

SECTION 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Basic Electrical Requirements specifically applicable to Division 16 Sections, in addition to Division 1 - General Requirements.

1.02 WORK SEQUENCE

- A. Install work in stages or phases to accommodate Owner's occupancy requirements and/or as shown on drawings. Provide temporary electrical service as required to accomplish phasing.

1.03 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittals.
- C. Mark dimensions and values in units to match those specified.

1.05 REGULATORY REQUIREMENTS

- A. Conform to applicable Building Codes.
- B. Electrical: Conform to NFPA 70.
- C. Obtain permits, and request inspections from authority having jurisdiction.

1.06 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Architect/Engineer before proceeding.

1.07 TRAINING & INSTRUCTION

- A. At times designated by the Owner, provide services of competent representative of the Contractor for period of at least 40 hours (in addition to the hours required and specified for special systems such as Fire Alarm etc.) to instruct the Owner's representatives in the operation and maintenance of the entire system.
- B. Training and instruction of Owners representatives is further discussed in the individual sections. Owner may choose to video tape all or part of such training sessions; Contractor shall allow such recording.

1.08 PENETRATIONS

A. Conduit or other Division 16 penetrations of floors, rated walls and exterior walls shall be sealed. Such sealant shall conform to the ratings of the walls or floors or as otherwise detailed on the drawings or specifications and shall be per Division 7. Provide and place sleeves for such penetrations to other trades in time for their placement.

1.09 NOTICE OF OBSERVATION OF THE WORK BY ENGINEER

When site review or observation by the Engineer is required or requested, Contractor shall provide minimum 24 hours notice prior to the date of such observation.

1.10 NOISE AND VIBRATION

Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure, rectify such conditions without cost to Owner.

1.11 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Submit as per Division 1 and sections of Division 16. Operation and maintenance instructions should include all nameplate data and design parameters. Clearly distinguish between information that pertains to the particular equipment and information which does not. Provide operating and maintenance manuals. Provide factory manuals (photocopy manuals are not acceptable). Provide three copies of each of the following systems: Fire Alarm System, Electrical Switchgear.

1.12 OPERATING TESTS

A. After all systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequence and operation throughout the range of operation. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections.

1.13 HOUSEKEEPING PADS

A. Provide concrete housekeeping pads for all Div 16 equipment

1.14 RECORD DRAWINGS

A. Prepare under provisions of Division 1, as work progresses, record drawings showing clearly the actual location and sizes of all Division 16 equipment installed. On underground or underslab conduit, provide exact dimensions of locations. Deliver record drawings on full size mylar film.

1.15 ACCESS PANELS

Access doors or panels for all devices requiring adjustment or maintenance shall be selected and provided under Division 16000; furnished to ceiling or wall contractor for their installation. Appearance of access doors shall be acceptable to Architect. Doors and panels shall be designed for the fire rating of wall or door in which they are installed.

1.16 ASSIST TESTING & BALANCING

Operate and adjust equipment as required for testing or observation by Engineer, Owners representatives, Building authorities, Fire officials or Testing and Balance contractor.

1.17 TEMPORARY UTILITIES

Provide temporary power and lighting required by all trades. Provide temporary power and lighting to all construction trailers. Lighting footcandle shall be in compliance with OSHA's regulations.

PART 2 PRODUCT-- Not Used

PART 3 EXECUTION

3.01 PERMITS

Secure and pay for all permits and associated fees

END OF SECTION

SECTION 16111

CONDUIT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal conduit.
- B. Flexible metal conduit.
- C. Liquidtight flexible metal conduit.
- D. Electrical metallic tubing.
- E. Nonmetal conduit.
- F. Electrical nonmetallic tubing.
- G. Flexible nonmetallic conduit.
- H. Fittings and conduit bodies.

1.02 RELATED SECTIONS

- A. Division 7 - Fire Stopping.
- B. Division 7- Roofing penetrations.
- C. Section 16118 - Underground Duct Bank.
- D. Section 16130 - Boxes.
- E. Section 16170 - Grounding and Bonding.
- F. Section 16190 - Supporting Devices.
- G. Section 16195 - Electrical Identification.

1.03 REFERENCES

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- B. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
- C. ANSI C80.5 - Rigid Aluminum Conduit.
- D. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- E. ANSI/NFPA 70 - National Electrical Code.
- F. NECA "Standard of Installation."
- G. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
- H. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
- I. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.04 DESIGN REQUIREMENTS

- A. Conduit Size: ANSI/NFPA 70.

1.05 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide for all conduit types.

1.06 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.

- B. Accurately record actual routing of all underslab and underground conduits; include dimensions from key building points and depth of bury.

1.07 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.08 FIELD SAMPLES

- A. Provide under provisions of Division 1.
- B. Provide field sample of conduit, if requested
- C. Provide field sample of expansion/deflection fitting, if requested

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle Products to site under provisions of Div. 1.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

1.10 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit prior to rough-in.
- C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 PRODUCTS

2.01 CONDUIT REQUIREMENTS

- A. Minimum Size: 1/2 inch unless otherwise specified.
- B. Underground Installations:
 - 1. More than Five Feet from Foundation Wall: Use rigid steel conduit, intermediate metal conduit , plastic coated conduit , thickwall nonmetallic conduit and thinwall nonmetallic conduit.
 - 2. Within Five Feet from Foundation Wall: Use rigid steel conduit, intermediate metal conduit , plastic coated conduit , thickwall nonmetallic conduit and thinwall nonmetallic conduit .
 - 3. In or Under Slab on Grade: Use rigid steel conduit, intermediate metal conduit, plastic coated conduit, thickwall nonmetallic conduit and thinwall nonmetallic conduit.
 - 4. Minimum Size: 3/4 inch .
- C. Outdoor Locations, Above Grade: Use rigid steel and aluminum conduit, intermediate metal conduit.
- D. In Slab Above Grade:
 - 1. Use rigid steel conduit, intermediate metal conduit and thickwall nonmetallic conduit.

