

**SECTION 26 05 33  
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

SPEC WRITER NOTES: Use this section only for NCA projects. Delete between //--//if not applicable to project. Also, delete any other item or paragraph not applicable in the section and renumber the paragraphs.

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, and electrically grounded raceway systems. Raceways are required for all wiring unless specified otherwise.
- B. Definitions: The term conduit, used in this specification, shall imply any of the raceway types specified.

**1.2 RELATED WORK**

- A. Section 06 10 00, ROUGH CARPENTRY: Mounting board for telephone closets.
- B. Section 07 60 00, FLASHING AND SHEET METAL: Fabrications for the deflection of water away from the building envelope at penetrations.
- C. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire rated construction.
- D. Section 07 92 00, JOINT SEALANTS: Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.
- E. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that apply to more than one section of Division 26.
- F. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- G. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground conduits.
- H. Section 31 20 00, EARTHWORK: Bedding of conduits.

**1.3 QUALITY ASSURANCE**

- A. Quality assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

A. Submit in accordance with Paragraph, SUBMITTALS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:

- a. Size and location of main feeders.
- b. Size and location of panels and pull boxes.
- c. Layout of required conduit penetrations through structural elements.
- d. The specific item proposed and its area of application shall be identified on the catalog cuts.

2. Certification: Prior to final inspection, submit to the Resident Engineer/COR four (4) copies of the certification that the equipment has been properly installed in accordance with the drawings and specifications.

**1.5 APPLICABLE PUBLICATIONS**

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. American National Standards Institute (ANSI):

- C80.1-20.....Electrical Rigid Steel Conduit
- C80.3-20.....Electrical Metallic Tubing - Steel
- C80.5-20.....Electrical Rigid Metal Conduit - Aluminum
- C80.6-18.....Electrical Intermediate Metal Conduit

C. National Electrical Manufacturers Association (NEMA):

- TC 3-21.....PVC Fittings for Use with Rigid PVC Conduit and Tubing
- FB 1-14.....Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

D. National Fire Protection Association (NFPA):

- 70-23.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

- 1-05.....Flexible Metal Conduit
- 5-16.....Surface Metal Raceway and Fittings
- 6-07.....Rigid Metal Conduit
- 50-15.....Safety Enclosures for Electrical Equipment

360-13.....	Safety Liquid-Tight Flexible Steel Conduit
467-22.....	Safety Grounding and Bonding Equipment
514A-13.....	Safety Metallic Outlet Boxes
514B-12.....	Safety Conduit, Tubing, and Cable Fittings
514C-14.....	Safety Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
651-11.....	Safety Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
651A-11.....	Safety Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit
797-07.....	Safety Electrical Metallic Tubing - Steel
1242-06.....	Safety Electrical Intermediate Metal Conduit - Steel

## **PART 2 - PRODUCTS**

### **2.1 MATERIAL**

- A. Conduits shall be in accordance with ANSI, NEMA, NEC, UL, as specified, and as shown on the drawings.
- B. Conduit Size: In accordance with the NEC, but not less than 13 mm (1/2 inch) unless otherwise shown. Where permitted by the NEC, 13 mm (1/2 inch) flexible conduit may be used for tap connections to recessed lighting fixtures.
- C. Conduit:
  1. Rigid steel conduit (RMC steel): Shall Conform to UL 6, ANSI C80.1.
  2. Rigid aluminum conduit (RMC aluminum): Shall Conform to UL 6A, ANSI C80.5.
  3. Intermediate metal conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
  4. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 volts or less.
  5. Flexible metal conduit (FMC): Shall Conform to UL 1.
  6. Liquid-tight flexible metal conduit (LTMC): Shall Conform to UL 360.
  7. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
  8. Surface metal raceway: Shall Conform to UL 5.
- D. Conduit Fittings:
  1. Rigid steel and IMC conduit fittings:
    - a. Fittings shall meet the requirements of UL 514B and NEMA FB 1.

- b. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
  - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
  - d. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
  - e. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
  - f. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
2. Rigid aluminum conduit fittings:
- a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
  - b. Locknuts and bushings: As specified for rigid steel and IMC conduit.
  - c. Set screw fittings: Not permitted for use with aluminum conduit.
3. Electrical metallic tubing fittings:
- a. Fittings shall meet the requirements of UL 514B and ANSI/NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set

screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.

