

# DIVISION 16 - ELECTRICAL



## SECTION 16010 - GENERAL PROVISIONS

### PART I GENERAL

#### 1.01 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Supplementary Conditions, and *General Requirements*, apply to work specified in this section.

#### B. WORK SPECIFIED ELSEWHERE

1. Basic materials & Methods: Section 16100
2. Electrical Service & Distribution System: Section 16400
3. Lighting: Section 16500

#### 1.02 SAFETY

A. In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours.

#### 1.03 SCOPE OF WORK

A. Furnish all materials and equipment (except those items specifically stated in Specifications or on the Drawings as being furnished by Owner or others), labor and incidentals required for the electrical work as indicated in these Specifications and Drawings, and as required to make a complete and operating installation, and to the satisfaction of the Owner and the Architect/Engineer.

B. Furnish competent supervision of the work to be performed at all times during the progress of the work.

C. The work includes (but is not necessarily limited to) the following:

1. Service entrances and mounting of metering equipment as required by the Utility Company.
2. Wiring and connections to equipment which is to be furnished and installed under other divisions in these specifications.
3. Installing, wiring, and connecting electrical equipment which is to be furnished by the Owner.
4. Electrical work incidental to the requirements of mechanical system(s).
5. Temporary wiring as required for other building functions during performance of electrical work.
6. Testing of electrical equipment and wiring.

#### 1.04 DRAWINGS

The Drawings shall indicate the general layout of the various items of equipment. However, layout of equipment, accessories, specialties, wireways, and conduit systems are diagrammatic unless specifically dimensioned, and do not necessarily indicate every required fitting elbow, transition, junction box, pull box, or similar items required for complete installation.

#### 1.05 JOB CONDITIONS

- A. Carefully investigate structural conditions, wall, furring and chase locations, and room finishes, and make actual measurements on the job so that all equipment such as panel boards, switches, receptacles, lighting fixtures, fire alarm stations, horns, annunciators, and accessories shall fit.
- B. Verify all measurements and be responsible for the correctness of same before ordering any materials or doing any work. No extra charge or compensation will be allowed because of any difference between the actual measurements and those indicated on the Drawings. Any difference which might be discovered by the Contractor shall be submitted to the Architect/Engineer for consideration before proceeding with the work.

#### 1.06 LAWS & PERMITS

- A. The latest published regulations of the National Electric Code, with the latest tentative interim amendments, shall be considered as included in these Specifications, and all applicable requirements shall be fully complied with.
- B. Apply for all permits, licenses, and inspection certificates and pay all fees incidental to the carrying on of the electrical work. Give notice to the proper authorities in ample time for the work to be inspected and approved as it progresses, and conceal no work until approved by the electrical inspectors having jurisdiction. The National Electric Code and National Board of Fire Underwriters and all state and local rulings shall be observed and shall govern the character of this work. Should the Drawings or these specifications in any way conflict with the Code, State, or local rules, promptly notify the Architect/Engineer in writing in order that necessary changes can be accomplished by appropriate modification.
- C. Upon completion of the installation, a certificate of approval from the electrical inspection department having jurisdiction thereon shall be furnished to the Owner, and all fees shall be paid by the Contractor. The certificate of inspection shall not release the workmanship or installation, should any develop within one year after the final acceptance of the work herein specified. Make all changes and repair all such defects without additional charge to the Owner and upon written notice from the Architect/Engineer.

#### 1.07 CUTTING, PATCHING & PAINTING

- A. Do all cutting and patching necessary for the installation of the work. Note that the integrity of any fire rated ceilings and/or ceiling-roof assemblies must be maintained. No cutting, drilling, or insertion of sleeves which may weaken a structural member shall be done without consent of the Architect/Engineer. Finished floors, walls, and ceilings shall not be broken without consent of the Architect/Engineer. Patching and repairs shall be made by the affected trades at the responsibility and cost of the Contractor.

- B. All patching and painting shall be accomplished so as to match finished materials, paint, or other finish to the satisfaction of the Architect/Engineer.

#### 1.08 EXAMINATION OF PREMISES

- A. Visit the site of the proposed work, inspect the facilities and become familiar with the difficulties and restrictions attending the execution of the Contract. No additional compensation will be allowed for failure to be so informed.

#### 1.09 MATERIALS & WORKMANSHIP

- A. Unless otherwise specified, all materials shall be new and unused and shall be listed by Underwriters' Laboratories, Inc., for the service intended.
- B. Workmanship shall conform to the best electrical installation practice.
- C. Equipment and accessories as installed shall be complete and operational. The exact location and arrangement of material and equipment shall be determined as work progresses to conform in the best possible manner with related work of other crafts. The work in all its details is subject to the approval of the Architect/Engineer. Any work or material which is rejected must be removed and replaced immediately.

