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**DIVISION 26 - ELECTRICAL**

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## SECTION 260500 - BASIC ELECTRICAL REQUIREMENTS

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions, Special Conditions and Division 1 specification sections, apply to work of this section.
- B. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required for their completion.
- C. The items in this section are supplementary to the requirements set forth in other portions of the specifications as indicated under Item "A" above.

#### 1.02 DRAWINGS

- A. The drawings show the location and general arrangement of equipment, electrical systems and related items. They shall be followed as closely as elements of the construction will permit.
- B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes and accessories as may be required to meet such conditions.
- C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.
- D. The architectural and structural drawings take precedence in all matters pertaining to the building structure, mechanical drawings in all matters pertaining to mechanical trades and electrical drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

#### 1.03 INSPECTION OF SITE

- A. Visit the site, examine and verify the conditions under which the work must be conducted before submitting proposal.
- B. The submitting of a proposal implies that the contractor has visited the site and understands the conditions under which the work must be conducted.

#### 1.04 ALTERNATES

- A. See Alternate Section and other applicable parts of the specifications.

#### 1.05 GUARANTEE

- A. Contractor guarantees that the installation is free from defects and agrees to replace or repair, any part of this installation which becomes defective within a period of one year following final acceptance, unless noted otherwise, provided that such failure is due to defects in the equipment, material or installation or to follow the specifications and drawings. File with the Owner any and all guarantees from the equipment manufacturers.

#### 1.06 CODES, PERMITS AND FEES

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for electrical work shall be secured and paid for by the contractor. All work shall conform to all applicable codes, rules and regulations.
- B. Rules of local utility companies shall be complied with. Check with the utility company supplying service to the installation and determine all devices including, but not limited to, all current and potential transformers, meter boxes, C.T. cabinets and meters which will be required and include the cost of all such items in proposal.
- C. All work shall be executed in accordance with the rules and regulations set forth in local and state

codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.

#### **1.07 STANDARDS OF MATERIAL AND WORKMANSHIP:**

- A. All materials shall be new. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:
  - 1. A.N.S.I. American National Standards Institute
  - 2. A.S.T.M. American Society for Testing Materials
  - 3. I.C.E.A. Insulated Cable Engineers Association
  - 4. I.E.E.E. Institute of Electrical and Electronics Engineers
  - 5. N.E.C. National Electrical Code
  - 6. N.E.M.A. National Electrical Manufacturer's Association
  - 7. U.L. Underwriters Laboratories, Inc.
- B. Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the Trades involved.
- C. All equipment of the same or similar systems shall be by the same manufacturer.

#### **1.08 RECORD DRAWINGS**

- A. Provide complete operating and maintenance instruction manuals covering all electrical equipment herein specified, together with parts lists. All literature shall be furnished in triplicate for Owner and shall be bound in book or ring binder form as directed by Architect/ Engineer.
- B. The operating and maintenance instructions shall include a brief, general description for all electrical systems including, but not limited to:
- C. Routine maintenance procedures.
- D. Trouble-shooting procedures.
- E. Shop Drawings
- F. Any equipment offered as a substitution shall be equal in quality, durability, appearance, ampacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system. All costs to make these items of equipment comply with these requirements including, but not limited to, conduit, wiring, bus work, enclosures and building alterations shall be included in the original bid. Similar equipment shall be by one manufacturer.

#### **1.09 SHOP DRAWINGS/SUBMITTALS**

- A. All shop drawings shall be submitted in groupings of similar and/or related items (lighting fixtures, switchgear, etc.). Incomplete submittal groupings will be returned unchecked.
- B. Submit for approval eight (8) copies of shop drawings for all electrical systems or equipment but not limited to the items listed below. Where items are referred to by symbolic designation on the drawings and specifications, all submittals shall bear the same designation (light fixtures). Refer to other sections of the electrical specifications for additional requirements.
  - 1. Main Switchboard
  - 2. Panelboards
  - 3. Motor Control
  - 4. Disconnect Switches
  - 5. Time Switches
  - 6. Wiring Devices
  - 7. Lighting Fixtures
  - 8. Fire Alarm System
  - 9. Clock and Program System

## **1.10 MANUFACTURERS LISTED**

- A. The listing of specific manufacturers does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed are not relieved from meeting these specifications in their entirety.
- B. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

## **1.11 USE OF EQUIPMENT**

- A. The use of any equipment, or any part thereof for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.
- B. Do not use Owner's lamps for temporary lighting except as allowed and directed by the Owner. Equip lighting fixtures with new lamps when the project is turned over to the Owner.

## **PART 2 EXECUTION**

### **2.01 INSTALLATION OF EQUIPMENT**

- A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the drawings and specifications, report such conflicts to the Architect/Engineer for resolution.

### **2.02 COORDINATION**

- A. Install work to avoid interference with work of other trades including, but not limited to, architectural and mechanical trades. Remove and relocate any work that causes an interference at contractor's expense. Disputes regarding the cause of an interference will be resolved by the Construction Manager or Architect/Engineer.

### **2.03 CHASES AND RECESSES**

- A. Provided by the architectural trades, but the contractor shall be responsible for their accurate location and size.

### **2.04 CUTTING, PATCHING AND DAMAGE TO OTHER WORK**

- A. Refer to General Conditions for requirements.
- B. All cutting, patching and repair work shall be performed by the contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

### **2.05 EXCAVATION AND BACKFILLING**

- A. Provide all excavation, trenching, tunneling, dewatering and backfilling required for the electrical work. Coordinate the work with other excavating and backfilling in the same area.
- B. Where conduit is installed less than 2'-6" below the surface of pavement, provide concrete encasement, 4" minimum coverage, all around or as shown on the electrical drawings.
- C. Backfill all excavations inside building, under drives and parking areas with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.
- D. Backfill outside building with granular material to a height 12 inches over top of pipe compacted to 95 percent compaction as specified above. Backfill remainder of excavation with unfrozen, excavated material in such a way to prevent settling. Tamp, roll as required.

### **2.06 EQUIPMENT FOUNDATION AND SUPPORTS**

- A. Shall be as required or as shown on plans or specified.

- B. Provide concrete bases and supports for floor mounted electrical equipment.
- C. Provide concrete house keeping bases 4" above finished floor, with leveling channels, where noted, for floor-mounted equipment.
- D. For equipment suspended from ceilings or walls, furnish and install all inserts, rods, structural steel frames, brackets and platforms required.

#### **2.07 EQUIPMENT CONNECTIONS**

- A. Make connections to equipment, motors, lighting fixtures, and other items included in the work in accordance with the approved shop drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. All additional connections not shown on the drawings, but called out by the equipment manufacturer's shop drawings shall be provided.

#### **2.08 ACCESS DOORS**

- A. Provide access doors for installation by architectural trades. In the walls, provide Milcor No. "DW" or "M" as required to make all controls, electrical boxes and other equipment installed by the contractor accessible. Minimum size 12 inches x 12 inches. In the ceiling, provide Milcor No. 3210, 3105 or 3206 for accessibility as mentioned above, 24 inches x 24 inches minimum size. The plaster or acoustical tile insert shall be by the architectural trades. Areas with accessible ceilings (ceilings where tiles are not fastened in place and can be individually removed without removal of adjacent tiles) will not require access doors.
- B. When access doors are in fire resistant wall or ceilings, they must bear the Underwriter's Laboratories, Inc., Label, with time design rating equal to or exceeding that of the wall or ceiling unless they were a part of the tested assembly.

#### **2.09 CLEANING**

- A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.
- B. Final cleanup shall include, but not be limited to, washing of fixture lenses or louvers, switchboards, substations, motor control centers, panels, etc. Fixture reflectors and lenses or louvers shall be left with no water marks or cleaning streaks.

