

2640 Fountain View Drive, Houston, Texas 77057 | 713.260.0600 | Mark Thiele, **Interim President & CEO Houston Housing Authority Board of Commissioners:** LaRence Snowden, *Chair* | Kristy M. Kirkendoll, *Vice Chair* Dr. Max Miller, Jr. | Stephanie Ballard | Andrea Hillard Cooksey | Kris Thomas | Guillermo "Will" Hernandez

The Houston Housing Authority ("HHA"), has issued this Amendment No. 1 to IFB 21-49 Electrical Services to Furnish and Install Carbon Monoxide Detectors for the purposes of incorporating the following documents into this solicitation:

- 1. Exhibit C Carbon Monoxide Detector Project; and,
- 2. Exhibit D Project Manual.

All other terms and conditions shall remain the same.

Date

Austin Y. Crotts, MA Procurement Specialist, Houston Housing Authority



A Fair Housing and Equal Employment Opportunity Agency. For assistance: Individuals with disabilities may contact the 504/ADA Administrator at 713-260-0353, TTY 713-260-0574 or <u>504ADA@housingforhouston.com</u> Exhibit C IFB 21-49

# **Carbon Monoxide Detector Project**

HOUSTON HOUSING AUTHORITY PROJECT Houston, Texas

- Prepared by -



N. CURTIS JONES, P.E. TEXAS PROFESSIONAL ENGINEER #58428 JONES ENGINEERS, LP 9820 Whithorn Drive Houston, Texas 77095 TEXAS REGISTERED ENGINEERING FIRM #F-3811

> Issue for Bid October 15, 2021 Project No. 4748

# JONES ENGINEERS, L.P.

Carbon Monoxide Detector Project Houston Housing Authority October 15, 2021 Page 1

Project Narrative:

The purpose of this project is to provide carbon monoxide sensors to the Houston Housing Authority properties that have gas appliances. The properties have many different layouts, and have 1, 2 and 3 levels. The code required carbon monoxide detectors shall be installed for each different unit layout. Sketches are provided for some typical unit layouts.

Carbon monoxide detectors with (120V, with battery backup) and wireless interconnect are to be utilized. Kidde, First Alert, and USI Electric or equivalent UL listed for the application are acceptable.

The new sensor shall be connected to a hot leg (un-switched) circuit with #12 THWN conductors routed in surface raceway to the nearest light fixture, switch, receptacle, or smoke detector (verify exact location of light fixture, switch, receptacle, or smoke detector in field). All sensors to be wirelessly interconnected for multi-level apartments and/or multiple sensors per floor. Existing conduit shall be utilized where possible. New conduit shall be surface mounted Wiremold V500 series (or equal). Provide junction box extenders as required.

Unit prices for carbon monoxide detectors and Wiremold shall be provided.

CARBON MONOXIDE SENSOR (120V, WITH BATTERY BACKUP), WIRELESS  $\langle CO \rangle$ INTERCONNECT. KIDDE, FIRST ALERT, AND USI ELECTRIC OR EQUIVALENT UL LISTED FOR THE APPLICATION ARE ACCEPTABLE. BED1 LIVI  $\langle co \rangle$ HALL CLO2 AC 8 **BATH** DINI CONNECT THE NEW SENSOR TO A HOT LEG (UN-SWITCHED) CIRCUIT WITH #12 THWN CONDUCTORS ROUTED IN SURFACE RACEWAY SERVING THE NEAREST LIGHT FIXTURE, SWITCH, RECEPTACLE, OR SMOKE DETECTOR (VERIFY EXACT LOCATION OF CLO HALL LIGHT FIXTURE, SWITCH, RECEPTACLE, OR SMOKE DETECTOR IN FIELD). ALL LNDR P SENSORS TO BE WIRELESSLY INTERCONNECTED FOR MULTI LEVEL APARTMENTS AND/OR MULTIPLE SENSORS PER FLOOR. UTILIZE EXISTING CONDUIT WHERE POSSIBLE, OTHERWISE USE SURFACE MOUNTED WIREMOLD V500 SERIES (OR EQUAL) FOR RACEWAY, PROVIDE JUNCTION BOX EXTENDERS AS REQUIRED. 1, 2 AND 3 LEVEL APARTMENT SKETCHES ARE TYPICAL. PROVIDE CODE REQUIRED CARBON MONOXIDE SENSOR(S) FOR EACH DIFFERENT APARTMENT LAYOUT. 0 0 0 0 PROVIDE AN INSTALLED UNIT PRICE FOR A CARBON MONOXIDE SENSOR. **KITC** PROVIDE AN INSTALLED PER FOOT UNIT PRICE FOR WIREMOLD V500 (OR EQUAL). ENTR CURTIS JONES, 01 - TYPICAL APARTMENT WITH 1 LEVEL 4748 5/2021 NOT TO SCALE THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY N. CURTIS JONES, JR, P.E. 58428

ISSUE FOR BID - 10/15/2021



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Consulting Mechanical/Electrical/Plumbing Engineers 9820 Whithorn Dr. Houston, Texas 77095 (713)222-7766 Texas Registered Engineering Firm #F-3811

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# 01 - TYPICAL APARTMENT WITH 2 LEVELS - LEVEL 1 NOT TO SCALE



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# 01 - TYPICAL APARTMENT WITH 2 LEVELS - LEVEL 2

NOT TO SCALE



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# 01 - TYPICAL APARTMENT WITH 3 LEVELS - LEVEL 1

NOT TO SCALE

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![](_page_7_Figure_0.jpeg)

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# 01 - TYPICAL APARTMENT WITH 3 LEVELS - LEVEL 2

NOT TO SCALE

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![](_page_8_Figure_2.jpeg)

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# 01 - TYPICAL APARTMENT WITH 3 LEVELS - LEVEL 3 NOT TO SCALE

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# PROJECT MANUAL DIVISION 26

# **Carbon Monoxide Detector Project**

HOUSTON HOUSING AUTHORITY PROJECT Houston, Texas

![](_page_9_Picture_4.jpeg)

9820 Whithorn Drive Houston, Texas 77095 Texas Registered Engineering Firm #F-3811

> Issue for Bid October 15, 2021 Project No. 4748

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#### SECTION 26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

# PART 1 GENERAL

# **1.01 SECTION INCLUDES**

- A. Single conductor building wire.
- B. Nonmetallic-sheathed cable
- C. Wiring connectors.
- D. Electrical tape.
- E. Oxide inhibiting compound.
- F. Wire pulling lubricant.
- G. Cable ties.
- H. Firestop sleeves.

