.

## 2.10 CONDUIT IDENTIFICATION BANDS

- A. Conduit identification bands shall be an embossed noncorroding, nonrusting metallic band which encircles the conduit and is permanently secured without the use of adhesives or screws.

## PART 3: EXECUTION

### 3.01 CONDUIT - USAGE

- A. Aluminum Rigid Conduit (A.R.C.) shall be used exclusively throughout the plant in all above grade installations. Aluminum conduit shall not be used below grade and shall not be encased with concrete or grout in any locations. All conduit stub-ups shall be Galvanized Rigid Steel and then a transition made to aluminum conduit for above grade installation.
- B. Galvanized Rigid Steel (G.R.S.) conduit shall be used above grade where aluminum is unacceptable. All conduit stub-ups from below grade shall be made with Galvanized Rigid Steel.
- C. PVC conduit shall be used for concrete encased duct bank-runs only unless detailed otherwise on the Drawings.
- D. Electrical Metallic Tubing (E.M.T.) shall be used only in finished office areas to supply 120/240 volt branch circuit lighting and receptacles through ceiling or wall spaces only. (Conduits supplying circuits of this type which penetrate an exterior wall or floor slab shall be G.R.S.).
- E. Sealite conduit shall be used only at motor terminations, equipment where vibration is present, or at

equipment requiring frequent movement for adjustment.

F. PVC coated GRS shall be utilized in corrosive areas at locations as noted on the Drawings.

### 3.02 INSTALLATION

A. Switch, outlet, and control station boxes shall be surface or flush mounted as noted on the Drawings.

B. No conduit smaller than 3/4-inch electrical trade size shall be used. Pull fittings shall be used when conduit runs exceed the equivalent of a 300 foot straight run (each 90° bend shall be the equivalent of 50 feet of straight conduit). The number of bends shall not exceed three (3) 90° bends or a 150 foot straight run with three 90° bends.

C. No wire shall be pulled into any conduit until the raceway run is complete in all details.

D. The ends of all conduits shall be tightly plugged to exclude debris and moisture while the buildings are under construction.

E. All conduits and fittings on exposed work shall be secured by means of metal clips and backplates.

F. All conduits on exposed work shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. Exceptions must be approved by the Engineer.

G. Conduit termination in gasketed enclosures shall be terminated with conduit hubs.

H. Conduit wall seals shall be used for all conduits penetrating walls below grade or other locations shown on the Drawings.

I. Expansion and deflection fittings shall be used where conduits cross building expansion joints.

J. Conduit runs concealed in floor slabs, walls, etc., shall stub up as close as possible to the equipment they feed.

K. Explosion proof conduit seals shall be located as detailed on the Power and Instrumentation Plan Drawings in accordance with the NEC. Explosion proof conduit seals are required in all Class I areas.

L. Conduit supports shall be spaced at intervals of 8 feet or less as required to obtain rigid construction and prevent sagging.

M. Conduit terminating in pressed steel boxes shall have double locknuts and insulated bushings.

N. Liquid tight, flexible metal conduit shall be used for all motor terminations and other equipment where vibration is present except hazardous locations.

O. Flexible couplings shall be used in hazardous locations for all motor terminations and other equipment where vibration is present.

P. All locknut and bushing-type conduit terminations shall be made using locknuts on the inside and outside of the enclosure. All locknuts shall be of the bonding type which penetrate the enclosure surface when tightened.

Q. Joints and connections shall be made up using a suitable thread lubricant to insure a tight joint and to prevent steel conduit threads from rusting. Conduit joints and connections shall be screwed up tight using wrenches to insure good conductivity.

- R. All explosion-proof sealing and drain-sealing fittings shall be sealed as follows:
1. Fitting hubs shall be dammed with fiber to prevent sealing compound from leaking out.
  2. Conductors shall be separated and fiber packed between and around the conductors.
  3. An approved sealing compound equal to Chico "A" shall be used to make the seal.
  4. Depth of seal shall be equal to the trade size of the conduit with a minimum depth of 5/8 inch.
  5. Where seals are installed above explosion-proof enclosures, seals of the self-draining type, Crouse-Hinds EZD, or equal, shall be used.
- S. Aluminum conduit additional requirements are as follows:
1. An anti-galling conductive thread lubricant shall be used for all joints and connections.
  2. If conduits leave a concrete encasement, they shall be coated with a bituminous paint for about 6 inches on each side of the exit point.
- T. Before cable installation, a test mandrel having a diametrical clearance of not more than 1/4 inch compared to the conduit interior diameter, shall be drawn through all conduits to be used for main distribution feeders.
- U. All threaded joints in conduits above lighting fixtures or other equipment that will trap water, where leakage into joint will migrate into equipment, shall be made watertight by applying sealing compound to threads when making up the joint.
- V. Conduit connections to enclosures (junction boxes or equipment housings) shall be on the bottom or on the side or back near the bottom to prevent entrance of water.
- W. Conduit shall not be supported from process or utility piping.
- X. For conduit installations, wire and cables shall be pulled into conduit in one piece between termination or splice points, and as follows:
1. The pulling tension recommended by the cable manufacturer shall be determined and observed. Pulling eyes are preferred for large cables.
  2. Petroleum-based greases shall not be used for lubricating wires and cables having neoprene or other nonmetallic exterior jackets. All insulated conductors shall be liberally coated with suitable pulling lubricant before pulling.
- Y. Drains shall be installed at the lowest points of all overhead conduits to remove water from the conduit system. Conduits emerging from the ground and extending above ground more than 10 feet shall be drained within two feet of grade.
- Conduit connections to enclosures (junction boxes or equipment housings) shall be on the bottom or on the side or back near the bottom. Drains or drain seals shall be installed in each enclosure and be as close as practical to the point of connection.
- Z. A conduit identification band shall be installed on all power, instrumentation, alarm and control conduits at each end of the run and at intermediate junction boxes, manholes, etc., as directed by the Engineer. Conduit bands shall be installed before conductors are pulled into conduits. Exact identification band location shall be coordinated with the Engineer at the time of installation to provide uniformity of placement and ease of reading. The Engineer shall be notified in the event of any

conduit number omission and it will be his responsibility to furnish a properly sequenced number to the Contractor. Conduit numbers shall be exactly as shown on the Drawings.

### 3.03 IDENTIFICATION APPLICATION SCHEME

- A. Conductors carrying instrumentation low level signals (4-20 ma, 1-5 V, etc.), are to be run only in "I" series conduits.
- B. Conductors carrying equipment alarm signals are to be run in "A" series conduits.
- C. In general other conductors for power, lighting, receptacles, instrumentation 120 V power, etc., shall be run in conduit prefixed with a letter designating the MCC or Panel from which it receives its power.

END OF SECTION

SECTION 16003

UNDERGROUND DUCT SYSTEM

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required, and install complete, ready for use, underground duct system as shown on the Drawings and/or specified herein.

1.02 SUBMITTALS

A. Submittals shall comply with Section 01340.

B. In addition, the submittals shall contain the following:

1. Manholes
2. Handholes
3. Plastic duct spacers and material
4. Above ground pull boxes

PART 2: PRODUCTS

2.01 GENERAL

A. Unless otherwise noted on the plans, the underground duct system shall be PVC Schedule 40 conduit encased in reinforced concrete.

B. All underground conduits not included in a duct bank shall be concrete encased with a minimum of 3 inch concrete on all sides. (This provision includes conduits that are under building floor slabs).