#### 1.10 TESTS

- A. Test all wiring to indicate that the completed system is free of short circuits and undesirable grounds, and is ready for operation. Insulation resistance of all wiring shall meet the performance suggested by the manufacturer. In order that a reasonable factor of safety be provided, the following table of insulation resistances is suggested as a guide:

1. For circuits of No. 14 or No 12 ... 1,000,000 OHMS
2. For circuits of No. 10 or larger with conductor ampacities based on NEC Tables 310-12 through 310-15 as follows:
  - a. 25 through 50 amperes ..... 250,000 OHMS
  - b. 51 through 100 amperes ..... 100,000 OHMS
  - c. 101 through 200 amperes ..... 50,000 OHMS

Note: All values to be determined with all switchboards, panel boards, fuse holders, switches, receptacles, and overcurrent devices in place. All values subject to modification where wiring and equipment is exposed to excessive humidity due to climatic or other conditions.

- B. Provide all necessary testing equipment for making tests. All tests shall be made in the presence of the Architect/Engineer or a representative thereof. When test results are not satisfactory, the Contractor shall make such adjustments and changes as are necessary and shall notify the Architect/Engineer that he is ready for another test. Repeat the test or tests which disclosed the faulty or defective work or equipment, and make such additional tests as the Architect/Engineer deems necessary.

- C. Perform a ground resistance test on each motor before energizing and submit a written report certifying the results of same. If insulation resistance is found to be low, notify the Architect/Engineer and do not energize the motor. The following tables gives minimum acceptable insulation resistance in megohms at various temperatures and for various voltage ratings with readings being taken after one minute of megger test run.

<u>Deg F°</u>	<u>Voltage</u>	
<u>Winding Temp.</u>	<u>120V</u>	<u>240V</u>
37	60.0	108.0
50	32.0	60.0
68	13.0	26.0
86	5.6	11.0
104	2.4	2.5

- D. Check direction of rotation of all motors and reverse connections as necessary. Contractor shall not attempt to "bump" motors while coupled to mechanical equipment that could be damaged by wrong rotation.

#### 1.11 GUARANTEE

- A. All materials and workmanship shall be guaranteed for a period of one year from the date of acceptance of the project as substantially completed in accordance with the Drawings and Specifications, or when beneficially used by the Owner, whichever first occurs as certified by the Architect/Engineer. Defects due to faulty materials, methods of installation or workmanship shall be repaired or replaced promptly with the least inconvenience and without expense to the Owner, and at time designated by the Architect/Engineer. This guarantee is in addition to any other or more specific performance guarantees called for in individual paragraphs.

#### 1.12 SUBMITTALS AND SHOP DRAWINGS

- A. Submit for review product data, shop drawings and samples. All cuts, catalogues, bulletins, diagrams, curves, etc. shall be submitted in six (6) copies. Trade names, manufacturers, and catalog numbers are mentioned herein and on the Drawings solely in order to establish a standard for the type, general design, and in order to establish a standard for the type, general design, and quality of product required. Other products similar in design of equal quality and complying with the Drawings and Specifications will be considered after the Contract is let. Where two or more manufacturers or materials are named, the Contractor may submit any of those named, provided they conform to the Specifications. The submission of samples may be required by the Architect/Engineer particularly wherever equipment or appliances are visible in finished areas. Demonstrations of a producer's ability to perform as specified shall be arranged if required. Dimensional data and weights shall be included. Review of submittal and shop drawings does not relieve the Contractor of the responsibility for fitting the equipment in the space allotted with space for electrical connection and for servicing, or for coordination of the work with work of other trades. Contractor shall review submittal and shop drawings and indicate by stamp or letter that he has reviewed them before forwarding them to the Architect/Engineer. Submittal and Drawings will

be returned after review indicating whether or not exceptions are taken and the required procedure to be followed thereafter. Where exceptions are taken, resubmission of revised submittal and/ shop drawing is required before construction is begun.

- B. Corrections or comments made on the submittal and drawings during this review do not relieve the Contractor from compliance with the requirements of the Drawings and Specifications. This review is for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. The Contractor is responsible for confirming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction.
- C. The products listed below shall be submitted for review after the award of the Contract and before any equipment or materials are purchased. If a product is unacceptable, another product shall be submitted. The list is a guide only, and all electrical equipment used in the job shall be submitted.
- D. Items to be submitted are:
  - 1. Lighting fixtures
  - 2. Combination starter & disconnect switches, Disconnect switches.
  - 3. Circuit breakers.
  - 4. Wiring devices & device plates, compression terminals, taps & splices for aluminum conductors.
- E. Further descriptions or information required with shop drawings shall be included with the description of materials specified herein.
- F. Detailed dimensioned shop drawings for the installation of the work in the electrical equipment rooms (areas) shall be prepared and submitted for review. These drawings shall be new drawings prepared by the Contractor and shall not be reproductions or tracings of the Architect/Engineer's Drawings. In preparing shop drawings, establish lines and levels for the work specified and check the Drawings to avoid interference with structural features and the work of other trades. Immediately call to the attention of the Architect/Engineer any interference for clarification in writing.