#### **2.10 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS**

- A. Equipment and materials shall be protected from theft, injury or damage.
- B. Protect conduit openings with temporary plugs or caps.
- C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Construction Manager or Architect/Engineer. Equipment set in place in unprotected areas must be provided with temporary protection.

#### **2.11 NAMEPLATES AND DIRECTORIES**

- A. Identify switchgear, motor controls, panelboards, safety switches, etc., with manufacturer's nameplate, shop order, where applicable on composite assemblies, and designations used on the Drawings. Nameplates shall be laminated phenolic plastic, beveled edged white with engraved black letters. Except where impractical, letters and numerals shall be a minimum of 1/4 inch high. Nameplates shall be mechanically secured. Pressure sensitive nameplates are not acceptable. Panel directories shall be neatly typed, showing equipment served and location for each breaker or switch with a clear plastic protective cover.
- B. For detailed requirements refer to Section 26 0553 IDENTIFICATION FOR ELECTRICAL SYSTEMS.

#### **2.12 EXTRA WORK**

- A. For any extra electrical work which may be proposed, this Contractor shall furnish to the Construction Manager, an itemized breakdown of the estimated cost of the materials and labor required to complete this work. The Contractor shall proceed only after receiving a written order from the Construction Manager establishing the agreed price and describing the work to be done.

### **2.13 DRAWINGS AND MEASUREMENTS**

- A. These Specifications and accompanying Drawings are intended to describe and provide for finished work. They are intended to be cooperative, and what is called for by either shall be as binding as if call for by both. The Contractor will understand that the work herein described shall be complete in every detail.
- B. The Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement shall be taken by the Contractor. The Contractor shall check latest Architectural drawings and locate light switches from same where door swings are different from Electrical Drawings.

**END OF SECTION**





## **SECTION 260501 - MINOR ELECTRICAL DEMOLITION**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Electrical demolition.

#### **1.02 SUMMARY**

- A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the system of minor electrical demolition as described in this specification.
- B. The demolition documents plans and specification have been prepared from existing non-as built documents and cursory non-invasive field investigation.
- C. It is the contractors obligation to become familiar with the extent of demolition and the existing condition before submitting their bid.
- D. During demolition if the contractor discovers unforeseen significant non code compliance conditions of the existing installation they shall notify the Architect and Engineer immediately in writing.
- E. During demolition the contractor shall record on the as-builts all demolished circuits numbers that can be used for new circuiting.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS AND EQUIPMENT**

- A. Materials and equipment for patching and extending work: As specified in individual sections.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that abandoned wiring and equipment serve only abandoned facilities.
- B. Demolition drawings are based on casual field observation.
- C. Report discrepancies to Redford Union Schools before disturbing existing installation.
- D. Report discrepancies to Strategic Energy Solutions, Inc. before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.

#### **3.02 PREPARATION**

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

#### **3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK**

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- E. Disconnect and remove abandoned panelboards and distribution equipment.

- F. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- G. Repair adjacent construction and finishes damaged during demolition and extension work.
- H. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- I. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.
- J. Provide additional hangers and supports as required for existing equipment during demolition to make the existing installation code compliance.

#### **3.04 CLEANING AND REPAIR**

- A. Clean and repair existing materials and equipment that remain or that are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

**END OF SECTION**

**SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 V AND LESS)**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Single conductor building wire.
- B. Metal-clad cable.
- C. Wire and cable for 600 volts and less.
- D. Wiring connectors.
- E. Sleeves and sleeve seals for cables

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 31 2316 - Excavation.
- C. Section 31 2323 - Fill: Bedding and backfilling.
- D. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

**1.03 REFERENCE STANDARDS**

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2001 (Reapproved 2007).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010.
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2009).
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- F. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); National Electrical Contractors Association; 2006.
- G. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; National Electrical Manufacturers Association; 2009 (ANSI/NEMA WC 70/ICEA S-95-658).
- H. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2009.
- I. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- K. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- L. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- M. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- N. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. Product Data: Provide for each cable assembly type.
- B. Test Reports: Indicate procedures and values obtained.
- C. Project Record Documents: Record actual locations of components and circuits.

#### **1.05 QUALITY ASSURANCE**

- A. Conform to requirements of NFPA 70.

#### **1.06 COORDINATION**

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

### **PART 2 PRODUCTS**

#### **2.01 CONDUCTOR AND CABLE APPLICATIONS**

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Concealed Dry Interior Locations: Use only building wire in raceway.
- D. Exposed Dry Interior Locations: Use only building wire in raceway.
- E. Above Accessible Ceilings: Use only building wire in raceway.
- F. Wet or Damp Interior Locations: Use only building wire with Type XHHW insulation in raceway.
- G. Exterior Locations: Use only building wire with Type XHHW insulation in raceway.
- H. Underground Installations: Use only building wire with Type XHHW insulation in raceway.
- I. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- J. Use solid conductors for control circuits.
- K. Use stranded conductors for control circuits.
- L. Use conductor not smaller than 12 AWG for power and lighting circuits.
- M. Use conductor not smaller than 14 AWG for control circuits.
- N. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.
- O. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.
- P. Conductor sizes are based on copper unless indicated as aluminum or "AL".
- Q. If aluminum conductor is substituted for copper conductor, size to match circuit requirements for conductor ampacity and voltage drop.

#### **2.02 CONDUCTOR AND CABLE MANUFACTURERS**

- A. Southwire Company: [www.southwire.com](http://www.southwire.com).
- B. Triangle Wire Company
- C. American Insulated Wire Corp.
- D. Rome.

#### **2.03 ALL CONDUCTORS AND CABLES**

- A. Provide products that comply with requirements of NFPA 70.

- B. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductor Material:
  - 1. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
  - 2. Tinned Copper Conductors: Comply with ASTM B33.
- H. Conductor Color Coding:
  - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
  - 2. Color Coding Method: Integrally colored insulation.
  - 3. Color Code:
    - a. 240/120 V High-Leg Delta, 3 Phase, 4 Wire System:
      - 1) Phase A: Black.
      - 2) Phase B (High-Leg): Orange.
      - 3) Phase C: Blue.
      - 4) Neutral/Grounded: White.
    - b. 240/120 V, 1 Phase, 3 Wire System:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Neutral/Grounded: White.
    - c. Equipment Ground, All Systems: Green.

#### **2.04 SINGLE CONDUCTOR BUILDING WIRE**

- A. Description: Single conductor insulated wire.
- B. Conductor Stranding:
  - 1. Feeders and Branch Circuits:
    - a. Size 10 AWG and Smaller: Solid.
    - b. Size 8 AWG and Larger: Stranded.
- C. Insulation Voltage Rating: 600 V.
- D. Insulation:
  - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
- E. Conductor: Copper.
- F. Insulation Voltage Rating: 600 volts.
- G. Insulation: NFPA 70, Type THHN/THWN/XHHW.

#### **2.05 METAL-CLAD CABLE**

- A. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.
- B. Conductor Stranding:
  - 1. Size 10 AWG and Smaller: Solid.
  - 2. Size 8 AWG and Larger: Stranded.
- C. Insulation Voltage Rating: 600 V.
- D. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

- E. Grounding: Full-size integral equipment grounding conductor.
- F. Armor: Steel, interlocked tape.
- G. Description: NFPA 70, Type MC.
- H. Conductor: Copper.
- I. Insulation Voltage Rating: 600 volts.
- J. Insulation Temperature Rating: 90 degrees C.
- K. Insulation Material: Thermoplastic.
- L. Armor Material: Aluminum or Steel.
- M. Armor Design: Interlocked metal tape.

## **2.06 WIRING CONNECTORS**

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

## **2.07 CONDUCTOR IDENTIFICATION**

- A. Provide color coding of conductors as follows:
- B. 208 Volt System: 240/120V, 3PH, 4W + GRD.
  - 1. Phase A: Black
  - 2. Phase B: Red
  - 3. Phase C: Blue
  - 4. Neutral: White
  - 5. Ground: Green
  - 6. Isolated Ground: Green with orange tape

## **2.08 SLEEVES FOR CABLES**

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated " wall pipe", equivalent to ductile-iron pressure pipe, with plain end and integral waterstop, unless noted otherwise.
- C. Sleeves for rectangular openings: Galvanized sheet steel with minimum 0.052 or 0.138 inch thickness and length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping.

## **2.09 SLEEVE SEALS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. Calpico, Inc.
  - 3. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
  - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 2. Pressure Plates: Carbon steel, include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that interior of building has been protected from weather.

- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that raceway installation is complete and supported.
- E. Verify that field measurements are as shown on the drawings.
- F. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

### 3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.
- C. Install metal-clad cable (Type MC) in accordance with NECA 120.
- D. Installation in Raceway:
  - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
  - 2. Pull all conductors and cables together into raceway at same time.
  - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
  - 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
- G. Terminate cables using suitable fittings.
  - 1. Metal-Clad Cable (Type MC):
    - a. Use listed fittings.
    - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
- H. Install conductors with a minimum of 12 inches of slack at each outlet.
- I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- J. Make wiring connections using specified wiring connectors.
  - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
  - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
  - 3. Do not remove conductor strands to facilitate insertion into connector.
  - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminants. Do not use wire brush on plated connector surfaces.
- K. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
- L. Insulate ends of spare conductors using vinyl insulating electrical tape.
- M. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- N. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

- O. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.
- P. Route wire and cable as required to meet project conditions.
  - 1. Wire and cable routing indicated is approximate unless dimensioned.
  - 2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
  - 3. Include wire and cable of lengths required to install connected devices within 10 ft of location shown.
- Q. Use wiring methods indicated.
- R. Pull all conductors into raceway at same time.
- S. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- T. Protect exposed cable from damage.
- U. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.
- V. Use suitable cable fittings and connectors.
- W. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- X. Clean conductor surfaces before installing lugs and connectors.
- Y. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- Z. 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.
- AA. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- AB. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 14, 12 and 10 AWG.
- AC. All cables larger than 10 AWG shall run continuous from point to point. Cable splices are NOT ACCEPTABLE.
- AD. All cables 6 AWG and larger shall be terminated at switches, panels, starters, etc., with double indent type compression lugs.
- AE. Trench and backfill for buried cable installation as specified. Install warning tape along entire length of direct burial cable, within 3 inches of grade, as specified in Section 26 0553.
- AF. Identify and color code wire and cable under provisions of Section 26 0553. Identify each conductor with its circuit number or other designation indicated.

### **3.04 CONNECTIONS**

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at outlets: Install conductor at each outlet, with at least 12 inches of slack.

### **3.05 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Coordinate sleeve selection and application with selection and application of firestopping.
- B. Concrete slabs and walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slab and walls.



- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeve opening.
- D. Fire-rated assemblies: Install sleeves for penetrations of fire-rated assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both wall surfaces.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and cable unless sleeve seal is to be installed.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- I. Interior penetrations of non-fire-rated walls and floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 section "Joint Sealants."
- J. Fire Rated Assembly Penetration: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground Exterior-Wall penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

### **3.06 SLEEVE SEAL INSTALLATION**

- A. Install to seal underground exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### **3.07 FIRESTOPPING**

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

### **3.08 FIELD QUALITY CONTROL**

- A. Perform inspection, testing, and adjusting in accordance with Section 01 4000.
- B. Inspect and test in accordance with NETA STD ATS, except Section 4.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
- D. Correct deficiencies and replace damaged or defective conductors and cables.
- E. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2.

**END OF SECTION**



## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Grounding and bonding components.
- E. Provide all components necessary to complete the grounding system(s) consisting of:
  - 1. Existing metal underground water pipe.
  - 2. Metal frame of the building.
  - 3. Existing metal underground gas piping system.
  - 4. Rod electrodes.
  - 5. Ground bars
  - 6. Connectors and accessories
  - 7. Fence post and gate grounding

#### 1.02 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- B. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2009.
- C. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2007.
- D. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

#### 1.03 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms maximum.

#### 1.04 SUBMITTALS

- A. Product Data: Provide for grounding electrodes and connections.
- B. Test Reports: Indicate overall resistance to ground.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Project Record Documents: Record actual locations of components and grounding electrodes.
- E. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

#### 1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

#### 1.06 SITE RESISTIVITY TESTING:

- A. The contractor shall ascertain the ground resistivity before installation of any ground system.
- B. It is the contractor's responsibility to advise the engineer of the resistivity of the site by submitting a test report before starting construction of the external ground ring.

## **PART 2 PRODUCTS**

### **2.01 GROUNDING AND BONDING REQUIREMENTS**

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

### **2.02 GROUNDING AND BONDING COMPONENTS**

- A. General Requirements:
  - 1. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
  - 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in addition to requirements of Section 26 0519:
  - 1. Use insulated copper conductors unless otherwise indicated.
    - a. Exceptions:
      - 1) Use bare copper conductors where installed underground in direct contact with earth.
      - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
- C. Connectors for Grounding and Bonding:
  - 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
  - 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
  - 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

### **2.03 MANUFACTURERS**

- A. Cooper Power Systems: [www.cooperpower.com](http://www.cooperpower.com).
- B. Framatome Connectors International: [www.fciconnect.com](http://www.fciconnect.com).
- C. Thompson Lighting Protection Company, Inc..

### **2.04 ELECTRODES**

- A. Manufacturers:
  - 1. Cooper Power Systems: [www.cooperpower.com](http://www.cooperpower.com).
  - 2. Framatome Connectors International: [www.fciconnect.com](http://www.fciconnect.com).
  - 3. Lightning Master Corporation: [www.lightningmaster.com](http://www.lightningmaster.com).
- B. Rod Electrodes: Copper-clad steel.
  - 1. Diameter: 3/4 inch.
  - 2. Length: 10 feet.
  - 3. Product: Lyncole Model XIT, cover shall be Lyncole Model XB-11 for non-traffic and concrete, Lyncole Model XB-12, for traffic or paved areas.
  - 4. The copper pipe shall be filled with non-hazardous Calsolyte.
  - 5. The backfill material shall be natural clay Lynconite.
- C. Foundation Electrodes: 3/0 AWG.

### **2.05 GROUND BARS**

- A. Provide 18" ground copper bar in rooms A121, B110, C110, C134, E121, E124 and F121. Provide new 24" main ground bar (M.G.B.) in room B11. Refer to drawings for locations.
- B. Provide #3/0 copper ground wire between each ground bar and to main building ground bar.

- C. Provide #3/0 connection from new main ground bar to existing ground mat.
- D. Remove and reconnect existing transformer grounds in rooms A121, B110, B111, C110, C134, E121, E124 and F121 to ground bars. Verify size in the field and provide copper grounding as required per NEC 250.66.
- E. Ground bars shall be manufactured exactly as specified. No deviations are allowed.
- F. Dimensions shall be accurate within 1/32 inch. Hole diameters shall be accurate within 1/64 inch.
- G. Bars shall be 1/4 inch thick solid pure copper and shall be electroplated with time 0.0003 inches thick typical, 0.0002 inches thick minimum.
- H. Product: Ground bar with stainless steel wall mounting brackets, standoff insulators, and lettered plexiglass covers.

## 2.06 CONNECTORS AND ACCESSORIES

- A. Mechanical Connectors: Bronze.
- B. Compression Connection: Double indent, tinned copper, two hole, long barrel, bolted connection type, with inspection window.
  - 1. Product: Thomas and Betts series 548##BE or equivalent.
- C. C crimp type lugs:
  - 1. Product: Thomas and Betts series 547## or equivalent.
- D. Water Pipe Clamps:
  - 1. Provide new #3/0 copper ground wire to existing water pipe.
  - 2. Standard UL accepted ground clamp.
  - 3. Water pipe clamps shall be custom made of brass. The clamp shall come into contact with minimum of 4 linear inches of pipe for the entire circumference of the pipe. Drill clamp to accept a 2-hole 1/2 inch hardware 4/0 lug, see detail on drawings.
  - 4. Product: Exothermic weld
- E. Wire:
  - 1. #6 THWN shall be stranded #6 copper with green THWN insulation suitable for wet installations.
  - 2. #2 THWN shall be stranded #2 copper with green THWN insulation suitable for wet installations.
  - 3. #4/0 THWN shall be stranded #4/0 copper with THWN insulation suitable for wet installations.
- F. Grounding Electrode Conductor:
  - 1. Existing to remain to building electrical service.
- G. Wire, Underground: bare solid, tinned plated copper.
- H. Anti-Oxidation Compound:
  - 1. Thomas and Betts KOPR-SHIELD (TM of Jet Lube Inc.)
  - 2. This product is available in small containers with a brush attached to the lid for easy application.
  - 3. There is no equivalent for this specification; no other compound will be accepted.
- I. Hardware:
  - 1. All hardware, bolts, nuts, washers and belleville washers shall be 18-8 stainless steel, see lug detail on drawings.

## 2.07 Fence Gate Jumper:

- A. Products: Erico Model FJ2Q24.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as shown on the drawings.

- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Verify existing conditions prior to beginning work.
- E. 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 grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.
- C. Make grounding and bonding connections using specified connectors.
  1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
  2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
  3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
  4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- D. Identify grounding and bonding system components in accordance with Section 26 0553.
- E. Compression Connectors:
  1. All compression connectors (for cable sizes no. 1/0 AWG and larger) shall employ hex or circumferential type crimps. The crimps shall emboss an indicator of the die used to make the crimp.
  2. Use two hole crimped connectors for bonding and grounding connections on conductors larger than no. 8 AWG.
  3. All compression connectors (for cable no. 1/0 AWG and larger) will have an inspection hole between the tang and the barrel of the connector.
  4. The cable end will be completely inserted into the connector before the crimps are made.
  5. Space between wire insulation and body of compression connectors shall be kept to a maximum of 1/16 inch. If space is greater than 1/16 inch, install clear heat shrink tubing (Burdny type HSC-FR-VISI-SHRINK) to cover bare wire.
- F. Install ground electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
- G. Plastic or metal straps shall be used to secure ground conductors every 12 inches horizontally and 18 inches vertically to the building columns or walls. If metallic straps are used they must be of the type which do not completely encircle the conductor.
- H. Do not use existing conduit, cable tray or any other existing mechanical duct to secure ground conductors.
- I. All grounding conductors within the building shall have green tape wrapped around the conduit or wire every 10'-0" unless otherwise noted.
- J. All mechanical connections shall be coated with corrosion preventative compound.
- K. All grounding conductors and grounding conduits shall be run exposed within the building whenever practical. Conductors should not be run concealed in slabs, columns, or walls.
- L. Water Pipe Ground:
  1. Water pipe ground conductor shall be connected ahead of the water meter on the incoming main city water pipe, where applicable.
  2. Tag ground conductor at main water pipe termination point, "DO NOT DISCONNECT" with brass tag.

- M. Bend Radius: The minimum bend radius throughout shall be 8 inches for #6 wire and smaller, 12 inches for wire larger than #6.
- N. All grounding conductors shall be continuous and unbroken. Grounding conductors shall have not be daisy-chained.
- O. Install 4 AWG bare copper wire in foundation footing where indicated.
- P. Provide grounding electrode, grounding electrode conductor and connect to building steel at foundation footing for each steel column at new Performing Art Addition and connect to main building ground bar in E111 with #3/0.
- Q. Provide bonding to meet requirements described in Quality Assurance.
- R. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing. Raceways shall not be used as grounding conductors.
- S. Grounding connections shall be at permanently accessible locations.
- T. Ground all metal fence lines, posts, and corner posts.
- U. Cable tray splices shall be connected with ground bonding jump strap.
- V. Apply Anti-Oxidation Compound to all connections, interior and exterior. Coat all wires before lugging. Coat all surfaces before connection.
- W. Ground Bars:
  1. All ground bar conductors shall run on a separate section of the cable tray superstructure or be run in PVC conduit. The PVC conduit may be run under the slab or may be run along the wall in PVC using PVC straps. DO NOT USE METAL STRAPS ON PVC GROUND CONDUCTOR CONDUITS.
  2. If any ground conductor MUST be run in EMT or rigid metallic conduit, bonding bushings must be used at each end.
  3. Do not run the conductor against an "I" beam or similar steel member as this will increase inductance.
- X. Fence Gate Jumper:
  1. The gate jumper shall be an 4/0 welding cable with sleeves on each end designed for exothermic welding.
  2. Remove the insulation at the bottom of the jumper down to the bare wire for water drainage.
- Y. Building Steel:
  1. If the building is a metal structure or has a metal frame or bar joists, bond these metal components to the main building ground bar with 4/0 tinned bare cable.
  2. All connections shall be steel to steel Cadweld bond. Bolted connections are not acceptable.
  3. Connect both ends of the 4/0 riser by Cadweld.

### 3.03 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA STD ATS except Section 4.
- B. Measure and record the earth resistivity at new Main Ground Bar (M.G.B.). If the resistivity is more than 25.0 ohms contact engineer immediately.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.13.
- D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

**END OF SECTION**





## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

#### 1.02 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

#### 1.03 SUMMARY

- A. ASTM A682 Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled, Spring Quality.
- B. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the system of conduit hangers and supports as described in this specification.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this project, with a minimum structural safety factor of five times the applied force.

#### 1.04 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. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

#### 1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

#### 1.06 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Power-Strut, Division of Allied Support Systems
- B. Thomas & Betts Corporation: [www.tnb.com](http://www.tnb.com).
- C. Hilti Corporation
- D. B-Line Systems Inc..
- E. ERICO, International Corporation.

#### 2.02 MATERIALS

- A. Hangers, Supports, Anchors, and Fasteners - General: Protective zinc coating either Electro-Plated (ASTM B633 SCI or SC3), Pre-Galvanized (ASTM A525 coating designation G90) or Hot-Dip Galvanized after fabrication (ASTM A123). The minimum thickness of zinc coating shall be 0.2 mill (5 micrometers).
- B. Provide materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.

- C. Supports: All structural steel or formed steel members shall be manufactured from galvanized ASTM A570 grade 33 steel, #16 gauge minimum.
- D. Supports and channels which sag, twist or show signs of inadequate or improper structural support for its' intended purpose, as determined by the Engineer shall be replaced by the contractor. All costs associated with the replacement of supports and channels shall be incurred by the contractor
- E. Anchors and Fasteners:
  - 1. Concrete Structural Elements: Use expansion anchors.
  - 2. Steel Structural Elements: Use beam clamps.
  - 3. Concrete Surfaces: Use expansion anchors.
  - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
  - 5. Solid Masonry Walls: Use expansion anchors or preset inserts.
  - 6. Sheet Metal: Use sheet metal screws.
  - 7. Wood Elements: Use wood screws.
- F. Formed Steel Channel:
  - 1. Product: Pre-galvanized strut
- G. Powder-Actuated Anchors:
  - 1. Product: Hilti DX series
- H. Conduit Hangers:
  - 1. Shall have a vertical load limit of 100 lbs, and a horizontal load limit of 25 lbs..
  - 2. Shall be available with either a plain hole for 1/4" bolt or a 1/4-20 thread impression.
  - 3. Shall be available for 3/8" through 2" EMT, rigid, and aluminum conduit.
  - 4. Shall be available pre-assembled with manufacturer's specialty fasteners for connection to building structures like beam, flange, drop wire/rod, wood structure, concrete and acoustical tee grid.
- I. Wire Rope Hangers:
  - 1. Wire rope hanger assemblies shall be made of galvanized steel.
  - 2. Hanger shall meet the fire rating requirements for DIN 4102-2 for 30 minutes at 30 percent of rated load.
  - 3. Rope hangers shall have a minimum safety factor of 5:1.
  - 4. Rope hangers are not permitted to support conduits.
  - 5. Rope hangers are permitted to hang light fixtures, were applicable.
  - 6. Hangers shall be fully adjustable.
  - 7. Manufacturer of wire rope hangers shall be:
    - a. ERICO, INC., Speed Link series.