2.02 MANHOLES AND HANDHOLES

A. Manholes and handholes shall be precast reinforced concrete structures with full bottom and sides and central drain sump. Tops shall be either reinforced concrete or galvanized steel plate as detailed on the Drawings. Manholes shall be designed for a Class H20 wheel load. Pulling-in irons and cable racks shall be furnished for units larger than 36 inches square. Any required cable racks, pulling-in irons, and hardware required in manholes or pull boxes shall be galvanized steel.

C. Block outs for duct bank entrance windows shall be sized by the Contractor to conform to duct bank elevations and duct bank contents as detailed on the Drawings. Reinforcing rods which are displaced by the location of the duct bank block out shall be bent outward to tie into the duct bank concrete.

D. Two sleeves shall be cast in the manhole and handhole floor to provide for insertion of grounding rods.

E. Entrance hatches shall not be less than 36 inches square (or the size of the lid if less than 36 inches square).

- F. Manholes shall be sized in accordance with Article 370 of the National Electrical Code.
  - G. Manholes shall be as manufactured by Brooks Products, Inc. or approved equal.
- 2.03 ABOVE GROUND PULL BOXES
- A. Above Ground Pull Boxes shall have a 10 GA. 316 stainless steel cover with 7/16" steel plate bottom hot-dipped galvanized after punching. Boxes shall be sized by contractor for each feeder in accordance with Articles 370 and 300-34 of the National Electrical Code. In particular, boxes shall be sized so that after final installation, the bending radius of the conductors shall not be less than eight times the overall diameter of the conductors.
  - B. Above Ground Pull Boxes that contain splices or taps, where approved in writing by the Engineer, shall be sized in accordance with Article 370-6 and Tables 370-6 (A) and 370-6 (B) of the National Electrical Code.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. All underground conduit runs and duct banks shall be encased in red concrete. Ducts shall be installed to drain away from buildings; ducts between manholes or handholes shall drain toward the handholes or manholes. Raceway slopes shall not be less than 3 inches per 100 feet.
- B. Duct Banks shall be reinforced with lead on the backfill covering new pipelines.
- C. Rigid steel conduit (or PVC coated conduit where specified) shall be used for all risers where the conduit leaves concrete encased duct run. See Details.
- D. The minimum cover for duct lines shall be 24 inches unless otherwise permitted by the Engineer in writing.
- E. Plastic spacers shall be used to hold conduit in place while the concrete is being poured and at spacings as recommended by the spacer manufacturer.
- F. Duct lines shall be laid in trenches on mats of bank gravel not less than 6 inches thick and well graded.
- G. There shall be not less than 3 inches of concrete between the outside of a conduit and the soil, and where multiple runs of conduit are installed in one envelope, there shall be not less than 2 inches of concrete between adjacent conduits. If conduits rise above grade, the encasement shall extend six (6) inches above.
- H. When plastic conduit passes through concrete walls, concrete envelopes shall be extended through and finished flush with inside surfaces. Watertight construction joints of an approved type shall be provided.
- I. Duct entrances to structures shall be made with steel conduit not less than 10 feet long. Duct entrances to manholes shall be made by extending the PVC conduit directly into the manhole window. If conduits run through equipment foundations or building floor slabs, the encasement shall butt the underside of foundation or slab.
- J. Where manholes and handholes use extension rings to provide the required depth, all joints shall be made watertight with bituminous mastic or other approved joint sealer.

- K. The exact location of the conduits within the duct bank shall be the Contractor's responsibility, however, the placement shall conform to the minimum power to instrumentation separation distances as detailed on the Drawings.
- L. Concrete shall be measured, mixed, placed and compacted as required for 2500 PSI concrete and as specified in Section 03260 and Section 3300.
- M. Backfill above duct banks shall be as specified in Division 2. All duct line concrete pours shall be continuous.
- N. Concrete shall be reinforced when laid on the backfill covering new pipelines, beneath roads, parking lots or any area subject to vehicular traffic. In these areas, install No. 4 reinforcing bars at 6 inches each way, extending 4 ft. beyond area needing protection.
- O. Concrete for encasing underground ducts shall be colored red (red dye) and shall have a maximum course aggregate size of 3/4".
- P. The duct bank routing drawings are diagrammatic and the location of pull points and equipment are approximate. The exact locations and routing of duct banks shall be governed by structural conditions, physical interference, and the location of electrical terminations on equipment. The exact location of pull points shall be determined by the Contractor and approved by the Engineer, based on the maximum number of conduit bends and the maximum allowed cable pulling tension recommended by the cable manufacturer.
- Q. The Contractor shall examine the architectural, structural, and mechanical plans and shop drawings for the various pieces of equipment in order to determine exact routing and final terminations of all duct banks, conduits and cables. Conduits shall be stubbed up as near as possible to equipment terminals.
- R. All underground conduits shall be swabbed clean before wire or cable is installed.
- S. Raceway terminations at manholes shall be with end bells.
- T. Where bends are required, long radius elbows, sweeps and offsets shall be used.
- U. Spare raceways shall be plugged and sealed watertight at all manholes, buildings, and structures.
- V. Raceways in use shall be sealed watertight at all manholes, buildings, and structures.
- W. Cables shall be trained in manholes and supported on racks and hooks. Furnish inserts on all manhole for mounting future racks as well as racks required for present installation.
- X. Fireproofing shall be furnished for all 5 KV cables in manholes. Each individual 5 KV cable shall be wrapped with an arc-proofing tape. The tap shall be applied in accordance with the manufacturer's recommendations. The wrapping shall extend into the end bells.

END OF SECTION

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SECTION 16004

WIRES AND CABLES  
(POWER AND CONTROL)

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required, and install, complete ready for operation, and field test the wire and cable system as shown on the Drawings and/or specified herein.

1.02 SUBMITTALS

- A. Submittals shall comply with Section 01340.
- B. In addition, the submittals shall contain the following:

- 1. Power and control wire
- 2. Termination and splice materials
- 3. Identification system

1.03 APPLICATIONS (600 VOLT OR LESS)

- A. Wire for lighting, receptacles, and other single phase circuits shall be NEC Type THHN/THWN.
- B. Wire for three-phase circuits shall be NEC Type THW for conductors No. 8 and larger and Type THW or Type THHN/THWN for conductors No. 10 and smaller.
- C. Wire for control circuits shall be NEC Type THHN/THWN No. 14 stranded.
- D. Cable for potentiometer circuits shall be multi-conductor No. 16 AWG twisted and shielded.
- E. Ground wire installed in raceways shall be NEC Type THW, green. Ground wires shall be bare where shown on drawings.

PART 2: PRODUCTS

2.01 600 VOLT CONDUCTORS

- A. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper. Aluminum cable will not be acceptable.
- B. No conductor smaller than No. 12 AWG shall be used for power circuits. Conductors No. 8 AWG, and larger shall be stranded. Insulation type shall be THW.
- C. 600 volt wire and cable shall be as manufactured by General Electric Co., General Cable Corp., Hatfield Wire and Cable Co., Pirelli Cable Corp., or equal.
- D. Multi-conductor control cable shall be stranded, 600 volt, cross-linked polyethylene insulated, neoprene jacketed, Firewall III as manufactured by the Cerro Wire & Cable Co. or equal.

E. Low voltage signal (Potentiometer or RTD) cable shall be cabled, threeconductor, 600 volt, polyethylene insulated, aluminum/polyester tape shielded with No. 18 AWG tinned copper drain wire with overall vinyl jacket and shall be Belden Catalog No. 8618 or equal.