2. Maximum Size Conduit in Slab: 3/4 inch; 1/2 inch for conduits crossing each other.
 - E. Wet and Damp Locations: Use rigid steel and aluminum conduit, intermediate metal conduit, thickwall nonmetallic conduit and, nonmetallic tubing.
 - F. Dry Locations:
 1. Concealed: Use rigid steel and aluminum conduit, intermediate metal conduit, electrical metallic tubing, thickwall nonmetallic conduit and nonmetallic tubing.
 2. Exposed: Use rigid steel and aluminum conduit, intermediate metal conduit, and thickwall nonmetallic conduit.
- 2.02 METAL CONDUIT
- A. Rigid Steel Conduit: ANSI C80.1.
 - B. Rigid Aluminum Conduit: ANSI C80.5.
 - C. Intermediate Metal Conduit (IMC): Rigid steel.
 - D. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit.
- 2.03 PVC COATED METAL CONDUIT
- A. Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil thick.
 - B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel fittings with external PVC coating to match conduit.
- 2.04 FLEXIBLE METAL CONDUIT
- A. Description: Interlocked steel construction.
 - B. Fittings: ANSI/NEMA FB 1.
- 2.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT
- A. Description: Interlocked steel or aluminum construction with PVC jacket.
 - B. Fittings: ANSI/NEMA FB 1.
- 2.06 ELECTRICAL METALLIC TUBING (EMT)
- A. Description: ANSI C80.3; galvanized tubing.
 - B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel; compression or set-screw type.
- 2.07 NONMETALLIC CONDUIT
- A. Description: NEMA TC 2; Schedule 40 PVC.
 - B. Fittings and Conduit Bodies: NEMA TC 3.
- 2.08 NONMETALLIC TUBING
- A. Description: NEMA TC 2.
 - B. Fittings and Conduit Bodies: NEMA TC 3.
- PART 3 EXECUTION
- 3.01 INSTALLATION
- A. Install conduit in accordance with NECA "Standard of Installation."
 - B. Install nonmetallic conduit in accordance with manufacturer's instructions.

- C. Arrange supports to prevent misalignment during wiring installation.
- D. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- E. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
- F. Fasten conduit supports to building structure and surfaces under provisions of Section 16190.
- G. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports
- H. Do not attach conduit to ceiling support wires.
- I. Arrange conduit to maintain headroom and present neat appearance.
- J. Route exposed conduit parallel and perpendicular to walls.
- K. Route conduit installed above accessible ceilings parallel & perpendicular to walls.
- L. Route conduit in and under slab from point-to-point.
- M. Do not cross conduits in slab.
- N. Maintain adequate clearance between conduit and piping.
- O. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.
- P. Cut conduit square using saw or pipecutter; de-burr cut ends.
- Q. Bring conduit to shoulder of fittings; fasten securely.
- R. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- S. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- T. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate or use factory elbows for bends in metal conduit larger than 2 inch size.
- U. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- V. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control or expansion joints.
- W. Provide suitable pull string in each empty conduit except sleeves and nipples.
- X. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- Y. Ground and bond conduit under provisions of Section 16170.
- Z. Identify conduit under provisions of Section 16195.

3.02 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 7.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.

END OF SECTION

SECTION 16112

SURFACE RACEWAY

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Surface metal raceways.
- B. Multi-outlet assemblies.
- C. Auxiliary gutters (wireways).

1.02 RELATED WORK

- A. Section 16121 - Wiring Devices: Receptacles.

1.03 REFERENCES

- A. FS W-C-582 - Conduit, Raceway, Metal, and Fitting; Surface.

1.04 SUBMITTALS

- A. Submit product data under provisions of Division 1.
- B. Include product data for surface metal raceways, multi-outlet assemblies, auxiliary gutters, and accessories.

PART 2 PRODUCTS

2.01 SURFACE METAL RACEWAY

- A. Surface Metal Raceway: sheet metal channel with fitted cover, suitable for use as surface metal raceway
- B. Size: As shown on Drawing.
- C. Finish: Gray enamel.
- D. Fittings: Couplings, elbows, and connectors designed for use with raceway system.
- E. Boxes and Extension Rings: Designed for use with raceway systems.

2.02 ACCEPTABLE MANUFACTURERS - MULTI-OUTLET ASSEMBLY

- A. Wiremold or equal
- B. Substitutions: Under provisions of Division 1.

2.03 MULTI-OUTLET ASSEMBLY

- A. Multi-outlet Assembly: sheet metal channel with fitted cover, with pre-wired receptacles, suitable for use as a multi-outlet assembly.
- B. Size: As indicated on Drawing.
- C. Receptacles: Outlets with receptacles as shown on Drawings.
- D. Finish: Gray or Buff enamel.
- E. Fittings: Couplings, elbows, outlet and device boxes, and connectors designed for use with multi-outlet system.

2.04 AUXILIARY GUTTERS

- A. Auxiliary Gutters: General purpose (Raintight for outdoors) type wireway, with knockouts.
- B. Size: length as required or as indicated on Drawings.
- C. Cover: Screw applied cover.
- D. Finish: Rust inhibiting primer coat with gray enamel finish.

PART 3 EXECUTION

3.01 INSTALLATION - SURFACE METAL RACEWAY AND MULTI-OUTLET ASSEMBLY

- A. Use flat-head screws to fasten channel to surfaces. Mount plumb and level.
- B. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- C. Maintain grounding continuity between raceway components to provide a continuous grounding path.
- D. Fastener Option: Use clips and straps suitable for the purpose.

3.02 INSTALLATION - AUXILIARY GUTTER

- A. Bolt auxiliary gutter to wall using two-piece hangers, or steel channels fastened to the wall or in self-supporting structure. Install level.
- B. Mount raintight gutter in horizontal position only.

END OF SECTION

SECTION 16123

BUILDING WIRE AND CABLE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Building wire and cable.
- B. Underground feeder and branch circuit cable.
- C. Service entrance cable.
- D. Wiring connectors and connections.

1.02 RELATED SECTIONS

- A. Section 16111 - Conduit.
- B. Section 16130 - Boxes.
- C. Section 16195 - Identification.

1.03 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide for each cable assembly type, if requested.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years experience.

1.06 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.07 FIELD SAMPLES

- A. Provide, if requested, lengths of cable assembly from each reel. Select each length to include complete set of manufacturer markings. Attach tag indicating cable size and application information.