### 1.13 PROTECTION OF FIXTURES, MATERIAL & EQUIPMENT

- A. Continuously maintain adequate protection of stored materials and installed work. Fixtures and equipment, whether stored under a roof or outside, shall be tightly covered with sheet polyethylene or waterproof tarpaulin and protected against dirt, rust, moisture, chemical and mechanical injury. Materials and equipment shall not be stored directly on the ground nor in areas where they will be subject to physical injury from vehicular traffic or construction machinery. Contractor shall see to it that conduit and equipment installed by him is not used by other trades as supports for scaffolds or personnel. Delicate equipment shall not be delivered to the job site unless they can be placed in completed and protected areas. Conduit openings shall be capped or plugged during installation.
- B. At the completion of the work, equipment, fixtures, exposed supports, and piping shall be cleaned to the satisfaction of the Architect/Engineer.

#### 1.14 ALLOWANCES

- A. Make due allowance for relocating any lighting fixture, wiring device, disconnect switch, motor controller, panel board or equipment item, prior to installation (whether furnished by the Contractor or by others and requiring electrical connections), a distance of 5'0" or less from the locations indicated on the Drawings without additional cost to the Owner.

#### 1.15 ROYALTIES & PATENTS

- A. Hold and save the Owner harmless from any patent violations in connection with items of equipment, wiring devices, or material furnished and installed.

#### 1.16 CLEANING UP & HOUSEKEEPING

- A. At the end of each work day, remove all debris, surplus materials or foreign matter (caused by the performance of the electrical work) from the premises. On completion of the work, the Contractor shall be responsible for leaving the premises in a clean condition.
- B. Keep stocks of material and equipment stored on the premises in a neat and orderly manner.

#### 1.17 STANDARDS & REGULATIONS

- A. The work under the electrical section shall comply with the latest edition of the applicable standards and codes of the following:
  - 1. UL Underwriters' Laboratories, Inc.
  - 2. NEMA National Electric Manufacturers Association
  - 3. NEC 2002 National Electrical Code (latest edition)
  - 4. Local and State Building Codes
  - 5. ANSI American National Standards Institute
  - 6. CBM Certified Ballast Manufacturer
  - 7. NFPA National Fire Protection Association
  - 8. ETL Electrical Testing Laboratories
- B. Include all items of labor and materials required to comply with such standards and codes. Where quantities, sizes or other requirements indicated on the Drawings, or herein specified are in excess of the requirements of the standards and codes, the Specifications and/or Drawings shall govern.

#### 1.18 RECORD DRAWINGS

- A. Upon completion of the project, furnish a complete set of the Drawings which will include all revisions, sketches, etc., which may have been required during construction. The Contractor shall mark these Drawings, in red pencil, to indicate exact, as-installed conditions.
- B. The as-installed conditions shall reflect any changes in equipment location or routing which did not follow that shown on the Contract Drawings. The changes in conduit and/or wiring sizes shall be indicated on these Drawings. During the course of installation, Contractor shall maintain a separate

set of Drawings for marking and noting all installation deviations. This set of Drawings shall be maintained continuously, and shall be used for no other purpose than indicating as-installed conditions.

#### 1.19 MANUFACTURERS' NAMEPLATES

- A. Each major component of the equipment shall have the manufacturer's name, address, model number, and rating on a plate securely affixed in a conspicuous place. The nameplate of a distributing agent will not be acceptable. NEMA Code ratings, or other data which are die-stamped into the surface of the equipment shall be stamped in an easily visible location.

#### 1.20 LINES AND LEVEL

- A. Contractor shall be responsible for the lines and levels of the electrical equipment, wireways, and conduit systems based on reference lines and bench marks established by the Contractor for the general work.

#### 1.21 TEMPORARY WIRING, LIGHTING & POWER AT THE SITE

- A. Furnish and install provisions for temporary light and power during the construction period conforming to all local code and State labor law requirements. Temporary light and power provisions to be included shall be as hereinafter specified and as required:
  1. Furnishing, installing, and maintaining all temporary service equipment as required until permanent service is installed and "alive", and switch-over of temporary systems when permanent service is ready.
  2. Providing any and/or all relocations of the temporary electric facilities as necessary to clear the permanent installations of all trades.
  3. Furnishing and installing all required lighting for Owner's signs.

#### 1.22 WORK RELATED TO EQUIPMENT NOT FURNISHED AS WORK OF THIS DIVISION OF SPECIFICATIONS

- A. Unless specifically indicated otherwise, any required electrical services for and required electrical connections to items shown on the Drawings and/or specified to be furnished in other divisions of Specifications or by Owner shall be electrically connected as work of this section.
- B. Electrical work for equipment specified in Division 15, *Mechanical*, shall be as specified hereinafter.
- C. Raceways, outlets, backboards, grounding connections, and other roughing-in indicated shall be provided as work of this section for telephone system.