2.02 5 KV SHIELDED CONDUCTORS

A. For 4160 volt service, conductors shall be rated 5 KV minimum. Conductor shall be copper with a corona, ozone and moisture resisting 115 mils EPR insulation rated to withstand a copper temperature of 90°C without deterioration. The shielding shall be 5 mil copper tape. A PVC jacket shall be employed overall. 5 KV conductors shall be Okonite Okoguard-Okoseal or Pirelli EPROTENAK Type MV90 or equal.

B. Terminations and splices must be designated to provide voltage stress relief and containing no air voids that would release ozone thereby deteriorating the cable. A class 2\* (IEEE Standard Test Procedures and Requirements for High-Voltage Alternating Current Terminations) termination for voltage stress control and complete external leakage insulation is required. Termination kits must contain performed pennant stress cones and be sized acceptable if made of EPR and used on EPR cable. Acceptable manufacturers are General Electric, G & W Electric, 3M Company, Okonite Co., or equal.

Splices shall be premolded, permanent. Straight or wye splices shall be suitable for manhole or direct burial installation. Splices shall be provided with suitable shield grounding devices as required.

C. All 5000V cable splices shall have the Engineer's approval in writing prior to installation.

2.03 SPLICES (480 VOLT POWER CONDUCTORS)

A. Conductors shall be joined with a compression type connector using the die as recommended by the splice manufacturer. Insulation integrity shall be maintained with use of either a heat shrink boot or outer covering and epoxy filling sized for the cable being spliced.

B. Splice kits shall be as manufactured by Ideal Industries, 3M Co., Raychem, or equal.

2.04 TERMINATION AND SPLICES (CONTROL CONDUCTORS)

A. Insulated compression type connectors shall be of the expanded vinyl insulated parallel or pigtail type as manufactured by Ideal Industries, 3M Co., Panduit Corp., or equal.

B. Spade connectors shall be of the type utilizing the upturned spade end design to prevent connector pullout. Connectors shall be as manufactured by Ideal Industries, 3M Co., Panduit Corp., or equal.

2.05 IDENTIFICATION

A. Wire markers used shall be of the heat shrinkable tube design with custom typed identification numbers, exactly as detailed on the Drawings. The tube and typed marking shall be of a permanent, non-smearing, solvent resistant design similar to Raychem TMS, Ideal Industries, 3M Co., or equal.

2.06 FIRE-PROOFING TAPE

A. Fire-proofing tape shall be Scotch No. 77 fire and electric arc proofing tape. To hold fire-proofing tape in place, band with two (2) overlapping laps of Scotch No. 69 glass cloth electrical tape.

2.07 WALL AND FLOOR SLAB OPENING SEALS

- A. Wall and floor slab openings shall be sealed with "Flame-Safe" as manufactured by Thomas & Betts Co. or equal.

### PART 3: EXECUTION

#### 3.01 INSTALLATION

- A. All conductors shall be carefully handled to avoid kinks or damage to insulation.
- B. Lubrications shall be used to facilitate wire pulling. Lubricants shall be U.L. approved for use with the insulation specified.
- C. Power conductors #2 AWG and larger shall be run in a conduit separate from the control conductors.
- D. All wires, cables, and each conductor of multiconductor cables (except lighting and receptacle wiring) shall be uniquely identified at each end with wire and cable markers.
- E. Except where shown on the Drawings or specified, 5 KV cable shall not be spliced. Where splicing is permitted, the cable manufacturer's recommendations shall be followed. Splice details shall be submitted to the Engineer for approval.
- F. Shielded instrumentation wire shall be installed from terminal to terminal with no splicing at any intermediate point.
- G. Shielded instrumentation wire shall be installed in conduit and pull boxes that contain only shielded instrumentation wire.
- H. Shielding on instrumentation wire shall be grounded at the transmitter end only.
- I. Use fire-proofing tape and glass tape in accordance with the manufacturer's instructions for fire-proofing 5 KV cables exposed in manholes, vaults, pull boxes, switchgear and other areas where cables are not protected by conduit. Fire-proofing methods using asbestos tapes shall not be used.
- J. Openings in slabs and walls through which wires and cables pass shall be sealed.
- K. Where cables pass through walls or floor slabs, the remaining openings shall be sealed against the passage of flame, smoke, and gas.

#### 3.02 TESTS

Wire and Cable Tests with Documentation shall be made as follows:

- A. Wire and cable for 600 volts and below shall be tested as follows:
  - 1. All cables and leads shall be tested for continuity and power leads for service above 125 volts shall be given a megger test.
  - 2. Wire and cable rated 600 volts and below shall have an insulation resistance test before connection to equipment. The test shall be made using a 500 volt megger. Measure phase to phase and phase to ground. The minimum insulation resistance value shall be 25 megohms.
  - 3. Lighting branch circuits and 120 volt services shall be tested during construction for continuity and identification and shall pass operational tests to see that circuits perform all functions for which they are designed.

- 4. All control wires shall be checked for continuity and identification by means of a D.C. test device using a bell and buzzer to "ring-out" the wires.
  
  - B. Wire and cable rated from 1000 volts to 5000 volts shall have an insulation resistance test made before connecting to equipment. Minimum insulation resistance shall be the megohms per 1000 feet valves specified in the applicable Insulated Cable Engineers Association (ICEA) standard for the type of wire or cable being tested.
- 3.03 IDENTIFICATION
- A. Wire markers shall be applied to all control, alarm, and instrumentation wires or cables installed under this project.
  
  - B. Wire numbers shall be exactly as noted on the Drawings. The Engineer shall be notified in the event of any wire number omission and it will be his responsibility to furnish a properly sequenced number to the Contractor.
  
  - C. Wire markers shall be installed before wires are connected to their designated terminals.
  
  - D. All power wiring not having individualized identification numbers shall be color coded with electrical tape or colored wire jacket in accordance with the following scheme.

120 volt supply  
Phase leads single or high speed: Yellow  
Low speed: Orange  
480 volt supply  
L1: Black  
L2: Red  
L3: Blue  
Neutral: White  
Equipment grounding conductor: Green  
Graphic panel and alarm: Blue  
Control: Red

- E. Phase taping shall be provided on all MCC feeders, branch circuits, etc., using the above colors and the following scheme.  
  
Phase A = One band  
Phase B = Two bands  
Phase C = Three bands

3.04 TERMINATION AND SPLICES

- A. 480 volt power conductors: Terminations use pressure connectors (split bolt type at motor terminal boxes). Splices (where allowed) use compression type connector and water-proof with heat shrink boot or epoxy filling. Splices allowed at terminal boxes only.
  
- B. Control Conductors: Termination on saddle-type terminals shall be wired directly with a maximum of two conductors. Termination on screw type terminals shall be made with a maximum of two conductors. Splices (where allowed) shall be made with insulated compression type connectors.
  
- C. Instrumentation Signal Conductors: (Including alarm, low and high level signals.) Terminations same as for control conductors. Splices allowed at terminal boxes only.
  
- D. 120 volt lighting and receptacles: Termination as device requires. Splices shall be made with wire nuts.

- E. In general, no splices will be allowed in manholes, handholes, or below grade located boxes. In special circumstances where splices are required, the Engineer may allow their use. However, the Contractor shall not proceed until written approval has been received from the Engineer.
- F. Splices shall not be made in push button control stations, control devices (i.e., pressure switches, flow switches, etc.), conduit bodies, etc.
- G. 5 KV conductors shall be terminated using termination kits approved by the Cable Manufacturer and in strict accordance with the manufacturer's instructions.