# 1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 Firestopping.
- B. Section 26 05 26 Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

# 1.03 REFERENCE STANDARDS

- A. ASTM B3 Standard Specification for Soft or Annealed Copper Wire 2013 (Reapproved 2018).
- B. ASTM B8 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft 2011 (Reapproved 2017).
- C. ASTM B33 Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation 2004 (Reapproved 2020).
- E. ASTM B800 Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes Annealed and Intermediate Tempers 2005 (Reapproved 2015).
- F. ASTM B801 Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy Wire for Subsequent Covering of Insulation 2018.
- G. ASTM D3005 Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2017.
- H. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- I. NECA 104 Recommended Practice for Installing Aluminum Building Wire and Cable 2012.
- J. NECA 121 Standard for Installing Nonmetallic-Sheathed Cable (Type NM-B) and Underground Feeder and Branch-Circuit Cable (Type UF) 2007.
- K. NEMA WC 70 Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2009.
- L. NETA ATS Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.
- M. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. UL 44 Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.
- O. UL 83 Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.
- P. UL 486A-486B Wire Connectors Current Edition, Including All Revisions.
- Q. UL 486C Splicing Wire Connectors Current Edition, Including All Revisions.
- R. UL 486D Sealed Wire Connector Systems Current Edition, Including All Revisions.
- S. UL 510 Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.

T. UL 719 - Nonmetallic-Sheathed Cables Current Edition, Including All Revisions.

#### 1.04 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

#### 1.05 QUALITY ASSURANCE

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

#### 1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

# 1.07 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

# PART 2 PRODUCTS

2.

# 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. Nonmetallic-sheathed cable is permitted only as follows:
  - 1. Where not otherwise restricted, may be used:
    - a. For branch circuit wiring in dry locations within one- and two-family dwellings and their attached or detached garages, and their storage buildings.
    - b. For branch circuit wiring in dry locations within multifamily dwellings permitted to be of Types III, IV, and V construction.
    - In addition to other applicable restrictions, may not be used:
    - a. Where exposed to damage.
    - b. For damp, wet, or corrosive locations.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Metal-clad cable is not permitted.
  - 1. Where not otherwise restricted, may be used:
    - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
      - 1) Maximum Length: 6 feet.
    - b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.
  - 2. In addition to other applicable restrictions, may not be used:
    - a. Where not approved for use by the authority having jurisdiction.
    - b. Where exposed to view.
    - c. Where exposed to damage.
    - d. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.
- F. Manufactured wiring systems are not permitted.

# 2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.

- 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. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.
- H. Conductor Material:
  - 1. Provide copper conductors except where aluminum conductors are specifically indicated or permitted for substitution. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
    - a. Substitution of aluminum conductors for copper is permitted, when approved by Owner and authority having jurisdiction, only for the following:
      - 1) Services: Copper conductors size 1/0 AWG and larger.
      - 2) Feeders: Copper conductors size 1/0 AWG and larger.
    - b. Where aluminum conductors are substituted for copper, comply with the following:
      - 1) Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.
      - 2) Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.
      - 3) Provide aluminum equipment grounding conductor sized according to NFPA 70.
      - 4) Equip electrical distribution equipment with compression lugs for terminating aluminum conductors.
  - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
  - 3. Tinned Copper Conductors: Comply with ASTM B33.
  - 4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.
- I. Minimum Conductor Size:
  - 1. Branch Circuits: 12 AWG.
  - 2. Control Circuits: 14 AWG.
- J. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- K. 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.
    - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
  - 3. Color Code:
    - a. 480Y/277 V, 3 Phase, 4 Wire System:
      - 1) Phase A: Brown.
      - 2) Phase B: Orange.
      - 3) Phase C: Yellow.
      - 4) Neutral/Grounded: Gray.
    - b. 208Y/120 V, 3 Phase, 4 Wire System:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
      - 4) Neutral/Grounded: White.

c. Equipment Ground, All Systems: Green.

# 2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
  - 1. Copper Building Wire:
    - a. Cerro Wire LLC: www.cerrowire.com/#sle.
    - b. Encore Wire Corporation: www.encorewire.com/#sle.
    - c. General Cable Technologies Corporation; [\_\_\_\_]: www.generalcable.com/#sle.
    - d. Service Wire Co: www.servicewire.com/#sle.
    - e. Southwire Company: www.southwire.com/#sle.
  - 2. Aluminum Building Wire (only where specifically indicated or permitted for substitution):
    - a. Encore Wire Corporation: www.encorewire.com/#sle.
    - b. Southwire Company: www.southwire.com/#sle.
    - c. Stabiloy, a brand of General Cable Technologies Corporation; [\_\_\_\_\_]: www.stabiloy.com/#sle.
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
  - 1. Feeders and Branch Circuits:
    - a. Size 10 AWG and Smaller: Solid.
    - b. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
  - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.

# 2.04 NONMETALLIC-SHEATHED CABLE

- A. Description: NFPA 70, Type NM multiple-conductor cable listed and labeled as complying with UL 719, Type NM-B.
- B. Conductor Stranding:
  - 1. Size 10 AWG and Smaller: Solid.
  - 2. Size 8 AWG and Larger: Stranded.
- C. Insulation Voltage Rating: 600 V.