#### 1.23 MECHANICAL EQUIPMENT

- A. All power wiring associated with Division 15, *Mechanical* shall be done as work of Division 16, *Electrical*. All power disconnect switches and single speed manual starting switches shall be furnished and installed as indicated under Division 16.

B. Except as may be indicated on the Drawings and/or hereinafter noted, all control wiring, conduits and outlets shall be done in accordance with these specifications.

**END OF SECTION 16010**

## SECTION 16100 - BASIC MATERIALS & METHODS

### PART I GENERAL

#### 1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions, and General Requirements, apply to the work in this section.
- B. WORK SPECIFIED ELSEWHERE
  - 1. General Provisions: Section 16010
  - 2. Electrical Service & Distribution System: Section 16400
  - 3. Lighting: Section 16500

#### 1.02 METHOD OF WIRING

- A. Complete metal raceways or enclosures shall be provided for conductors throughout all systems specified. Equipment and devices purchased by the Contractor which are not constructed with housings for mounting and enclosing all live parts, shall be installed in metal cabinets. All equipment, enclosures, raceways, etc., shall be appropriate for the atmospheres and hazards encountered within their associated areas.

#### 1.03 CONDUIT

- A. Conduit shall be provided in standard 10 ft lengths, each length bearing the Underwriters' Laboratories label. Conduit shall not be smaller than 1/2" except where noted otherwise.
- B. All conduit run exposed to weather and/or in wet or damp locations shall be rigid threaded heavy wall steel conduit.
- C. Where PVC conduit is used, contractor shall provide separate ground wire(s) sized in accordance with Articles 250-94 or 250-95 of the N.E.C.
- D. The exterior and interior surfaces of all rigid steel conduit and steel electrical metallic tubing shall be thoroughly and evenly protected against corrosion with a zinc coating. The galvanized protection shall be coated with either a lacquer or enamel finish both inside and outside.
- E. Conduit shall be concealed wherever possible or exposed as shown and/or noted on the Drawings and as specified hereinafter. All exposed conduit shall run parallel with building walls using right angle bends. Exposed diagonal runs specifically shown otherwise.
- F. Conduit shall be installed at least 12" from hot water piping in parallel runs, at least 6" in cross-runs and at least 3" from cold water piping.
- G. Conduit shall be installed so as to provide drainage. It shall be incumbent upon the Contractor to exercise the necessary precautions to install conduits as far as it is possible to prevent the accumulation of water. All conduits shall be thoroughly cleaned and swabbed out before any wires or cables are drawn in. A #14 galvanized iron or nylon fish wire shall be left in every rigid conduit

or metallic tubing which is left by the Contractor for installation of wires or cables by others.

- H. Where building construction or other conditions make it impossible to use standard threaded couplings, approved watertight unions shall be installed.
- I. In mechanical equipment spaces, ceiling outlets and conduit may be exposed, with due consideration given to ventilating ducts and mechanical piping. Where numerous ducts occur, conduits and outlets shall be installed after the ventilating ducts. All exposed conduit runs shall be rigidly supported or secured in place by means of approved hangers suited to the conditions under which they are used. Puncturing of ductwork or hanging from ductwork equipment such as light fixtures, ceiling hangers, conduits, etc., is prohibited unless specifically noted otherwise.
- J. All conduits shall be secured to outlet boxes, junction boxes or cabinets by placing approved locknuts on outside of box and locknuts and bushings on the inside of box.
- K. Conduit terminals, 1-1/4" and larger shall be equipped with approved insulating bushings.
- L. Couplings, connectors, and fittings shall be approved type specifically designed and manufactured for the purpose. Where final connection to equipment with rigid conduit is not practicable, such as to equipment with adjustable mountings, at transformers to eliminate transmission of vibration, etc., flexible conduit shall be used.
- M. Contractor shall coordinate the work with all trades in determining the exact location of all conduits.
- N. If conduit runs from point to point exceed 150-ft. in length or exceeds total bend limitations, provide pull boxes in locations accessible at all times.
- O. Provide pipe sleeves for all electrical conduit passing through walls, partitions, ceiling, floors, etc. The sleeves shall be of sufficient length to extend through the full thickness of the construction, with ends flush with the finish on each side, unless noted otherwise.
- P. Where conduit runs must penetrate fire walls, smoke partitions or rated ceilings, Contractor must seal openings in an approved manner.