1.08 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Conductor sizes are based on copper unless indicated as aluminum or "AL".
- C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

- D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.09 COORDINATION

- A. Coordinate Work under provisions of Section Division 1.
- B. Determine required separation between cable and other work.
- C. Determine cable routing to avoid interference with other work.

PART 2 PRODUCTS

2.01 BUILDING WIRE AND CABLE

- A. Description: Single conductor insulated wire.
- B. Conductor: Copper
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: ANSI/NFPA 70, Type THW, THHN/THWN, or XHHW

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable has been completed.

3.02 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.03 WIRING METHODS

- A. Concealed Dry Interior Locations: Use only building wire in raceway.
- B. Exposed Dry Interior Locations: Use only building wire in raceway.
- C. Above Accessible Ceilings: Use only building wire in raceway.
- D. Wet or Damp Interior Locations: Use only building wire in raceway.
- E. Exterior Locations: Use only building wire in raceway or metal clad cable.
- F. Underground Installations: Use only building wire in raceway.

3.04 INSTALLATION

- A. Install products in accordance with manufacturers instructions.
- B. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- C. Use stranded conductors for control circuits.
- D. Use conductor not smaller than 12 AWG for power and lighting circuits.
- E. Use conductor not smaller than 16 AWG for control circuits.
- F. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet .
- G. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet
- H. Pull all conductors into raceway at same time.
- I. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- J. Protect exposed cable from damage.
- K. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure. Do not rest cable on ceiling panels.

- L. Use suitable cable fittings and connectors.
- M. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- N. Clean conductor surfaces before installing lugs and connectors.
- O. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- P. Terminate aluminum conductors with tin-plated aluminum- bodied compression connectors only. Fill with anti- oxidant compound before installing conductor.
- Q. Use suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.
- R. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
- S. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- T. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.05 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Section 16195.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.06 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Division 1.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- D. Verify continuity of each branch circuit conductor.

END OF SECTION

SECTION 16130

BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall and ceiling outlet boxes.
- B. Floor boxes.
- C. Pull and junction boxes.

1.02 RELATED SECTIONS

- A. Division 7 - Firestopping.
- B. Division 8 - Access Doors.
- C. Section 16140 - Wiring Devices: Wall plates in finished areas, floor box service fittings, fire-rated poke-through fittings, and access floor boxes.
- D. Section 16160 - Cabinets and Enclosures.

1.03 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- C. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- D. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NFPA 70 - National Electrical Code.

1.04 SUBMITTALS FOR CLOSEOUT

- A. Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.05 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide Products listed and classified by Underwriters Laboratories, Inc., or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.

Boxes

- B. Nonmetallic Outlet Boxes: NEMA OS 2.0
- C. Cast Boxes: NEMA FB 1, Type FD, aluminum or cast ferrous alloy. Provide gasketed cover by box manufacturer.
- D. Wall Plates for Finished Areas: As specified in Section 16140.

2.02 FLOOR BOXES

- A. Floor Boxes: NEMA OS 1, fully or semi-adjustable, 1-1/2 inches deep.
- B. Material: Cast metal or Formed steel.
- C. Service Fittings: As specified in Section 16140.

2.03 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Hinged Enclosures: As specified in Section 16160.
- C. Surface Mounted Cast Metal Box: NEMA 250, Type 4 or 6; flat-flanged, surface mounted junction box:
 - 1. Material: Galvanized cast iron or Cast aluminum.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
- D. In-Ground Cast Metal Box: NEMA 250, Type 6, recessed cover box for flush mounting:
 - 1. Material: Galvanized cast iron or Cast aluminum.
 - 2. Cover: with neoprene gasket and stainless steel cover screws.
 - 3. Cover Legend: "ELECTRIC"
- E. Fiberglass Handholes: Die molded glass fiber hand holes:
 - 1. Cable Entrance: Pre-cut 6 inch x 6 inch cable entrance at center bottom of each side.
 - 2. Cover: Glass fiber weatherproof cover with nonskid finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify locations of floor boxes and outlets prior to rough-in.

3.02 INSTALLATION

- A. Install boxes in accordance with NECA "Standard of Installation."
- B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- C. Set wall mounted boxes at elevations to accommodate mounting heights indicated or specified in section for outlet device.
- D. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box location up to 10 feet if required to accommodate intended purpose.
- E. Orient boxes to accommodate wiring devices oriented as specified in Section 16140.
- F. Maintain headroom and present neat mechanical appearance.

- G. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- H. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- I. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 7.
- J. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- K. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- L. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- M. Use flush mounting outlet box in finished areas.
- N. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- O. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in acoustic rated walls.
- P. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- Q. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- R. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- S. Use adjustable steel channel fasteners for hung ceiling outlet box.
- T. Do not fasten boxes to ceiling support wires.
- U. Support boxes independently of conduit.
- V. Use gang box where more than one device is mounted together. Do not use sectional box.
- W. Use gang box with plaster ring for single device outlets.
- X. Use cast outlet box in exterior locations exposed to the weather and wet locations.
- Y. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.
- Z. Set floor boxes level.
- AA. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.03 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate installation of outlet box for equipment connected under Section 16180.

3.04 ADJUSTING

- A. Adjust floor box flush with finish flooring material.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused box openings.

3.05 CLEANING

- A. Clean installed work.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

3.06 LABELING

Label each junction box cover with cabling circuit numbers.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Device plates and decorative box covers.
- E. Floor box service fittings.
- F. Poke-through service fittings.
- G. Access floor box.

1.02 RELATED SECTIONS

- A. Section 16113 - Underfloor Duct.
- B. Section 16130 - Boxes.

1.03 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA WD 1 - General Requirements for Wiring Devices.
- C. NEMA WD 6 - Wiring Device -- Dimensional Requirements.
- D. NFPA 70 - National Electrical Code.

1.04 SUBMITTALS FOR REVIEW

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1.05 SUBMITTALS FOR INFORMATION

- A. Submit manufacturer's installation instructions.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

1.07 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide Products listed and classified by Underwriters Laboratories, Inc., or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.08 EXTRA MATERIALS

- A. Furnish two of each style, size, and finish wall plate.

