

**SECTION 27 05 33  
CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS**

**SPEC WRITER NOTES:**

1. Use this section only for NCA projects. Delete text between // \_\_\_\_\_ // not applicable to project. Edit remaining text to suit project.
2. Contact Department of Veterans Affairs' (VA) AHJ, Spectrum Management and COMSEC Service (SMCS), Special Communications Team (SMCS 07A2), Telephone (202-461-5301/5311), for technical assistance.
3. When using this section, always include Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS in project.

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

**SPEC WRITER NOTE:** Insert cemetery name and contract identification number.

1. New state-of-the-art fully functional conduits, fittings, and boxes to form complete, coordinated raceway system for FMS and OI&T communications cabling installed in VA's National Cemetery (NCA) // \_\_\_\_\_ // to regulate communication pathways to accommodate the facility's entire TIP to buildings, // building areas, // and // fenced areas // unless otherwise officially specified and shown of the drawings. // Contract // Project // Number: // \_\_\_\_\_ //.
- B. See Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS for requirements governing work of this section.

**1.2 RELATED REQUIREMENTS**

**SPEC WRITER NOTE:** Update and retain references only when specified elsewhere in this section.

- A. Mounting Board for Communication Closets: Section 06 10 00, ROUGH CARPENTRY.
- B. Sealing around penetrations to maintain integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- C. Fabrications for deflection of water away from building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.

- D. Sealing around conduit penetrations through building envelope to prevent moisture migration into building: Section 07 92 00, JOINT SEALANTS.
- E. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- F. General electrical requirements and items common to more than one Division 27 section: Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS.

### 1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. National Electrical Manufacturers Association (NEMA):
  - 1. TC-3-15 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
  - 2. FB-1-14 - Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing (EMT) and Cable.
- C. National Fire Protection Association (NFPA):
  - 1. 70-17 - National Electrical Code (NEC).
- D. UL LLC (UL):
  - 1. 1-05 - Flexible Metal Conduit.
  - 2. 5-16 - Surface Metal Raceway and Fittings.
  - 3. 6-07 - Electrical Rigid Metal Conduit-Steel.
  - 4. 50-15 - Electrical Equipment, Non-Environmental Considerations.
  - 5. 360-13 - Liquid-Tight Flexible Steel Conduit.
  - 6. 467-13 - Grounding and Bonding Equipment.
  - 7. 514A-13 - Metallic Outlet Boxes.
  - 8. 514B-12 - Conduit, Tubing, and Cable Fittings.
  - 9. 514C-14 - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
  - 10. 651-11 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
  - 11. 651A-11 - Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit.
  - 12. 797-07 - Electrical Metallic Tubing-Steel.
  - 13. 1242-06 - Electrical Intermediate Metal Conduit-Steel.
- E. United States Department of Veterans Affairs (VA):
  - 1. VA Construction and Facilities Management (CFM):
    - a. DG OIT - Office of Information & Technology, 2011.
    - b. DM Electrical - Electrical Design Manual, 2015.

- c. DM Telecom - Telecommunications & Special Telecommunications Systems Design Manual, 2016.
- d. PRSDM - Physical Resilience Security Design Manual for VA Life-Safety Protected Facilities, 2016.

#### 1.4 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

#### 1.5 WARRANTY

SPEC WRITER NOTE: Always retain construction warranty. FAR includes Contractor's one year labor and material warranty.

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

### PART 2 - PRODUCTS

#### 2.1 PRODUCTS - GENERAL

SPEC WRITER NOTE: Coordinate with Section 27 10 00, STRUCTURED CABLING to ensure type THW insulation is not specified for use in 13 mm (1/2 inch) conduit.

- A. Conduit Size: NFPA 70, but minimum 19.05 mm (1/2 inch), unless otherwise shown on drawings. Where permitted by NFPA 70, 25.40 mm (1 inch) flexible conduit is acceptable for tap connections to recessed lighting fixtures.
- B. Conduit:
  1. Rigid galvanized steel: UL 6, ANSI C80.1.
  2. Rigid aluminum: UL 6A, ANSI C80.5.
  3. Rigid intermediate steel conduit (IMC): UL 1242, ANSI C80.6.
  4. Electrical metallic tubing (EMT): UL 797, ANSI C80.3. Maximum 105 mm (4 inch) and only with cable rated maximum 600 Volts.
  5. Flexible galvanized steel conduit: UL 1.
  6. Liquid-tight flexible metal conduit: UL 360.
  7. Direct burial plastic conduit: UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
  8. Surface metal raceway: UL 5.
- C. Conduit Fittings:

1. Rigid Steel and IMC Conduit Fittings: UL 514B and NEMA FB 1.
  - a. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Steel or malleable iron materials. Integral retractable type IMC couplings are also acceptable.
  - b. Locknuts: Bonding type with sharp edges for digging into metal wall of an enclosure.
  - c. Bushings: Metallic insulating type, with insulating insert molded or locked into fitting metallic body. Metal or nonmetallic bushing materials are not acceptable.
  - d. Erickson (Union-Type) and Set Screw Type Couplings: Approved for use in concrete to complete conduit run. Provide case-hardened steel set screws with hex head and cup point to firmly seat in conduit wall for positive ground. Do not tighten set screws with pliers.
  - e. Sealing Fittings: Threaded cast iron type. Provide continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates in finish to match other electrical plates in same 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. Maximum 0.4 percent copper permitted in aluminum fittings.
  - b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
  - c. Set Screw Fittings: Not acceptable for use with aluminum conduit.
3. Electrical Metallic Tubing Fittings: UL 514B and NEMA FB-1, steel or malleable iron materials.
  - a. Couplings and Connectors: Concrete tight and rain tight, with insulated throats connectors.
    - 1) Provide gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller.
    - 2) Provide set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches).

- 3) Provide case-hardened steel set screws with hex head and cup point to firmly seat in wall of conduit for positive grounding.
    - b. Do not use indent type connectors or couplings.
    - c. Do not use die-cast or pressure-cast zinc-alloy fittings or "pot metal" fittings.
  4. Flexible Steel Conduit Fittings:
    - a. Comply with UL 514B, steel or malleable iron materials.
    - b. Clamp type, with insulated throat.
  5. Liquid-tight flexible metal conduit fittings: UL 514B and NEMA FB-1, steel or malleable iron materials.
    - a. Provide fittings with threaded grounding cone, steel or plastic compression ring, and gland for tightening. Connectors to have insulated throats.
  6. Direct Burial Plastic Conduit Fittings:
    - a. Fittings: UL 514C and NEMA TC-3.
    - b. As recommended by conduit manufacturer.
  7. Surface Metal Raceway Fittings: As recommended by raceway manufacturer.
  8. Expansion and Deflection Couplings:
    - a. Comply with UL 467 and UL 514B.
    - b. Allowable Deflection, Expansion, or Contraction in Any Direction: 19 mm (0.75 inch).
    - c. Allowable Angular Deflection: 30 degrees.
    - d. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents according to UL 467 and NFPA 70 tables for ground conductors.
    - e. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
1. Parts and Hardware: Zinc-coat or equivalent corrosion protection.
  2. Individual Conduit Hangers: To suit application, with pre-assembled closure bolt and nut and provisions for receiving hanger rod.
  3. Multiple Conduit (Trapeze) Hangers: Minimum 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 2.8 mm (0.11 inch) thick steel, cold formed, lipped channels; with minimum 9 mm (3/8 inch) diameter steel hanger rods.

4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Junction, and Pull Boxes: UL 50 and UL 514A.
1. Cast metal where required by NFPA 70 or shown on drawings, and equipped with rustproof boxes.
  2. Sheet Metal Boxes: Galvanized steel, except as otherwise shown on drawings.
  3. Install flush mounted wall or ceiling boxes with raised covers so that front face of raised cover is flush with adjacent finish surface. Install surface mounted wall or ceiling boxes with surface style flat or raised covers.
- F. Wireways: Equip with hinged covers, except where removable covers are shown on drawings.
- G. Warning Tape: Standard, 0.10 mm (4 mil) thick, polyethylene 76 mm (3 inch) wide non-detectable type tape, red with black letters, and imprinted "CAUTION BURIED COMMUNICATIONS CABLE BELOW".

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION - GENERAL**

- A. Install conduit as follows:
1. In complete runs before pulling in cables or wires.
  2. Flattened, dented, or deformed conduit is not acceptable. Remove and replace damaged conduits with new undamaged material.
  3. Ensure conduit installation does not encroach into ceiling height head room, walkways, or doorways.
  4. Cut square with hacksaw, ream, remove burrs, and draw up tight.
  5. Mechanically continuous.
  6. Independently support conduit at 2400 mm (8 feet) on center. Supports such as suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts are not acceptable.
  7. Support 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 rough-in stage to prevent entry of debris, until wires are pulled in.
  9. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit

installations, provide locknut inside enclosure, made up wrench tight. Do not make conduit connections to junction box covers.