END OF SECTION



SECTION 16005

GROUNDING SYSTEM

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code and as hereinafter specified and shown on the Drawings. Refer to Detail Drawings.
- B. It is the intent of this Specification that all new enclosures of current carrying equipment (and other metallic devices as detailed or directed by the Engineer) be interconnected by copper equipment grounding conductors.

PART 2: PRODUCTS

2.01 MATERIALS

- A. Conduit shall be as specified under Section 16002.
- B. Wire shall be as specified under Section 16004.
- C. Ground rods shall be copper clad steel, 3/4" x 10' long unless shown otherwise on the Drawings. Rods shall be copperweld or an approved equal product.
- D. Grounding plates shall be copper, not less than 1/4" x 24" x 24" .

PART 3: EXECUTION

3.01 INSTALLATION

- A. Grounding conductors shall be run in all power conduits. Galvanized rigid steel conduits stubbed-up from below a motor control center shall be fitted with insulated grounding bushings and connected to the motor control center ground bus. The grounding wire shall be sized in accordance with Table 250-95 of the National Electrical Code, except that a minimum No. 12 AWG shall be used.
- B. Liquid-tight flexible metal conduit in sizes 1-1/2 inches and larger shall have bonding jumpers. Bonding jumpers shall be external, run parallel (not spiral), and fastened with plastic tie wraps.
- C. All equipment enclosures, motor and transformer frames, conduit systems, cable armor, exposed structural steel, and similar items shall be grounded.
- D. Exposed connections shall be made by means of approved grounding clamps. Exposed connections between different metals shall be sealed with No-Oxide Paint Grade A or approved equal. All buried connections shall be made by welding process equal to Cadweld.
- E. All underground conductors shall be laid slack and where exposed to mechanical injury, shall be protected by pipes or other substantial guards. If guards are iron pipe or other magnetic material, conductors shall be electrically connected to both ends of the guard to prevent the inductive choke effect. Connections shall be made as specified previously.
- F. The Contractor shall exercise care to insure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.
- G. Bare copper grounding conductors shall be located in the bottom of all duct banks and shall be

extended and connected to the equipment ground bus at each MCC. At equipment not provided with a ground bus, the conductor shall be connected directly to the equipment enclosures frame. The conductor size may be reduced from that included in the duct bank for connection to certain pieces of equipment where approved by the Engineer.

- H. All metal hardware in manholes or pull boxes shall be bonded to the bare copper duct bank grounding conductors and to a driven ground rod in the manhole.
- I. At each building or structure, the Contractor shall connect the bare copper duct bank conductor to the building structural steel and foundation reinforcing steel, to cold water piping and to at least one 3/4-inch x 10 foot copperweld grounding electrode. The location shall be as directed by the Engineer.
- J. The Contractor shall tie the grounding system at each new structure into the existing plant grounding system as directed by the Field Engineer.

### 3.02 TESTS

- A. The Contractor shall test and document the ground resistance of the system. All test equipment shall be provided by the Contractor and approved by the Engineer. Dry season resistance of the system shall not exceed five ohms. If such resistance can not be obtained with the system as shown, the Contractor shall provide additional grounding as directed by the Engineer, without additional expense to the Owner or Engineer.

END OF SECTION

SECTION 16007

MISCELLANEOUS ELECTRICAL EQUIPMENT

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required, and install complete ready for operation, and field test the miscellaneous electrical equipment as shown on the Drawings and/or specified herein.

1.02 DESCRIPTION OF SYSTEM

- A. The following equipment is included under this Section:

1. Panelboards
2. Disconnect Switches
3. Pushbutton Control Stations
4. Magnetic Motor Starters (rack or wall mounted)
5. Fractional Horsepower Motor Starting Switches
6. Dry Transformers
7. Wiring Devices
8. 24 Hour Programmable Timers
9. On/Off Repeat Cycle Timers
10. Corrosion Resistant Equipment Enclosures (NEMA 4X)
11. Contactors
12. Photocells
13. Control Relays
14. Corrosion Inhibitors
15. Pressure Switches
16. Limit Switches
17. Wireways

1.03 SUBMITTALS

- A. Submittals shall comply with Section 01340.
- B. In addition the submittals shall contain applicable information on all products specified in this

Section.

## PART 2: PRODUCTS

### 2.01 PANELBOARDS

- A. Boxes shall be made from galvanized code gauge steel having multiple knockouts unless otherwise noted. Boxes shall be of sufficient size to provide a minimum gutter space of 4 inches on all sides.
- B. Bus bars for the mains shall be of copper. Full size neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Phase bussing shall be full height without reduction. Cross connectors shall be copper.
- C. Neutral bussing shall have suitable lugs for outgoing feeder requiring a neutral connection.
- D. Hinged doors covering all circuit breaker handles shall be included in all panel trims.
- E. Doors shall have semi-flush type cylinder lock and catch, except that doors over 48 inches in height shall have a vault handle and 3 point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Two keys shall be supplied for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover shall be furnished on each door.
- F. All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished with ANSI Z55.1, No. 61 light gray paint over a rust inhibiting phosphatized coating.
- G. Panelboards shall be equipped with circuit breakers with frame size and trip settings as shown on the Drawings.
- H. Circuit breakers shall be molded case, bolt-in type.
- I. Circuit breakers used in 120/208 volt distribution panelboards shall have an interrupting capacity of not less than 10,000 amperes, RMS symmetrical.
- J. Circuit breakers noted on the Drawings for emergency and/or night-light circuits shall be suitable for switching duty.
- K. GFCI (Ground Fault Circuit Interrupter) shall be provided for circuits where indicated on the Drawings. GFCI units shall be 1 pole, 120 volt, molded case, bolt-on breakers, incorporating a solid state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be U.L. listed Class A, Ground I device (5 milliamp sensitivity, 25 millisecond trip time), and an interrupting capacity of 1,000 amperes RMS.

### 2.02 DISCONNECT SWITCHES

- A. Disconnect switches shall be heavy-duty, quick-make, quick-break, visible blades, 600 volt, 3 pole with full cover interlock.
- B. Enclosure type shall be NEMA 12 for indoor applications and NEMA 3R for outdoor applications except as shown on the Drawings or indicated otherwise herein.
- C. NEMA Type 4X enclosures shall be stainless steel.
- D. NEMA Type 7 enclosures shall be cast iron.

E. Switches shall be as manufactured by Westinghouse, General Electric, or equal.

#### 2.03 PUSHBUTTON CONTROL STATIONS

- A. Control stations shall be heavy-duty type, with full size operators and function identification nameplate (i.e., on-off).
- B. NEMA Type 4X enclosures shall be fiberglass reinforced polyester material.
- C. NEMA Type 7 enclosures shall be cast iron.
- D. Control stations shall be as manufactured by Westinghouse, General Electric, or equal.

