

**SECTION 16010**  
**BASIC ELECTRICAL REQUIREMENTS**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to this Section.
- B. This section is a Division-16 basic Electrical Materials and Methods section, and is part of each Division-16 section making reference to electrical raceways specified herein.

**1.2 SUMMARY**

- A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 16. It expands and supplements the requirements specified in sections of Division 1.

**1.3 ROUGH-IN**

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

**1.4 ELECTRICAL INSTALLATIONS**

- A. Coordinate electrical equipment and materials installation with building components.
- B. Verify all dimensions by field measurements.
- C. Arrange for chases, slots and openings streets, sidewalk, and curbs to allow for electrical installations.
- D. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
- E. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work.
- F. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- G. Coordinate the installation of electrical materials and equipment with other trades.
- H. Coordinate connection of electrical systems with existing underground utilities and services. Comply with requirements of governing regulations, franchised

service companies, and controlling agencies. Obtain all necessary permits from local jurisdiction, franchised service companies, and controlling agencies.

## **1.5 CUTTING AND PATCHING**

- A. This Article specifies the cutting and patching of electrical equipment, components, and materials to include removal and legal disposal of selected materials, components, and equipment.
- D. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
- E. Arrange for repairs required to restore other work, because of damage caused as a result of electrical installations.
- F. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.
- G. Perform cutting, fitting, and patching of electrical equipment and materials required to:
  - 1. Uncover work to provide for installation of ill-timed work.
  - 2. Remove and replace defective work.
  - 3. Remove and replace work not conforming to requirements of the contract Documents.
  - 4. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect/Engineer observation of concealed work.
- H. Cut, remove and legally dispose of selected electrical equipment, components, and materials as indicated, including, but not limited to removal of electrical items indicated to be removed and items made obsolete by the new work.
- J. Protect the structure furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- K. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
- L. Locate, identify, and protect electrical service passing through work area and serving other areas required to be maintained operational. When transit services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover.

## **1.6 ELECTRICAL SUBMITTALS**

- A. Refer to the Conditions of the Contract (General and Supplementary) and Division 1 Section: SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES for submittal definitions, requirements, and procedures.
- B. Submittal of shop drawings, product data, and samples will be accepted only when submitted by the Contractor. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.

## **1.7 PRODUCT OPTIONS AND SUBSTITUTIONS**

Refer to the Instructions to Bidders and the Division 1 Sections "PRODUCTS AND SUBSTITUTION" for requirements in selecting products and requesting substitutions.

## **1.8 PRODUCT LISTING**

- A. Prepare listing of major electrical equipment and materials for the project.
- B. Provide all information requested.
- C. Submit this listing as a part of the submittal requirement specified in the Division 1 Section: "PRODUCTS AND SUBSTITUTION".
- D. When two or more items of the same material or equipment are required, they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, wire, conduit, fittings, sheet metal, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in Work, except as otherwise indicated.
- E. Provide products which are compatible within systems and other connected items.

## **1.9 ELECTRICAL IDENTIFICATION - NAMEPLATES AND WARNINGS:**

Provide permanent operational data nameplate on each item power service, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

- A. Nameplates: Furnish permanently installed on electrical equipment and devices including, but not limited to, the following items:
  - 1. Enclosures for panels.
  - 2. Enclosures for separately enclosed devices to disconnect switches, circuit breakers, contactors, time switches, control stations and relays.
- B. Nameplate designations shall clearly state:
  - 1. Equipment enclosure nameplates:
    - a. Manufacturer's nameplate including equipment design rating of current, voltage, bus bracing rating, or as applicable.
- C. Nameplate material: Engraved, laminated, plastic with white letters engraved through black background. Letters shall be 3/16" high for devices and minimum 1/4" high for equipment and enclosures. Adhesives are not acceptable.
- D. Provide cable tags in each hand hole. Bundle each multi-wire circuit separately and place cable tag indicating circuit number on the tag.