### **2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES**

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

#### **3.02 INSTALLATION OF FABRICATED METAL SUPPORTS**

- A. Comply with installation requirements in Division 05 Section " Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with A WS D1.1/D1.1M.

### **3.03 CONCRETE BASES**

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28 day compressive strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section " Cast-in-place concrete."
- C. Anchor equipment to concrete bases.
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

#### **3.04 PAINTING**

- A. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780

**END OF SECTION**



## SECTION 260534 - CONDUIT

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Electrical metallic tubing (EMT).
- B. Rigid polyvinyl chloride (PVC) conduit.
- C. Conduit fittings.
- D. Conduit, fittings and conduit bodies.

#### 1.02 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems.
- E. Section 26 0537 - Boxes.

#### 1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
- B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- D. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); National Electrical Contractors Association; 2003.
- E. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2007.
- F. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; National Electrical Manufacturers Association; 2003.
- G. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; National Electrical Manufacturers Association; 2004.
- H. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- J. UL 651 - Schedule 40 and 80 Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- K. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

#### 1.04 SUBMITTALS

- A. Project Record Documents: Accurately record actual routing of conduits larger than 2 inches.

#### 1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

- 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.

## **PART 2 PRODUCTS**

### **2.01 CONDUIT REQUIREMENTS**

- A. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
- C. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

### **2.02 METAL CONDUIT**

- A. Manufacturers:
  - 1. Allied Tube & Conduit: [www.alliedtube.com](http://www.alliedtube.com).
  - 2. Beck Manufacturing, Inc: [www.beckmfg.com](http://www.beckmfg.com).
  - 3. Wheatland Tube Company: [www.wheatland.com](http://www.wheatland.com).
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

### **2.03 ELECTRICAL METALLIC TUBING (EMT)**

- A. Manufacturers:
  - 1. Allied Tube & Conduit: [www.alliedeg.com](http://www.alliedeg.com).
  - 2. Beck Manufacturing, Inc: [www.beckmfg.com](http://www.beckmfg.com).
  - 3. Wheatland Tube Company: [www.wheatland.com](http://www.wheatland.com).
- B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
  - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 2. Material: Use steel or malleable iron.
  - 3. Connectors and Couplings: Use compression (gland) or set-screw type.
    - a. Do not use indenter type connectors and couplings.
- D. Description: ANSI C80.3; galvanized tubing.
- E. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron compression type.
- F. Factory painted conduit: Allied Tube & Conduit "True Color EMT"

### **2.04 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT**

- A. Manufacturers:
  - 1. AFC Cable Systems, Inc: [www.afcweb.com](http://www.afcweb.com).
  - 2. Electri-Flex Company: [www.electriflex.com](http://www.electriflex.com).
  - 3. International Metal Hose: [www.metalhose.com](http://www.metalhose.com).
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
  - 1. Manufacturer: Same as manufacturer of conduit to be connected.

2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.
- D. Description: NEMA TC 2; Schedule 40 PVC.
- E. Fittings and Conduit Bodies: NEMA TC 3.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Verify routing and termination locations of conduit prior to rough-in.
- E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.
- C. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- D. Conduit Support:
  1. Secure and support conduits in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
  2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E. Connections and Terminations:
  1. Use suitable adapters where required to transition from one type of conduit to another.
  2. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
  3. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
- F. Penetrations:
  1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
  2. Make penetrations perpendicular to surfaces unless otherwise indicated.
  3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
  4. Conceal bends for conduit risers emerging above ground.
  5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
  6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
  7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
  8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- G. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
  1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
  2. Where conduits are subject to earth movement by settlement or frost.

- H. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
  - 1. Where conduits pass from outdoors into conditioned interior spaces.
  - 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- I. Provide grounding and bonding in accordance with Section 26 0526.

### **3.03 INTERFACE WITH OTHER PRODUCTS**

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified required.

**END OF SECTION**



## SECTION 260535 - SURFACE RACEWAYS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Surface metal raceways.
- B. Wireways.

#### 1.02 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 2726 - Wiring Devices: Receptacles.

#### 1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings; Current Edition, Including All Revisions.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including dimensions, knockout sizes and locations, materials, fabrication details, finishes, service condition requirements, and accessories.

#### 1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

### PART 2 PRODUCTS

#### 2.01 RACEWAY REQUIREMENTS

- A. Provide all components, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
- C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

#### 2.02 WIREWAYS

- A. Description: Lay-in wireways and wiring troughs with removable covers; listed and labeled as complying with UL 870.
- B. Wireway Type, Unless Otherwise Indicated:
- C. Where wireway size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

#### 2.03 MANUFACTURERS

- A. Wiremold Company; Model V4000: [www.wiremold.com](http://www.wiremold.com).
- B. Hubbell Wiring Systems; 4000 Series: [www.hubbell-wiring.com](http://www.hubbell-wiring.com)

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install raceways in a neat and workmanlike manner in accordance with NECA 1.
- C. Install raceways plumb and level.
- D. Arrange wireways and associated raceway connections to comply with NFPA 70, including but not limited to requirements for deflected conductors and wireways used as pullboxes. Increase size of wireway where necessary.
- E. Secure and support raceways in accordance with Section 26 0529 at intervals complying with NFPA 70 and manufacturer's requirements.
- F. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- G. Wireway Supports: Provide steel channel as specified in Section 26 0529.
- H. Close unused raceway openings.
- I. Provide grounding and bonding in accordance with Section 26 0526.

**END OF SECTION**

## SECTION 260537 - BOXES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

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

#### 1.02 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 26 2726 - Wiring Devices: Wall plates in finished areas.

#### 1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- B. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2007.
- C. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association; 2008.
- D. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; National Electrical Manufacturers Association; 2008.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

#### 1.04 SUBMITTALS

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

#### 1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Appleton Electric: [www.appletonelec.com](http://www.appletonelec.com).
- B. The Wiremold Company: [www.wiremold.com](http://www.wiremold.com).
- C. Thomas & Betts Corporation.
- D. Raco. A Hubbell Company.

#### 2.02 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. Minimum size for communications, fire alarm, sound system and security system rough-ins shall be 4" square, 3-1/2" deep unless otherwise noted.

- B. Cast Boxes: NEMA FB 1, Type FD, cast ferrous alloy. Provide gasketed cover by box manufacturer. Provide threaded hubs.
- C. Wall Plates for Finished Areas: As specified in Section 26 2726.

### **2.03 FLOOR BOXES**

- A. Floor Boxes: NEMA OS 1, fully adjustable, 1-1/2 inches deep.
- B. Material: Cast metal.
- C. Shape: Rectangular.
- D. Refer to plans for device series and model number.

### **2.04 ENCLOSURES AND CABINETS**

- A. Hinged cover enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
  - 1. Metal enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- B. Cabinets:
  - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.

### **2.05 PULL AND JUNCTION BOXES**

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Hinged Enclosures: As specified in Section 26 2716.
- C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
  - 1. Material: Galvanized cast iron.
  - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

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

### **3.02 INSTALLATION**

- A. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.
- B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.
- C. Coordinate installation of outlet boxes for equipment connected under Section 26 2717.
- D. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- E. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
  - 1. Adjust box locations up to 10 feet if required to accommodate intended purpose.
- F. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726.
- G. Maintain headroom and present neat mechanical appearance.
- H. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- I. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

- J. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified.
- K. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- L. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- M. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- N. Use flush mounting outlet box in finished areas.
- O. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- P. Provide separate boxes for emergency power and normal power systems.
- Q. Locate outlet boxes so that wall plates do not span different building finishes.
- R. Locate outlet boxes so that wall plates do not cross masonry joints.
- S. 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.
- T. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- U. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- V. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- W. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.
- X. Use gang box where more than one device is mounted together. Do not use sectional box.
- Y. Use gang box with plaster ring for single device outlets.
- Z. Set floor boxes level.

### **3.03 ADJUSTING**

- A. Adjust floor boxes 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.

### **3.04 CLEANING**

- A. Clean interior of boxes to remove dust, debris, and other material.

**END OF SECTION**



## **SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Electrical identification requirements.
- B. Identification for raceway and metal-clad cable.
- C. Identification for conductors and communication and control cable.
- D. Underground-line warning tape.
- E. Underground warning tape.
- F. Warning signs and labels.
- G. Warning labels and signs.
- H. Equipment identification labels

#### **1.02 REFERENCE STANDARDS**

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2007.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2007.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

#### **1.03 QUALITY ASSURANCE**

- A. Conform to requirements of NFPA 70.

#### **1.04 COORDINATION**

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagram, and the Operation and Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.

### **PART 2 PRODUCTS**

#### **2.01 IDENTIFICATION REQUIREMENTS**

- A. Identification for Equipment:
  - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
- B. Identification for Conductors and Cables:
  - 1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
  - 2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
- C. Buried Electrical Lines: Underground warning tapes.
- D. Conduit: Conduit markers.

- E. Electrical Distribution and Control Equipment Enclosures: Nameplates.
- F. Junction Box Load Connections: Wire markers.
- G. Outlet Box Load Connections: Wire markers.
- H. Panel Gutter Load Connections: Wire markers.

## **2.02 MANUFACTURERS**

- A. Brady Corp B-500 Series.
- B. Panduit
- C. Thomas & Betts.
- D. Substitutions: See Section 01 6000 - Product Requirements.

## **2.03 RACEWAY IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for printed Legend:
  - 1. Power Circuits: Black letters on an orange field.
  - 2. Legend: Indicate system or service and voltage, if applicable
- C. Snap -Around labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suite diameter of raceway or cable it identifies and to stay in place by gripping action.

## **2.04 UNDERGROUND-LINE WARNING TAPE**

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
  - 1. Not less than 6 inches (150 mm) wide by 4 mils (0.102 mm) thick
  - 2. Compounded for permanent direct-burial service.
  - 3. Embedded continuous metallic strip or core.
  - 4. Printed legend shall indicate type of underground line.

## **2.05 EQUIPMENT IDENTIFICATION LABELS**

- A. Engraved, Laminated Acrylic or Melamine Labels: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).
- B. Nameplates: Engraved three-layer laminated plastic, white letters on black background. Mechanically secured nameplates
- C. Letter Size:
  - 1. Use 1/8 inch letters for identifying individual equipment and loads.
  - 2. Use 1/4 inch letters for identifying grouped equipment and loads.
- D. Information: List the name of the equipment or electrical board, voltage, phase, number of wires. For branch overcurrent devices list the breaker or switch number, what it feeds, size of breaker or fuse, type of fuse.
- E. Labels: Embossed adhesive tape, with 3/16 inch black letters on white background. Use only for identification of individual wall switches, receptacles and control device stations.
- F. WIRE AND CABLE MARKERS
  - 1. Manufacturers:
  - 2. Brady Corporation: [www.bradyid.com](http://www.bradyid.com).
  - 3. Seton Identification Products: [www.seton.com](http://www.seton.com).
  - 4. HellermannTyton: [www.hellermanntyton.com](http://www.hellermanntyton.com).
- G. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.



- H. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- I. Legend: Power source and circuit number or other designation indicated.
- J. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- K. Minimum Text Height: 1/8 inch.
- L. Color: Black text on white background unless otherwise indicated.
- M. UNDERGROUND WARNING TAPE
  - 1. Manufacturers:
    - a. Brady Corporation: [www.bradyid.com](http://www.bradyid.com).
- N. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- O. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
- P. Legend: Type of service, continuously repeated over full length of tape.
- Q. Color:

## **2.06 WARNING SIGNS AND LABELS**

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
  - 1. Materials:
  - 2. Minimum Size: 7 by 10 inches unless otherwise indicated.
- C. Warning Labels:
  - 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester, or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
  - 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
  - 3. Minimum Size: 2 by 4 inches unless otherwise indicated.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.
- B. Degrease and clean surfaces to receive nameplates and labels.

### **3.02 APPLICATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
  - 1. Surface-Mounted Equipment: Enclosure front.
  - 2. Flush-Mounted Equipment: Inside of equipment door.
  - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
  - 4. Elevated Equipment: Legible from the floor or working platform.
  - 5. Interior Components: Legible from the point of access.
  - 6. Conductors and Cables: Legible from the point of access.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- E. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished

grade.

### 3.03 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Attach non adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- E. Color-Coding for phase and voltage level identification. 600V and less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors
  - 1. Color shall be factory applied.
  - 2. Colors for 208/120V circuits:
    - a. Phase A: Black
    - b. Phase B: Red
    - c. Phase C: Blue
  - 3. Colors for 480/277 circuits:
    - a. Phase A: Brown
    - b. Phase B: Orange
    - c. Phase C: Yellow
- F. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility
- G. Underground-Line Warning Tape: During backfilling of trenches install continuous Underground-Line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.
- H. Painted Identification: Prepare surface and apply paint according to Division 09 painting sections.

**END OF SECTION**

## SECTION 265100 - INTERIOR LIGHTING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts.
- E. Lamps.
- F. Luminaire accessories.

#### 1.02 RELATED REQUIREMENTS

- A. Section 26 0537 - Boxes.
- B. Section 26 0919 - Enclosed Contactors: Lighting contactors.
- C. Section 26 0923 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
- D. Section 26 2726 - Wiring Devices: Manual wall switches and wall dimmers.
- E. Section 26 5600 - Exterior Lighting.

#### 1.03 REFERENCE STANDARDS

- A. ANSI C78.379 - American National Standard for Electric Lamps -- Reflector Lamps -- Classification of Beam Patterns; 2006.
- B. ANSI C82.1 - American National Standard for Lamp Ballast - Line Frequency Fluorescent Lamp Ballast; 2004.
- C. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- E. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; National Electrical Contractors Association; 2006.
- F. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; National Electrical Contractors Association; 2006.
- G. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; National Electrical Manufacturers Association; 2006.
- H. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association.
- I. NFPA 70 - National Electrical Code; National Fire Protection Association 2008.
- J. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association; 2009.
- K. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- L. UL 935 - Fluorescent-Lamp Ballasts; Current Edition, Including All Revisions.
- M. UL 1598 - Luminaires; Current Edition, Including All Revisions.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
  - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
  - 3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
  - 4. Notify Strategic Energy Solutions, Inc. of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
  - 2. Provide photometric calculations where luminaires are proposed for substitution.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
  - 1. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IESNA LM-63 standard format upon request.
  - 2. Ballasts: Include wiring diagrams and list of compatible lamp configurations.
  - 3. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.
  - 4. Fluorescent Emergency Power Supply Unit: Include list of compatible lamp configurations and associated lumen output.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- F. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.
- G. Ballast product specification sheet from manufacturer.