PART 2 PRODUCTS

2.01 WALL SWITCHES

- A. Manufacturers: Leviton Decora or equal
- B. Single Pole Switch: Leviton model 1221-I or equal.
- C. Double Pole Switch: Leviton model 1222-I or equal.
- D. Color: as selected by Architect
- H. Description: NEMA WD 1, Heavy-Duty, AC only general-use snap switch.
- J. Body and Handle: plastic with toggle or rocker handle.
- K. Ratings: Match branch circuit and load characteristics.

2.02 WALL DIMMERS

- A. Manufacturers: Lutron Nova T star series with preset control.
- B. Description: NEMA WD 1; Semiconductor dimmer for incandescent lamps, Type as indicated on drawings
- C. Body and Handle: plastic with linear slide.
- D. Voltage: see drawings.
- E. Power Rating: Match load shown on drawings, 600 watts minimum.
- F. Accessory Wall Switch: Match dimmer appearance.

2.03 RECEPTACLES

- A. Acceptable Manufacturers: Leviton Decora Series.
- B. Description: NEMA WD 1, Heavy-duty general use receptacle.
- C. Device Body: plastic.
- D. Configuration: NEMA WD 6, type as specified and indicated.
- E. Convenience Receptacle: Type 5-20.
- F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.
- G. Telephone Jack: see telephone system specs.

2.04 WALL PLATES

- A. Decorative Cover Plate: Smooth stainless steel
- B. Weatherproof Cover Plate: Gasketed cast metal with hinged gasketed device cover.

2.05 FLOOR MOUNTED SERVICE FITTINGS

- A. Pedestal Convenience Receptacle:
 - 1. Walker Model 523AL or equal.
 - 2. Housing: Satin aluminum.
 - 3. Device Plate: Stainless steel.
 - 4. Configuration: One duplex
- B. Flush Cover Convenience Receptacle:
 - 1. Walker Model 889 or equal.
 - 2. Material: cast iron
 - 3. Configuration: Duplex opening, brass cover plate to match floor material
- C. Pedestal Communication Outlet:
 - 1. Walker 500 series or equal.

2. Housing: Satin aluminum
6. Device Plate: Stainless steel
7. Configuration: one telephone jack & cover plate
- D. Flush Cover Communication Outlet:
 1. Walker 500 series or equal.
 2. Material: Aluminum
 3. Configuration: 2-1/8 x 1 inch combination threaded opening.
- E. Pedestal Combination Fitting:
 1. Walker 1325 PT or equal.
 2. Housing: Satin aluminum.
 3. Device Plate: Stainless steel.
 4. Configuration: One duplex convenience receptacle with one bushed opening, 1 inch inside diameter.
- F. Flush Cover Combination Fitting:
 1. Walker 880CS2 with 828R and 829CK or equal.
 2. Material: Brass.
 3. Configuration: Duplex opening with 2-1/8 x 1 inch combination threaded opening.
- G. Protective Ring: Brass finish.
- H. Split Nozzle: Brass finish.
- I. Carpet Ring: Brass

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions prior to beginning work.
- B. Verify that outlet boxes are installed at proper height.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that floor boxes are adjusted properly.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. Verify that openings in access floor are in proper locations.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.03 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation."
- B. Install devices plumb and level.
- C. Install switches with OFF position down.
- D. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- E. Do not share neutral conductor on load side of dimmers.
- F. Install receptacles with grounding pole on bottom.
- G. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- H. Connect wiring devices by wrapping conductor around screw terminal.
- I. Use jumbo size plates for outlets installed in masonry walls.

- J. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- K. Install protective rings or split nozzle on active flush cover service fittings.
- L. Do not use type "AC" cable for device connection. "MC" cable may be used if approved by local authority. "MC" cable may not be used for homerun back to panel.

3.04 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 16130 to obtain mounting heights specified or indicated on drawings.
- B. Install wall switch 48 inches above finished floor.
- C. Install convenience receptacle 18 inches above finished floor.
- D. Install convenience receptacle 6 inches above backsplash of counter, unless shown otherwise.
- E. Install dimmer 48 inches above finished floor.
- F. Install telephone jack 18 inches above finished floor.
- G. Install telephone jack for side-reach wall telephone to position top of telephone at 54 inches above finished floor.
- H. Install telephone jack for forward-reach wall telephone to position top of telephone at 48 inches above finished floor.

3.05 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.
- F. Verify that each telephone jack is properly connected and circuit is operational.

3.06 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.07 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 16160

CABINETS AND ENCLOSURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hinged cover enclosures.
- B. Cabinets.
- C. Terminal blocks.

1.02 RELATED SECTIONS

- A. Section 16190 - Supporting Devices.

1.03 REFERENCES

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems.
- C. ANSI/NFPA 70 - National Electrical Code.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's standard data for enclosures and cabinets.
- B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.05 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.06 EXTRA MATERIALS

- A. Provide two of each cabinet key.

PART 2 PRODUCTS

2.01 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250, Type 1 or 3R steel enclosure.
- B. Covers: Continuous hinge, held closed by flush latch operable
- C. Provide interior panel for mounting terminal blocks and electrical components; finish with white enamel.
- D. Enclosure Finish: Manufacturer's standard enamel.

2.02 CABINETS

- A. Boxes: Galvanized steel

- B. Backboard: Provide plywood backboard for mounting terminal blocks. Paint matte white.
- C. Fronts: Steel, with concealed hinge, and flush lock, keyed to match branch circuit panelboard. Finish with gray baked enamel.
- D. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power wiring.
- E. Provide accessory feet for free-standing equipment.

2.03 TERMINAL BLOCKS

- A. Terminal Blocks: ANSI/NEMA ICS 4.
- B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- C. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
- D. Provide ground bus terminal block, with each connector bonded to enclosure.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive Work.

3.02 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.
- C. Install cabinet fronts plumb.

END OF SECTION

SECTION 16170

GROUNDING AND BONDING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Bonding.

1.02 RELATED SECTIONS

- A. Division 3 - Concrete Reinforcement.
- B. Division 3 - Cast-In-Place Concrete.

1.03 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. NPFA 99 - Health Care Facilities.

1.04 GROUNDING ELECTRODE SYSTEM

- A. Metal underground water pipe.
- B. Metal frame of the building.
- C. Concrete-encased electrode.
- D. Metal underground gas piping system.
- E. Rod electrode.