## **1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.
- B. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.
- C. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

### **1.11 RECORD DOCUMENTS**

- A. Refer to the Division 1 Section: PROJECT CLOSE-OUT, or PROJECT RECORD DOCUMENTS for requirements. The following paragraphs supplement the requirements of Division 1.
- B. Mark drawings to indicate revisions to conduit size and location: actual light locations, dimensioned from centerlines of streets.
- C. Mark specifications to indicate approved substitutions; change orders, actual equipment and materials used.

### **1.12 WARRANTIES**

- A. Provide one year warranty on all work performed
- B. Provide two year warranty on all Ballasts.
- C. Compile and assemble the warranties specified in Division 16, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.
- D. Provide complete warranty information for each item to include product or equipment data of beginning of warranty or bond; duration of warranty or bond and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

### **1.13 CLEANING**

- A. Refer to Civil Engineering for general requirements for final cleaning.
- B. Clean all light poles fixtures, lamps and lenses prior to final acceptance. Replace all inoperative lamps.
- C. At completion of work contractor shall remove rubbish, waste and debris resulting from operations. Remove equipment and implements of service, and leave entire work area neat and clean, to the satisfaction of the owner.

## **PART 2 - PRODUCTS**

Not applicable

**PART 3 - EXECUTION**

Not applicable

**END OF SECTION**

**SECTION 16035  
ACCEPTANCE TESTING AND CALIBRATION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-16 basic Electrical Materials and Methods section, and is part of each Division-16 section making reference to electrical raceways specified herein.

**1.2 INSPECTION AND TESTS**

- A. General
  1. Upon completion and adjustment of the work under this Division of the Specification, all systems shall be tested by the Contractor to demonstrate that all wiring and equipment furnished, installed and/or connected under this Division has been properly installed, is in good operating condition and will function in the required manner. Faulty or defective wiring and equipment shall be replaced and the associated system Re-tested to demonstrate the elimination of such faults or defects.
  2. If laws, ordinances or any public authority require any of the work performed by the Contractor under this Division of the Specification to be specifically tested, inspected or approved, the Contractor shall arrange for the same at no cost to the Owner.
  3. The necessary tests on the electrical systems shall be made in the presence of the City's Representative. The Contractor shall notify him one (1) week in advance of the date for all tests. The Contractor shall provide qualified personnel and all required equipment to properly calibrated, to perform all tests specified in this Division of the Specification, and/or required by inspection authorities. All fees for testing and inspection shall be paid by the Contractor.
  4. Shop and field inspections and tests made by the City's Representative shall in no way relieve the Contractor from his responsibility to furnish satisfactory materials and workmanship. The right is reserved by the City's Representative to reject any material or work at any time before the final acceptance if, in his opinion, the material and/or work do not conform to the requirements of the Specifications.
  5. The final inspection and test shall be made only after the City's Representative is satisfied that the work specified in this Division of the Specification has been completely installed. The acceptance of the Work shall not in any way prejudice the City's rights to demand new replacement of defective material and/or workmanship. All parts of the electrical system for which the contractor is responsible shall be adjusted and left in proper operating condition.
- B. Grounding

1. See Section 16450 for additional information and requirements.
2. Completed wiring system shall be free of short circuits and unwanted grounds.

### **1.3 CALIBRATION**

- A. Calibrate and adjust all components requiring same as directed, in accordance with manufacturer's procedures and recommendations, or as required for the following categories of equipment.
  1. Lighting fixtures (lamp positions, reflector positions, etc. required).
- B. Provide overloads in all motor starters, in accordance with motor nameplate data and as recommended by the manufacturer.

### **PART 2 - PRODUCTS**

Not Applicable

### **PART 3 - EXECUTION**

Not Applicable

**END OF SECTION**

## **SECTION 16040 SUBMITTALS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-16 basic Electrical Materials and Methods section, and is part of each Division-16 section making reference to electrical raceways specified herein.

#### **1.2 WORK INCLUDED**

- A. This Section describes the general requirements and purpose of submittals for Division 16 equipment and materials.

#### **1.3 RELATED WORK**

- A. The general term "Shop Drawings" includes manufacturer's standard drawings and specifications, text data and maintenance and operating instructions including recommended spare parts list. Submittals shall be made and approvals as required, rendered in accordance with conditions of the Contract. In addition to identification requirements contained therein, proper equipment and/or system designations shall be affixed to all related electrical shop drawings.