#### **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of NFPA 70.
- B. Conform to requirements of NFPA 70 and NFPA 101.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

#### **1.07 DELIVERY, STORAGE, AND PROTECTION**

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

#### **1.08 FIELD CONDITIONS**

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

#### **1.09 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide two year manufacturer warranty for all linear fluorescent ballasts.
- C. Provide three year full warranty for fluorescent emergency power supply units.
- D. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

#### **1.10 COORDINATION**

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

#### **1.11 WARRANTY**

- A. Special warranty for emergency lighting batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
  - 1. Warranty period for Emergency Fluorescent ballast and self powered Exit sign batteries: Seven years from date of substantial completion. Full warranty shall apply for the first year, and prorated warranty for the remaining six years.
- B. Special warranty for ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
  - 1. Warranty period for electronic ballasts: Five years from date of substantial completion.
- C. Special warranty for T5, T5HO, and T8 fluorescent lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials and workmanship, f.o.b. the nearest shipping point to project site, within specified warranty period specified below.
  - 1. Warranty period: Two years from date of substantial completion

#### **1.12 EXTRA MATERIALS**

- A. Furnish two of each plastic lens type.
- B. Furnish ten replacement lamps for each lamp type.
- C. Furnish two of each ballast type.
- D. Furnish two of each emergency battery type.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Refer to fixture schedule on drawings.

#### **2.02 LUMINAIRES**

- A. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- B. Provide products that comply with requirements of NFPA 70 and NFPA 101.
- C. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
  - 1. Ceiling Compatibility: Comply with NEMA LE 4.
  - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.

### 2.03 LUMINAIRES

- A. Furnish products as indicated in Schedule included on the Drawings.

### 3.01 BALLASTS AND CONTROL UNITS

- A. Fluorescent Ballasts General: high power factor, electronic, suitable for lamps specified
  - 1. Voltage: Match luminaire voltage. (refer to fixture schedule)
  - 2. Certify fluorescent ballast design and construction by Certified Ballast Manufacturers, Inc.
    - a.
- B. Manufacturers for Linear fluorescent ballasts:
  - 1. Philips Advance.
  - 2. Osram Sylvania
  - 3. General Electric
- C. Fluorescent Program Rapid-Start Ballasts
  - 1. Physical Characteristics
    - a. the ballast shall be physically interchangeable with a standard electromagnetic and standard electronic ballast.
    - b. The electronic ballast shall be provided with integral leads, color-coded to ANSI standard C82.11 (latest version).
  - 2. Performance Requirements
    - a. Ballast shall operate from a nominal line voltage of 120, 277 volts (verify with schedule) +/-10%, 60Hz.
    - b. The electronic ballast's input current shall have a Total Harmonic Distortion (THD) of less than 10% when used with primary lamp.
    - c. The electronic ballast shall have a Power Factor greater than 98% when used with primary lamp.
    - d. The electronic ballast shall support a sustained short to ground or open circuit of any output leads.
    - e. The electronic ballast shall be sound rated A.
    - f. Ballast output frequency to the lamps shall be above 80kHz to minimize interference with infrared control systems, and eliminate visible flicker.
    - g. Ballast shall be rated to start lamps at 32 degree F (0 degree C).
    - h. Ballast shall be wire for parallel operation of lamps.
  - 3. Regulatory Requirements
    - a. Ballast shall meet the requirements of the Federal Communications Commission rules and regulations, part 18, for Non-Consumer equipment.
    - b. The electronic ballast shall comply with all applicable state and federal efficiency standards.
    - c. The electronic ballast shall be Underwriters Laboratories (UL) listed (Class P) and CSA Certified where applicable.
    - d. Ballast shall be UL listed type HL for hazardous locations.
  - 4. Other & Warranty
    - a. The electronic ballast shall not contain Polychlorinated Biphenyl (PCB's).
    - b. The electronic ballast shall carry a five year warranty. Submit copy of warranty with project record documents.

- D. Ballasts for Compact fluorescent lamps
  - 1. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated.
    - a. Lamp end-of-life detection and shut down circuit
    - b. Automatic lamp starting after lamp replacement
    - c. Sound Rating: A
    - d. Total harmonic Distortion Rating: Less than 10 percent
    - e. Transient Voltage Protection: IEEE C62.41, category A or better.
    - f. Operating Frequency: 20 KHz or higher.
    - g. Lamp Current Crest Factor: 1.7 or less
    - h. BF: 0.95 or higher, unless otherwise indicated
    - i. Power Factor: 0.95 or higher
- E. High Intensity Discharge (HID) Ballasts
  - 1. Description: Electromagnetic ballast for Metal Halide Lamps, complying with ANSI C82.4 and UL 1029. Include the following features, unless otherwise indicated:
    - a. Ballast Circuit: Constant-wattage autotransformer or regulating high power factor type.
    - b. Minimum starting temperature: Minus 22 deg F for single lamp ballast.
    - c. Normal ambient temperature: 104 deg F.
    - d. Open-circuit operation that will not reduce average life.
    - e. Low-noise ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.
  - 2. Substitutions: See Section 01 6000 - Product Requirements.
  - 3. Lamps: Suitable for lamp type and quantity specified for luminaire.
  - 4. Product:
- F. Fluorescent Lamp Emergency Power Supply: Emergency battery power supply suitable for installation in ballast compartment of fluorescent luminaire, capable of operating one or two lamps as noted for 90 minutes while in emergency mode. Ballast shall be UL listed. Provide a warranty for a full five (5) years from date of purchase. Manufacturer : Provide Bodine B50ST for linear fluorescents and Bodine B74CST for compact fluorescents or equals by IOTA or GE.
  - 1. Lamp Ratings: one fluorescent lamp 1400 lumens.
  - 2. Battery: Sealed lead calcium type, rated for 10 year life.
  - 3. Include self test capability and AC ON indicator light, installed to be operable and visible from the outside of an assembled fixture.

### 3.02 LAMPS

- A. Manufacturers:
  - 1. Philips Lighting Company
  - 2. Osram Sylvania
  - 3. GE Lighting: [www.gelighting.com](http://www.gelighting.com).
  - 4. Venture Lighting
  - 5. Substitutions: See Section 01 6000 - Product Requirements.
  - 6. Manufacturer Limitations: Where possible, provide lamps produced by a single manufacturer.
  - 7. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.
- B. All Lamps:
  - 1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
  - 2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
  - 3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
  - 4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Strategic Energy Solutions, Inc. to be inconsistent in perceived color temperature.
- C. Compact Fluorescent Lamps: Wattage and bulb type as indicated, with base type as required for luminaire.

1. Low Mercury Content: Provide lamps that pass the EPA Toxicity Characteristic Leaching Procedure (TCLP) test for characteristic hazardous waste.
  2. Correlated Color Temperature (CCT): 4,100 K unless otherwise indicated.
  3. Color Rendering Index (CRI): Not less than 80.
  4. Average Rated Life: Not less than 10,000 hours for an operating cycle of three hours per start.
- D. Linear Fluorescent Lamps: Wattage and bulb type as indicated, with base type as required for luminaire.
1. Low Mercury Content: Provide lamps that pass the EPA Toxicity Characteristic Leaching Procedure (TCLP) test for characteristic hazardous waste.
  2. T8 Linear Fluorescent Lamps:
    - a. Correlated Color Temperature (CCT): 4,100 K unless otherwise indicated.
    - b. Color Rendering Index (CRI): Not less than 80.
    - c. Average Rated Life: Not less than 20,000 hours for an operating cycle of three hours per start.
- E. High Intensity Discharge (HID) Lamps: Wattage as indicated, with bulb type, burning position, and base type as required for luminaire.
1. Metal Halide Lamps:
    - a. Non-Reflector Type Metal Halide Lamps: Phosphor coated lamp finish unless otherwise indicated.
    - b. Provide ANSI type O-rated protected metal halide lamps where required for open luminaires provided with compatible exclusionary sockets.
    - c. Ceramic Metal Halide Lamps:
      - 1) Correlated Color Temperature (CCT): 4,000 K unless otherwise indicated.
      - 2) Color Rendering Index (CRI): Not less than 80.
- F. Lamp Types: As specified for each fixture.