#### 2.04 MAGNETIC MOTOR STARTERS AND COMBINATION STARTERS (RACK OR WALL MOUNTED)

- A. Motor starters shall be 2 or 3 pole, 1 or 3 phase as required, 60 Hertz, 600 volt, magnetically operated, full voltage non-reversing except as shown on the Drawings. NEMA sizes shall be as required for the horsepower shown on the Drawings.
- B. Each motor starter shall have a 120 volt operating coil and control power transformer. Auxiliary contacts shall be provided as shown on the Drawings or required.
- C. Three phase starters shall have 3 overload relays. Overload relays shall be adjustable for trip point and for automatic or manual reset.
- D. Built-in control stations and indicating lights shall be furnished as shown on the Drawings.
- E. Enclosure type shall be NEMA 12 except as shown on the Drawings.
- F. NEMA Type 4X enclosures shall be fiberglass reinforced polyester.
- G. Switches provided in combination starters shall be unfused, quick-make, quick-break with operating mechanism mounted in a fixed portion of the enclosure. Door mounted mechanism will not be acceptable.
- H. Motor circuit protectors provided in combination starters shall be molded case with adjustable magnetic trip only. They shall be specifically designed for use with magnetic motor starters.
- I. Combination magnetic motor starters shall be as manufactured by Westinghouse, General Electric, or equal.

#### 2.05 FRACTIONAL HORSEPOWER MOTOR STARTING SWITCHES

- A. Manual motor starters shall be furnished and installed for all 115/230 volt, single phase motors. The starters shall be of the horsepower rated, two (2) pole design with manual reset melting alloy overload elements.
- B. Enclosure type shall be NEMA 12 except as shown on the Drawings.
- C. NEMA Type 4 enclosure shall be fiberglass reinforced polyester.
- D. Starters shall be as manufactured by General Electric, Westinghouse, or equal.

#### 2.06 DRY TRANSFORMERS

- A. Transformers shall be dry type, two-winding, 480-120/208 volt, 3 phase with KVA ratings as shown on the Drawings.
- B. Four full capacity taps shall be furnished, two 2-1/2 percent above and two 2-1/2 percent below rated primary voltage.
- C. Transformers shall be constructed with 150 degrees C winding rise/220 degrees C insulation system, suitable for use in a 40 degree C ambient.
- D. Transformers shall be as manufactured by Westinghouse, Jefferson, General Electric, Square D, or equal.

## 2.07 WIRING DEVICES

### A. Switches

- 1. General purpose switches shall be AC quiet type General Electric 20 Amp, 120/277 volt #GE 5951 (single pole) or #GE 5953 (three-way), Hubbell, or equal.
- 2. Weatherproof switches shall be standard duty NEMA 4X control stations Westinghouse #5665D36, General Electric, or equal.

### B. Receptacles

- 1. Duplex receptacles shall be NEMA 5-15R and single receptacles shall be NEMA 5-20R.
- 2. General use receptacles shall be General Electric 15 Amp, 120 volt GE 4065 (duplex), 20 Amp, 120 volt GE 4102 (single) and 20 Amp, 250 volt GE 4182 (single), Hubbell, or equal.
- 3. Receptacles noted on the Drawings as being Ground Fault Interrupter type (GFI) shall be Hubbell GF-5262 series or equal. Exterior receptacles shall have weatherproof cover plate.

### C. Device Plates

- 1. Devices installed in finished rooms shall be provided with Type 302 stainless steel face plates.
- 2. Devices in areas exposed to weather or designated to be weatherproof on the plans shall be provided with hinged gasketed covers. All receptacles located outdoors shall have covers. Receptacles located in buildings, except MCC & Switchgear Rooms, shall be weatherproof with hinged gasketed covers.

## 2.08 24-HOUR PROGRAMMABLE TIMERS

- A. The time switch shall be of the program type, capable of programming at 15 minute intervals of the day. Program tabs shall be captive on the dial, and shall be easily set by hand without tools to obtain or to change the desired programming schedule. The switching condition shall be maintained when adjacent tabs are set alike.
- B. The unit shall be powered by a self-starting, enclosed, 120 volt, synchronous motor capable of continuous accurate operation. A reserve power precision wound spring and associated escapement device shall be integrally mounted to maintain time settings during power failures of up to 24 hours.

- C. The switch mechanism shall be a self-contained unit rated at not less than 20 amps, 120 volts, single pole, double throw and shall be readily replaceable in the field.
- D. An omitting device shall be furnished as an integral part of the time switching operation to be skipped for any preselected day or days of the week.
- E. The time switch shall be Model #8007 as manufactured by Tork, Paragon, or equal.

#### 2.09 ON/OFF REPEAT CYCLE TIMERS

- A. On/Off Repeat Cycle Timer shall be a solid state timer. Two independent knobs referenced to a calibrated scale provide the individual time settings. Two front mounted pilot lights indicate timing status. The timing base for each of the two timers states (On time and Off time) is generated by an internal oscillator set by a precision capacitor and a dial adjustable, potentiometer. Provide "Off" period or "On" period timing first as required by the drawings.
- B. Timers shall be DA100 Miniflex Series On/Off Repeat Cycle Timers as manufactured by Gulf Western Manufacturing Co., Eagle Signal division, or equal.

#### 2.10 CORROSION RESISTANT EQUIPMENT ENCLOSURES (NEMA 4X)

- A. All electrical equipment located within an area designated on the Drawings as NEMA 4X shall be housed in an enclosure in conformance with the following Specifications.
- B. Boxes for panelboards, starters, control stations, auxiliary controls, etc., shall be manufactured of a high impact strength fiberglass reinforced polyester material specifically designed for use in corrosive areas. The back and sides shall be of a one piece construction. Doors or covers shall be attached with 316 stainless steel captive fasteners or hinges. The cover to box joint shall be made watertight with a mechanically retained gasket. All pushbutton operators, selector switches, handles, etc., mounted on the enclosure face shall be manufactured of the basic fiberglass reinforced polyester or polycarbonate material with gasketing to prevent leakage. **BOXES SHALL HAVE INTERIOR COMPONENTS FACTORY INSTALLED, WIRED AND TESTED AND SHALL NOT BE BUILT UP AT THE JOB SITE.** Boxes shall be Krydon as manufactured by Crouse Hinds, Nelsworth as manufactured by Nelson Electric, or equal.

#### 2.11 CONTACTORS

- A. Lighting and miscellaneous use contactors shall have amp ratings and number of poles as detailed on the Drawings. Contactors shall be suitable for continuous duty with all types of lighting and resistive loads. Coils shall be rated 120 volts unless noted otherwise and suitable for continuous operation.
- B. Contactors shall be as manufactured by the manufacturer of the motor starters.

#### 2.12 PHOTOCELLS

- A. The photocells shall be suitable for power duty with individual fixtures or for pilot duty with contactors as detailed on the Drawings. The units shall be complete with adjustable stem to permit tilting of the lens up to 80 degrees from the horizontal and internal lens louvers to ensure natural daylight actuation. Enclosure shall be NEMA 4X. Contacts shall be rated for 1000 watts continuous at 120 volts. The unit shall turn on at 3 footcandles and off at 7 footcandles.
- B. Photocells shall be Intermac series, K1100, paragon bulletin 2600, or equal.

- C. All 480 VAC exterior lighting shall be activated by photocells.

## 2.13 CONTROL RELAYS

- A. 2 Pole relays shall have double pole double throw contacts rated 10 amps continuous at 120 VAC, 80% P.F. relay shall have a clear polycarbonate dust cover. Coil shall be rated 120 VAC. Relay shall be Potter & Brunfield KRP series or equal.
- B. Time delay relays shall be of the adjustable solid state type with adjustable ranges as shown on the control drawings. Solid State Time Delay relays shall be as manufactured by Potter & Brunfield or equal.
- C. Other control relays shall be electrically held or permanent magnet latched type with convertible contact cartridges which can be arranged in any normally open or normally closed combinations. Contacts shall be rated 10 amps minimum continuous at 120 VAC, 60 Hertz. Coil shall be rated 120 volts AC, 60 Hertz. Relays shall be Allen-Bradley Bulletin 700 or equal.