#### **1.4 SUBMITTAL REQUIREMENTS**

- A. The attached Submittal list specifies the data to be submitted for various materials and equipment used in this Work. Comply with instructions as noted therein.
- B. Refer to respective Equipment Specification Sections for additional submittal requirements.

### **PART 2 - PRODUCTS**

Not Applicable

### **PART 3 - EXECUTION**

Not Applicable



**ATTACHMENT "A"**  
**SUBMITTALS**

	<b><u>Mfg.</u></b>	<b><u>Cat</u></b>	<b><u>Marked</u></b>	<b><u>Shop</u></b>	<b><u>Wiring</u></b>	<b><u>Submit</u></b>
		<b><u>No.</u></b>	<b><u>Brochure</u></b>	<b><u>Dwg.</u></b>	<b><u>Diagram</u></b>	<b><u>For</u></b>
Control Devices	X	X	X			(1)(2)
Lighting:						
- Poles	X	X	X	X		(1)(2)
- Lamps & Accessories	X	X	X	X		(1)(2)
Panelboard	X	X	X			(1)(2)
Handholes	X	X	X			(1)(2)

Instructions: Submit all items marked with an "X".

- (1) Submit for approval.
- (2) Submit for Owner's records only.

**END OF SECTION**

**SECTION 16112  
UNDERGROUND RACEWAYS, MANHOLES,  
TRENCHING, BACKFILLING AND COMPACTING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-16 basic Electrical Materials and Methods section, and is part of each Division-16 section making reference to electrical raceways specified herein.

**1.2 DESCRIPTION**

- A. The conditions of the Construction Contract and Division 1 - General Requirements and Section 16010 - General Provisions apply to the work specified in this Section.
- B. Perform all trenching, backfilling and compacting for underground utilities and street lights as shown on Drawings and as herein specified.
- C. Furnish and install all underground systems as shown on Drawings and herein specified, including the following systems:
  - 1. All handholes.
  - 2. Underground conduits.
- D. Related Work Specified Elsewhere: Exterior pole mounted lighting: Section 16530.

**1.3 QUALITY ASSURANCE**

- A. Inspection and Testing: Inspection and testing by OWNER'S Designated Representative and/or a Soils Technician, hired and paid for by OWNER, will be conducted as required during the trenching and backfilling operations to assure compliance with this Specification.
- B. Requirements of Regulatory Agencies:
  - 1. It shall be CONTRACTOR's responsibility and duty to be familiar with local, state and federal rules and regulations relating to this type of work and he shall assume the responsibility for compliance therewith.
  - 2. A permit for crossing a railroad or road will be obtained by OWNER from the agency operating the railroad or road, and CONTRACTOR shall comply with all requirements governing the issuance of such permit as to time limits, safety precautions, type of materials, method of construction and performance security, at no extra cost to owner.

3. All other permits required shall be obtained and paid for by CONTRACTOR.
4. Warning Lights and Barricades: CONTRACTOR shall provide, as directed by OWNER's Designated Representative, warning lights or barricades for open trenches or excavations, and whenever required by OSHA.

## **PART 2 - PRODUCTS**

### **2.1 UNDERGROUND SYSTEM**

- A. Pre-cast handholes are acceptable but product data and/or shop drawings must be submitted for final approval before installation can begin.
- B. All handholes shall have covers and frames of heavy-duty type. Handhole shall be colored concrete lets to match landscape. Lid shall be lettered "Electric".
- C. All direct burial conduit shall be rigid steel or PVC, Schedule 40.

### **2.2 SOIL MATERIALS**

- A. Compaction and backfill requirements will be established by the civil engineer.

