

## SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
  - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

#### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. FMC: Flexible metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. LFNC: Liquidtight flexible nonmetallic conduit.
- F. NBR: Acrylonitrile-butadiene rubber.
- G. RNC: Rigid nonmetallic conduit.

#### 1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Custom enclosures and cabinets.

2. For handholes and boxes for underground wiring, including the following:
  - a. Duct entry provisions, including locations and duct sizes.
  - b. Frame and cover design.
  - c. Grounding details.
  - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
  - e. Joint details.
- C. Samples for Initial Selection: For wireways and surface raceways with factory-applied texture and color finishes.
  1. Size: As requested by Owner or Architect minimum of 4 samples.
- D. Samples for Verification: For each type of exposed finish required for wireways and surface raceways, prepared on Samples of size indicated below.
  1. Size: As requested by Owner or Architect minimum of 4 samples.
- E. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  1. Structural members in the paths of conduit groups with common supports.
  2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- F. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
  1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- G. Qualification Data: For professional engineer and testing agency.
- H. Source quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Alflex Inc.
  - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - 5. Electri-Flex Co.
  - 6. Maverick Tube Corporation.
  - 7. O-Z Gedney; a unit of General Signal.
  - 8. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Aluminum Rigid Conduit: ANSI C80.5.
- D. IMC: ANSI C80.6.
- E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
  - 1. Comply with NEMA RN 1.
  - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- F. EMT: ANSI C80.3.
- G. FMC: Zinc-coated steel or aluminum.
- H. LFMC: Flexible steel conduit with PVC jacket.
- I. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
  - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
  - 2. Fittings for EMT: Steel or die-cast, set-screw or compression type.
  - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

- J. Joint Compound for Rigid Steel Conduit: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

## 2.2 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - 3. Arnco Corporation.
  - 4. CANTEX Inc.
  - 5. CertainTeed Corp.; Pipe & Plastics Group.
  - 6. Condux International, Inc.
  - 7. ElecSYS, Inc.
  - 8. Electri-Flex Co.
  - 9. Lamson & Sessions; Carlon Electrical Products.
  - 10. RACO; a Hubbell Company.
  - 11. Thomas & Betts Corporation.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- C. LFNC: UL 1660.
- D. Fittings for and RNC: NEMA TC 3; match to conduit or tubing type and material.
- E. Fittings for LFNC: UL 514B.

## 2.3 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman.
  - 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type, Flanged-and-gasketed type where indicated or required by code or location of installation.
- E. Finish: Manufacturer's standard enamel finish.

#### 2.4 NONMETALLIC WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Hoffman.
  - 2. Lamson & Sessions; Carlon Electrical Products.
- B. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

#### 2.5 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Thomas & Betts Corporation.
    - b. Walker Systems, Inc.; Wiremold Company (The).
    - c. Wiremold Company (The); Electrical Sales Division.

#### 2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
  - 2. EGS/Appleton Electric.
  - 3. Erickson Electrical Equipment Company.
  - 4. Hoffman.
  - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
  - 6. O-Z/Gedney; a unit of General Signal.
  - 7. RACO; a Hubbell Company.
  - 8. Thomas & Betts Corporation.
  - 9. Walker Systems, Inc.; Wiremold Company (The).
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

- E. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.
- F. Nonmetallic Floor Boxes: Nonadjustable, round.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum or galvanized, cast iron with gasketed cover.
- I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
- J. Cabinets:
  - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.

## 2.7 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## 2.8 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. Calpico, Inc.

3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.9 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by a independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit.
2. Concealed Conduit, Aboveground: Rigid steel conduit.
3. Underground Conduit: RNC, Type EPC-80-PVC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC or LFNC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.
6. Application of Handholes and Boxes for Underground Wiring:
  - a. Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Fiberglass enclosures with polymer-concrete frame and cover, SCTE 77, Tier 15 structural load rating.
  - b. Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Heavy-duty fiberglass units with polymer-concrete frame and cover, SCTE 77, Tier 8 structural load rating.

- c. Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.
- B. Comply with the following indoor applications, unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed, Not Subject to Severe Physical Damage: EMT.
  3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
  4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  6. Damp or Wet Locations: Rigid steel conduit
  7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits in contact with concrete.
- 3.2 INSTALLATION
- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
  - B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.



- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Change from RNC, Type EPC-40-PVC, to rigid steel conduit, or before rising above the floor
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
- L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
  - 1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
  - 2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
  - 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where otherwise required by NFPA 70.
- N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).
1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
    - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
    - d. Attics: 135 deg F (75 deg C) temperature change.
  2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.
  3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- O. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures normal branch lighting only, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- Q. Set metal floor boxes level and flush with finished floor surface.
- R. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- ### 3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS
- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
  - 1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
  - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

### 3.4 SLEEVE-SEAL INSTALLATION

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

### 3.5 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

### 3.6 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION