26 0533 - Raceways and Boxes for Electrical Systems

PART 1 - GENERAL

1.1. SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Raceways include the following:

1. Rigid Galvanized Conduit (RGC), zinc coated.
2. Electrical Metallic Tubing (EMT).
3. Liquidtight Flexible Metal Conduit (LFMC).
4. Polyvinyl Chloride Conduit (PVC) Schedule 40.
5. PVC Coated Rigid Galvanized Conduit.

C. Boxes, enclosures, and cabinets include the following:

1. Device boxes.
2. Outlet boxes.
3. Pull and junction boxes.
4. Cabinets and hinged cover enclosures.
5. Cable access box.
6. Conduit Bodies.

D. Related Requirements:

1. Section 078413 “Penetration Firestopping” for firestopping at conduit and box entrances.
2. Section 260543 “Underground Ducts and Raceways for Electrical Systems” for exterior ductbanks, manholes, and underground utility construction.
3. Section 270528 “Pathways for Communications Systems” for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

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1.2. REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1. C80.1:Rigid steel conduit, zinc-coated RGS.
2. C80.3:Electrical metallic tubing, zinc-coated (EMT).

B. Federal Standards (FS)

1. W-C-586: Conduit outlet boxes, bodies, and entrance caps.

C. National Electrical Contractors Association (NECA).

D. National Electrical Manufacturers Association (NEMA).

1. FB1: Fitting, cast metal Boxes, and conduit bodies, and cable assemblies.
2. OS1: Sheet-steel outlet boxes, device boxes, covers, and box supports.
3. 250: Enclosures for electrical equipment (1000 volts and below).
4. TC2: Rigid nonmetallic conduit.
5. ICS-6: Industrial control system enclosure.
6. RN1: Polyvinyl chloride (PVC) externally coated galvanized rigid steel conduit.

E. National Fire Protection Association (NFPA)

1. 70: National Electrical Code (NEC), latest edition.

F. Occupational Safety and Health Administration (OSHA)

1. 29 CFR 1910.7 - Definitions and requirements for a Nationally Recognized Testing Laboratory (NRTL).

G. Underwriters Laboratories (UL)

1. 6: Rigid metal conduit.
2. 50: Enclosures for electrical equipment.
3. 360: Liquid-tight flexible metal conduit.
4. 486A: Wire connectors and soldering lugs for use with copper conductors.
5. 514A: Metallic outlet boxes.
6. 514B: Fittings for conduit and outlet boxes.
7. 797: Electric metallic tubing.

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8. 870: Wireways, auxiliary gutter, and associated fittings.
9. 1242: Intermediate metal conduits.

1.3. SUBMITTALS

A. Product data for wireway and fittings, floor boxes, hinged cover enclosures, and cabinets.

1.4. QUALITY ASSURANCE

A. Comply with latest edition of the NFPA 70 “National Electrical Code” for components and installation.

1. Boxes shall be sized in accordance with NEC Article 370.

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms “Listed and Labeled”: As defined in the “National Electrical Code,” Article 100.
2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.

C. Comply with NECA “Standard of Installation.”

D. Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.1. GENERAL

A. Enclosures shall conform to NEMA standards.

2.2. MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Metal Conduit and Tubing:
   a. Allied Tube and Conduit, Grinnell Co.
   b. Thomas & Betts Corp.
   c. Wheatland Tube.

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B. Conduit Bodies and Fittings:

1. Appleton Electric Co.
2. Hubbell, Inc.
3. Thomas & Betts Corp.

C. Boxes, Enclosures, and Cabinets:

1. Hoffman Engineering Co.
2. Thomas & Betts Corp.
3. Cooper Industries, Midwest Electric.

2.3. METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1 and UL 6.

B. Galvanized Rigid Steel Conduit: ANSI C80.1.

C. Electrical Metallic Tubing and Fittings: UL 797, and ANSI C80.3 with compression-type fittings.

1. Connectors shall have an insulated throat, smooth bell-shaped end or a bushing.

D. Liquidtight Flexible Metal Conduit: UL 360.

E. Fittings: UL 514B and NEMA FB 1, compatible with conduit and of the threaded type. Set Screw fittings are not allowed.

2.4. OUTLET AND DEVICE BOXES

A. Sheet Metal Boxes: NEMA OS 1 and UL 514A.

B. Cast Metal Boxes: NEMA FB 1, type FD, cast ferroalloy box with threaded hubs, and with gasketed cover.

C. Cast Metal Boxes: NEMA FB 1, type FD, cast ferroalloy box with threaded hubs, and with gasketed cover.

D. Exposed Outlet Boxes for junction boxes and wall switch boxes: UL 514A steel, malleable iron or cast-iron boxes with threaded conduit entry for surface mounting in areas having exposed conduit systems.

E. Flush Outlet Boxes: UL 514A hot-dip galvanized steel, square or rectangular, 2-1/8 inches deep by four inches high, with extension ring where necessary.

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F. Boxes for lighting fixtures: Flush mounted or in concealed areas: octagonal, four inches by 2-1/8 inches deep, galvanized steel, with fixture stud supports and attachments to properly support ceiling and bracket type lighting fixtures. Surface mounted: malleable or cast-iron boxes with threaded conduit hub.

G. Gangable Outlet Boxes: 2-1/2 inches deep by four inches high with partitions as required.

H. Fittings: UL 514B.

2.5. PULL AND JUNCTION BOXES

A. Small Sheet Metal Boxes: NEMA OS 1 and UL 514A.

B. Cast Metal Boxes:

1. Threaded-hub type conforming to UL 514A and UL 514B.

2. Galvanized steel conforming to UL 514A and UL 514BB.

2.6. CABINETS AND ENCLOSURES

A. Hinged Cover Enclosures: NEMA 250, steel enclosure with continuous hinge cover and flush latch. Finish inside and out with manufacturer's standard enamel.

B. Cabinets: NEMA 250, type 1, code gauge galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

1. Cabinets shall be constructed with interior dimensions not less than those indicated on the Drawings.

2. Provide 3/4-inch plywood backboard unless otherwise indicated.

3. Key latch to match panelboards. Provide two keys with each cabinet unless otherwise notified.

C. Safety: UL 50.

D. Control Enclosures: NEMA ICS-6 and NEMA 250.

E. Telephone and Signal Cabinets shall be constructed in accordance with NEC Article 312.10.

F. All locks in project shall be keyed alike.

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PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine raceways prior to installation. No crushed or deformed raceway shall be installed.

3.2. WIRING METHODS

A. Outdoors: Use the following wiring methods:

1. Exposed to chemicals: PVC coated rigid galvanized steel conduit and fittings.
2. No exposition to chemicals: RGC.
3. Underground, Single Run: PVC schedule 40 conduit and fittings.
4. Underground, Grouped: PVC schedule 40 conduit and fittings.
5. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Liquidtight flexible metal conduit.
6. Boxes and Enclosures: NEMA Type 3R or 4X (corrosive chemicals).

B. Indoors: Use the following wiring methods:

1. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Liquidtight flexible metal conduit.
2. Damp or Wet Locations: RGC.
3. Exposed no damp or wet location: EMT.
4. Concealed: EMT. EMT shall only be used for lighting, receptacles, communications, fire alarm, security and environmental controls in concealed locations indoors.
5. Boxes and Enclosures: NEMA Type 1 in dry areas, NEMA 3R in damp or wet locations, NEMA 4X in chemical exposure areas.

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C. Conduit Use:

1. Install rigid galvanized steel (RGS) conduit or intermediate metal conduit (IMC) for all distribution panelboard feeders, panelboard feeders, and transformer feeders.

2. Install electrical metallic tubing (EMT) for communication/signal, lighting and branch circuits.

3. Use rigid galvanized steel (RGS) conduit for all exposed conduit systems within electrical and mechanical equipment rooms and electrical closets from floor level to a height of 8 feet above finished floor. Conduit for communication/signal, lighting and branch circuits may be transitioned to EMT above 8 feet above finished floor.

4. Use polyvinyl chloride (PVC) conduit for lightning protection or grounding system as indicated on drawings.

3.3. INSTALLATION

A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions. Install to withstand forces for the Seismic forces indicated in Section 26 05 29 "Hangers and Supports for Electrical Systems."

B. Minimum size raceway shall be 3/4 inch, unless otherwise noted. Conduit for security and signal systems shall be as follows:

1. No run shall contain more than two (2) 90-degree bends, or the equivalent.

2. Provide pull and junction boxes required to meet the above criteria.

3. Bends in conduit, 1-inch and larger, shall have minimum inside radii of 12 times the nominal conduit diameter.

C. Conceal conduit including EMT, unless otherwise indicated, within finished walls, ceilings, and floors.

1. Raceways shall not be attached to the ceiling suspension system.

2. Do not anchor or strap raceways to wall furring channels or to other raceways.

D. Keep raceways at least 6 inches away from parallel runs of fully insulated flues and fully insulated steam or hot water pipes. Raceways installed near uninsulated flues and steam or hot water pipes shall be subject to the approval of the Project Manager. Install horizontal raceway runs above water and steam piping.

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E. Install raceways level and square and at proper elevations. Install raceways at elevations which maintain headroom and at locations which avoid interference with other work requiring grading of pipe, the structure, finished ceiling, walls, etc.

F. Complete raceway installation before starting conductor installation. Raceways shall be fished and swabbed before conductors are pulled.