1.05 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 25 ohms.

1.06 SUBMITTALS

- A. Product Data: Provide data for grounding electrodes and connections.
- B. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- C. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation and installation of exothermic connectors.

1.07 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of grounding electrodes.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years experience.

1.09 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.

- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.01 ROD ELECTRODE

- A. Material: Copper or Copper-clad steel.
- B. Diameter: 3/4 inch
- C. Length: 10 feet

2.02 MECHANICAL CONNECTORS

- A. Material: Bronze.

2.03 EXOTHERMIC CONNECTIONS

- A. Manufacturers: Cadweld or Thermoweld.

2.04 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: 2/0 AWG.
- C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

2.05 GROUNDING WELL COMPONENTS

- A. Well Pipe: 8" diameter by 24 inch long clay tile or concrete pipe with belled end.
- B. Well Cover: Cast iron with legend "GROUND" embossed on cover.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
- C. Provide grounding well pipe with cover at each rod location. Install well pipe top flush with finished grade.
- D. Install 4 AWG bare copper wire in foundation footing where indicated.
- E. Provide bonding to meet Regulatory Requirements.
- F. Bond together metal siding not attached to grounded structure; bond to ground.
- G. Bond together reinforcing steel and metal accessories in pool and fountain structures.
- H. Install transient suppression plate where indicated
- I. Provide isolated grounding conductor for circuits supplying electronic cash registers, personal computers and other electronic equipment

- J. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

3.03 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall- of-potential method.

END OF SECTION

SECTION 16180

EQUIPMENT WIRING SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical connections to equipment specified under other sections.

1.02 RELATED SECTIONS

- A. Section 11400 - Food Services Equipment.
- B. Section 15450 - Plumbing Equipment.
- C. Section 15784 - Unit Air Conditioners.
- D. Section 16111 - Conduit.
- E. Section 16123 - Building Wire and Cable.
- F. Section 16130 - Boxes.

1.03 REFERENCES

- A. NEMA WD 1 - General Purpose Wiring Devices.
- B. NEMA WD 6 - Wiring Device Configurations.
- C. ANSI/NFPA 70 - National Electrical Code.

1.04 SUBMITTALS

- A. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.05 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.06 COORDINATION

- A. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.
- B. Determine connection locations and requirements.
- C. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- D. Sequence electrical connections to coordinate with start-up schedule for equipment.

PART 2 PRODUCTS

2.01 CORDS AND CAPS

- A. Attachment Plug Construction: Conform to NEMA WD 1.
- B. Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
- C. Cord Construction: ANSI/NFPA 70, Type SO or SJO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
- D. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- D. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.
- E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- F. Install disconnect switches, controllers, control stations, and control devices as indicated.
- G. Modify equipment control wiring with terminal block jumpers as indicated.
- H. Provide interconnecting conduit and wiring between devices and equipment where indicated.
- I. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Conduit and equipment supports.
- B. Anchors and fasteners.

1.02 REFERENCES

- A. NECA - National Contractors Association.
- B. ANSI/NFPA 70 - National Electrical Code.

1.03 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog data for fastening systems.
- B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.04 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.01 PRODUCT REQUIREMENTS

- A. Materials and Finishes: Provide adequate corrosion resistance.
- B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- C. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Use precast insert system, expansion anchors, powder actuated anchors and preset inserts
 - 2. Steel Structural Elements: Use beam clamps, steel ramset fasteners, and welded fasteners.
 - 3. Concrete Surfaces: Use self-drilling anchors and expansion anchors.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.
 - 5. Solid Masonry Walls: Use expansion anchors and preset inserts.
 - 6. Sheet Metal: Use sheet metal screws.
 - 7. Wood Elements: Use wood screws.

2.02 STEEL CHANNEL

- A. Description: Galvanized steel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- D. Do not use spring steel clips and clamps.
- E. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- F. Obtain permission from Architect/Engineer before drilling or cutting structural members.
- G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- H. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- I. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.
- J. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END OF SECTION

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Conduit markers.

1.02 RELATED SECTIONS

- A. Section 09900 - Painting.

1.03 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.04 SUBMITTALS

- A. Product Data: Provide catalog data for nameplates, labels, and markers.
- B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.05 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.01 NAMEPLATES AND LABELS

- A. Nameplates: Engraved three-layer laminated plastic, black letters on white background for normal power; red background/white letter for emergency power panels
- B. Locations:
 - 1. Each electrical distribution and control equipment enclosure.
 - 2. Communication cabinets.
- C. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background. Use only for identification of individual wall switches and receptacles, control device stations,

2.02 WIRE MARKERS

- A. Description: Cloth, tape, split sleeve, or tubing type wire markers.
- B. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
- C. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.

2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on shop drawings.

2.03 CONDUIT MARKERS OR PAINT

- A. Location: Furnish markers or paint band for each conduit longer than 6 feet .
- B. Spacing: 20 feet on center.
- C. Color:
 1. 480 Volt System: black
 2. 208 Volt System: black w/ blue stripes
 3. Fire Alarm System: Red
 4. Telephone System: yellow
 5. Other Systems: by specific letter description

2.04 UNDERGROUND WARNING TAPE

- A. Description: 4 inch wide plastic tape, detectable type, colored yellow with suitable warning legend describing buried electrical lines

2.05 JUNCTION BOXES

- A. Label covers of all junction boxes with circuits served

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive nameplates and labels.

3.02 APPLICATION

- A. Install nameplates and labels parallel to equipment lines.
- B. Secure nameplate to equipment front using screws, rivets or adhesive.
- C. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
- D. Identify underground conduits using underground warning tape. Install one tape per trench at 3 inches below finished grade.

END OF SECTION

SECTION 16441

ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fusible switches.
- B. Nonfusible switches.
- C. Fuses.

1.02 REFERENCES

- A. NEMA KS 1 - Enclosed Switches.
- B. NFPA 70 - National Electrical Code.
- C. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Type.
- D. UL 198E - Class R Fuses.

1.03 SUBMITTALS

- A. Product Data: Provide switch ratings and enclosure dimensions.
- B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.
- B. Maintain one copy of each document on site.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum 3 years experience.