# 2.05 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.
- B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.
- C. Wiring Connectors for Splices and Taps:
  - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
  - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
  - 3. Connectors for Aluminum Conductors: Use compression connectors.
- D. Wiring Connectors for Terminations:
  - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
  - 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
  - 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
  - 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
  - 5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
  - 6. Aluminum Conductors: Use compression connectors for all connections.

- 7. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
- 8. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
- H. Mechanical Connectors: Provide bolted type or set-screw type.
  - 1. Manufacturers:
    - a. Burndy LLC: www.burndy.com/#sle.
    - b. Ilsco: www.ilsco.com/#sle.
    - c. Thomas & Betts Corporation: www.tnb.com/#sle.
- I. Compression Connectors: Provide circumferential type or hex type crimp configuration.
  - 1. Manufacturers:
    - a. Burndy LLC: www.burndy.com/#sle.
    - b. Ilsco: www.ilsco.com/#sle.
    - c. Thomas & Betts Corporation: www.tnb.com/#sle.
- J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
  - 1. Manufacturers:
    - a. Burndy LLC: www.burndy.com/#sle.
    - b. Ilsco: www.ilsco.com/#sle.
    - c. [\_\_\_\_].

# 2.06 ACCESSORIES

- A. Electrical Tape:
  - 1. Manufacturers:
    - a. 3M: www.3m.com/#sle.
  - Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
  - Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
- B. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
  - 1. Manufacturers:
    - a. Burndy LLC: www.burndy.com/#sle.
    - b. Ideal Industries, Inc: www.idealindustries.com/#sle.
    - c. Ilsco: www.ilsco.com/#sle.
- C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
  - 1. Manufacturers:
    - a. 3M: www.3m.com/#sle.
    - b. American Polywater Corporation: www.polywater.com/#sle.
    - c. Ideal Industries, Inc: www.idealindustries.com/#sle.
- D. Cable Ties: Material and tensile strength rating suitable for application.
- E. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
  - 1. Products:
    - a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.

# 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 field measurements are as indicated.
- E. 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. Circuiting Requirements:
  - 1. Unless dimensioned, circuit routing indicated is diagrammatic.
  - 2. When circuit destination is indicated without specific routing, determine exact routing required.
  - 3. Arrange circuiting to minimize splices.
  - 4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
  - 5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
  - 6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
  - 7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
    - a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
    - b. Increase size of conductors as required to account for ampacity derating.
    - c. Size raceways, boxes, etc. to accommodate conductors.
  - 8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
  - 9. Provide oversized neutral/grounded conductors where indicated and as specified below.
    - a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.
    - b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Install aluminum conductors in accordance with NECA 104.
- E. Install nonmetallic-sheathed cable (Type NM-B) in accordance with NECA 121.
- F. 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.
- G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- H. 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.

- I. Terminate cables using suitable fittings.
- J. Install conductors with a minimum of 12 inches of slack at each outlet.
- K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- L. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- M. 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 contaminates. Do not use wire brush on plated connector surfaces.
  - 5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
  - 6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  - 7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- N. 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.
- O. Insulate ends of spare conductors using vinyl insulating electrical tape.
- P. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- R. 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.

# 3.04 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA 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.
- C. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 26 05 19

#### SECTION 26 05 29 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### **1.01 SECTION INCLUDES**

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

# 1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 05 33.13 Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- C. Section 26 05 36 Cable Trays for Electrical Systems: Additional support and attachment requirements for cable tray.
- D. Section 26 05 33.16 Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- E. Section 26 25 13 Low-Voltage Busways: Additional support and attachment requirements for busway.
- F. Section 26 51 00 Interior Lighting: Additional support and attachment requirements for interior luminaires.
- G. Section 26 51 33 Luminaires, Ballasts, and Drivers Lutron: Additional support and attachment requirements for luminaires.
- H. Section 26 56 00 Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

#### 1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- B. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM B633 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.
- D. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- E. MFMA-4 Metal Framing Standards Publication 2004.
- F. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- G. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 101 Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 5B Strut-Type Channel Raceways and Fittings Current Edition, Including All Revisions.

# **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

# 1.05 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.

# 1.06 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.
- C. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

# PART 2 PRODUCTS

#### 2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
  - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
  - 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
  - 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
  - 4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
  - 5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
  - 6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
    - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
  - 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
  - 2. Conduit Clamps: Bolted type unless otherwise indicated.
  - 3. Manufacturers:
    - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    - b. Erico International Corporation: www.erico.com/#sle.
    - c. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
    - d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
    - e. Thomas & Betts Corporation: www.tnb.com/#sle.
- C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
  - 1. Manufacturers:
    - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    - b. Erico International Corporation: www.erico.com/#sle.
    - c. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.

- d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
- e. Thomas & Betts Corporation: www.tnb.com/#sle.
- D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
  - 1. Comply with MFMA-4.
- E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
  - 1. Minimum Size, Unless Otherwise Indicated or Required:
    - a. Equipment Supports: 1/2 inch diameter.
    - b. Busway Supports: 1/2 inch diameter.
    - c. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch diameter.
    - d. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter.
    - e. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
    - f. Outlet Boxes: 1/4 inch diameter.
    - g. Luminaires: 1/4 inch diameter.
- F. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
  - 1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
  - 2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
  - 3. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
  - 4. Manufacturers:
    - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    - b. Erico International Corporation: www.erico.com/#sle.
    - c. PHP Systems/Design: www.phpsd.com/#sle.
    - d. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
- G. Anchors and Fasteners:
  - 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
  - 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
  - 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
  - 4. Hollow Masonry: Use toggle bolts.
  - 5. Hollow Stud Walls: Use toggle bolts.
  - 6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
  - 7. Sheet Metal: Use sheet metal screws.
  - 8. Wood: Use wood screws.
  - 9. Plastic and lead anchors are not permitted.
  - 10. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    - a. Comply with MFMA-4.
    - b. Channel Material: Use galvanized steel.
    - c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