10. Flashing of roofing membrane penetrations is specified in Section 07 60 00, FLASHING AND SHEET METAL.
11. Aluminum conduits in wet locations are not acceptable.
12. Unless otherwise indicated on drawings or specified, install conduits concealed within finished walls, floors and ceilings.

B. Conduit Bends:

1. Make bends with standard conduit bending machines.
2. Conduit hickey is acceptable for slight offsets, and for straightening stubbed out conduits.
3. Bending of conduits with pipe tee or vise is not acceptable.

C. Layout and Homeruns:

1. Install conduit with wiring, including homeruns, as shown on drawings.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing proposed deviations have been submitted to and approved by Contracting Officer's Representative (COR).

D. Fire Alarm:

SPEC WRITER NOTE: Check "Fire Detection and Alarm" Section number. There may be two sections with the same number.

1. Paint fire alarm conduit red (red "top-coated" conduit from conduit manufacturer is acceptable in lieu of painted conduit) as specified in Section 28 31 00, FIRE DETECTION AND ALARM.

### 3.2 CONCEALED WORK INSTALLATION

A. In Concrete:

1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs 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 structural drawings.
  - b. Approved by COR before construction and after submission of drawing showing location, size, and position of each penetration.
4. Do not install conduit in concrete less than 75 mm (3 inches) thick.

- a. Conduit outside diameter larger than 1/3 of 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 center of slab so there will be minimum 19 mm (3/4 inch) of concrete around conduits.
5. Install couplings and connections watertight. Provide UL approved conductive type thread compounds to ensure low resistance ground continuity through conduits. Do not tighten set screws with pliers.
- B. In Furred or Suspended Ceilings and Walls:
1. Conduit for conductors above 600 Volts:
    - a. Rigid steel or rigid aluminum.
    - b. Aluminum conduit mixed indiscriminately with other types in same system is not acceptable.
  2. Conduit for conductors 600 Volts and below:
    - a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in same system is not acceptable.
  3. Align and run conduit parallel or perpendicular to building lines.
  4. Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (6 feet) of flexible metal conduit extending from junction box to fixture.
  5. Do not tighten set screws with pliers.

### 3.3 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on 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. Aluminum conduit mixed indiscriminately with other types in same system is not acceptable.
- C. Conduit for Conductors 600 Volts and below:
  1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in system is not acceptable.
- D. Align and run conduit parallel or perpendicular to building lines.
- E. Install horizontal runs close to ceiling or beams and secure with conduit straps.



- F. Support horizontal or vertical runs at maximum 2400 mm (8 foot) intervals.
- G. Surface metal raceways: Provide only where shown on drawings.
- H. Painting:
  1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
  2. Paint conduits containing cables rated over 600 Volts safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. Paint legends with 50 mm (2 inch) high black numerals and letters, showing cable Voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

### 3.4 EXPANSION JOINTS

- A. Provide expansion and deflection couplings for conduits 75 mm (3 inches) and larger, secured to building structure on opposite sides of building expansion joint. Install couplings according to manufacturer's instructions.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of expansion joint. Connect conduits to junction boxes with sufficient flexible conduit slack to produce 125 mm (5 inch) vertical drop midway between ends. Install copper green ground bonding jumper at flexible conduit. Expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are also acceptable.
- C. Install expansion and deflection couplings where shown on Drawings.

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

- D. Seismic Areas: Provide conduits rigidly secured to building structure on opposite sides of building expansion joint with junction boxes on both sides of joint. Connect conduits to junction boxes with 375 mm (15 inches) of slack flexible conduit. Install copper green ground bonding jumper at flexible conduit.