1.06 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by UL or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.07 EXTRA MATERIALS

- A. Provide 3 of each size and type fuse installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS, ENCLOSED SWITCHES:

2.02 ENCLOSED SWITCHES

- A. Fusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate Class R fuses.
- B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C. Enclosures: NEMA KS 1.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.

2.03 FUSES

- A. Manufacturers: Bussman or equal
- B. Description: Dual element, current limiting, time delay, one-time fuse, 600 volt, UL 198E, Class RK 1, RK 5.
- C. Interrupting Rating: 200,000 rms amperes.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install disconnect switches where indicated.
- B. Install fuses in fusible disconnect switches.
- C. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

END OF SECTION

SECTION 16470 - PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Distribution panelboards.
- B. Branch circuit panelboards.

1.02 RELATED WORK

- A. Section 16190 - Supporting Devices.
- B. Section 16195 - Electrical Identification: Engraved nameplates.

1.03 REFERENCES

- A. NECA (National Electrical Contractors Association) "Standard of Installation."
- B. NEMA AB 1 - Molded Case Circuit Breakers.
- C. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- D. NEMA KS 1 - Enclosed Switches.
- E. NEMA PB 1 - Panelboards.
- F. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- G. NFPA 70 - National Electrical Code.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.05 PROJECT RECORD DOCUMENTS

- A. Record actual locations of Products; indicate actual branch circuit arrangement.

1.06 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.07 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.
- B. Maintain one copy of each document on site.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 3 years experience.

1.09 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

1.10 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings or instructed by manufacturer.

1.11 MAINTENANCE MATERIALS

- A. Provide two of each panelboard key.
- B. Provide two fuse pullers.

1.12 EXTRA MATERIALS

- A. Provide 3 of each size and type of fuse.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Siemens, Square D, GE, Eaton.

2.02 DISTRIBUTION PANELBOARDS

- A. Panelboards: NEMA PB 1, circuit breaker type.
- B. Service Conditions:
 - 1. Temperature: 110 degrees F
- C. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
- D. Minimum integrated short circuit rating unless noted otherwise on drawings: 22000 amperes rms symmetrical for 240 volt panelboards; 14000 amperes rms symmetrical for 480 volt panelboards, or as indicated.
- E. Molded Case Circuit Breakers: NEMA AB 1. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- F. Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower, with bimetal overload relay. Coil operating voltage: 120 volts, 60 Hertz. Size as shown on Drawings. Provide unit mounted control power transformer and HAND-OFF-AUTO selector switch, STOP-START pushbutton station and indicating light in front cover.
- G. Provide circuit breaker accessory trip units and auxiliary switches as indicated.
- H. Enclosure: NEMA PB 1, Type 1, (Type 3R, if outdoors)

- I. Cabinet Front: Surface type, fastened with concealed trim clamps. Provide hinged door with flush lock. Finish in manufacturer's standard gray enamel.
- 2.03 BRANCH CIRCUIT PANELBOARDS
- A. Lighting and Appliance Branch Circuit Panelboards: NEMA PB1, circuit breaker type.
 - B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled.
 - C. Minimum integrated short circuit rating unless noted otherwise on drawings: 10,000 amperes rms symmetrical for 240 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards, or as indicated.
 - D. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.
 - E. Enclosure: NEMA PB 1, Type 1, (Type 3R if outdoors)
 - F. Cabinet Front: with concealed trim clamps, concealed hinge, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
- 2.04 LOAD CENTERS
- A. Load Centers type panel boards are not acceptable and shall not be used.
- 2.05 FUSES
- A. Manufacturers: Bussman or equal.
 - B. Fuses 600 Amperes and Less: Dual element, current limiting, time delay, one-time fuse, 600 volt, UL Class RK 1, RK 5, as indicated.
 - C. Fuses 601 Amperes and Larger: Current limiting, time delay, one time fuse, 600 volt, UL Class L.
 - D. Interrupting Rating: 200,000 rms amperes.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1.
- B. Install panelboards plumb. Install recessed panelboards flush with wall finishes. Provide supports in accordance with Section 16190.
- C. Height: 6 ft to top of panelboard; install panelboards taller than 6 ft with bottom no more than 4 inches above floor.
- D. Provide filler plates for unused spaces in panelboards.
- E. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- F. Provide engraved plastic nameplates under the provisions of Section 16195.

- G. For each 4 spare circuit breakers, provide spare 1" conduit out of each recessed panelboard to an accessible location above ceiling or below floor. Minimum of one such conduit.

3.02 FIELD QUALITY CONTROL

- A. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.
- B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION

SECTION 16476

ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Enclosed circuit breakers.

1.02 RELATED WORK

- A. Section 16190 - Supporting Devices.
- B. Section 16195 - Electrical Identification: Engraved nameplates.

1.03 REFERENCES

- A. NECA (National Electrical Contractors Association) "Standard of Installation."
- B. NEMA AB 1 - Molded Case Circuit Breakers
- C. NFPA 70 - National Electrical Code.

1.04 SUBMITTALS

- A. Product Data: Provide catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.
- B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 3 years experience.

1.07 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

1.08 EXTRA MATERIALS

- A. Provide 3 of each size and type current limiter.

PART 2 PRODUCTS

- 2.01 MANUFACTURERS: Square D; Eaton, GE, Siemens.

2.02 MOLDED CASE CIRCUIT BREAKER

- A. Circuit Breaker: NEMA AB 1.
- B. Service Conditions:
 - 1. Temperature: 110 degrees F maximum.

2.03 TRIP UNITS

- A. Field-Adjustable Trip Circuit Breaker: Provide circuit breakers with frame sizes 200 amperes and larger with mechanism for adjusting [long time] [short time] [continuous current] [[short time] [long time] pickup current] setting for automatic operation. Range of Adjustment: manufacturers standard
- B. Field-Changeable Ampere Rating Circuit Breaker: Provide circuit breakers with frame sizes 200 amperes and larger with changeable trip units.