# PART 3 EXECUTION

# 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

# 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment:
  - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
  - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
  - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Conduit Support and Attachment: Also comply with Section 26 05 33.13.
- I. Cable Tray Support and Attachment: Also comply with Section 26 05 36.
- J. Box Support and Attachment: Also comply with Section 26 05 33.16.
- K. Busway Support and Attachment: Also comply with Section 26 25 13.
- L. Interior Luminaire Support and Attachment: Also comply with Section 26 51 00.
- M. Exterior Luminaire Support and Attachment: Also comply with Section 26 56 00.
- N. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- O. Secure fasteners according to manufacturer's recommended torque settings.
- P. Remove temporary supports.
- Q. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

#### 3.03 FIELD QUALITY CONTROL

- A. Inspect support and attachment components for damage and defects.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective support and attachment components.

# END OF SECTION 26 05 29

#### SECTION 26 05 33.13 CONDUIT FOR ELECTRICAL SYSTEMS

# PART 1 GENERAL

# **1.01 SECTION INCLUDES**

- A. Galvanized steel rigid metal conduit (RMC).
- B. Aluminum rigid metal conduit (RMC).
- C. Intermediate metal conduit (IMC).
- D. PVC-coated galvanized steel rigid metal conduit (RMC).
- E. Flexible metal conduit (FMC).
- F. Liquidtight flexible metal conduit (LFMC).
- G. Electrical metallic tubing (EMT).
- H. Rigid polyvinyl chloride (PVC) conduit.
- I. Conduit fittings.
- J. Accessories.

# 1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 Cast-in-Place Concrete: Concrete encasement of conduits.
- B. Section 07 84 00 Firestopping.
- C. Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
- D. Section 26 05 26 Grounding and Bonding for Electrical Systems.
  - 1. Includes additional requirements for fittings for grounding and bonding.
- E. Section 26 05 29 Hangers and Supports for Electrical Systems.
- F. Section 26 05 33.16 Boxes for Electrical Systems.
- G. Section 26 05 53 Identification for Electrical Systems: Identification products and requirements.
- H. Section 26 21 00 Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
- I. Section 27 10 00 Structured Cabling: Additional requirements for communications systems conduits.

# 1.03 REFERENCE STANDARDS

- A. ANSI C80.1 American National Standard for Electrical Rigid Steel Conduit (ERSC) 2015.
- B. ANSI C80.3 American National Standard for Electrical Metallic Tubing -- Steel (EMT-S) 2015.
- C. ANSI C80.6 American National Standard for Electrical Intermediate Metal Conduit (EIMC) 2018.
- D. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- E. NECA 101 Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2013.
- F. NECA 102 Standard for Installing Aluminum Rigid Metal Conduit 2004.
- G. NECA 111 Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) 2017.
- H. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- I. NEMA RN 1 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit 2018.
- J. NEMA TC 2 Electrical Polyvinyl Chloride (PVC) Conduit 2020.
- K. NEMA TC 3 Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing 2021.

- L. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL 1 Flexible Metal Conduit Current Edition, Including All Revisions.
- N. UL 6 Electrical Rigid Metal Conduit-Steel Current Edition, Including All Revisions.
- O. UL 6A Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel Current Edition, Including All Revisions.
- P. UL 360 Liquid-Tight Flexible Steel Conduit Current Edition, Including All Revisions.
- Q. UL 514B Conduit, Tubing, and Cable Fittings Current Edition, Including All Revisions.
- R. UL 651 Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings Current Edition, Including All Revisions.
- S. UL 797 Electrical Metallic Tubing-Steel Current Edition, Including All Revisions.
- T. UL 1242 Electrical Intermediate Metal Conduit-Steel Current Edition, Including All Revisions.
- U. UL 1660 Liquid-Tight Flexible Nonmetallic Conduit Current Edition, Including All Revisions.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
  - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
  - 4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

#### 1.05 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

#### **1.06 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### PART 2 PRODUCTS

#### 2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
  - 1. Under Slab on Grade: Use PVC-coated galvanized steel rigid metal conduit or rigid PVC conduit.
  - 2. Exterior, Direct-Buried: Use PVC-coated galvanized steel rigid metal conduit or rigid PVC conduit.
  - 3. Exterior, Embedded Within Concrete: Use PVC-coated galvanized steel rigid metal conduit or rigid PVC conduit.

- 4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
- 5. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.
- 6. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.
- D. Embedded Within Concrete:
  - 1. Within Slab on Grade: Not permitted.
  - 2. Within Slab Above Ground: Not permitted.
- E. Concealed Within Masonry Walls: Use electrical metallic tubing (EMT).
- F. Concealed Within Hollow Stud Walls: Use electrical metallic tubing (EMT) or MC Cable.
- G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.
- I. Exposed, Interior, Not Subject to Physical Damage: Use electrical metallic tubing (EMT).
- J. Exposed, Interior, Subject to Physical Damage: Use intermediate metal conduit (IMC).
  - 1. Locations subject to physical damage include, but are not limited to:
    - a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
- K. Exposed, Exterior: Use galvanized steel rigid metal conduit.
- L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- M. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
  1. Maximum Length: 6 feet.
- N. Connections to Vibrating Equipment:
  - 1. Dry Locations: Use flexible metal conduit.
  - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
  - 3. Maximum Length: 6 feet unless otherwise indicated.
  - 4. Vibrating equipment includes, but is not limited to:
    - a. Transformers.
    - b. Motors.