#### 1.04 WIRE AND CABLE

- A. Provide a complete system of new wire and cable as specified herein and as shown on Drawings. All wiring and conduit indicated on the Drawings is based on copper conductors.
- B. All wire and cable shall be delivered to the job in complete coils or reels with the manufacturer's name and approved tag attached thereto, indicating wire size and type of insulation and with the National Fire Protection Association's approval.
- C. All branch circuit wiring for lighting fixtures, wiring devices, etc., shall be provided as required to complete the installation, and shall be connected to panel board branch circuits in accordance with panel board schedules.
- D. Branch circuit wire shall not be smaller than #12; however, control wiring may be #14 and shall be installed in continuous runs between terminal points, without splices. The 120 volt branch circuits extending more than 100-ft. from the associated panel shall be not less than #10 to the first fixture

or other current-consuming outlet.

- E. Branch circuit conductors shall be copper, rated 600 volts, shall be solid up to and including size #10, stranded thereafter unless specified or noted otherwise.
- F. Lighting branch circuit wiring shall be suitable for 75 deg. C. operating temperature, or types appropriate for dry or wet locations. Feeders, subfeeders and motor power wiring regardless of size shall be rated 600 volts and shall be suitable for 75 deg. C. operating temperature, of types appropriate for dry or wet locations.
- G. Fixture wiring shall be 14 or 16 gauge, stranded, rated 600 volts and shall be suitable for 90 deg. C. operating temperature, (150 deg. C under high temperature operating conditions) of types appropriate for dry or wet locations.
- H. Unless otherwise specified, wire for the various services shall be of the following types:
  - 1. Branch lighting circuits, Type "THHN", "TW", "THW" or "THWN".
  - 2. Branch power circuits, Type "THHN", "THW", or "THWN".
  - 3. Mainfeeders and sub-feeders, Type "THHN", "THW", "XHHW" or "THWN-2".
  - 4. Fixture wiring, type "TFN" (Type "SFF" for high temperatures).
- I. Wire and cable shall be as manufactured by:
  - 1. American Insulated Wire Corporation
  - 2. Triangle Conduit & Cable Company
  - 3. General Cable Corporation
  - 4. ITT Royal Electric
  - 5. Phelps Dodge
  - 6. Anaconda, Okonite, Simplex or approved equal.
- J. Powdered soap stone or other commercially produced wire lubricant may be utilized to ease wire pulling; however, any such lubricant shall be of a type of produce no deteriorating effect on conductor insulation or on the interior of associated wireway.
- K. No. 6 and larger conductors may utilize 1", banks of appropriate colored tape.

#### 1.05 TAPS, SPLICES & TERMINATIONS

- A. All secondary feeder taps shall be made of cast copper, 2-bolt type connector, with insulating covers. Terminal connections shall be made with 2-bolt, clamp type lugs, as manufactured by:
  - 1. O.Z. Electric Manufacturing Co.
  - 2. Thomas & Betts
- B. Tapes and splices for branch circuit wiring #14 to #6 shall be made with approved solderless pressure spring connectors with insulating covers as manufactured by:
  - 1. Minnesota Mining & Manufacturing Company
  - 2. Ideal Industries, Inc.
  - 3. Buchanan Electrical Products Corporation
- C. Tape shall be Scotch #33 and shall be applied so that the insulation is not less than that of the wire.

- D. U.L. approved tin-plated aluminum body compression terminations, splices, and taps shall be used on all aluminum conductors. Bolt type mechanical connectors shall not be used. Compression fittings shall be pre-fitted with compound, Penetrox A13 or equal, with zinc particles in a synthetic base not harmful to the conductor insulation. Terminations shall be equal to Burndy Hyplug and Hylag/Hylink type AYP or UA-A. Insulating cover shall be Burndy Type YS-A. Tap connectors shall be Burndy H-crimpit Type YF. O.Z. Electrical Manufacturing Co.; Burndy

#### 1.06 ACCESS PANELS

- A. Coordinate the locations of access panels furnished in other sections for maintaining the accessibility of electrical facilities in enclosed areas.

#### 1.07 PAINTING

- A. All shop-fabricated and factory-built equipment not galvanized or protected by plating, shall be cleaned and given one shop coat or red lead or zinc-chromate primer, before delivery to the site. Any portions of the shop coat damaged in delivery or during construction shall be recoated. All finish painting will be recoated. All finish painting will be done under Section 09900, "Painting". Do not paint nameplates, labels, tags, stainless steel or chromium-plated items such as motor shafts, levers, handles, trim strips, etc.