## **PART 3 - EXECUTION**

### **3.1 UNDERGROUND ELECTRICAL DUCT SYSTEMS**

- A. Underground Work: CONTRACTOR shall do all excavating, concrete work and backfilling, unless otherwise noted. Trenching, backfilling, shoring and compacting shall be in accordance with this Section. CONTRACTOR shall furnish and install all manholes, cable pits, conduit, fittings, manhole hardware, and grounding, unless otherwise noted.
- B. Conduit:
  1. Conduit shall be rigid PVC, Schedule 40 of the sizes and number as indicated on Drawings. Exception: where rigid steel is called out on the Drawings or herein specified for structural strength of duct system, such as under roadways.
  2. Use rigid steel conduit when pushing conduits.
  3. Adapters shall be provided where the conduit run changes from PVC to heavy wall steel conduit construction.
  4. When a duct terminates at a terminal pole, the last five feet (minimum) of duct shall be rigid steel, including all conduits on the pole.
  5. In laying the conduit, all joints shall be staggered at least 6 inches both vertically and horizontally. All joint/fittings shall be joined together by means of an approved solvent cement system. The joints/fittings shall then be taped with one (1) layer of 3M Brand "Duct" tape.
  6. A 200-pound poly rope shall be installed and left in all spare conduit not containing wire or cable.

7. All conduits shall be swabbed clean before cable or poly rope installation and kept clean and free of contaminants throughout construction.
- D. Manholes, Handholes and Cable Pits:
1. CONTRACTOR shall install handholes in accordance with the details shown on Drawings and as hereinafter specified.
  2. CONTRACTOR shall install one 5/8 by 120-inch copper clad ground rods in each handhole. Ground rods shall protrude 6 inches above the manhole floor and shall be connected by a length of exposed No. 6 AWG, copper conductor secured to the side walls. Each ground wire shall be secured with a suitable thermoweld type ground rod connection.

### 3.2 TRENCHING

- A. General Excavation:
1. Excavation shall be made to the alignment and depth shown on Drawings and limited to not more than 100 feet in advance of conduit, cable or concrete duct laying, unless otherwise authorized by OWNER'S Designated Representative. All excavations shall be made by open cut, unless otherwise approved by OWNER or shown on Drawings. The banks of trenches shall be so cut to meet the requirements of federal, state and local codes and regulations
- B. Rock Excavation
1. Rock occurring in excavation shall be uncovered by CONTRACTOR and measured by OWNER before its removal by CONTRACTOR. Any rock removed before OWNER'S inspection and measurements shall be construed as general excavation and CONTRACTOR cannot obtain additional compensation for its removal. Rock occurring in excavation for conduit, cable and concrete duct work shall be measured at its cable and concrete duct work shall be measured at its actual width but not more than 24 inches greater than the outside diameter of the conduit, cable and concrete duct. Rock occurring in excavation for handholes and other construction shall be measured to include 12 inch clearance from outside face of the structure. The bottom of the rock excavation shall be 6 inches below the bottom of the conduit, cable and concrete duct. The volume in cubic yards will be computed by the method of average end areas.
- C. Trench:
1. Pavements of all types shall be cut with a saw or other equipment in order to provide a straight edge for replacement.
  2. Excavation for handholes and similar items shall be sufficient to permit the carrying out of the construction as required.
- D. Disposal of Waste Materials:
1. Any material found in the excavation as determined by OWNER'S Designated Representative to be unsuitable for backfill shall be separated from the suitable material.
  2. Unsuitable and excess suitable materials shall be removed from the work site as directed by OWNER'S Designated Representative, and at the expense of the contractor.

### **3.3 SHORING AND SHEETING**

- A. Shoring, sheeting, bracing and similar items as may be required to support the side of the excavation and to prevent any movement which may in any way endanger personnel or injure or delay the work or endanger adjacent buildings or other structures shall be put in place and maintained by CONTRACTOR at his own expense. Where sheeting and bracing are used, the trench width shall be of such width to allow proper placement of the conduit, cable or concrete duct and backfill. Trench sheeting shall remain in place until conduit has been laid, around it compacted to a depth of 12 inches over the top of the conduit. Steel sheeting and bracing shall be removed in such a manner as not to endanger the constructed conduit, cable, concrete duct, structure, utilities or property, whether public or private.
- B. Where wood sheeting or wood skeleton sheeting is driven along side the conduit, cable or concrete duct, it shall be cut off and left in place to an elevation 18 inches above the top of the conduit.
- C. If removal of the skeleton sheeting might cause a collapse of the trench wall and/or a widening of the trench at the top of the conduit, cable or concrete duct, the skeleton sheeting system may be left in place.
- D. A trench shield or trench box made of steel or wood and adequately braced may be used. This shield shall be pulled along in the trench and the conduit or concrete duct bedded and jointed inside the box. Care shall be exercised in moving the shield so that the previously laid conduit or concrete duct and backfill is not disturbed.