# 2.02 CONDUIT REQUIREMENTS

- A. Electrical Service Conduits: Also comply with Section 26 21 00.
- B. Communications Systems Conduits: Also comply with Section 27 10 00.
- C. Fittings for Grounding and Bonding: Also comply with Section 26 05 26.
- D. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- E. Provide products listed, classified, and labeled as suitable for the purpose intended.
- F. Minimum Conduit Size, Unless Otherwise Indicated:
- G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

# 2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
  - 1. Allied Tube & Conduit: www.alliedeg.com/#sle.
  - 2. Republic Conduit: www.republic-conduit.com/#sle.
  - 3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

- C. Fittings:
  - 1. Manufacturers:
    - a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
    - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
  - 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 3. Material: Use steel or malleable iron.
  - 4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

# 2.04 INTERMEDIATE METAL CONDUIT (IMC)

- A. Manufacturers:
  - 1. Allied Tube & Conduit: www.alliedeg.com/#sle.
  - 2. Republic Conduit: www.republic-conduit.com/#sle.
  - 3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.
- B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- C. Fittings:
  - 1. Manufacturers:
    - a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
    - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
  - 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 3. Material: Use steel or malleable iron.
  - 4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

# 2.05 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
  - 1. Thomas & Betts Corporation: www.tnb.com/#sle.
  - 2. Robroy Industries: www.robroy.com/#sle.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.
- D. PVC-Coated Fittings:
  - 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
  - 2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
  - 3. Material: Use steel or malleable iron.
  - 4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.
- E. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

# 2.06 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
  - 1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
  - 2. International Metal Hose: www.metalhose.com/#sle.
- B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- C. Fittings:
  - 1. Manufacturers:
    - a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
    - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
    - c. Thomas & Betts Corporation: www.tnb.com/#sle.
  - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 3. Material: Use steel or malleable iron.

a. Do not use die cast zinc fittings.

#### 2.07 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
  - 1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
  - 2. Electri-Flex Company: www.electriflex.com/#sle.
  - 3. International Metal Hose: www.metalhose.com/#sle.
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
  - 1. Manufacturers:
    - a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
    - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
    - c. Thomas & Betts Corporation: www.tnb.com/#sle.
  - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 3. Material: Use steel or malleable iron.
    - a. Do not use die cast zinc fittings.

#### 2.08 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
  - 1. Allied Tube & Conduit: www.alliedeg.com/#sle.
  - 2. Republic Conduit: www.republic-conduit.com/#sle.
  - 3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.
- 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. Manufacturers:
    - a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
    - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
  - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 3. Material: Use steel or malleable iron.
    - a. Do not use die cast zinc fittings.
  - 4. Connectors and Couplings: Use compression (gland) or set-screw type.
    - a. Do not use indenter type connectors and couplings.

# 2.09 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
  - 1. Cantex Inc: www.cantexinc.com/#sle.
  - 2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
  - 3. JM Eagle: www.jmeagle.com/#sle.
- 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.

#### 2.10 ACCESSORIES

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

- Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-D. force.
- E. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.
- F. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.
- Sealing Systems for Roof Penetrations: Premanufactured components and accessories as G. required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
  - Products: 1.
    - Menzies Metal Products; Electrical Roof Stack and Cap: www.menziesa. metal.com/#sle.
    - b. Menzies Metal Products: Electrical Retro Box: www.menzies-metal.com/#sle.
- Flashing Panels for Exterior Wall Penetrations: Premanufactured components and Η. accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed. 1
  - Manufacturers:
    - а Quickflash Weatherproofing Products, Inc: www.guickflashproducts.com/#sle.
- I. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
  - 1. Products:
    - HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro a. Series/HydroFlame Custom Built: www.holdrite.com/#sle.
- Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for J. concrete encasement in open trench installation; suitable for the conduit/duct arrangement to be installed.
- Bore Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for installation K. within casing; furnished with roller wheels to facilitate installation, openings to facilitate grout flow, and holes for stabilization cable; suitable for the casing and conduit/duct arrangement to be installed.

# PART 3 EXECUTION

# 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- Β. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

# 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install intermediate metal conduit (IMC) in accordance with NECA 101.
- Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by Ε. the manufacturer.
- Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111. F.
- G. Conduit Routina:
  - Unless dimensioned, conduit routing indicated is diagrammatic. 1.
  - When conduit destination is indicated without specific routing, determine exact routing 2. required.
  - 3. Conceal all conduits unless specifically indicated to be exposed.
  - Conduits in the following areas may be exposed, unless otherwise indicated: 4
    - a. Electrical rooms.
    - b. Mechanical equipment rooms.
    - Within joists in areas with no ceiling. C.

- 5. Unless otherwise approved, do not route conduits exposed:
  - a. Across floors.
  - b. Across roofs.
  - c. Across top of parapet walls.
  - d. Across building exterior surfaces.
- 6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
- 7. Arrange conduit to maintain adequate headroom, clearances, and access.
- 8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
- 9. Arrange conduit to provide no more than 150 feet between pull points.
- 10. Route conduits above water and drain piping where possible.
- 11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
- 12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
- 13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
  - a. Heaters.
  - b. Hot water piping.
  - c. Flues.
- 14. Group parallel conduits in the same area together on a common rack.
- H. Conduit Support:
  - 1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 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.
  - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
  - 4. Use conduit strap to support single surface-mounted conduit.
    - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
  - 5. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
  - 6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
  - 7. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
  - 8. Use non-penetrating rooftop supports to support conduits routed across rooftops (only where approved).
  - Use of spring steel conduit clips for support of conduits is permitted only as follows:
     a. Support of electrical metallic tubing (EMT) up to 1 inch (27 mm) trade size
    - concealed above accessible ceilings and within hollow stud walls.
  - 10. Use of wire for support of conduits is not permitted.
  - 11. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.
- I. Connections and Terminations:
  - 1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
  - 2. Where two threaded conduits must be joined and neither can be rotated, use threepiece couplings or split couplings. Do not use running threads.
  - 3. Use suitable adapters where required to transition from one type of conduit to another.
  - 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
  - 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.