#### 1.08 GROUNDING

- A. All metallic conduits, supports, cabinets, switchboards, motor controls, and all other electrical equipment shall be permanently and effectively grounded. All grounding shall be in accordance with local codes having jurisdiction and shall comply with the N.E.C.
- B. Provide and wire up, complete, the grounding system for the building. Unless otherwise indicated, provide #4/0 bare copper conductor in 1" rigid galvanized conduit from the grounding bus in the service panel board to the system ground rod and incoming cold water service. The ground conductor and conduit shall be bonded at both ends. Water pipe connection shall be with a Thomas & Betts Co. #900 series, or equal, ground fitting that bonds both conduit and conductor to water pipe. Provide a bonding jumper with approved ground clamps around the water meter as required. Unless otherwise indicated, ground rods shall be 3/4 in. x 10 ft. copper clad or copper weld.
- C. All grounding conductors shall be amply protected from mechanical injury and shall be supported in an approved manner. Where conductors are located in concrete, they shall be installed in conduit. Where ground conductors enter or emerge from slabs bearing directly on fill or soil, the voids between the conductor and surrounding conduit shall be filled with a compound to provide in effective water seal.
- D. Grounding conductors shall not be smaller than #12 AWG. Conductors shall be high conductivity copper, and sizes larger than #10 shall be stranded, except as hereinbefore specified.
- E. Connections shall be made with solder less pressure type connectors; and connectors shall be bolted or clamped to equipment and conduits.
- F. Connectors shall be equivalent to those produced by the O.Z. Electric Company, Burndy, or equal.

- G. Grounding pole of each polarized receptacle shall be bonded to its outlet box with conductor size in accordance with Table 250-95 of the National Electrical Code and a machine or self-tapping screw, self-grounding type.
- H. Grounding type insulated bushing shall be installed on all raceways at switches used as service equipment. Bonding jumpers shall be provided in accordance with Table 250-95 of the National Electrical Code (NEC).
- I. Each panel board shall contain an approved ground bus for the connection of all ground conductors.

#### 1.09 PROTECTION OF EXISTING UTILITIES

- A. When existing utilities which are not shown on the Drawings are encountered within areas of construction, notify the Architect before proceeding with any work that would damage the existing utility. Protect all existing utilities from damage during construction operations, and damage incurred shall be repaired or replaced to the satisfaction of the Architect without additional compensation.

#### 1.10 MOUNTING HEIGHTS

- A. Mounting heights of outlets and equipment shall be in accordance with the following list of dimensions above finished floors, except that deviations from these heights shown on the Drawings shall take precedence.
  1. Duplex receptacles - 18" (except 42" for receptacles mounted above kitchen counters and 4'6" in mechanical spaces).
  2. Wall switch - 4'6"
  3. Wall mounted exist sign - Bottom of trim 2" clear of door lintel
  4. Safety switch - 5'9"
  5. Telephone outlets - 12"
  6. Panel boards: Topmost operating handle of control device - 6'0"
  7. Bracket fixture - 7'0" above floor or, where mounted above exterior door, mirror or medicine cabinet, at a height just sufficient to clear the swing of the door or medicine cabinet.
- B. The above mounting heights may be adjusted as required to permit bottom or top of plate to align with mortar joints in unfinished masonry walls, provided joints are not raked. Where joints are raked, adjust height as required to insure that center of outlet box will be in the center of masonry unit. Where outlets at different levels are shown adjacent, they shall, where possible, be installed on a common vertical centerline.

#### 1.11 BOXES

- A. Outlet Boxes shall be galvanized or approved plastic and of standard sizes suitable for the use intended.
- B. Ceiling outlets for fixtures installed in dry wall or plastered ceilings shall be 4" octagonal, 2-1/8" deep. Outlet boxes above suspended ceiling shall be installed adjacent to each recessed fixture in

such manner as to be accessible through the opening in the ceiling in which the fixture is installed. All outlets for the attachment of fixtures shall be provided with fixture studs securely anchored to the boxes.

## 1.12 WIRING DEVICES

- A. Switches Except as noted otherwise, switches for local control of lighting shall be specification grade, ivory color, quiet type, 20 amp capacity at 208/120 volts, single pole, 2-pole, 3-way or 4-way arranged singly. Switches shall be in accordance with the following schedule of catalog numbers listed.

<u>Type</u>	<u>Hubbell No.</u>	<u>Leviton No.</u>
Single Pole	1221-1	1221-1
Double Pole	1222-1	1222-1
3-Way	1223-1	1223-1
Combination Pilot Light Switch	-----	5226-1

- B. Receptacles Except as noted otherwise, receptacles shall be as follows:

1. Duplex convenience receptacles 15A/2P, 3 wire, 120 volts, grounding type: Hubbell or Leviton #5262-1.
2. Duplex receptacles, 15A/2P, 3 wire 120 volt; weatherproof, grounding type: Hubbell #52CM62 with #56210 plate (5211 place for FS boxes).
3. Range receptacle, 50A/2P, 3 wire, 250 volt, grounding type: Hubbell or Leviton #9367 with 9368 plug.
4. Receptacles shall be ivory, except that those connected to the emergency system shall be red.