2.04 PRODUCT OPTIONS AND FEATURES

- A. Provide accessories to NEMA AB 1.
- B. Shunt Trip Device: 120 volts, AC.
- C. Undervoltage Trip Device: 120 volts, AC.
- D. Auxiliary Switch: 120 volts, AC.
- E. Alarm Switch: 120 volts, AC.
- F. Electrical Operator: 120 volts, AC.
- G. Handle Lock: Include provisions for padlocking.
- H. Provide mechanical trip device.
- I. Provide insulated grounding lug in each enclosure.
- J. Provide Products suitable for use as service entrance equipment where so applied.

2.05 ENCLOSURE

- A. Enclosure: NEMA AB 1, Type 1; 3R if outdoors
- B. Fabricate enclosure from steel.
- C. Finish using manufacturer's standard enamel finish.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install enclosed circuit breakers where indicated, in accordance with manufacturer's instructions.
- B. Install enclosed circuit breakers plumb. Provide supports in accordance with Section 16190.
- C. Height: 5 ft to operating handle.
- D. Provide engraved plastic nameplates under the provisions of Section 16195.

3.02 FIELD QUALITY CONTROL

- A. Inspect and test each circuit breaker to NEMA AB 1.
- B. Inspect each circuit breaker visually.
- C. Perform several mechanical ON-OFF operations on each circuit breaker.

- D. Verify circuit continuity on each pole in closed position.
- E. Determine that circuit breaker will trip on overcurrent condition, with tripping time to NEMA AB 1 requirements.
- F. Include description of testing and results in test report.

3.03 ADJUSTING

- A. Adjust trip settings so that circuit breakers coordinate with other overcurrent protective devices in circuit.
- B. Adjust trip settings to provide adequate protection from overcurrent and fault currents.

END OF SECTION

SECTION 16477

FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fuses.
- B. Spare fuse cabinet.

1.02 RELATED SECTIONS

- A. Section 09900 - Painting: Painting of spare fuse cabinet.

1.03 REFERENCES

- A. NFPA 70 - National Electric Code.
- B. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1
- B. Product Data: Provide data sheets showing electrical characteristics including time-current curves.

1.05 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1
- B. Record actual fuse sizes.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years experience.

1.07 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by UL.

1.08 MAINTENANCE MATERIALS

- A. Provide two fuse pullers.

1.09 EXTRA MATERIALS

- A. Provide three of each size and type fuse installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Bussmann.
- B. Littelfuse.
- C. Substitutions: Under provisions of Division 1

- 2.02 FUSE REQUIREMENTS
 - A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
 - B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
 - C. Main Service Switches Larger than 600 amperes: Class L time delay.
 - D. Main Service Switches: Class RK1 time delay.
 - E. Power Load Feeder Switches Larger than 600 amperes: ClassL time delay.
 - F. Power Load Feeder Switches: Class RK1 time delay.
 - G. Motor Load Feeder Switches: Class RK1 time delay.
 - H. Lighting Load Feeder Switches Larger than 600 amperes: Class L time delay.
 - I. Lighting Load Feeder Switches: Class RK1 time delay.
 - J. Other Feeder Switches Larger than 600 amperes: Class L time delay.
 - K. Other Feeder Switches: Class RK1 time delay.
 - L. Power Branch Circuits: Class RK1 time delay.
 - M. Motor Branch Circuits: Class RK1 time delay.

- 2.03 CLASS RK1 (TIME DELAY) FUSES
 - A. Manufacturers:
 - 1. Bussmann or equal .

- 2.04 CLASS RK1 (NON-TIME-DELAY) FUSES
 - A. Manufacturers:
 - 1. Bussmann or equal .

- 2.05 CLASS RK5 FUSES
 - A. Manufacturers:
 - 1. Bussmann or equal.

- 2.06 CLASS J (TIME DELAY) FUSES
 - A. Manufacturers:
 - 1. Bussmann or equal .

- 2.07 CLASS J (NON-TIME-DELAY) FUSES
 - A. Manufacturers:
 - 1. Bussmann or equal .

- 2.08 CLASS T FUSES
 - A. Manufacturers:
 - 1. Bussmann or equal .

- 2.09 CLASS L (FAST-ACTING) FUSES
 - A. Manufacturers:
 - 1. Bussmann or equal.

- 2.10 CLASS L (TIME DELAY) FUSES
 - A. Manufacturers:
 - 1. Bussmann or equal .

2.11 CLASS G FUSES

- A. Manufacturers:
 - 1. Bussmann or equal .

2.12 SPARE FUSE CABINET

- A. Description: Wall-mounted sheet metal cabinet, suitably sized to store spare fuses and fuse pullers specified.
- B. Doors: Hinged, with hasp for Owner's padlock.
- C. Finish: Standard ANSI Gray.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install fuses in accordance with manufacturer's instructions.
- B. Install fuse with label oriented such that manufacturer, type, and size are easily read.
- C. Install spare fuse cabinet in main electrical room.

END OF SECTION

SECTION 16481

ENCLOSED MOTOR CONTROLLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manual motor starters.
- B. Magnetic motor starters.
- C. Combination magnetic motor starters.

1.02 RELATED SECTIONS

- A. Section 16190 - Supporting Devices.
- B. Section 16195 - Electrical Identification: Engraved nameplates.

1.03 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Type.
- C. UL 198E - Class R Fuses.
- D. NECA "Standard of Installation," published by National Electrical Contractors Association.
- E. NEMA AB 1 - Molded Case Circuit Breakers.
- F. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- G. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- H. NEMA KS 1 - Enclosed Switches.

1.04 SUBMITTALS

- A. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- B. Test Reports: Indicate field test and inspection procedures and test results.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 3 years experience.

1.07 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

1.08 EXTRA MATERIALS

- A. Provide 3 of each size and type fuse installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Square D, Eaton, GE, Siemens.

