SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

This Section uses the term "Architect." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

See "Sustainable Design Considerations" Article in the Evaluations for a discussion of sustainable design requirements that may impact the editing of this Section.

1. GENERAL
   * + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
      1. SUMMARY
         1. Section Includes:

Metal conduits and fittings.

Nonmetallic conduits and fittings.

Metal wireways and auxiliary gutters.

Nonmetal wireways and auxiliary gutters.

Surface raceways.

Boxes, enclosures, and cabinets.

Handholes and boxes for exterior underground cabling.

Related Requirements:

Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.

Retain first subparagraph below for underground conduits, handholes, and boxes; delete if incidental exterior underground raceways, handholes, and boxes are specified in this Section.

Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

* + - 1. DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

* + - * 1. ARC: Aluminum rigid conduit.
        2. GRC: Galvanized rigid steel conduit.
        3. IMC: Intermediate metal conduit.
      1. SUBMITTALS
         1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
         2. Manufacturer’s installation instructions shall be provided along with product data.
         3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
         4. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

USE PARAGRAPH BELOW WITH EPD REQUIREMENT WHEN PROJECT ESTIMATE IS $1M OR MORE.

* + - * 1. Submit an Environmental Product Declaration (EPD) from the manufacturer for steel conduit within this specification section, if available. A statement of the contractor’s good faith effort to obtain the EPD shall be provided if not available.

Manufacturer-provided EPDs must be Product Specific Type III (Third-Party Reviewed), in adherence with ISO 14025 *Environmental labels and declarations*, ISO 14044 *Environmental management – Life cycle assessment*, and ISO 21930 *Core rules for environmental product declarations of construction products and services.*

Retain "Shop Drawings" Paragraphparagraph below for custom enclosures only.

* + - * 1. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
        2. Samples: For [**wireways**] [**nonmetallic wireways**] [**and**] [**surface raceways**] and for each color and texture specified, [**12 inches (300 mm)**] <**Insert dimension**> long.
        3. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.

INFORMATIONAL SUBMITTALS

Retain "Coordination Drawings" Paragraph below if Drawings do not include detailed conduit routing plans and if Project involves unusual coordination requirements.

Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

Structural members in paths of conduit groups with common supports.

HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

Retain "Qualification Data" Paragraph below if source quality-control tests are required to be certified by a professional engineer. Coordinate with qualification requirements in Section 014000 "Quality Requirements."

Qualification Data: For professional engineer.

Retain "Seismic Qualification Data" Paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 260548.16 "Seismic Controls for Electrical Systems." See ASCE/SEI 7 for certification requirements for equipment and components.

Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

Source quality-control reports.

1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications. For definitions of terms and requirements for Contractor's product selection, see Section 016000 "Product Requirements."

* + - 1. METAL CONDUITS AND FITTINGS
         1. Metal Conduit:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Allied Tube & Conduit Corp.

Western Tube & Conduit Corp.

Wheatland Tube Co.

Or equal.

Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

GRC: Comply with ANSI C80.1 and UL 6.

Retain "ARC" Paragraphparagraph below for corrosion resistance and for power distribution at frequencies above 60 Hz or for other special conditions.

ARC: Comply with ANSI C80.5 and UL 6A.

IMC: Comply with ANSI C80.6 and UL 1242.

PVC-Coated Steel Conduit: PVC-coated [**rigid steel conduit**] [**IMC**].

Comply with NEMA RN 1.

Coating Thickness: 0.040 inch (1 mm), minimum.

EMT: Comply with ANSI C80.3 and UL 797.

In "FMC" Paragraphparagraph below, zinc-coated steel is most common type and provides some additional protection from physical damage. Aluminum is much lighter and easier to install.

FMC: Comply with UL 1; [**zinc-coated steel**] [**or**] [**aluminum**].

LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

* + - * 1. Metal Fittings:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Cooper/Crouse-Hinds.

OZGedney Co.

Thomas & Betts Corp.

Or equal.

Comply with NEMA FB 1 and UL 514B.

Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Fittings, General: Listed and labeled for type of conduit, location, and use.

Coordinate "Conduit Fittings for Hazardous (Classified) Locations" Subparagraphsubparagraph below with Drawings.

Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.

Fittings for EMT:

Material: [**Steel**] [**or**] [**die cast**].

Type: [**Setscrew**] [**or**] [**compression**].

Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

Retain "Joint Compound for IMC, GRC, or ARC" Paragraphparagraph below to require some threaded joints of IMC, GRC, or ARC, or their fittings, to be treated with joint compound for improved conductivity, resistance to oxidation, or ease of assembly and disassembly.

* + - * 1. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.
      1. NONMETALLIC CONDUITS AND FITTINGS
         1. Nonmetallic Conduit:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Cantex, Inc.

Carlon.

National Pipe & Plastic Inc.

Or equal.

Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

See Evaluations for descriptions of nonmetallic conduit types.

Fiberglass:

Comply with NEMA TC 14.

Comply with UL 2515 for aboveground raceways.

Comply with UL 2420 for belowground raceways.

ENT: Comply with NEMA TC 13 and UL 1653.

RNC: [**Type EPC-40-PVC**] <**Insert type**>, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

LFNC: Comply with UL 1660.

Retain one or more of three HDPE paragraphs below.

See Evaluations for a discussion of the three types.

Rigid HDPE: Comply with UL 651A.

Continuous HDPE: Comply with UL 651A.

Coilable HDPE: Preassembled with conductors or cables and complying with ASTM D3485.

RTRC: Comply with UL 2515A and NEMA TC 14.

* + - * 1. Nonmetallic Fittings:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Cantex, Inc.

Carlon.

National Pipe & Plastic Inc.

Or equal.

Fittings, General: Listed and labeled for type of conduit, location, and use.

Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

Fittings for LFNC: Comply with UL 514B.

Solvents and Adhesives: As recommended by conduit manufacturer.

* + - 1. METAL WIREWAYS AND AUXILIARY GUTTERS
         1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Mono-Systems Inc.

Thomas & Betts Corp.

Wiremold Co.

Or equal.

* + - * 1. Description: Sheet metal, complying with UL 870 and NEMA 250, [**Type 1**] [**Type 3R**] [**Type 4**] [**Type 12**] <**Insert type**> unless otherwise indicated, and sized according to NFPA 70.

Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

* + - * 1. Fittings and Accessories: Include covers, 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.

Retain one or more options in "Wireway Covers" Paragraphparagraph below. If retaining more than one type, indicate locations of each type on Drawings.

* + - * 1. Wireway Covers: **[Hinged type] [Screw-cover type] [Flanged-and-gasketed type**] unless otherwise indicated.
        2. Finish: Manufacturer's standard enamel finish.
      1. NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS
         1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Hoffman.

Carlon.

National Pipe & Plastics Inc.

Or equal.

* + - * 1. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Retain one of two "Description" paragraphs below.

* + - * 1. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
        2. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
        3. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
        4. Solvents and Adhesives: As recommended by conduit manufacturer.
      1. SURFACE RACEWAYS

Insert requirements for finish-coat paint color, if applicable, in "Surface Metal Raceways" Paragraphparagraph below. See painting Sections for optional field-finish coats.

* + - * 1. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
        2. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. [**Manufacturer's standard enamel finish in color selected by Architect**] [**Prime coated, ready for field painting**].

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

MonoSystems, Inc.

Wiremold; Legrand North America, LLC.

Wiring Device-Kellems; Hubbell Incorporated, Commercial, and Industrial.

Or equal.

* + - * 1. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from [**manufacturer's standard**] [**custom**] colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.

Panduit Corp.

Wiremold; Legrand North America, LLC.

Or equal.

* + - * 1. Tele-Power Poles:

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

MonoSystems, Inc.

Panduit Corp.

Wiremold; Legrand North America, LLC.

Or equal.

Material: [**Galvanized steel with ivory baked-enamel finish**] [**Aluminum with clear anodized finish**].

Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

* + - 1. BOXES, ENCLOSURES, AND CABINETS
         1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.

Eaton (Crouse-Hinds).

Hubbell Incorporated.

Or equal.

* + - * 1. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
        2. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

In "Cast-Metal Outlet and Device Boxes" Paragraphparagraph below, aluminum boxes are suitable for use with steel raceways in most environments. Type FD is a device box with extra depth. Many other configurations are available.

* + - * 1. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, [**ferrous alloy**] [**aluminum**], Type FD, with gasketed cover.
        2. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

See Editing Instruction No. 2 in the Evaluations for a discussion of floor boxes.

* + - * 1. Metal Floor Boxes:

Material: [**Cast metal**] [**or**] [**sheet metal**].

Type: [**Fully adjustable**] [**Semi-adjustable**].

Shape: Rectangular.

Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

* + - * 1. Nonmetallic Floor Boxes: Nonadjustable, [**round**] [**rectangular**].

Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

* + - * 1. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
        2. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).

Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

* + - * 1. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
        2. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, [cast aluminum] [galvanized, cast iron] with gasketed cover.
        3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
        4. Device Box Dimensions: [**4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep)**] [**4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep)**]<**Insert dimension**>.
        5. Gangable boxes [are allowed] [are prohibited].

Coordinate "Hinged-Cover Enclosures" Paragraphparagraph below with Drawings if hinged-cover enclosures other than NEMA 250, Type 1 are required, such as for very dusty areas; or if consideration should be given to use of NEMA 250, Type 3R or Type 12 enclosures.

* + - * 1. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, [**Type 1**] [**Type 3R**] [**Type 4**] [**Type 12**] <**Insert type**> with continuous-hinge cover with flush latch unless otherwise indicated.

Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

Nonmetallic Enclosures: [**Plastic**] [**Fiberglass**].

Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

* + - * 1. Cabinets:

NEMA 250, [**Type 1**] [**Type 3R**] [**Type 12**] <**Insert type**> 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.

Key latch to match panelboards.

Metal barriers to separate wiring of different systems and voltage.

Accessory feet where required for freestanding equipment.

Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

* + - * 1. CORROSION RESISTANT BOXES

Plastic Coated Outlet and Junction Boxes: Threaded type malleable iron boxes coated with 40 mils thick polyvinylchloride coating.

Non-Metallic Junction and Pullboxes: Glass fiber reinforced polyester.

* + - 1. HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

See Editing Instruction No. 3 in the Evaluations. Verify with manufacturers that units of types specified are available in sizes required. Indicate the size of each enclosure on Drawings, and use a symbol or other notation to differentiate between handholes and pull boxes.

* + - * 1. General Requirements for Handholes and Boxes:

Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Retain one or more of three paragraphs below to select enclosure type(s) for areas not subject to traffic by vehicles. Indicate location of each type in "Raceway Application" Article. For enclosures with cover options, verify that selected cover is available with load rating specified in "Raceway Application" Article. If retaining more than one type of box and cover combination, indicate location of each type on Drawings.

* + - * 1. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Armorcast Products Company.

Oldcastle Enclosure Solutions.

Quazite; Hubbell Incorporated, Power Systems.

Or equal.

Standard: Comply with SCTE 77.

First option in "Configuration" Subparagraphsubparagraph below facilitates bottom conduit entry. Second option may be provided by a separate slab placed in the excavation under an open-bottom enclosure; third option is obtained by molding or fabricating the bottom integrally with the body of unit.

Configuration: Designed for flush burial with [**open**] [**closed**] [**integral closed**] bottom unless otherwise indicated.

Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

Cover Legend: Molded lettering, [**"ELECTRIC."**] <**Insert legend**>.

Retain "Conduit Entrance Provisions" Subparagraphsubparagraph below if conduit enters enclosure through the side. Otherwise, entry is made through an open bottom or through side openings cut in the field, as specified in "Installation of Underground Handholes and Boxes" Article. Coordinate with Drawings.

Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

Handholes [**12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long)**] <**Insert dimensions**> and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

* + - * 1. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of [**polymer concrete**] [**reinforced concrete**] [**cast iron**] [**hot-dip galvanized-steel diamond plate**] [**fiberglass**].

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Armorcast Products Company.

Oldcastle Enclosure Solutions.

Quazite; Hubbell Incorporated, Power Systems.

Or equal.

Standard: Comply with SCTE 77.

Retain "Color of Frame and Cover" Subparagraphsubparagraph below if choosing a metal frame and cover; otherwise, delete.

Color of Frame and Cover: [**Gray**] [**Green**].

First option in "Configuration" Subparagraphsubparagraph below facilitates bottom conduit entry. Second option may be provided by a separate slab placed in the excavation under an open-bottom enclosure; third option is obtained by molding or fabricating the bottom integrally with the body of unit.

Configuration: Designed for flush burial with [**open**] [**closed**] [**integral closed**] bottom unless otherwise indicated.

Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

Cover Legend: Molded lettering, [**"ELECTRIC."**] <**Insert legend**>.

Retain "Conduit Entrance Provisions" Subparagraphsubparagraph below if conduit enters enclosure through the side. Otherwise, entry is made through an open bottom or through side openings cut in the field, as specified in "Installation of Underground Handholes and Boxes" Article. Coordinate with Drawings.

Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

Handholes [**12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long)**] <**Insert dimensions**> and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

* + - 1. SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

Retain this article for underground handholes and pull boxes. Delete if handholes and pull boxes are specified only in Section 260543 "Underground Ducts and Raceways for Electrical Systems." See Evaluations.

* + - * 1. 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.

Retain one of first two subparagraphs below; retain first subparagraph to require an independent testing agency to test for compliance with SCTE requirements; retain second subparagraph to require testing by manufacturers' laboratories. See Evaluations for a discussion of testing.

Tests of materials shall be performed by an independent testing agency.

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.

Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

* + - 1. NAMEPLATES AND TAGS
         1. General: Precision engraved letters and numbers with uniform margins, character size minimum 3/16 inch high.

Phenolic: Two color laminated engraver’s stock, 1/16 inch minimum thickness, machine engraved to expose inner core color (white).

Aluminum: Standard aluminum alloy plate stock, minimum .032 inches thick, engraved areas enamel filled or background enameled with natural aluminum engraved characters.

Materials for Outdoor Applications: As recommended by nameplate manufacturer to suit environmental conditions.

1. EXECUTION
   * + 1. RACEWAY APPLICATION

Retain this article to specify type of raceway to be installed. Coordinate with conductor and cable wiring methods specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and in other electrical, communications, and security Sections. See "Writing Guide" Article in the Evaluations for instructions on editing this article.

* + - * 1. Outdoors: Apply raceway products as specified below unless otherwise indicated:

Exposed Conduit: [**GRC**] [**IMC**] [**RNC, Type EPC-40-PVC**] [**RNC, Type EPC-80-PVC**].

Concealed Conduit, Aboveground: [**GRC**] [**IMC**] [**EMT**] [**RNC, Type EPC-40-PVC**].

Underground Conduit: RNC, [**Type EPC-40-PVC**] [**Type EPC-80-PVC**], [**direct buried**] [**concrete encased**].

Retain first option in first subparagraph below if raceway may be exposed to physical damage.

Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): [**LFMC**] [**LFNC**].

Boxes and Enclosures, Aboveground: NEMA 250, [**Type 3R**] [**Type 4**].

* + - * 1. Indoors: Apply raceway products as specified below unless otherwise indicated:

Exposed, Not Subject to Physical Damage: [**EMT**] [**ENT**] [**or**] [**RNC**].

Exposed, Not Subject to Severe Physical Damage: [**EMT**] [**RNC identified for such use**].

Exposed and Subject to Severe Physical Damage: [**GRC**] [**IMC**]. Raceway locations include the following:

Loading dock.

Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

Mechanical rooms.

Gymnasiums.

<**Insert designations of applicable spaces or locations**>.

Concealed in Ceilings and Interior Walls and Partitions: [**EMT**] [**ENT**] [**or**] [**RNC, Type EPC-40-PVC**].

Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

Damp or Wet Locations: [**GRC**] [**IMC**].

Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 [**stainless steel**] [**nonmetallic**] in institutional and commercial kitchens and damp or wet locations.

* + - * 1. Minimum Raceway Size: **[1/2-inch (16-mm)] [3/4-inch (21-mm)]** trade size.
        2. Raceway Fittings: Compatible with raceways and suitable for use and location.

Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

EMT: Use [**setscrew**] [**or**] [**compression**], [**steel**] [**cast-metal**] fittings. Comply with NEMA FB 2.10.

Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

Retain first paragraph below for high-frequency installation.

* + - * 1. 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.
        2. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

Coordinate first paragraph below with Drawings.

* + - * 1. Install surface raceways only where indicated on Drawings.
        2. Do not install nonmetallic conduit where ambient temperature exceeds [**120 deg F (49 deg C)**] <**Insert temperature**>.
      1. INSTALLATION
         1. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
         2. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
         3. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
         4. Do not fasten conduits onto the bottom side of a metal deck roof.
         5. 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.
         6. Complete raceway installation before starting conductor installation.
         7. Arrange stub-ups so curved portions of bends are not visible above finished slab.

First paragraph below is more restrictive than NFPA 70, which permits up to four quarter bends in a conduit run. Retain paragraph for more conservative design, with less stress being placed on conductors being pulled in.

* + - * 1. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
        2. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
        3. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
        4. Support conduit within 12 inches (300 mm) of enclosures to which attached.
        5. Raceways Embedded in Slabs:

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. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.

Arrange raceways to cross building expansion joints at right angles with expansion fittings.

Arrange raceways to keep a minimum of [**1 inch (25 mm)**] [**2 inches (50 mm)**] <**Insert dimension**> of concrete cover in all directions.

Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

Some authorities having jurisdiction may not permit nonmetallic tubing in fire-rated slabs in subparagraph below.

Change from ENT to [**RNC, Type EPC-40-PVC,**] [**GRC**] [**or**] [**IMC**] before rising above floor.

* + - * 1. Stub-Ups to Above Recessed Ceilings:

Use EMT, IMC, or RMC for raceways.

Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

Retain "Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions" Paragraphparagraph below to require application of protective joint compound to threads of rigid steel conduit or IMC and to their fittings where these raceways are installed outdoors or in wet, damp, or corrosive conditions. This optional requirement exceeds NFPA 70 rules. If retaining, coordinate with Drawings indicating wet, damp, or corrosive indoor locations.

* + - * 1. 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.
        2. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

Retain one of first two paragraphs below to exceed NFPA 70 requirements. NFPA 70 requires insulated bushings or other smooth, rounded entry provisions for conduit terminations at all locations where conductors are No. 4 AWG and larger, regardless of the environment. NFPA 70 requires bonding of all service conductors, but does not require bonding to be accomplished with grounding bushings. See Evaluations for further discussion.

* + - * 1. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
        2. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
        3. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
        4. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
        5. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
        6. 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. Cap underground raceways designated as spare above grade alongside raceways in use.

Retain "Surface Raceways" Paragraphparagraph below if applicable.

* + - * 1. Surface Raceways:

Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.

Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

* + - * 1. Install raceway sealing fittings at accessible locations according to NFPA 70 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 according to NFPA 70.

See Evaluations for discussion of types of and locations for raceway seals.

* + - * 1. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

Where an underground service raceway enters a building or structure.

Conduit extending from interior to exterior of building.

Conduit extending into pressurized duct and equipment.

Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.

Where otherwise required by NFPA 70.

* + - * 1. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

Retain "Expansion-Joint Fittings" Paragraphparagraph below unless locations for expansion fittings for RNC are indicated on Drawings. See Evaluations.

* + - * 1. Expansion-Joint Fittings:

Install in each run of aboveground RNC 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). Install in each run of aboveground RMC[**and EMT**] conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).

Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

Revise list below to include all locations in Project with environmental conditions that require considering expansion-joint fittings in conduit runs. For each Project, consider only locations with PVC conduit with straight-run length exceeding 25 feet (7.6 m) or metal conduit in lengths over 100 feet (30 m). Also revise temperature change for each location so it safely represents conditions anticipated. Temperature-change figures below are examples of maximum total swings from the lowest to the highest environmental temperatures at the indicated types of locations and must be revised to represent temperature swings or changes that may occur at Project locations.

Outdoor Locations Not Exposed to Direct Sunlight: [**125 deg F (70 deg C)**] <**Insert temperature**> temperature change.

Outdoor Locations Exposed to Direct Sunlight: [**155 deg F (86 deg C)**] <**Insert temperature**> temperature change.

Indoor Spaces Connected with Outdoors without Physical Separation: [**125 deg F (70 deg C)**] <**Insert temperature**> temperature change.

Attics: [**135 deg F (75 deg C)**] <**Insert temperature**> temperature change.

<**Insert location and corresponding temperature change**>.

Formula in first subparagraph below provides about 15 percent safety factor (extra expansion-contraction capability).

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 for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

Install expansion fittings at all locations where conduits cross building or structure expansion joints.

Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

Retain option in "Flexible Conduit Connections" Paragraphparagraph below if flexible connections are required for recessed and semirecessed luminaires.

* + - * 1. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of [**36 inches (915 mm)**] [**72 inches (1830 mm)**] of flexible conduit for [**recessed and semirecessed luminaires,**]equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

Use LFMC in damp or wet locations subject to severe physical damage.

Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

* + - * 1. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to [**center**] [**top**] [**bottom**] of box unless otherwise indicated.
        2. 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. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
        3. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
        4. Locate boxes so that cover or plate will not span different building finishes.
        5. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
        6. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
        7. Set metal floor boxes level and flush with finished floor surface.
        8. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

Use paragraph below for new work.

* + - * 1. Number of Raceways: Do not change number of raceways to less than the number indicated on the drawings.

Each raceway shall enclose one circuit unless otherwise indicated on the drawings.

Use paragraph below and its subparagraphs for rehab work when allowing reuse of existing raceways. See information at end of section, specifically “when permitting reuse of existing raceways”.

* + - * 1. Number of Raceways: Do not change number of raceways to less than the number indicated on the drawings except when appropriate for advantageous reuse of existing exposed and concealed raceways (The contract documents do not indicate location, number, size or condition of existing raceways). Existing raceways may be reused if the following conditions are met:

The existing raceway must be of adequate size for the new conductors to be installed therein (NFPA 70 Chapter 9, Tables 1, 4, & 5; Appendix C, Tables C1-C12a). More circuits may be enclosed by existing raceways than the circuiting shown on the drawings provided conductor sizes are increased to compensate for derating (adjustment factors) and other considerations required by NFPA 70 Article 310-15.

Remove existing conductors.

Demonstrate to the Director’s Representative that the existing raceway is clear of obstructions and in good condition.

Check ground continuity. When ground continuity of existing raceway is inadequate install insulated grounding bushings, grounding wedges, bonding straps, grounding jumpers or equipment grounding conductors to establish effective path to ground.

Install insulated bushings to replace damaged or missing bushings. Replace non-insulated bushings with insulated bushings on raceway sizes 1 inch and larger.

Install vertical conductor supports to replace existing or missing vertical conductor supports.

Install extension rings on existing boxes when the number of new conductors installed therein exceeds NFPA 70 requirements.

Furnish the Director’s Representative with marked up drawings showing size and routing of existing raceways with number and size of new conductors installed therein. The drawings will be forwarded to the design Director’s Representative for verification of NFPA 70 compliance.

Furnish the Director’s Representative with marked up drawings showing size and routing of existing raceways with number and size of new conductors installed therein. The drawings will be forwarded to the design Director’s Representative engineer for verification of NFPA 70 compliance.

Indicate mounting height on drawings if different than listed, or modify list.

|  |  |
| --- | --- |
| Lighting Fixtures | 6’-0” |
| Lighting Fixtures in Stairway | 7’-6” |
| Exit Lights | 8’-0” where ceiling height allows a minimum of 6 inch clearance between ceiling and top of exit light. Otherwise mount exit light so that it’s top is 6 inches below finished ceiling. Adjust height and clearances as required to suit installation over doors. |
| Night Lights | 2’-0” |
| Hose Cabinet Lights | 1’-0” above top of cabinet |
| Switches | 4’-0” |
| Single & Duplex Receptacles | 1’-6”\* |
| Water Cooler Receptacles | 2’-0” |
| Clock Receptacles | 7’-6” |
| Range Receptacle | 1’-6” |
| Special Purpose Receptacles | 4’-0” |
| Thermostats | 5’-0” |
| Manual Fire Alarm Boxes | 4’-0” |
| Audible Notification Appliances | 8’-0” where ceiling height allows a minimum of 6 inch clearance between ceiling and top of appliance. Otherwise mount appliance so that it’s top is 6 inches below finished ceiling. |
| Visible Notification Appliances | Install outlet so that the bottom of the visible lens will be 6’-8” AFF. |
| Combination Audible/Visible Notification Appliances | Install outlet so that the bottom of the visual lens will be 6’-8” AFF, and the audible section will be above the visible section. |
| Radio | 2’-0” |
| Television | 2’-0” |
| Telecommunications | 2’-0” |
| Telephone | 2’-0” |
| Telephone Marked W.T. | Install outlet so that the highest operable part of the wall mounted telephone will not be more than 4’-0” AFF. |

* + - * 1. Raceway Schedule:

Rigid Ferrous Metal Conduit: Install in all locations unless otherwise specified or indicated on the drawings.

Intermediate Ferrous Metal Conduit: May be installed in all dry and damp locations except:

Hazardous areas.

Where other type raceways are specified or indicated on the drawings.

Electrical Metallic Tubing:

May be installed concealed as branch circuit conduits above suspended ceilings where conduit does not support fixtures or other equipment.

May be installed concealed as branch circuit conduits in hollow areas in dry locations, including:

Hollow concrete masonry units, except where cores are to be filled.

Drywall construction with sheet metal studs, except where studs are less than 3-1/2 inches deep.

Edit subparagraph below to meet security concerns of the client agency and building occupancy.

May be installed exposed as branch circuit conduits in dry non-hazardous locations at elevations over 10’-0” above finished floor where conduit does not support fixtures or other equipment.

Flexible Metal Conduit: Install equipment grounding conductor in the flexible metal conduit and bond at each box or equipment to which conduit is connected:

Use for final conduit connection to recessed lighting fixtures in suspended ceilings. Use 4 to 6 feet of flexible metal conduit (minimum size 1/2 inch) between junction box and fixture. Locate junction box at least 1 foot from fixture and accessible if the fixture is removed.

Use 1 to 3 feet of flexible metal conduit for final conduit connection to:

Emergency lighting units.

Dry type transformers.

Motors with open, drip-proof or splash-proof housings.

Equipment subject to vibration (dry locations).

Equipment requiring flexible connection for adjustment or alignment (dry locations).

Include below for appropriate rehab projects.

Use for concealed branch circuit conduits above existing non-removable suspended ceilings where rigid type raceways cannot be installed due to inaccessibility of space above ceiling.

May be installed concealed as branch circuit conduits in drywall construction with sheet metal studs, except where studs are less than 3-1/2 inches deep.

Liquid-tight Flexible Metal Conduit: Install equipment grounding conductor in liquid-tight flexible metal conduit and bond at each box or equipment to which conduit is connected:

Use 1 to 3 feet of liquid-tight flexible metal conduit (UL listed and marked suitable for the installation’s temperature and environmental conditions) for final conduit connection to:

Motors with weather-protected or totally enclosed housings.

Equipment subject to vibration (damp and wet locations).

Equipment requiring flexible connection for adjustment or alignment (damp and wet locations).

Surface Metal Raceway: Use as exposed raceway system in finished spaces at locations indicated on the drawings.

Use surface metal raceway system of size required for number of wires to be installed therein. (Use specific size when indicated on the drawings).

Do not run raceway through walls that have a plaster finish nor through masonry walls or floors. Install a pipe sleeve, or a short length of conduit with junction boxes or adapter fittings for raceway runs through such areas. Run raceway along top of baseboards, care being taken to avoid telephone and other signal wiring. Where raceway crosses chair railing or picture molding, cut the chair railing or picture molding to permit the raceway to lie flat against the wall. Run raceway around door frames and other openings. Run raceway on ceiling or walls perpendicular to or parallel with walls and floors.

Use subparagraph below for attaching raceway, where raceway may be subject to vandalism.

Secure one piece raceway every 30 inches alternately with 2 hole straps, and support clips (2 hole strap, support clip, 2 hole strap, etc.). Secure 2 piece raceway every 30 inches alternately with 2 hole straps and fasteners through back of raceway (2 hole strap, fastener through back, 2 hole strap, etc.).

Use subparagraph below for attaching raceway, in controlled areas such as offices, residences, etc.

Secure raceway at intervals not exceeding 36 inches.

Install separate equipment grounding conductor for grounding of equipment. The raceway alone will not be considered suitable for use as an effective path to ground.

Outlet box covers for pendant mounted fluorescent fixtures may be omitted if the fixture canopy is notched to receive the raceway and the canopy fits snugly against the ceiling.

Where equipment is mounted on an outlet box and the equipment base is larger than the outlet box, provide finishing collar around equipment base and outlet box or provide finishing collar/outlet box:

Finishing Collar: Same finish and peripheral dimensions as the equipment base, including provisions for mounting, slots to fit over raceway and of depth to cover outlet box and extend back to ceiling or wall.

Combination Finishing Collar/Outlet Box: Same finish and peripheral dimensions as the equipment base to be mounted thereon, gage or thickness of metal as required by National Electrical Code, including provision for mounting and knockouts for entrance of raceway.

Wireways: May be used indoors in dry locations for exposed raceway between grouped, wall mounted equipment.

* + - * 1. Box Schedule for Concealed Conduit System:

Non-Fire Rated Construction:

Depth: To suit job conditions and comply with NFPA 70 Article 370.

For Lighting Fixtures: Use galvanized steel outlet boxes designed for the purpose.

For Fixtures Weighing 50 lbs. or Less: Box marked “FOR FIXTURE SUPPORT”.

For Fixtures More Than 50 lbs: Box listed and marked with the weight of the fixture to be supported (or support fixture independent of the box).

For Ceiling Suspended Fans:

For Fans Weighing 35 lbs or Less: Marked “Acceptable for Fan Support.”

For Fans Weighing More Than 35 lbs, up to 70 lbs: Marked “Acceptable for Fan Support up to 70 lbs (or support fan independent of the box).”

For Junction and Pull Boxes: Use galvanized steel boxes with flush covers.

For Switches, Receptacles, Etc:

Plaster or Cast-In-Place Concrete Walls: Use 4 inch or 4-11/16 inch galvanized steel boxes with device covers.

Walls Other Than Plaster or Cast-In-Place Concrete: Use type of galvanized steel box which will allow wall plate to cover the opening made for the installation of the box.

Recessed Boxes in Fire Rated (2 hour maximum) Bearing and Nonbearing Wood or Steel Stud Walls (Gypsum Wallboard Facings):

Use listed single and double gang metallic outlet and switch boxes. The surface area of individual outlet or switch boxes shall not exceed 16 square inches.

The aggregate surface area of the boxes shall not exceed 100 square inches per 100 square feet of wall surface.

Securely fasten boxes to the studs. Verify that the opening in the wallboard facing is cut so that the clearance between the box and the wallboard does not exceed 1/8 inch.

Separate boxes located on opposite sides of walls or partitions by a minimum horizontal distance of 24 inches. This minimum separation distance may be reduced when wall opening protective materials are installed according to the requirements of their classification.

Use wall opening protective material in conjunction with boxes installed on opposite sides of walls or partitions of staggered stud construction in accordance with the classification requirements for the protective material.

Other Fire Rated Construction: Use materials and methods to comply with the listing requirements for the classified construction. Conduits Penetrating Concrete Floor Slabs (Concrete slabs that are both ceilings and floors shall be treated as floor slabs):

Provide a minimum of 2 inches between conduits that vertically penetrate elevated concrete slabs.

Use materials and methods to comply with the listing requirements for the classified construction.

* + - * 1. Conduit Installed Exposed:

Install conduit exposed where indicated on the drawings. If not indicated, conduit may be installed exposed, as approved, in:

Unfinished spaces, and finished spaces housing mechanical or electrical equipment that is generally accessible only to facility maintenance personnel.

Areas where existing conduits have been installed exposed.

Areas where conduit cannot be installed concealed.

Install conduit tight to the surface of the building construction. Exception:

Where otherwise indicated or directed.

Install vertical runs perpendicular to the floor.

Install runs on the ceiling perpendicular or parallel to the walls.

Install horizontal runs parallel to the floor.

Do not run conduits near heating pipes.

Installation of conduit directly on the floor will not be permitted.

* + - * 1. Box Schedule for Exposed Conduit System:

Indicate on drawings, type of enclosure required for each box if other than NEMA 1.

Dry and Damp Locations: Use zinc electroplate or hot dipped galvanized threaded type malleable iron or cast iron alloy outlet, junction, and pullboxes or conduit bodies provided with a volume marking in conjunction with ferrous raceways unless otherwise specified or indicated on the drawings.

Galvanized steel boxes may be used in conjunction with conduit sizes over 1 inch in non-hazardous dry and damp locations.

Galvanized steel boxes may be used in conjunction with electrical metallic tubing where it is allowed (specified) to be installed exposed as branch circuit conduits at elevations over 10’-0” above finished floor.

Wet Locations: Use threaded type malleable iron or cast iron alloy outlet junction, and pullboxes or conduit bodies (provided with a volume marking) with hot dipped galvanized or other specified corrosion resistant coating in conjunction with ferrous raceways unless otherwise specified or indicated on the drawings.

Use corrosion resistant boxes in conjunction with plastic coated rigid ferrous metal conduit.

Finishing Collar or Combination Finishing Collar/Outlet Box (Surface Mounted Equipment Used with Exposed Raceway):

Use finishing collar where surface mounted equipment is installed on an exposed raceway outlet box and the equipment base is larger than the outlet box.

Use combination finishing collar/outlet box where surface mounted equipment is not indicated to be installed on an exposed raceway outlet box, but raceway cannot be run directly into equipment body due to equipment design.

* + - 1. INSTALLATION OF UNDERGROUND CONDUIT

Retain this article if Project includes small amounts of exterior underground wiring 600 V and less. Delete if Section 260543 "Underground Ducts and Raceways for Electrical Systems" is included in the Project Manual.

* + - * 1. Direct-Buried Conduit:

Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.

Install backfill as specified in Section 312000 "Earth Moving."

After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."

Retain one of first two subparagraphs below to specify type of stub-up for direct-buried conduits in Project.

Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

Retain first two subparagraphs below with either of last two subparagraphs above.

Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.

For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

Retain "Warning0 Planks" or "Underground Warning Tape" Subparagraphsubparagraph below to specify type of underground warning for direct-buried conduits in Project.

Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.

Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

* + - 1. INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

Retain this article if Project includes small amounts of exterior underground wiring 600 V and less. Delete if Section 260543 "Underground Ducts and Raceways for Electrical Systems" is included in the Project Manual. See Editing Instruction No. 3 in the Evaluations.

* + - * 1. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
        2. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
        3. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
        4. Install handholes with bottom below frost line, <**Insert depth of frost line below grade at Project site**> below grade.

First paragraph below requires Contractor to select hardware to install and support cable. Delete if cable support is not required. If required, revise paragraph to refer Contractor to Drawings, and show specific requirements on Drawings for each enclosure.

* + - * 1. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

Delete paragraph below if conduits enter enclosure through open bottom.

* + - * 1. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
      1. SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS
         1. Install 0sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
      2. FIRESTOPPING
         1. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."
      3. PROTECTION
         1. Protect coatings, finishes, and cabinets from damage and deterioration.

Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533