## 2.14 CORROSION INHIBITORS

- A. All area control panels, area monitor panels, instrumentation terminal cabinets, or any other control or junction panel that contains electrical or electronic equipment or terminal strips shall be furnished with an internally mounted chemically treated corrosion inhibitor pad.
- B. The corrosion inhibitor pads shall be as manufactured by Hoffman Engineering Co., or equal.

## 2.15 PRESSURE SWITCHES

- A. Pressure switches shall have a snap action precision switch equipped with silver contacts. Contact force shall be maintained at a high level up to the instant of snap over avoiding dead center conditions. Contacts shall be single pole, double throw rated 5 amps and shall be convertible to open or close on increasing or decreasing pressure. Pressure switches shall have a Range of adjustment of 0 to 150 PSI with an adjustable differential of 2 to 18 PSI, and wetted parts shall be 316 stainless steel. Pressure switches shall have a NEMA 4 enclosure. Pressure switches shall be Allen-Bradley Bulletin 836, Static-O-Ring, or equal. Provide pulsation snubber with pressure switches used on pump discharges. Explosion proof pressure switches shall be used on any digester gas applications.

## 2.16 LIMIT SWITCHES

- A. Limit switches shall be wobble stick type, side mounted, with head as required for the particular application. Switches shall be non plug in style in NEMA 13 Olight Enclosure. Switches shall be mounted in such a way that the wobble stick will not be deflected beyond the "Maximum Travel" position. Limit switches shall have a minimum contact rating of 3 amp continuous at 120 volts and shall have a maximum travel to reset of 40. Limit switches shall be Allen-Bradley Bulletin 802T or equal. Sealed contacts are required on devices outdoors or in areas subject to corrosion (NEMA 4X areas).

## 2.17 EQUIPMENT IN CHLORINE BUILDING

- A. Any new electrical equipment installed in and around the Chlorine Building shall be fabricated from corrosion resistant materials. In particular, all switch and receptacle cover plates shall be stainless steel and conduit shall be PVC coated Rigid Galvanized Steel, Plasti-Bond or equal.

2.18 WIREWAYS

- A. Wireways shall be steel "Square-Duct" as manufactured by the Square D Co., or equal.

2.19 ELECTRICAL DEVICES FURNISHED WITH MECHANICAL EQUIPMENT

- A. Unless otherwise specified or shown in other sections of the specifications, all electrical power, control or instrumentation devices furnished as a "package" with mechanical equipment shall conform to the latest issue and addenda to the Joint Industry Council Electrical Standards for Mass Production Equipment (EMP-1-67) or as modified herein.
- B. Panels housing electrical equipment shall be either NEMA 4X (non-metallic corrosion resistant or 316 stainless steel) or NEMA 12 (dust tight) suitable for floor or wall mounting as detailed on the Electrical Power and Instrumentation Plan Sheets. Where specified to the NEMA 4X refer to Section 16 Miscellaneous Electrical Equipment for construction details.
- C. Separate power, control and instrumentation terminal strips shall be provided for all external panel connections. All terminal points shall have identification numbers approved by the ENGINEER.
- D. All panels housing electrical equipment shall be designed for front access only.
- E. Conductors extending beyond a panel to other auxiliary equipment which is wired on a skid type or a package base shall be protected by aluminum rigid conduit. Where terminating at a motor or other similar device requiring frequent movement or which produces excessive vibration liquid tight type flexible conduit shall be used. Liquid tight conduit will be limited to three (3) feet maximum length at any termination.
- F. Gasketed type conduit hibs will be used for all conduit penetrations of the panel.
- G. A main panel power disconnect device shall be an integral part of the panel and shall be one of the following types:
  - 1. A horsepower rated heavy duty safety switch or non-automatic circuit breaker for 480 volt, one phase or three phase panels.
  - 2. A heavy duty safety switch, non-automatic circuit breaker or fractional horsepower manual motor starter switch without overloads for 120 volt, one phase panels.
- H. Unless otherwise noted all panels supplied with a 480 volt power feeder shall be provided with an integrally mounted dual winding 120 volt control power transformer with primary and secondary fusing. Control power transformers shall have the neutral grounded.
- I. Starters incorporated into panels shall have thermal type overload relays in each underground conductor. Overloads shall be adjustable for either manual or automatic reset. Starters shall be NEMA sized in accordance with the HP shown on the drawings.
- J. All wiring shall be copper conductors with NEC insulation designation of MTW or THWN
- K. All devised shall be of a heavy duty industrial type quality. Devices mounted in panel interiors shall be suitable for use in non-ventilated panels subjected to a 40 degrees C ambient without system deterioration.
- L. Schematic (elementary) diagrams, wiring (interconnection) diagrams, and equipment lists shall be furnished for all panels. For panels containing a complex control scheme, a written operational theory shall be crossreferenced to the schematic diagram. The wiring diagram in

its "as-built" form shall be fastened to the panel door. The equipment list shall identify the manufacturer, manufacturer's part of model number and a cross reference as to its location in the panel.

- M. Contacts for external alarms or equipment interlocking shall be of the isolated contact type and provided as required per individual equipment specifications, Process and Instrumentation Drawings, or the Electrical Control Schematics. Contacts shall be rated at 10 amps continuous pilot duty.
- N. Input or output instrumentation level signals shall in general be 4-20 ma and provided as required per individual equipment specifications and the process and Instrumentation Drawings.
- O. Auxiliary devices (pressure switches, flow switches, etc.) located remotely from panels but furnished under this section shall have enclosures in conformance with the area classification noted on the Electrical Drawings.

END OF SECTION

SECTION 16008

LIGHTING FIXTURES AND ACCESSORIES

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install complete ready for operation and field test the interior and exterior lighting system as shown on the Drawings and/or Specifications herein.

1.02 SUBMITTALS

- A. Submittals shall comply with Section 01340.
- B. In addition, the submittals shall contain the following:

- 1. Fixtures
- 2. Ballasts
- 3. Poles

PART 2: PRODUCTS

2.01 FIXTURES

- A. Lighting fixtures shall be furnished as required by the schedules on the Drawings, shall be complete with required lamps, ballasts, guards, enclosures, and lenses, and be completely wired. Unless otherwise indicated, fluorescent lamps shall be standard warm white, mercury vapor shall be deluxe white, and sodium vapor lamps shall be high pressure type. Where fixtures are to be installed recessed, verify the type of ceiling or wall construction and furnish the appropriate frames, mounting devices, and hardware.
- B. When mounting ceiling lights in vicinity of monorails make sure there is adequate clearance for all crane movements. This may entail mounting lights after crane is installed. Contractor is responsible for coordinating final location of light fixtures in all buildings with monorails or cranes. Final location shall be approved by the Engineer.

2.02 FLUORESCENT BALLASTS

- A. Ballasts for fluorescent fixtures shall be integral with the fixture, high power factor (minimum 90% P.F.) CMB certified, UL listed, Class P with integral thermal protection in both the core and coil assembly and the capacitor assembly.