- d. Indent type connectors or couplings are prohibited.
  - e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
4. Flexible steel conduit fittings:
    - a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
    - b. Clamp type, with insulated throat.
  5. Liquid-tight flexible metal conduit fittings:
    - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
    - b. Only steel or malleable iron materials are acceptable.
    - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
  6. Direct burial plastic conduit fittings:
    - a. Fittings shall meet the requirements of UL 514C and NEMA TC3.
    - b. As recommended by the conduit manufacturer.
  7. Surface metal raceway fittings: As recommended by the raceway manufacturer.
  8. Expansion and deflection couplings:
    - a. Conform to UL 467 and UL 514B.
    - b. Accommodate, 19 mm (3/4 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
    - c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
    - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
- E. Conduit Supports:
1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
  2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.

3. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.
  4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- F. Outlet, Junction, and Pull Boxes:
1. UL-50 and UL-514A.
  2. Cast metal: Where required by the NEC or shown on the drawings, and equipped with rustproof boxes.
  3. Sheet metal boxes: Galvanized steel.
  4. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.
- G. Wireways: Equip with hinged covers, except where removable covers are shown.

### **PART 3 - EXECUTION**

#### **3.2 INSTALLATION**

- A. Install conduits in accordance with NEC, UL, as shown on the drawings, in accordance with manufacturer's recommendations, and as required below:
1. In complete runs before pulling in conductors and cables.
  2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
  3. Ensure that conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
  4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
  5. Ensure that conduit shall be mechanically and electrically continuous.
  6. Independently support conduit at 2.4 m (8 feet) on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
  7. Support conduit within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
  8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
  9. Conduit installations under fume and vent hoods are prohibited.

10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
11. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
12. Do not use aluminum conduits in wet locations.
13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors, and ceilings.

B. Conduit Bends:

1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

C. Layout and Homeruns:

1. Install conduit with wiring, including homeruns, as shown.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COTR/Resident Engineer.

### 3.2 CONDUIT PENETRATIONS

A. Cutting or Drilling Holes:

1. Mark up proposed locations of conduit penetrations in the structural sections such as ribs or beams with permanent markers prior to cutting or drilling through. Field inspect the proposed locations with Resident Engineer/COR. Obtain approval of the Resident Engineer/COR prior to cutting and drilling through structural sections.
2. Only cut or drill holes through concrete and masonry structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed.

- B. Fire Stop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with rock wool fiber or silicone foam sealant only.

Completely fill and seal clearances between raceways and openings with the fire stop material.

SPEC WRITER NOTES: Verify that roof penetration details are shown on the architectural drawings.

- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS.

### **3.3 CONDUIT INSTALLATION - CONCEALED**

#### A. In Concrete:

1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
2. Align and run conduit in direct lines.
3. Install conduit through concrete beams only when the following occurs:
  - a. Where shown on the structural drawings.
  - b. As approved by the Resident Engineer/COR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
4. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
  - a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
  - b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
  - c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.

#### B. Furred or Suspended Ceilings and in Walls:

1. Conduit for conductors above 600 volts:
  - a. Rigid steel or rigid aluminum.
  - b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.



2. Conduit for conductors 600 volts and below:
  - a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
3. Align and run conduit parallel or perpendicular to the building lines.
4. Connect recessed lighting fixtures to conduit runs with maximum 1.8 m (6 feet) of flexible metal conduit extending from a junction box to the fixture.
5. Tightening set screws with pliers is prohibited.

#### **3.4 CONDUIT INSTALLATION - EXPOSED**

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for conductors above 600 volts:
  1. Rigid steel or rigid aluminum.
  2. Different type of conduits mixed indiscriminately in the system is prohibited
- C. Conduit for conductors 600 volts and below:
  1. Rigid steel, rigid aluminum, IMC, or EMT.
  2. Different type of conduits mixed indiscriminately in the system is prohibited.
- D. Align and run conduit parallel or perpendicular to the building lines.
- E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- F. Support horizontal or vertical runs at not over 2.4 m (8 feet) intervals.
- G. Surface metal raceways: Use only where shown.
- H. Painting:
  1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
  2. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (2 inches) high black numerals and letters, showing the cable voltage rating.  
Provide legends where conduits pass through walls and floors and at maximum 6 M (20 feet) intervals in between.