## 1.13 SWITCH & RECEPTACLE PLATES

- A. All switch, receptacle and telephone outlet device plates shall be made of approved plastic. All plates for multiple gang requirements shall be one-piece construction. Plates shall be as manufactured by Hubbell or Leviton. Screws shall be of metal with countersunk heads and finished to match that of the plate.
- B. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16" from the vertical or horizontal.

**END OF SECTION 16100**

## SECTION 16400 - ELECTRICAL SERVICE AND DISTRIBUTION SYSTEM

### PART I GENERAL

#### 1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions, and *General Requirements*, apply to the work in this section.
- B. WORK SPECIFIED ELSEWHERE
  - 1. General Provisions: Section 16010
  - 2. Basic materials & Methods: Section 16100
  - 3. Lighting: Section 16500

#### 1.02 MAIN SERVICE

- A. All fees and charges, including power company's charges, in connection with the above shall be paid as work of this section.

### PART II PRODUCTS

#### 2.01 SWITCHING & PROTECTIVE DEVICES

##### A. Circuit Breakers

1. Unless otherwise noted, circuit breakers shall be molded case, rated as indicated on drawings, UL listed, meet NEMA standards, and be suitable for mounting and operating in any position in switchboards, panel boards, motor control centers, bus ways plug-in units or in individual enclosures.
2. Circuit breakers shall have over center, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle indication. Two and three-pole breakers shall be common trip. Each circuit breaker shall have a permanent trip unit containing individual thermal and magnet trip elements in each pole. The circuit breaker shall be constructed to accommodate the supply connections at either end. Circuit breaker operating handles shall assume a center position when tripped. All breakers shall be calibrated for operation in an ambient temperature of 40°C. All bedroom circuits shall be fault protected.
3. Lugs shall be UL Listed for copper and aluminum conductors.
4. Breakers must be completely enclosed in a molded case. Non-interchangeable trip breakers shall have their covers sealed; interchangeable trip breakers shall have the trip unit sealed to prevent tampering. Ampere ratings shall be clearly visible. Contacts shall be of non-welding silver alloy.
5. The minimum interrupting ratings of the circuit breakers shall be at least equal to the available short circuit at the line terminals.

6. Molded case circuit breakers shall be thermal magnetic type that provides inverse time delay overload and instantaneous short circuit protection by means of a thermal magnetic element.

**PART III EXECUTION (Not Used)**

**END OF SECTION 16400**

## SECTION 16500 - LIGHTING

### PART I GENERAL

#### 1.01 SUMMARY

- A. The lighting work in this project includes:
  - 1. Interior lighting fixtures
  - 2. Exterior lighting fixtures.
  - 3. Exit signs

#### 1.02 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions, and *General Requirements*, apply to the work in this section.
- B. WORK SPECIFIED ELSEWHERE
  - 1. Division Sixteen
    - a. General Provisions: Section 16010
    - b. Basic materials & Methods: Section 16100
    - c. Electrical Service & Distribution System: Section 16400

#### 1.03 QUALITY ASSURANCE

- A. Conform to NFPA 70.
- B. Conform to NFPA 101 requirements for:
  - 1. Exit signs.
- C. Furnish products listed by Underwriters Laboratories Inc. and classified as suitable for installed use and environmental conditions.

#### 1.04 SUBMITTALS

- A. Product data, for each product specified in this section., submit product data for ballasts and other components and accessories furnished with lighting fixtures.
- B. Coordination drawings for information.
- C. Field test report for each inspection and test specified in this section for information. Describe inspections and tests, list observations, indicate corrective action taken, and state conclusions and recommendations for future action.
- D. Operation and maintenance data for each product specified in this section.

#### 1.05 PROJECT CONDITIONS

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- A. Review drawings to determine project conditions. Determine working clearance around and between construction elements such as beams, columns, walls, and ceilings. Determine spaces reserved for related work.
- B. Locations of lighting fixtures and emergency lighting products indicated on drawings are approximate unless dimensioned. Determine exact locations before roughing in supports.

## **PART II PRODUCTS**

### **2.01 FIXTURES**

- A. Furnish, assemble, install, and wire up complete, all lighting fixtures including those for general illumination, exit sign, emergency lighting, and exterior lighting, except where otherwise indicated on the Drawings. Fixtures shall be complete with lamps, lamp holders, and all necessary accessories. Fixtures shall bear the Underwriters' Laboratories, Inc. label of approval and be purchased, wired, and installed in accordance with applicable codes.
- B. Provide adequate and safe protection for fixtures during construction and at completion of the work; they shall be clean and free of all foreign materials, dust, etc.
- C. Furnish and set all inserts, anchors, studs, and hangers for the support of lighting fixtures and respective equipment, and make all necessary adjustments required therein.
- D. All fixtures shall be as indicated on the Drawings. The absence of type or quantity in the fixture schedule will not relieve the Contractor of the responsibility for furnishing all fixtures indicated on the Drawings.
- E. Location and spacing of fixtures are shown on Plans.