2.03 FLUORESCENT FIXTURES

- A. Florescent fixtures used in damp locations shall be enclosed and gasketed type with energy efficient lamps. Lamps shall be Sylvania Super Saver, G.E. Watt-Mizer or equal. Fixtures shall be Keystone Nautilus Series or equal. Fluorescent fixtures for MCC and Switchgear Rooms shall be industrial baked enamel, Keystone Dynamo Series or equal.

2.04 SODIUM VAPOR BALLASTS

- A. Ballasts for 250 watt lamps and above shall be high power factor, auto-regulator type, capable of starting with plus or minus ten percent input voltage variation, and capable of operating with an input voltage dip to 75 percent of nominal operating voltage.
  - B. Ballasts for 150 watt lamps and below shall be high power factor auto transformer type, capable of starting with plus or minus five percent input voltage dip to 75 percent of nominal operating voltage.
  - C. Ballasts shall be rated minus 20 F to plus 150 F, shall have grounded screw shell, meet all ANSI, NEMA and National Electric Code requirements, and UL listed. Ballasts shall be capable of operation under continuous open circuit conditions.
  - D. Ballasts shall be as manufactured by General Electric Co., Westinghouse Corporation, GTE Sylvania Inc., or equal.
- 2.05 HIGH PRESSURE SODIUM FIXTURES
- A. Area Flood lights shall be heavy-duty, weatherproof floodlight, General Electric Type HLX Power-flood or equal for operation of one 400 watt Lucalox High Pressure Sodium (HPS) lamp from a nominal 480V, 60 Hertz power source. It shall consist of durable die-cast aluminum housing, integral ballast, charcoal filtered, optical assembly, aluminum reflector, heavy-gauge galvanized steel trunion, corrosion resistant hardware, built-in aiming site, and tempered heat resistant cover glass. Light distribution shall be NEMA 6X5.
  - B. Building mounted outdoor flood lights shall be General Electric VLU Power Flood or equal with 250 watt High Pressure Sodium Lamp or as indicated on the drawings.
  - C. All fixtures located in doors in damp locations shall be General Electric Filter-Guard or equal with 100 or 150 watts HPS lamps as indicated on the Drawings.
  - D. The fixtures to be used in stairwells and at Primary Effluent Station shall be Wallpacks, G.E. Walllighter or equal with 70 to 100 watts High Pressure Sodium Lamp as noted on the Drawings.
- 2.06 PENDANT FIXTURES
- A. Pendant Fixtures shall be mounted as required by the Drawings. All office areas shall have fixtures mounted at 11 feet above floor level, or as indicated on the Drawings.
- 2.07 POLES AND POLE-MOUNTED FIXTURES
- A. Unless otherwise specified, all poles shall be United Lighting Standards Square Painted Bronze, or engineer approved equal. Poles shall be 25 foot suited for area wind rating, or engineer approved equal. Suited for area wind rating with all required mounting brackets and other hardware. The poles shall, as close as possible, match existing light poles at plant.
- 2.08 CONCRETE POLE BASE
- A. Concrete bases for exterior lighting shall be detailed on the Electrical Detail Drawing.

### PART 3: EXECUTION

#### 3.01 INSTALLATION

- A. Unless otherwise indicated on the Drawings, pendant fixtures shall be suspended with rigid stems such as conduit. The use of threaded rods is prohibited. Fixtures over two feet long shall be supported with a minimum of two stems. Each stem shall be provided with a ball and socket type self-aligning hanger as manufactured by Appleton, Crouse-Hinds, or equal. Pendant fixtures shall be grounded by means of separate conductor connected to a grounding bushing or lug in the outlet box.
- B. Conduit run in areas with hung ceilings shall be installed in the space above the hung ceiling as close to the structure as possible. Conduits shall be supported from the structure.
- C. Contractor shall refer to Drawings for Luminaire Voltage required.
- D. Refer to lighting fixture schedules on Drawings for actual fixtures to be furnished in different areas of the Plant.

#### 3.02 CLEANING UP

- A. All fixtures shall be left in a clean condition, free of dirt and defects, before acceptance by the Engineer.

END OF SECTION



SECTION 16011  
ELECTRIC MOTORS

**PART 1: GENERAL**

**1.01 SCOPE OF WORK**

A. Furnish all labor, materials, equipment, and incidentals required, and install, complete and ready for operation, and field test the motors and related appurtenances as shown on the Drawings or as specified herein.

**1.02 QUALIFICATIONS**

A. Motors shall be of sufficient size for the duty to be performed and shall not exceed their full rated load when the driven equipment is operating a specified capacity. Unless otherwise noted, motors driving pumps shall not be overloaded at any head or discharge condition of the pumps.

**1.03 SUBMITTALS**

A. Submittals shall comply with Section 01340.

B. In addition, the submittals shall contain the following:

1. Complete nameplate data showing ambient temperature rating, service factor, efficiency at 1/2, 3/4 and full load and power factor of 1/2, 3/4 and full load.
2. Motor outline, dimensions and weight.
3. Descriptive bulletins, including full description of insulation system.
4. Bearing design data.
5. Special features (i.e., space heaters, temperature detectors, etc.).

**PART 2: PRODUCTS**

**2.01 GENERAL**

A. Standards. Motor shall be built in accordance with IEEE Standards, NEMA Standard-MGI, latest revision, and to the requirements specified herein. Where a conflict may exist, these specifications take precedence.

B. Type. Motors specified herein are three-phase squirrel cage for 1/2 Hp and above; or single-phase types for less than 1/2 Hp.

C. Rating. Each motor shall develop ample torque for its required service throughout its acceleration range at a voltage 10 percent below nameplate rating. Where detailed on the Electrical Drawings to be operated on a reduced voltage starter, the motor shall develop ample torque under the conditions imposed by the reduced voltage starting method.

The motor shall 1 not be required to deliver more than its rated nameplate horsepower, at unity (1.0) service factor, under any condition of mechanical or hydraulic loading.

All motors shall be continuous time rated suitable for operation in a 40 degree C ambient

unless noted otherwise.

D. Specific motor data such as HP, RPM, enclosure type, etc., is specified under the detailed specification for the mechanical equipment with which the motor is supplied.

E. All motors 1 Hp and larger shall be of the high efficiency type in accordance with Paragraph 2.07E.

## 2.02 ENCLOSURE TYPES

A. All motors shall be of the totally-enclosed fan-cooled type unless indicated otherwise under the Detailed Mechanical Specifications.

## 2.03 NAMEPLATES

A. The motor manufacturer's nameplates shall be engraved or stamped on stainless steel and fastened to the motor frame with stainless steel screws or drive pins. Nameplates shall indicate clearly all of the items of information enumerated in NEMA Standard MGI-10.38 or MGI-20.60, as applicable.

## 2.04 CONDENSATION HEATERS

A. Condensation heaters, where specified under the detailed mechanical specifications shall conform to the following:

1. Heaters shall be of the cartridge or flexible wrap around type installed within the motor enclosure adjacent to core iron. Heaters shall be rated for 120 V, single phase with wattage as required. The heater wattage and voltage shall be embossed on the motor nameplate. Power leads for heaters shall be brought out at the motor lead junction box.

B. All motors 100 HP and larger shall have a 120 V space heater for moisture control.

## 2.05 WINDING TEMPERATURE DETECTORS

A. Where specified under the detailed mechanical specifications for individual equipment, or on all A.C. motors to be connected to a variable speed drive, or on all motors 100 HP and above, there shall be a factory installed winding temperature detector with leads terminating in the main conduit box. This device shall protect the motor against damage from overheating caused by single phase, over load, high ambient, abnormal voltage, locked rotor, frequent starts or ventilation failure. The protective device shall have normally closed contacts. Essential auxiliary relays and controls shall be mounted in the controller enclosure. Not less than two (2) detectors shall be furnished with each motor requiring such detector with one left as a spare.