### **PART 3 EXECUTION**

#### **4.01 EXAMINATION**

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

#### **4.02 PREPARATION**

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

#### **4.03 INSTALLATION**

- A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.
- B. Install products according to manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship), NECA 500 (commercial lighting), and NECA 502 (industrial lighting).
- D. Suspended Ceiling Mounted Luminaires:
  1. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
  2. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members, or to building structure.



3. Secure pendant-mounted luminaires to building structure.
  4. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
  5. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
  6. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- E. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).
  - F. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
  - G. Support luminaires larger than 2 x 4 foot size independent of ceiling framing.
  - H. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
  - I. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
  - J. Install clips to secure recessed grid-supported luminaires in place.
  - K. Install accessories furnished with each luminaire.
  - L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within fixture; use flexible conduit.
  - M. Fluorescent Luminaires Controlled by Dual-Level Switching: Connect such that each switch controls the same corresponding lamps in each luminaire.
  - N. Emergency Lighting Units:
    1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
  - O. Exit Signs:
    1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
  - P. Fluorescent Emergency Power Supply Units:
    1. For field-installed units, install inside luminaire unless otherwise indicated. Where installation inside luminaire is not possible, install on top of luminaire.
    2. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal ballast(s) in luminaire. Bypass local switches, contactors, or other lighting controls.
  - Q. Remote Ballasts: Install in accessible location as indicated or as required to complete installation, using conductors per manufacturer's recommendations not exceeding manufacturer's recommended maximum conductor length to luminaire.
  - R. Install lamps in each luminaire.
  - S. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

#### **4.04 FIELD QUALITY CONTROL**

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Strategic Energy Solutions, Inc..
- E. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer

from normal power to battery and retransfer to normal.

**4.05 ADJUSTING**

- A. Aim and adjust fixtures as directed.
- B. Position exit sign directional arrows as indicated.

**4.06 CLEANING**

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosures.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.

**4.07 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Just prior to Substantial Completion, replace all lamps that have failed.

**4.08 PROTECTION**

- A. Protect installed luminaires from subsequent construction operations.

**4.09 PROTECTION**

- A. Relamp luminaires that have failed lamps at Substantial Completion.

**4.10 SCHEDULE - See Drawings**

**END OF SECTION**

## SECTION 265600 - EXTERIOR LIGHTING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Exterior luminaires.
- B. Ballasts.
- C. Lamps.
- D. Poles and accessories.

#### 1.02 RELATED REQUIREMENTS

- A. Section 33 7116.33 - Wood Electrical Utility Poles.
- B. Section 03 3000 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.
- C. Section 26 0537 - Boxes.

#### 1.03 REFERENCE STANDARDS

- A. ANSI C82.4 - American National Standard for Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type); 2002.
- B. ANSI O5.1 - American National Standard for Wood Poles -- Specifications and Dimensions; 2008.
- C. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002.
- D. IESNA RP-8 - American National Standard Practice for Roadway Lighting; Illuminating Engineering Society of North America; 2000(R2005) (ANSI/IES RP8).
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- F. NECA/IESNA 501 - Recommended Practice for Installing Exterior Lighting Systems; 2006.
- G. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 1598 - Luminaires; Current Edition, Including All Revisions.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
- C. 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.
- D. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- E. Maintenance Materials: Furnish the following for Redford Union Schools's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Touch-Up Paint: 2 gallons, to match color of pole finish.

## **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

## **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- C. Receive, handle, and store wood poles in accordance with ANSI O5.1.
- D. Package aluminum poles for shipping according to ASTM B 660.
- E. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion.
- F. Retain factory-applied pole wrappings on metal poles until right before pole installation. For pole with nonmetallic finished, handle with web fabric straps.

## **1.08 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk do to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alteration from special warranty coverage.
  - 1. Warranty period for luminaires, metal Corrosion and color retention: Five years from date of Substantial Completion.
  - 2. Warranty period for lamps: Replace lamps and fuses that fail within 12 months from date of substantial completion; Furnish replacement lamps and fuses that fail within the second 12 months from date of substantial completion.
  - 3. Warranty period for poles: repair or replace lighting poles that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of substantial completion.

## **1.09 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps: Furnish at least two of each type
  - 2. Glass and plastic lenses, covers, and other optical parts: Furnish at least two of each type.
  - 3. Ballasts: Furnish at least two of each type and rating installed.
  - 4. Globes and Guards: Furnish at least two of each type.

## **PART 2 PRODUCTS**

### **2.01 LUMINAIRE TYPES**

- A. Furnish products as indicated in luminaire schedule included on the Drawings.

### **2.02 LUMINAIRES**

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp

and distribute the light.

- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

### **2.03 BALLASTS**

- A. All Ballasts:
  - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
  - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
- B. High Intensity Discharge (HID) Ballasts: ANSI C82.4, and UL 1029 metal halide lamp ballast, suitable for lamp specified. Capable of open-circuit operation without reduction of average lamp life. Include the following features:
  - 1. Ballast circuit: Constant-wattage autotransformer or regulating high power-factor type..
  - 2. Minimum starting temperature : Minus 22 deg F.
  - 3. Normal ambient operation temperature: 104 deg F.
  - 4. Ballast Fuse: One in each underground power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

### **2.04 LAMPS**

- A. Manufacturers:
  - 1. Osram Sylvania
  - 2. Venture Lighting
- B. All Lamps:
  - 1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
  - 2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
  - 3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
  - 4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Strategic Energy Solutions, Inc. to be inconsistent in perceived color temperature.
- C. Compact Fluorescent Lamps: 4-pin, TCLP compliant, rated 26-57 Watts, minimum CRI 82, color temperature 4100K unless noted otherwise in Luminaire Schedule.
- D. Metal Halide Lamps: ANSI C78.1372, with minimum CRI 70 and color temperature 4000K unless otherwise noted in the Luminaire Schedule.
- E. Pulse Start, Metal Halide Lamps: Minimum CRI 70 and color temperature 4000K unless otherwise noted in the Luminaire Schedule.
- F. Ceramic Metal Halide Lamps: Minimum CRI 80 and color temperature 4000K unless otherwise noted in the Luminaire Schedule.

### **2.05 POLES**

- A. All Poles:
  - 1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Provide extension rings to bring outlet boxes flush with finished surface.

- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### **3.02 INSTALLATION**

- A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.
- B. Install products according to manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA/IESNA 501 (exterior lighting).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. Install accessories furnished with each luminaire.
- F. Bond products and metal accessories to branch circuit equipment grounding conductor.
- G. Install poles plumb, mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
  - 1. Grout around each base. Use nonshrink or expanding concrete grout firmly packed to fill space.
  - 2. Install base covers, unless otherwise indicated.
  - 3. Use a short piece of 1/2 inch diameter pipe to make drain hole through grout. Arrange to drain condensation from interior of pole.
- H. Install lamps in each luminaire.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Strategic Energy Solutions, Inc..

### **3.04 ADJUSTING**

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Strategic Energy Solutions, Inc.. Secure locking fittings in place.

### **3.05 CLEANING**

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

### **3.06 CLOSEOUT ACTIVITIES**

**END OF SECTION**