### 3.5 CONDUIT SUPPORT INSTALLATION

- A. Safe Working Load: Maximum 1/4 of fastening devices proof test load.
- B. Provide pipe straps or individual conduit hangers to support individual conduits with 2.5 m (8 foot) on center maximum distance between supports.
- C. Support multiple conduit runs with trapeze hangers. Provide trapeze hangers designed to support load equal to or greater than sum of

conduit weights, wires, hanger itself, and 90 kg (200 lbs.). 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: Steel or malleable iron concrete inserts set in place before concrete placement.
  - 2. Existing Construction:
    - a. Steel expansion anchors minimum 6 mm (1/4 inch) bolt size and minimum 28 mm (1-1/8 inch) embedment.
    - b. Power set fasteners minimum 6 mm (1/4 inch) diameter with depth of penetration minimum 75 mm (3 inches).
    - c. Provide 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: Provide machine screw fasteners or other devices, designed and approved for application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is not acceptable.
- J. Chain, wire, or perforated strap to support or fasten conduit is not acceptable.
- K. Spring steel type supports or fasteners are not acceptable except as horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Provide riser clamps and supports at vertical conduit runs according to NFPA 70 and as shown on drawings. Provide cable and wire supports with fittings that include internal wedges and retaining collars.

### **3.6 BOX INSTALLATION**

- A. Boxes for Concealed Conduits:
  - 1. Flush mounted.
  - 2. Provide raised covers for boxes to suit wall or ceiling, construction and finish.
- B. In addition to boxes shown on drawings, install additional boxes where required to prevent damage to cables and wires during pulling in operations.

- C. Remove knockouts only as required and plug unused openings. Provide threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. Back-to-back outlet boxes in same wall are not acceptable. Maintain minimum 600 mm (24 inches), center-to-center lateral spacing between boxes.
- E. Minimum outlet box for ground fault interrupter (GFI) receptacles: 100 mm (4 inches) square by 55 mm (2-1/8 inches) deep, with device covers coordinated with wall material and thickness.
- F. Stencil or install phenolic nameplates on box covers identified on riser diagrams; for example "SIG-FA JB No. 1".
- G. Identify circuits on branch circuit junction box covers with black marker.

**3.7 // COMMUNICATION // AND // ELECTRONIC SAFETY AND SECURITY // SYSTEM CONDUIT**

- A. Install communication raceway system as shown on drawings.
- B. Minimum Conduit Size: 19 mm (3/4 inch), but minimum size shown on drawings.
- C. Equip conduit ends with insulated bushings.
- D. Provide pull boxes after every two 90 degree bends at 100 mm (4 inch) conduits within buildings. Size boxes according to NFPA 70.
- E. Terminate vertical conduits/sleeves through closet floors minimum 75 mm (3 inches) below floor and minimum 75 mm (3 inches) below ceiling of floor below.
- F. Terminate conduit runs to and from closet backboard or interstitial space at top or bottom of backboard. Conduits to enter communication closets next to wall and be flush with backboard.
- G. Where drilling is required for vertical conduits, locate holes where approved in structural sections, such as ribs or beams.
- H. Seal empty conduits located in communication closets or on backboards with standard non-hardening duct seal compound to prevent moisture and gas entry and to meet fire resistance requirements.
- I. Maximum four quarter turns (90 degree bends) are permitted in conduit runs between pull boxes/backboards. Minimum communication conduit bend radius as follows (special long radius):

| Sizes of Conduit | Radius of Conduit Bends |
|------------------|-------------------------|
| Trade Size       | mm, Inches              |

| Sizes of Conduit<br>Trade Size | Radius of Conduit Bends<br>mm, Inches |
|--------------------------------|---------------------------------------|
| 3/4                            | 150 (6)                               |
| 1                              | 230 (9)                               |
| 1-1/4                          | 350 (14)                              |
| 1-1/2                          | 430 (17)                              |
| 2                              | 525 (21)                              |
| 2-1/2                          | 635 (25)                              |
| 3                              | 775 (31)                              |
| 3-1/2                          | 900 (36)                              |
| 4                              | 1125 (45)                             |

J. Provide 19 mm (3/4 inch) thick fire retardant treated plywood specified in Section 06 10 00, ROUGH CARPENTRY on communication closet walls where shown on drawings. Install plywood with bottom edge 300 mm (1 foot) above finished floor.

K. Provide and pull wire in empty conduits, except through floor sleeves.

### 3.8 FIRESTOPPING

A. Firestopping: Where conduits, wireways, and other // communications // and // electronic safety and security // raceways pass through fire partitions, fire walls, smoke partitions, or floors, install fire stop that provides an effective barrier against spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with only rock wool fiber or silicone foam sealant. Completely fill and seal clearances between raceways and openings with fire stop material.

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

### 3.9 WATERPROOFING

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

### 3.10 CLEANING

A. Remove and legally dispose of debris and excess material from project site.

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