### **3.4 BACKFILLING AND COMPACTING**

- A. Backfill at Conduit, Cable and Concrete Duct Zone:
  - 1. Unless otherwise indicated on Drawings, selected suitable material backfill free from rock, frozen material, large clods of earth, broken concrete, boulders, chunks of wood and similar items, shall be deposited on both sides of the conduit. The backfill material com backed per civil engineer specifications.
- B. Improper Backfilling: Where there is evidence of improper backfilling, trenches shall be re-opened to the depth required for proper compaction and backfilled as specified herein.

### **3.5 PROTECTION OF EXISTING UTILITIES**

- A. All existing utilities and structures shall be protected from damage during excavation and backfilling if trenches. If any of the existing utilities are damaged during construction, the damage shall be properly repaired by CONTRACTOR at his expense.
- B. Before any digging, trenching, or excavation, CONTRACTOR shall notify the local utility company (gas, telephone, electric) and have then locate and identify any existing underground utilities.

### **3.8 RESTORATION OF SURFACE**

Unless otherwise noted on Drawings, CONTRACTOR shall restore to original condition all surfaces disturbed from site drainage and/or utility construction under this Contract.

**END OF SECTION**

**SECTION 16142**  
**ELECTRICAL CONNECTIONS FOR EQUIPMENT**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-16 basic Electrical Materials and Methods section, and is part of each Division-16 section making reference to electrical raceways specified herein.

**1.2 DESCRIPTION OF WORK**

- A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.
- B. Applications of electrical power connections specified in this section includes but not limited to the following:
  - 1. To lighting fixtures.
  - 2. Gates.
  - 3. Chargers.
  - 4. Water features.
- C. Electrical identification for wire/cable conductors is specified in Division-16 section, "Electrical Identification", and is work of this section.

**1.3 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors and terminals, of types and ratings required, and ancillary connection materials, including electrical insulating tape, soldering fluxes, and cable ties, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firms with at least 2 years of successful installation experience with projects utilizing electrical connections for equipment similar to that required for this project.
- C. NEC compliance: Comply with applicable requirements of NEC as to type products used and installation of electrical power connections (Terminals and Splices), for junction boxes, motor starters, and disconnect switches.
- D. IEEE Compliance: Comply with Std 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to connections and terminations.

- E. ANSI Compliance: Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.
- F. UL Compliance: Comply with UL Std. 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors" including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are UL-listed and labeled.
- G. ETL Compliance: Provide electrical connection products and materials which are ETL-listed and labeled.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of product):  
 Adalet-PLM Div, Scott and Fetzer Company  
 Allen-Stevens Conduit Fittings Corporation  
 AMP Incorporated.  
 Appleton Electric Company  
 Arrow-Hart Div, Crouse-Hinds Company  
 Atlas Technologies, Inc.  
 Bishop Div, General Signal Corporation  
 Burndy Corporation  
 Eagle Electric Mfg. Company  
 Electroline Mfg Company  
 Gardner Bender, Inc.  
 General Electric Company  
 Gould, Inc.  
 Harvey Hubbell Inc.  
 Ideal Industries, Inc.  
 Pyle National Company  
 Reliable Electric Company  
 Square D Company.  
 Thomas and Betts Corporation

### **2.2 ACCEPTABLE MANUFACTURERS**

- A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and termination of types indicated.
- B. Wires, Cables, and Connectors:
- C. General: Provide wires, cables, and connectors complying with Division-16 basic electrical materials and methods section "Wires and Cables".