- 6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
- 7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
- J. 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 84 00.
- K. Underground Installation:
  - 1. Minimum Cover, Unless Otherwise Indicated or Required:
    - a. Underground, Exterior: 24 inches.
    - b. Under Slab on Grade: 12 inches to bottom of slab.
  - 2. Provide underground warning tape in accordance with Section 26 05 53 along entire conduit length for service entrance where not concrete-encased.
- L. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 03 30 00 with minimum concrete cover of 3 inches on all sides unless otherwise indicated.
- M. 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 calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
  - 3. Where conduits are subject to earth movement by settlement or frost.
- N. 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.
- O. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- P. Provide grounding and bonding in accordance with Section 26 05 26.
- Q. Identify conduits in accordance with Section 26 05 53.

# 3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements, for additional requirements.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

D. Correct deficiencies and replace damaged or defective conduits.

# 3.04 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

# 3.05 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

# END OF SECTION 26 05 33.13

#### SECTION 26 05 33.16 BOXES FOR ELECTRICAL SYSTEMS

#### PART 1 GENERAL

#### **1.01 SECTION INCLUDES**

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Floor boxes.
- D. Underground boxes/enclosures.
- E. Accessories.

#### 1.02 RELATED REQUIREMENTS

- A. Section 08 31 00 Access Doors and Panels: Panels for maintaining access to concealed boxes.
- B. Section 26 05 26 Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 Hangers and Supports for Electrical Systems.
- D. Section 26 05 33.13 Conduit for Electrical Systems:
  - 1. Conduit bodies and other fittings.
  - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- E. Section 26 05 33.23 Surface Raceways for Electrical Systems:
- F. Section 26 05 53 Identification for Electrical Systems: Identification products and requirements.
- G. Section 26 27 26 Wiring Devices:
  - 1. Wall plates.
  - 2. Floor box service fittings.
  - 3. Access floor boxes.
  - 4. Additional requirements for locating boxes for wiring devices.

#### 1.03 REFERENCE STANDARDS

- A. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- B. NECA 130 Standard for Installing and Maintaining Wiring Devices 2010.
- C. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- D. NEMA OS 1 Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports 2013.
- E. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- F. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. SCTE 77 Specification for Underground Enclosure Integrity 2017.
- H. UL 50 Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- I. UL 50E Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- J. UL 508A Industrial Control Panels Current Edition, Including All Revisions.
- K. UL 514A Metallic Outlet Boxes Current Edition, Including All Revisions.

# 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

- 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
- 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
- 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
- 6. Coordinate the work with other trades to preserve insulation integrity.
- 7. Coordinate the work with other trades to provide walls suitable for installation of flushmounted boxes where indicated.
- 8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### 1.05 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
- 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, and installation of product.

#### **1.06 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

# PART 2 PRODUCTS

#### 2.01 BOXES

- A. General Requirements:
  - 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
  - 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
  - 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
  - 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
  - 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
  - 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
  - 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
  - 3. Use suitable concrete type boxes where flush-mounted in concrete.
  - 4. Use suitable masonry type boxes where flush-mounted in masonry walls.
  - 5. Use raised covers suitable for the type of wall construction and device configuration where required.
  - 6. Use shallow boxes where required by the type of wall construction.
  - 7. Do not use "through-wall" boxes designed for access from both sides of wall.
  - 8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
  - 9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.

- 10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
- 11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
- 12. Minimum Box Size, Unless Otherwise Indicated:
  - a. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
  - b. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
- 13. Wall Plates: Comply with Section 26 27 26.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
  - Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
    - 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
    - 3. Junction and Pull Boxes Larger Than 100 cubic inches:
      - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
- D. Floor Boxes:
  - 1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 27 26; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
  - 2. Manufacturer: Same as manufacturer of floor box service fittings.
- E. Underground Boxes/Enclosures:
  - 1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
  - 2. Size: As indicated on drawings.
  - 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
  - 4. Applications:
    - a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
    - b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 15 load rating.
    - c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
  - 5. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
    - a. Manufacturers:
      - 1) Hubbell Incorporated; Quazite Products:
        - www.hubbellpowersystems.com/#sle.
      - 2) MacLean Highline: www.macleanhighline.com/#sle.
      - 3) Oldcastle Precast, Inc: www.oldcastleprecast.com/#sle.
    - b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

# 2.02 ACCESSORIES

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for boxes and facade materials to be installed.
  - 1. Manufacturers:
    - a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.

# PART 3 EXECUTION

# 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

#### 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- F. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- G. Box Locations:
  - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 31 00 as required where approved by the Architect.
  - 2. Unless dimensioned, box locations indicated are approximate.
  - Locate boxes as required for devices installed under other sections or by others.
     a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 27 26.
  - 4. Locate boxes so that wall plates do not span different building finishes.
  - 5. Locate boxes so that wall plates do not cross masonry joints.
  - 6. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
  - 7. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
  - 8. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
    - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
    - b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
  - 9. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 33.13.
  - 10. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    - a. Concealed above accessible suspended ceilings.
    - b. Within joists in areas with no ceiling.
    - c. Electrical rooms.
    - d. Mechanical equipment rooms.
- H. Box Supports:
  - 1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
  - 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
- I. Install boxes plumb and level.
- J. Flush-Mounted Boxes:
  - 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
  - 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.

- 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- K. Install boxes as required to preserve insulation integrity.
- L. Underground Boxes/Enclosures:
  - 1. Install enclosure on gravel base, minimum 6 inches deep.
  - 2. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
- M. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- N. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- O. Close unused box openings.
- P. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- Q. Provide grounding and bonding in accordance with Section 26 05 26.
- R. Identify boxes in accordance with Section 26 05 53.

#### 3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

#### 3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

# END OF SECTION 26 05 33.16

#### SECTION 26 05 33.23 SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

# PART 1 GENERAL

# **1.01 SECTION INCLUDES**

- A. Surface raceway systems.
- B. Wireways.