#### **3.5 CONDUIT INSTALLATION - DIRECT BURIAL**

- A. Exterior routing of Lighting Systems and Other Branch circuits (600 Volt and Less, and 1.5 m (5 feet) from the buildings):
  1. Conduit: Thick wall PVC or high-density PE, unless otherwise shown.

2. Mark conduit at uniform intervals to show the kind of material, direct burial type, and the UL approval label.
3. Install conduit fittings and terminations as recommended by the conduit manufacturer.
4. Tops of conduits shall be as follows unless otherwise shown:
  - a. Not less than 600 mm (24 inches) below finished grade.
  - b. Not less than 750 mm (30 inches) below road and other paved surfaces.
  - //c. Installation under railroad tracks is prohibited.//
5. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
6. Excavation for conduit bedding and back-filling of trenches is specified in Section 31 20 00, EARTH MOVING.
  - a. Cut the trenches neatly and uniformly.
  - b. Do not kink the conduits.
7. Seal conduits, including spare conduits, at building entrances and at outdoor terminations for equipment with a suitable compound that prevents the entrance of moisture and gases.
8. Where metal conduit is shown, install threaded heavy wall rigid steel galvanized conduit or type A20 rigid steel galvanized conduit coated with 0.5 mm (20 mil) bonded PVC, or rigid steel or IMC, PVC coated or standard coated with bituminous asphaltic compound.
9. Warning tape shall be continuously placed 300 mm (12 inches) above conduits or electric lines.

### **3.6 CONDUIT INSTALLATION - HAZARDOUS LOCATIONS**

- A. Use rigid steel conduit only, notwithstanding requirements otherwise specified in this or other sections of these specifications.
- B. Install UL approved sealing fittings, that prevent passage of explosive vapors, in hazardous areas equipped with explosive proof lighting fixtures, switches, and receptacles, as required by the NEC.

### **3.7 CONDUIT INSTALLATION - WET OR DAMP LOCATIONS**

- A. Unless otherwise shown, use conduits of rigid steel or IMC.
- B. Provide sealing fittings, to prevent passage of water vapor, where conduits pass from warm to cold locations, i.e., (refrigerated spaces, constant temperature rooms, air-conditioned spaces building exterior walls, roofs) or similar spaces.
- C. Unless otherwise shown, use rigid steel or IMC conduit within 1.5 m (5 feet) of the exterior and below concrete building slabs in contact with

soil, gravel, or vapor barriers. Conduit shall include an outer factory coating of 0.5 mm (20 mil) bonded PVC or field coat with asphaltum before installation. After installation, completely coat damaged areas of coating.

### **3.8 CONDUIT INSTALLATION - MOTORS AND VIBRATING EQUIPMENT**

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. Provide liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside (air stream) of HVAC units, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with flexible metal conduit.

### **3.9 CONDUIT INSTALLATION - EXPANSION JOINTS**

- A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inches) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.
- C. Install expansion and deflection couplings where shown.

SPEC WRITER NOTES: Include the following paragraph for seismic areas only.

//D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed.//

### **3.10 CONDUIT SUPPORTS**

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.

- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 feet) on center.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
  - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
  - 2. Existing Construction:
    - a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
    - b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
    - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

### **3.11 BOX INSTALLATION**

- A. Boxes for Concealed Conduits:
  - 1. Flush mounted.

2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
- B. In addition to boxes shown on the drawings, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. For new boxes, remove only box knockouts if used to terminate conduits. If new conduits are terminated into existing boxes, plug any existing unused knockouts. Use threaded plugs for cast metal boxes and snap-in metal covers to plug unused openings of sheet metal boxes.
- D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inches), center-to-center lateral spacing shall be maintained between boxes.)
- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2 1/8 inches) deep, with device covers for the wall material and thickness involved.
- F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example: "SIG-FA JB No. 1".
- G. On all Branch Circuit junction box covers, identify the circuits with permanent black marker.

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