- D. Wires/Cables: Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes and ratings, of wires/cables which are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 20 degrees C (68 degrees F).
- E. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications.
- F. Electrical Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, electrical solder, electrical soldering flux, wirenuts and cable ties and recommended for use by accessories manufacturers for type services indicated.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

### **3.2 INSTALLATION OF ELECTRICAL CONNECTIONS**

- A. Install electrical connections as indicated; in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.
- B. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.
- C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.
- E. Cover Splices with electrical insulating material equivalent to, or of greater insulation resistively rating, than electrical insulation rating of those conductors being spliced.
- F. Prepare cables and wires, by cutting and stripping covering armor jacket, and insulating properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.
- G. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

- H. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque-tightening value for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL's 486A.
- I. Fasten identification markers to each electrical power supply wire/cable indicating their voltage, phase and feeder number in accordance with Division Identification". Affix markers on each terminal conductor, as close as possible to the point of connection.

### **3.3 FIELD QUALITY CONTROL**

- A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

**END OF SECTION**

## **SECTION 16450 GROUNDING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-16 basic Electrical Materials and Methods section, and is part of each Division-16 section making reference to electrical raceways specified herein.

#### **1.2 DESCRIPTION OF WORK**

- A. Extent of grounding work is indicated by drawings and schedules.
- B. Types of grounding specified in this section include Solid grounding.
- C. Applications of grounding work in this section include the following:
  - 1. Grounding rods.
  - 2. Service equipment.
  - 3. Enclosures
  - 4. Equipment.
- D. Requirements of this section apply to electrical grounding work specified elsewhere in the specifications.

#### **1.3 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors, terminals and fittings, of types and ratings required, and ancillary grounding materials, including stranded cable, copper braid and bus, ground rods and plates electrodes, whose projects have been in satisfactory use in similar service for not less than 3 years.
- B. Installer: Qualified with at least 3 years of successful installation experience on projects with electrical grounding work similar to that required for project.
- C. NEC Compliance: Comply with applicable requirements of UL Standards Nos. 467 and 869 pertaining to electrical grounding and bonding.

- E. IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical grounding.

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

Handle electrical grounding accessories and components carefully to avoid damage; store in original wrappings and protect from dirt and weather.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

Subject to compliance with requirements, provide grounding products of one of the following:

B-Line Systems, Inc.  
Burndy Corporation  
Crouse-Hinds Company  
Electrical Components Div; Gould Inc.  
General Electric Supply Company  
Ideal Industries, Inc.  
Thomas and Betts Corporation

#### **2.2 GROUNDING SYSTEMS**

- A. Materials and Components:
- B. General: Except as otherwise indicated, provide electrical grounding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, terminals (solderless lugs), rounding rods/electrodes bonding jumper braid, and additional accessories needed for complete installation. Where more than one type unit meets indicated requirements, selection is Installer's option. Where materials or components are not indicated, provide products complying with NEC, UL IEEE, and established industry standards for applications indicated.
- C. General: Provide raceways, and electrical boxes and fittings complying with Division-16 Basic Materials and Methods sections "Raceways" and "Electrical Boxes and Fittings", in accordance with the following listing:
  - 1. Rigid steel conduit (heavy wall).
  - 2. Liquid-tight flexible metal conduit.
  - 3. PVC Schedule 40 rigid plastic.
- D. Conductors: Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NEC.
- E. Conductors: Copper cable.

- F. Bonding Jumper Braid: Copper braided tape, constructed of 30-gauge bare copper wires and properly sized for indicated applications.
- G. Flexible Jumper Strap: Flexible flat conductor, 490 strands of 30-gauge bare copper wire; 3/4" wide, 9-1/2" long; 48,250 c. Protect braid with copper bolt hole ends with holes sized for 3/8" diameter bolts.
- H. Electrical Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type services indicated.
- I. Field Welding: Comply with AWS Code for procedures, appearance and quality of welds; and methods used in correcting welding work. Provide welded connections where grounding conductors connect to underground grounding rods/electrodes.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Installer must examine areas and conditions under which electrical grounding connections are to be made and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

### **3.2 INSTALLATION OF ELECTRICAL GROUNDING**

- A. General: Install electrical grounding systems where shown, in accordance with applicable portions of NEC, with NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.
- B. Coordinate with other electrical work as necessary to interface installation of electrical grounding system with other work.
- C. Weld grounding conductors to underground grounding rods/electrodes.
- D. Ground all metallic conduits, wireways, metal enclosures of busways, cable boxes, electrical equipment housings and all non-current carrying metallic parts. Use metallic conduit system for equipment and enclosure grounding but not as a system ground conductor. Include a code sized copper grounding conductor in nonmetallic conduits.
- E. Feeder runs and branch circuit wiring in non-metallic conduit shall carry a code sized ground conductor per circuit properly connected for electrical ground continuity.

- F. Do not use flexible conduit as a ground path. Include code sized green conductor in all flex conduit.
- G. Provide bonding devices, fittings or jumpers at expansion fitting, isolation sections or wherever continuity of ground is broken.

**END OF SECTION**

## **SECTION 16470 PANELBOARDS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-16 basic Electrical Materials and Methods section, and is part of each Division-16 section making reference to electrical raceways specified herein.

#### **1.2 DESCRIPTION OF WORK**

- A. Extent of panelboard, and enclosure work, including cabinets and cut out boxes is indicated by drawings and schedules.
- B. Types of panelboards and enclosures in this section include Lighting and power panelboards.
- C. Refer to other Division-16 sections for cable/wire, connectors and electrical raceway work required in conjunction with panelboards and enclosures; not work of this section.

#### **1.3 QUALITY ASSURANCE**

- A. **Manufacturers:** Firms regularly engaged in manufacture of water proof free standing panelboards and enclosures, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. **NEC Compliance:** Comply with NEC as applicable to installation of panelboards, cabinets, and cut out boxes. Comply with NEC requirements pertaining to installation of wiring and equipment in wet locations.
- C. **UL-Compliance:** Comply with applicable requirements of Std NO. 67, "Electrical Panelboards", and Stds No.'s 50, 869, 486A, 486B, and 1053 pertaining to panelboards, accessories and enclosures. Provide units which are UL-listed and labeled.
- D. **NEMA Compliance:** Comply with NEMA Stds Pub/No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)", Pub/No. PB1, "Panelboards", and Pub/No. PB 1.1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or less".
- E. **Federal Specification Compliance:** Comply with FS W-P-115, "Power Distribution Panel", pertaining to panelboards and accessories.

## **1.4 SUBMITTALS**

- A. Comply with pertinent provision of Section 01340.
- B. Product Data: Submit manufacturer's data on panelboards.

## **PART 2 -PRODUCTS**

### **2.1 MANUFACTURES**

Subject to compliance with requirements, provide products of one of the following (for each type and rating of panelboard and enclosure):

Meyers  
Unicorn  
S.Q.D.  
General Electric  
Cutner Hammer

### **2.2 PANELBOARDS**

- A. General: Except as otherwise indicated, provide meter facilities, panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials, design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated.
- B. Lighting Panelboards: Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown; with anti-burn solderless pressure type lug connectors approved for copper conductors. Provide suitable lugs on neutral bus for each outgoing feeder required; provide bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate properly with panelboards.
- C. Panelboard Enclosures: Provide zinc coated steel cabinet NEMA 3R type enclosures, in sizes and NEMA types as indicated, code-gauge, minimum 12-gauge thickness. Construct with multiple knockout and wiring gutters. Provide fronts with adjustable trim clamps, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed piano door hinges and door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering.



## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

Installer must examine areas and conditions under which panelboards and enclosures are to be installed, and notify Contractor in writing of condition detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

### **3.2 INSTALLATION OF PANEL**

- A. General: Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC Standards and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Coordinate installation of panelboards and enclosures with cable and raceway installation work.
- C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B.
- D. Anchor enclosures firmly to house keeping pad, ensuring that they are permanently and mechanically secure.
- E. Provide properly wired electrical connection within enclosures.
- F. Fill out panelboard's circuit directory card upon completion of installation work.