G. Support raceways and boxes as specified in Section 26 05 29 “Hangers and Supports for Electrical Systems.”

1. Boxes for fixtures on suspended ceilings shall be supported independently of the ceiling supports.

2. Boxes shall not be supported from sheet-metal roof decks.

H. Use temporary closures to prevent foreign matter from entering raceway.

I. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

J. Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.

1. Bends in conduit, for telecommunications and signal systems, that is 3/4 inch and larger shall have a minimum inside radii 12 times the nominal conduit diameter.

2. No run shall contain more than three (3) 90 degree bends, or the equivalent. Provide pullboxes, junction boxes, and conduit bodies as required to meet the bends criteria.

K. Use raceway fittings compatible with raceway and suitable for use and location.

L. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions, except as otherwise indicated.

M. Raceways or sections of raceways which pass through to damp, concealed, or underground location shall be of a type allowed for such locations by the NEC, and shall extend a minimum of 12 inches beyond the damp, concealed, or underground area.

N. Floor and Wall Penetrations:

1. Penetrations through walls or floors shall be sealed to prevent moisture and rodent entry and to deter air transfer.

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2. Seal penetrations of walls which separate individually temperature or humidity-controlled areas, to prevent air circulation.

O. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members and follow the surface contours as much as practical.

1. Run parallel or banked raceways together, on common supports where practical.

2. Make bends in concentric or banked runs from same center line to make bends concentric. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.

P. Join raceways with fittings designed and approved for the purpose and make joints tight.

1. Use bonding locknuts and bushings at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.

2. Use insulating bushings for all conduits to protect conductors.

3. Provide expansion fittings for all raceways passing through the building expansion joints.

Q. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, or where conduits enter enclosures without threaded hubs, use two locknuts, one inside and one outside the box to securely bond the conduit to the enclosure. In addition a bushing shall be installed on the interior threaded end of the conduit to protect conductor insulation.

R. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed. In addition a bushing shall be installed on the interior threaded end of the chase nipple to protect conductor insulation.

S. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.

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T. Stub-Up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit. When required for vibration, flexible metal conduit may be installed from 6 inches above the floor to the equipment. Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush plugs flush with floor.

U. Liquidtight Flexible Connections: Use maximum of 6 feet of flexible conduit for recessed and semi-recessed lighting fixtures; 2 feet maximum for equipment subject to vibration, noise transmission, or movement including for all motors. Use liquidtight flexible conduit in wet or damp locations.

V. Metal conduits shall be mechanically and electrically continuous between outlets, junction and pull boxes, panels, cabinets and similar equipment. Conduits shall enter and be secured to enclosures so that each system is electrically continuous throughout.

W. Install hinge on-hinged cover enclosures and cabinets plumb. Support at each corner at a minimum, or as directed by the Project Manager.

X. Provide grounding connections for raceway, boxes, and components. Tighten connectors and terminals, including screws and bolts according to equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

1. Provide ground bushings for all feeder and RGS conduits at panelboards, transformers, pull boxes, and all other termination points.

2. Where knockouts are used, provide double locknuts, one on each side with a grounding bushing or grounding locknut, predrilled or field drilled holes used on the inside (use grounding bushings on conduit 1 inch and larger).

Y. Field Cut Conduit: Where conduit has to be cut in the field, it shall be cut square using a hand or power hacksaw or approved pipe cutter using cutting knives. The cut ends of the field-cut conduit shall be reamed to remove burrs and sharp edges.

Z. Field Threaded Conduit: Where threads have to be cut on conduit, the threads shall have the same effective length and shall have the same thread dimensions and taper as specified for factory-cut threads on conduit.

AA. Boxes: Shall be provided in the wiring or raceway system for pulling wires, making connections, and mounting devices or fixtures. Each box shall have the volume required by NFPA 70 for the number and size of conductors in the box.

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1. Outlet boxes: Each outlet box shall have a machine screw which fits into a tapped hole in the box for the ground connection.
2. Mounting light fixtures: Boxes for mounting fixtures shall be not less than 4 inches square.
3. Concealed wiring: Boxes installed for concealed wiring shall be provided with extension rings or plaster covers. The front edge of the box shall be flush or recessed not more than 1/4 inch from the finished wall surface (whether the finished surface is drywall, or drywall and a sound-absorbing material).
4. Boxes in masonry block, gypsum-wall board or tile walls: Shall be square-cornered tile-type, or standard boxes shall have square-cornered tile-type covers.
5. Wet locations: Cast metal boxes installed in wet locations and boxes installed flush with exterior surfaces shall be gasketed.

AB. EMT entering an enclosure without threaded hubs: Provide a connector with threads and cast or machined locknut. The connector body and locknut shall be installed so that firm contact is made on each side of the enclosure.

3.4. PROTECTION

1. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
3. Repair damage to PVC or paint finishes with matching touch-up coating recommended by the manufacturer.

3.5. CLEANING

A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

End of 26 0533 - Raceways and Boxes for Electrical Systems