2.02 MANUAL CONTROLLERS

- A. Manual Motor Controller: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller with overload element, red pilot light, auxiliary contact, toggle operator.
- B. Fractional Horsepower Manual Controller: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, pilot light, and toggle operator.
- C. Motor Starting Switch: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, with pilot light and key toggle operator.
- D. Enclosure: NEMA ICS 6; Type 1, 3R if outdoors

2.03 AUTOMATIC CONTROLLERS

- A. Magnetic Motor Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
- B. Reversing Controllers: Include electrical interlock and integral time delay transition between FORWARD and REVERSE rotation.
- C. Two Speed Controllers: Include integral time delay transition between FAST and SLOW speeds.
- D. Coil operating voltage: 120 volts, 60 Hertz.
- E. Overload Relay: NEMA ICS; bimetal
- F. Enclosure: NEMA ICS 6, Type 1; 3R if outdoors

2.04 PRODUCT OPTIONS AND FEATURES

- A. Auxiliary Contacts: NEMA ICS 2,2 each field convertible contacts in addition to seal-in contact.
- B. Cover Mounted Pilot Devices: NEMA ICS 2, heavy duty type.
- C. Pilot Device Contacts: NEMA ICS 2, Form Z, rated A150.
- D. Pushbuttons: Unguarded type.
- E. Indicating Lights: LED type.
- F. Selector Switches: Rotary type.
- G. Relays: NEMA ICS 2
- H. Control Power Transformers: 120 volt secondary, 150 VA minimum, in each motor starter. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure.

2.05 DISCONNECTS

- A. Combination Controllers: Combine motor controllers with motor circuit protector disconnect in common enclosure.

- B. Thermal Magnetic Circuit Breakers: NEMAAB1, with integral thermal and instantaneous magnetic trip in each pole.

2.06 FUSES

- A. Manufacturers: Bussman, Littelfuse
- B. Description: 600 volt, UL 198E, Class RK 1, RK 5.
- C. Interrupting Rating: 200,000 rms amperes.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install enclosed controllers where indicated, in accordance with manufacturer's instructions.
- B. Install enclosed controllers plumb. Provide supports in accordance with Section 16190.
- C. Height: 5 ft to operating handle.
- D. Install fuses in fusible switches.
- E. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- F. Provide engraved plastic nameplates under the provisions of Section 16195.
- G. Provide neatly typed label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.02 FIELD QUALITY CONTROL

- A. Inspect and test each enclosed controller to NEMA ICS 2.

END OF SECTION

SECTION 16510

INTERIOR LUMINAIRES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior luminaires and accessories.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts.
- E. Fluorescent dimming ballasts and controls.
- F. Fluorescent lamp emergency power supply.
- G. Lamps.
- H. Luminaire accessories.

1.02 RELATED SECTIONS

- A. Air distribution accessories for air handling luminaires.
- B. Section 16130 - Boxes.

1.03 REFERENCES

- A. ANSI C78.379 - Electric Lamps - Incandescent and High- Intensity Discharge Reflector Lamps - Classification of Beam Patterns.
- B. ANSI C82.1 - Ballasts for Fluorescent Lamps -Specifications.
- C. ANSI C82.4 - Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).
- D. ANSI/NFPA 70 - National Electrical Code.
- E. ANSI/NFPA 101 - Life Safety Code.
- F. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- B. Product Data: Provide dimensions, ratings, and performance data.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.
- D. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of each luminaire.

1.06 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include replacement parts list.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 3 years experience.

1.08 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Conform to requirements of NFPA 101.
- C. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.09 EXTRA MATERIALS

- A. Provide 2 of each plastic lens.
- B. Provide 10 replacement lamp of each type of lamp installed.
- C. Provide 2 of each ballast type.

PART 2 PRODUCTS

2.01 LUMINAIRES, EMERGENCY AND EXIT LIGHTS

- A. Furnish products as specified on Drawings.
- B. Install ballasts, lamps, and specified accessories at factory.

2.02 BALLASTS

- A. Fluorescent Ballast:
 - 1. Description: Electronic ballast, less than 10% T.H.D.
 - 2. Provide ballast suitable for lamps specified.
 - 3. Voltage: Match luminaire voltage.
 - 4. Source Quality Control: Certify ballast design and construction by Certified Ballast Manufacturers, Inc. Provide ballasts by Advance or Magnatek.
- B. High Intensity Discharge (HID) Ballast:
 - 1. Description: ANSI C82.4
 - 2. Provide ballast suitable for lamp specified.
 - 3. Voltage: Match luminaire voltage.

2.03 FLUORESCENT LAMP EMERGENCY POWER SUPPLY (if scheduled)

- A. Description: Emergency battery power supply suitable for installation in ballast compartment of fluorescent luminaire.
- B. Lamp Ratings: One F40CW lamp providing 00 lumens, minimum
- C. Battery: Sealed lead calcium type, rated for 10 year life.
- D. Include TEST switch and AC ON indicator light, installed to be operable and visible from the outside of an assembled luminaire.

2.04 LAMPS

- A. Incandescent Lamp Manufacturers: GE, Sylvania, Philips.
- B. Fluorescent Lamp Manufacturers: GE, Sylvania, Philips
- C. High Intensity Discharge (HID) Lamp Manufacturers: GE, Sylvania, Philips
- D. Provide lamp type specified for luminaire.
- E. Reflector Lamp Beam Patterns: ANSI C78.379.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrate and supporting grids for luminaires.
- B. Examine each luminaire to determine suitability for lamps specified.

3.02 INSTALLATION

- A. Install in accordance with manufacturers instructions.
- B. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- C. Support luminaires larger than 2 x 4 foot size independent of ceiling framing.
- D. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- E. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- F. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling T's to support surface mounted luminaires as required. Fasten surface mounted luminaires to ceiling T using bolts, screws, rivets, or suitable clips.
- G. Install recessed luminaires to permit removal from below.
- H. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- I. Install clips to secure recessed grid-supported luminaires in place.
- J. Install wall mounted fixtures at height as indicated on Drawings or scheduled.
- K. Install accessories furnished with each luminaire.
- L. Connect fixtures to branch circuit outlets provided under Section 16130
- M. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- N. Bond products and metal accessories to branch circuit equipment grounding conductor.
- O. Install specified lamps in each luminaire, emergency lighting unit and exit sign.

3.03 INTERFACE WITH OTHER PRODUCTS

- A. Interface with air handling accessories furnished and installed under Section 15930

3.04 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.05 ADJUSTING

- A. Aim and adjust luminaires as directed.
- B. Adjust exit sign directional arrows as indicated.
- C. Relamp luminaires that have failed lamps at Substantial Completion.

3.06 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosure.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

3.07 DEMONSTRATION

- A. Provide demonstration of luminaire operation.

END OF SECTION