# 1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 Hangers and Supports for Electrical Systems.
- C. Section 26 05 33.13 Conduit for Electrical Systems.
- D. Section 26 05 33.16 Boxes for Electrical Systems.
- E. Section 26 05 53 Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 27 26 Wiring Devices: Receptacles.

# 1.03 REFERENCE STANDARDS

- A. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- B. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- D. NEMA PRP 5 Installation Guidelines for Surface Nonmetallic Raceway 2015.
- E. UL 5 Surface Metal Raceways and Fittings Current Edition, Including All Revisions.
- F. UL 111 Outline of Investigation for Multioutlet Assemblies Current Edition, Including All Revisions.
- G. UL 870 Wireways, Auxiliary Gutters, and Associated Fittings Current Edition, Including All Revisions.

# 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the placement of raceways with millwork, furniture, equipment, etc. installed under other sections or by others.
  - 2. Coordinate rough-in locations of outlet boxes provided under Section 26 05 33.16 and conduit provided under Section 26 05 33.13 as required for installation of raceways provided under this section.
  - 3. Verify minimum sizes of raceways with the actual conductors and components to be installed.
  - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not install raceways until final surface finishes and painting are complete.
  - 2. Do not begin installation of conductors and cables until installation of raceways is complete between outlet, junction and splicing points.

# 1.05 SUBMITTALS

- A. See Section 01 30 00 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. Surface Raceway Systems: Include information on fill capacities for conductors and cables.
- 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.

# 1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

# 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 as suitable for the purpose intended.
- C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

# 2.02 SURFACE RACEWAY SYSTEMS

- A. Manufacturers:
  - 1. Hubbell Incorporated: www.hubbell.com/#sle.
  - 2. MonoSystems, Inc: www.monosystems.com/#sle.
  - 3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
- B. Surface Metal Raceways: Listed and labeled as complying with UL 5.
- C. Multioutlet Assemblies: Listed and labeled as complying with UL 111.

#### 2.03 WIREWAYS

- A. Manufacturers:
  - 1. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com/#sle.
  - 2. Enduro Composites: www.endurocomposites.com/#sle.
  - 3. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
  - 4. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- B. Description: Lay-in wireways and wiring troughs with removable covers; listed and labeled as complying with UL 870.
- C. Wireway Type, Unless Otherwise Indicated:
- D. Finish for Painted Steel Wireways: Manufacturer's standard grey unless otherwise indicated.
- E. Minimum Wireway Size: 4 by 4 inches unless otherwise indicated.
- F. Where wireway size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

# PART 3 EXECUTION

# 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes and conduit terminations are installed in proper locations and are properly sized in accordance with NFPA 70 to accommodate raceways.
- C. Verify that mounting surfaces are ready to receive raceways and that final surface finishes are complete, including painting.
- D. Verify that conditions are satisfactory for installation prior to starting work.

# 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).

- 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 05 29 at intervals complying with NFPA 70 and manufacturer's requirements.
- F. Close unused raceway openings.
- G. Provide grounding and bonding in accordance with Section 26 05 26.

#### 3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements, for additional requirements.
- B. Inspect raceways for damage and defects.
- C. Correct wiring deficiencies and replace damaged or defective raceways.

# 3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

# 3.05 PROTECTION

A. Protect installed raceways from subsequent construction operations.

END OF SECTION 26 05 33.23

#### SECTION 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS

# PART 1 GENERAL

# **1.01 SECTION INCLUDES**

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Floor marking tape.
- G. Warning signs and labels.

# 1.02 RELATED REQUIREMENTS

- A. Section 09 91 13 Exterior Painting.
- B. Section 09 91 23 Interior Painting.
- C. Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- D. Section 26 05 73 Power System Studies: Arc flash hazard warning labels.
- E. Section 26 23 00 Low-Voltage Switchgear: Factory-installed mimic bus.
- F. Section 26 27 26 Wiring Devices Lutron: Device and wallplate finishes; factory premarked wallplates.

# 1.03 REFERENCE STANDARDS

- A. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. UL 969 Marking and Labeling Systems Current Edition, Including All Revisions.

# 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
  - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
  - 2. Do not install identification products until final surface finishes and painting are complete.

# 1.05 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- 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.

# 1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

# 1.07 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

# 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.
  - a. Switchboards:
    - 1) Identify ampere rating.
    - 2) Identify voltage and phase.
    - 3) Identify power source and circuit number. Include location when not within sight of equipment.
    - 4) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
  - b. Panelboards:
    - 1) Identify power source and circuit number. Include location when not within sight of equipment.
    - 2) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
    - 3) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
  - c. Transformers:
    - 1) Identify kVA rating.
    - 2) Identify voltage and phase for primary and secondary.
    - 3) Identify power source and circuit number. Include location when not within sight of equipment.
    - 4) Identify load(s) served. Include location when not within sight of equipment.
  - d. Centralized Emergency Lighting Inverters:
    - 1) Identify input and output voltage and phase.
    - 2) Identify power source and circuit number for normal power source. Include location when not within sight of equipment.
    - 3) Identify load(s) served. Include location.
  - e. Transfer Switches:
    - 1) Identify voltage and phase.
    - 2) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.
    - 3) Identify load(s) served. Include location when not within sight of equipment.
    - 4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.
  - f. Electricity Meters:
    - 1) Identify load(s) metered.
- 2. Service Equipment:

a. Use identification nameplate to identify each service disconnecting means.

- 3. Emergency System Equipment:
  - a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
  - b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
  - c. Use identification nameplate to identify emergency operating instructions for emergency system equipment.
- 4. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
- 5. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
- 6. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
- 7. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
- 8. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.