### **3.3 GROUNDING**

Provide equipment grounding connections for panelboards as indicated. Tighten connections to comply with tightening torques specified in UL Stds 486A and B to assure permanent and effective grounds.

### **3.4 FIELD QUALITY CONTROL**

- A. Prior to energization of circuitry, check all accessible connections to manufacturer's tightening torque specifications.
- B. Prior to energization of panelboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.
- C. Prior to energization, check panelboards for electrical continuity of circuits, and for short-circuits.

- D. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

**END OF SECTION**

## **SECTION 16530 SITE LIGHTING FIXTURES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-16 basic Electrical Materials and Methods section, and is part of each Division-16 section making reference to electrical raceways specified herein.

#### **1.2 QUALITY ASSURANCE**

- A. Applicable Standards:
  - 1. UL label for ballasts.
  - 2. Ballasts conforming to UL, ANSI and NEMA standards.

#### **1.3 SUBMITTALS**

- A. General:
  - 1. Mark each submittal with fixture type designation; indicated data applicable to designated fixture.
  - 2. Owner will require submittal of complete sample fixture for all fixture types.
  - 3. Owner reserves right to require submittal of original photometric test reports by independent testing laboratory for each fixture type specified.
  - 4. Submit photometric run of entire area with submittal package.
- B. Shop Drawings:
  - 1. Catalog number, fixture designation and other information required for complete identification of components and complete unit.
  - 2. Complete bill of material including quantity, description and rating of every component, including lamps, ballasts, fuses and lampholders.
  - 3. Manufacturer's Standard Specification covering construction details, types and gauges of materials and finish for items specified in this Section.
  - 4. Outline Drawings including sections indicating overall dimensions, arrangement of equipment and net weights.
  - 5. Wiring Diagrams.

### **PART 2 - PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Refer to Lighting Fixture Schedule for basic fixture descriptions. Provide fixtures with features specified in Article 2.2 below.

- B. Approved site lighting fixture manufacturers.
  - 1. Gardco.

## 2.2 MATERIALS

- A. General: Provide fixtures complete with all required self-aligning and adjustable supporting devices, frames and facilities for pole and cable mounting as required.
- B. Fixture housing & finishes as noted in lighting fixture schedule.
- C. Ballasts:
  - 1. Acceptable Manufacturers:
    - Valmont Electric Company
    - Advance Transformer Company
    - Magnetic Lighting Products (Universal)
  - 2. Ballast Case: Heavy gauge steel or aluminum with color-coded neoprene jacketed leads brought out through sealed nipple providing weather-tight unit.
  - 3. Ballast Housing: Integral part of luminaire; cast aluminum, weather-sealed to protect against moisture, corrosion, dust and bug entry.
  - 4. Ballast Characteristics: Newest Technology Pulse Start Metal Halide Ballasts.
  - 5. Noise Control: Designed for quiet operation without amplification of noise due to improper attachment of ballast within compartment.
  - 6. Supply Conductors Minimum Temperature Rating: Marked inside each ballast wiring compartment.
- D. Lampholders:
  - 1. Heavy duty porcelain, rated at 600 volts, base.
  - 2. Integral part of ballast housing or reflector assembly.
  - 3. Designed with protection of socket assemblies against breakage and accidental damage.
- E. Lighting Standards (Poles): As indicated in Lighting Fixture Schedule on Drawings with following features:
  - 1. Pole welded to base.
  - 2. Reinforced handhold and flush, gasketed cap; located near pole base.
  - 3. Four galvanized steel anchor bolts, galvanized hexagonal head nuts (two each bolt), washers and shims.
  - 4. Designed to withstand wind gusts of 100 miles per hour while equipped with luminaries and accessories.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install luminaries and standards using necessary hardware and anchor bolts at locations shown on Drawings.
- B. Coordinate installation of fixtures to avoid interferences.

- C. Aim floodlights and adjust luminaries for desired lighting patterns.
- D. Leave fixtures in satisfactory working order, free of dirt and smudges.
- E. Effectively ground fixtures.

**END OF SECTION**