## 2.06 SINGLE PHASE MOTORS

A. General. Unless otherwise specified, motors smaller than 143T (1/2 HP) frame shall be single phase, capacitor start. Small fan motors may be split-phase or shaded pole type if such are standard for the equipment. Wound rotor or commutator type single-phase motors are not acceptable unless their specific characteristics are necessary for the application.

B. Voltage. Motors shall be rated for operation at 115 volts, single phase, 60Hz. Should unusual conditions require a three phase motor on a frame smaller than 143T, it shall be designed for 200 volts, three phase, 60 Hz, but only after written approval has been received from the ENGINEER.

C. Enclosure. Motors shall be totally-enclosed in conformity with NEMA STANDARD- MGI-10.35. Small fan motors may be open type if suitably protected from moisture, dripping water and lint accumulation.

Locked rotor current shall not be greater than specified in NEMA Standard MGI-12.32, Design "N".

D. Bearings. Motors shall be provided with sealed ball bearings lubricated for 1-0 years normal use.

E. Motors shall be designed for severe duty and shall be suitable for operation in moist air with hydrogen sulfide gas present.

#### 2.07 THREE PHASE MOTORS - FRAMES 143T THROUGH 449T

A. General. All motors 1/2 Hp and larger shall be on a NEMA frame 143T or larger. Motors shall be designed and connected for operation on a 240 or 480 volt, three phase, 60 Hz alternating current system, as applicable. Dual voltage (230/460) rated motors are acceptable.

All motors shall be NEMA Design B, normal starting torque unless noted otherwise. Starting KVA/HP (Locked rotor) shall not exceed the values given in NEMA Standard MGI-10.37. Motors shall be as manufactured by Reliance, Siemens, Magnatec, General Electric or approved equal.

B. Bearings. Antifriction motor bearings shall be designed to be regreasable and initially shall be filled with grease suitable to ambient temperatures to 40 degrees C. Bearings shall be AFBMA Types BC or RN, heavy duty, or shall otherwise be shown to be suitable for the intended application in terms of B-10 rating life, Class M3 or better.

All grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic type as manufactured by the Alemite Division of the Stewart-Warner Corporation.

C. Insulation. Insulation systems shall be Class B or F (except as modified below) and shall be manufacturer's premium grade, resistant to attack by moisture, acids, alkalis, and mechanical or thermal shock.

D. Enclosures. Motors shall have a cast iron frame and cast iron or stamped steel conduit box. Conduit box shall be split from top to bottom and shall be capable of being rotated to four positions. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and between the conduit box and its cover. Motor leads shall be sealed with a nonwicking, nonhygroscopic insulating material. A pad with drilled and tapped hole, not less than 1/4-inch diameter, shall be provided inside the conduit box for a motor frame grounding stud.

1. Open drip proof. Manufacturer's standard design with Class B insulation, stamped steel motor lead junction boxes and 1.15 service factor (at 40 degrees C).

2. Totally enclosed fan cooled. TEFC motors shall include Class B insulation, cast iron junction box, 1.15 service factor (at 40 degrees C), tapped drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger), upgrade insulation by

additional dips and bakes to increase moisture resistance.

3. Explosion proof. Explosion proof motors shall include Class B insulation, 1.15 service factor (at 40 degrees C) tapped drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger), UL label for Class 1, Div. 1, Group D hazardous areas.
4. Severe duty. Motors shall be of the corrosion resistant type conforming to motors designated by the manufacturer as "Chemical Duty", "Mill and Chemical", "Custom Severe Duty", or similar applicable manufacturer's quality designation. Severe duty motors shall include Class F insulation (applied at Class B rise), 1.15 service factor (at 40 degrees C), tapped drain holes (corrosion resistant plug for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger), epoxy finish, upgrade insulation by additional dips and bakes to increase moisture resistance.
5. Submersible/Explosion proof. Motors shall be housed in a water-tight casing and shall have Class F insulated windings which shall be moisture resistant. Pump motors shall have cooling characteristics suitable for continuous operation in a totally, partially, or nonsubmerged condition without overheating or other damage. The power cable shall be of adequate length to allow the unit to be wired as detailed on the electrical drawings without splices. The motor shall be listed as suitable for use in a Class 1, Division 1, Group C and D hazardous location. The cable entry junction box and motor shall be separated by a terminal board which shall isolate the motor interior from foreign materials gaining access through the pump top.

E. High Efficiency Motors

1. All three phase, single speed motors rated shall be of the high efficiency type. Motors shall have a Guaranteed Minimum Efficiency not less than the values indicated below. Efficiency values shall be based on tests performed in accordance with NEMA Standard MG1-12.53A, MG12.53b IEEE 112. Motors with horsepower or RPM's not listed shall conform to comparable standards of construction and materials as those for listed motors.

Guaranteed Minimum Efficiency

Hp	1800 RPM	1200 RPM
1	81.5%	75.5%
1-1/2	81.5%	81.5%
2	81.5%	84.5%
3	86.5%	86.5%
5	88.5%	86.5%
7-1/2	88.5%	86.5%
10	88.5%	88.5%
15	90.5%	88.5%
20	90.2%	90.2%
25	91.7%	90.2%
30	91.7%	90.2%
40	91.7%	91.7%
50	93.0%	91.7%
60	93.0%	91.7%
75	93.0%	93.0%
100	93.6%	93.0%

2. All high efficiency motors 100 HP (except when connected to Variable Frequency Drives) and larger shall be provided with a heavy duty industrial type power factor correction capacitor selected, recommended, and furnished by the motor manufacturer to raise the motor power factor to approximately 95 percent. Capacitors shall utilize non-PCB biodegradable dielectric fluid within an enclosure compatible with NEMA 4 atmosphere. The capacitor shall be mounted on the equipment base plate adjacent to the motor and shall be connected to the motor junction box with liquid tight flexible conduit by the equipment manufacturer.

F. The operating power factor of the motors shall range from 93 to 95 percent at full load and 95 to 98 percent when partially loaded. Capacitor current shall not exceed the motor no-load magnetizing current.

G. Motors shall be suitable for operation in moist air with hydrogen sulfide gas present.

H. All motors shall have a final coating of chemical resistant corrosion and fungus protective epoxy fortified enamel finish sprayed over red primer over all interior and exterior surfaces. Starter bore and rotor of all motors shall be epoxy coated.

I. All fittings, bolts, nuts, and screws shall be plated to resist corrosion. Bolts and nuts shall have hexheads.

J. Motors shall be provided with condensate drain holes and epoxy coated motor windings to protect against moisture.

**PART 3: EXECUTION**

**A. Tests and Checks**

The following minimum tests and checks with documentation shall be made before energizing the motors:

1. Check motor nameplate HP and current rating.
2. Check motor grounding connection.

3. Check motor shaft for free rotation.
4. Check motor bearings for proper lubrication.
5. Check motor shaft end play.
6. Check motor wiring for proper size, conformance to color code and proper identification.
7. Test insulation resistance of each motor with a 500 volt megger for 30 seconds.
8. Check motor for proper rotation.
9. Perform 30 minute run-in test on each motor.
10. Check vibration and bearing temperature.

END OF SECTION