- a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches wide, painted in accordance with Section 09 91 23 and 09 91 13.
- Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
   a. Service equipment.
  - a. Service equipment.
  - b. Elevator control panels.
- 10. Arc Flash Hazard Warning Labels: Comply with Section 26 05 73.
- B. Identification for Conductors and Cables:
  - 1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
  - 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. Identification for Raceways:
  - 1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
  - 2. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
  - 3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
  - 4. Use underground warning tape to identify underground raceways.
  - 5. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet.
- D. Identification for Boxes:
  - 1. Use voltage markers to identify highest voltage present.
  - 2. Use voltage markers or color coded boxes to identify systems other than normal power system.
    - a. Color-Coded Boxes: Field-painted in accordance with Section 09 91 23 and 09 91 13 per the same color code used for raceways.
    - b. For exposed boxes in public areas, do not color code.
  - 3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
    - a. For exposed boxes in public areas, use only identification labels.
  - 4. Use warning labels to identify electrical hazards for boxes containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
- E. Identification for Luminaires:
  - 1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

# 2.02 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
  - 1. Manufacturers:
    - a. Brimar Industries, Inc: www.brimar.com/#sle.
    - b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
  - 2. Materials:
    - a. Indoor Clean, Dry Locations: Use plastic nameplates.
    - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
  - 3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically nonconductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
  - 4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laseretched text.
  - 5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laseretched text.

- 6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
  - 1. Manufacturers:
    - a. Brady Corporation: www.bradyid.com/#sle.
    - b. Brother International Corporation: www.brother-usa.com/#sle.
    - c. Panduit Corp: www.panduit.com/#sle.
  - 2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
  - 3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
  - 1. Minimum Size: 1 inch by 2.5 inches.
  - 2. Legend:
    - a. System designation where applicable:
      - 1) Emergency Power System: Identify with text "EMERGENCY".
    - b. Equipment designation or other approved description.
  - 3. Text: All capitalized unless otherwise indicated.
  - 4. Minimum Text Height:
    - a. System Designation: 1 inch.
    - b. Equipment Designation: 1/2 inch.
  - 5. Color:
    - a. Normal Power System: White text on black background.
    - b. Emergency Power System: White text on red background.
    - c. Fire Alarm System: White text on red background.
- D. Format for General Information and Operating Instructions:
  - 1. Minimum Size: 1 inch by 2.5 inches.
  - 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
  - 3. Text: All capitalized unless otherwise indicated.
  - 4. Minimum Text Height: 1/4 inch.
  - 5. Color: Black text on white background unless otherwise indicated.
- E. Format for Receptacle Identification:
  - 1. Minimum Size: 3/8 inch by 1.5 inches.
  - 2. Legend: Power source and circuit number or other designation indicated.
  - 3. Text: All capitalized unless otherwise indicated.
  - 4. Minimum Text Height: 3/16 inch.
  - 5. Color: Black text on clear background.
- F. Format for Fire Alarm Device Identification:
  - 1. Minimum Size: 3/8 inch by 1.5 inches.
  - 2. Legend: Designation indicated and device zone or address.
  - 3. Text: All capitalized unless otherwise indicated.
  - 4. Minimum Text Height: 3/16 inch.
  - 5. Color: Red text on white background.

# 2.03 WIRE AND CABLE MARKERS

- A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wraparound 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.
- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- E. Minimum Text Height: 1/8 inch.
- F. Color: Black text on white background unless otherwise indicated.

#### 2.04 VOLTAGE MARKERS

- A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- C. Minimum Size:
  - 1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
  - 2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
  - 3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
  - 4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- D. Legend:

F

- 1. Markers for Voltage Identification: Highest voltage present.
- 2. Markers for System Identification:
  - a. Emergency Power System: Text "EMERGENCY".
- Color: Black text on orange background unless otherwise indicated.

#### 2.05 UNDERGROUND WARNING TAPE

- A. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
- C. Legend: Type of service, continuously repeated over full length of tape.
- D. Color:

#### 2.06 FLOOR MARKING TAPE

A. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlaminate, 3 inches wide, with alternating black and white stripes.

#### 2.07 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 selfadhesive 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.

# 3.02 INSTALLATION

- 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. Branch Devices: Adjacent to device.
  - 6. Interior Components: Legible from the point of access.
  - 7. Conduits: Legible from the floor.

- 8. Boxes: Outside face of cover.
- 9. Conductors and Cables: Legible from the point of access.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
- G. Mark all handwritten text, where permitted, to be neat and legible.

#### 3.03 FIELD QUALITY CONTROL

A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

# END OF SECTION 26 05 53

#### SECTION 26 05 83 WIRING CONNECTIONS

# PART 1 GENERAL

#### **1.01 SECTION INCLUDES**

A. Electrical connections to equipment.

#### 1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 05 33.13 Conduit for Electrical Systems.
- C. Section 26 05 33.16 Boxes for Electrical Systems.
- D. Section 26 27 26 Wiring Devices.
- E. Section 26 28 16.16 Enclosed Switches.
- F. Section 26 29 13 Enclosed Controllers.

#### 1.03 REFERENCE STANDARDS

- A. NEMA WD 1 General Color Requirements for Wiring Devices 1999 (Reaffirmed 2015).
- B. NEMA WD 6 Wiring Devices Dimensional Specifications 2016.
- C. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
  - 2. Determine connection locations and requirements.
- B. Sequencing:
  - 1. Install rough-in of electrical connections before installation of equipment is required.
  - 2. Make electrical connections before required start-up of equipment.

#### 1.05 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- 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.

#### 1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

# PART 2 PRODUCTS

# 2.01 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
  - 1. Colors: Comply with NEMA WD 1.
  - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
  - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches: As specified in Section 26 28 16.16 and in individual equipment sections.

- C. Wiring Devices: As specified in Section 26 27 26.
- D. Flexible Conduit: As specified in Section 26 05 33.13.
- E. Wire and Cable: As specified in Section 26 05 19.
- F. Boxes: As specified in Section 26 05 33.16.

# 2.02 EQUIPMENT CONNECTIONS

# PART 3 EXECUTION

# 3.01 EXAMINATION

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

# 3.02 ELECTRICAL CONNECTIONS

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

# END OF SECTION 26 05 83