### **2.02 LAMPING-UP**

- A. Manufacturers: Products of the listed manufacturers, provided they comply with requirements of the contract documents, will be among those considered acceptable.
  - 1. Duro-Test Lighting Company.
  - 2. G.E. Lighting.
  - 3. Lithonia Corp.
- B. The Contractor shall furnish and install lamps – fluorescent and incandescent, in all lighting fixtures, including those existing to remain.
  - 1. Incandescent lamps shall be inside-frosted, 130 volts.  
Reflector Lamp Beam Pattern: Define in accordance with ANSI C78.379.
  - 2. Flood, spot and heat lamps shall be as indicated on the Drawings.
  - 3. Fluorescent Lamp shall be T-8 120 volt.

### **2.03 EXIT SIGNS SYSTEM.**

- A. Exit signs shall have the word "EXIT" printed in red letters at least 6" in height. The letters and associated arrows shall be of red translucent material placed on opaque background. Each sign shall be equipped with a minimum of two lamps and designed for operation on two separate circuits, one normal and one battery operated integral with the fixture.

### **PART III EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine elements and surfaces intended to support products. Examine lighting outlets to verify proper location. Examine branch circuit wiring to verify suitability, including that of existing fixtures to remain.
- B. Verify branch circuit identification and switching arrangements for each conductor. Verify that each product conforms to regulatory requirements and to specification requirements. Verify that product wiring, lamp holders, and other components are suitable for specified lamps.
- C. Correct any unsatisfactory conditions, including any existing fixtures to remain, either interior or exterior, before installing products of this section.

3.02 **PREPARATION:** Clean surfaces to receive work, and protect surrounding elements from work of this section.

#### **3.03 FIXTURE SUPPORTS & INSTALLATION.**

- A. For any type ceiling which itself does not provide sufficient support for fixtures, either arrange with other subcontractors to strengthen ceiling or support fixtures structure above independently of ceiling.
- B. Fixtures supported by ceiling framing members shall be securely fastened thereto by mechanical means, such as bolts, screws, or rivets. Clips designed and approved for the purpose shall be permitted.
- C. Suspended fluorescent fixtures in continuous rows shall have one stem at the beginning of the row, one stem at each channel joint, and one stem at the end of the row.
- D. Fluorescent fixtures mounted individually on stems shall each have two single stem hangers. Fluorescent fixtures individually surface mounted shall be supported at both ends.
- E. Fixtures to be installed in or on painted ceilings and/or walls shall not be installed until painting is completed. Fixtures installed with paint applied over factory finished will be rejected.
- F. Thermal insulation shall not be installed within 24 inches of the top or within 3 inches of the sides of a recessed fixture enclosure, wiring compartment, or ballast unless labeled for the purpose. Work of this section includes advising other trades of this requirement so that proper clearances are maintained.
- G. Articles 410-13 and 410-76 of the National Electrical Code regarding installation of lighting fixtures in combustible ceilings or walls shall apply.

### 3.04 COMMISSIONING

- A. Verify that products are properly bonded to ground.
- B. Verify that wiring connections conform to manufacturer's instructions.

### 3.05 FIELD QUALITY CONTROL

- A. Inspect installed products to observe damage.
- B. Perform tests and demonstration required by governing authority.
- C. Operation Test:
  - 1. Energize each lighting branch circuit to verify proper connection, installation, and operation of products specified in this section.
  - 2. Exercise integral testing circuit of each emergency lighting unit and accessory unit. De-energize each branch circuit connected to emergency lighting units and accessories to verify proper connection, installation, and operation of each product specified in this section.
- D. Correction of Defective Work: Replace defective products.

### 3.06 ADJUSTING

- A. Aim adjustable lighting fixtures as directed by the architect.
- B. Adjust trim to eliminate light leaks.

### 3.07 CLEANING

- A. Use cleaning methods and materials recommended by product manufacturer.
- B. Clean inside of enclosures to remove dust and debris, including existing fixtures to remain, both interior and exterior.
- C. Clean finishes to remove dust and dirt; touch up damage.
- D. Clean electrical parts to remove dust, grease, and other materials that are harmful or conductive.
- E. Clean surfaces of reflective and refractive lighting control elements.

### 3.08 DEMONSTRATION

- A. Demonstrate operations of products specified in this section and provide instruction to the owner's designated personnel.
- B. Conduct walking tour of the project. Briefly describe location, function, operation, and maintenance of each product.
- C. Demonstrate operation, control, adjustment, troubleshooting, servicing, and maintenance of each

distinct product.

**3.09 PROTECTION**

- A. Installed lighting fixtures may be used to provide lighting for construction personnel.

**3.10 CONTRACT CLOSEOUT**

- A. Replace failed lamps within 1 week of substantial completion.

**END OF SECTION 16500**

