

SECTION 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL EQUIPMENT

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. General: The Contractor shall provide the labor, tools, equipment, and materials necessary to provide raceways in accordance with the plans and as specified herein.
- B. Miscellaneous: Types of raceways specified in this section include the following:
 - 1. Electrical metallic tubing.
 - 2. Flexible metal conduit.
 - 3. Rigid metal conduit.
 - 4. PVC coated Rigid metal conduit.
 - 5. Rigid, non-metallic conduit.
 - 6. Liquid-tight flexible non-metallic conduit.
 - 7. Wireways.

1.02 QUALITY ASSURANCE

- A. Codes and Standards: Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.
 - 1. National Electrical Manufacturers Association (NEMA) Compliance: Comply with applicable requirements of NEMA Standards Publications pertaining to raceways.
 - 2. Underwriters' Laboratories (UL) Compliance and Labeling: Comply with applicable requirements of UL safety standards pertaining to electrical raceway systems. Provide raceway products and components which have been UL-listed and labeled. Provide listed fire resistance ratings for joint sealers as applicable in accordance with American Society for Testing and Materials (ASTM) E814.
 - 3. National Electrical Code (NEC) Compliance: Comply with applicable requirements of NEC pertaining to construction and installation of raceway systems.

4. National Fire Protection Association (NFPA) Compliance: Comply with applicable requirements of NFPA standards relating to fire ratings of wall, floors, and ceilings penetrated by conduits.

1.03 SUBMITTALS

- A. General: Furnish manufacturer's product data, test reports, and materials certifications as required.
- B. Submittals: Submit the following:
 1. Provide product data for each type of the following products:
 - a. Raceway and fittings.
 - b. Wireway and fittings.
 2. Provide manufacturer's written installation instructions for wireway, metallic raceway, and non-metallic raceway products.

PART 2 – PRODUCTS

2.01 METAL CONDUIT

- A. General: Provide metal conduit of types, grades, sizes, and weights (wall thicknesses) for each service area as indicated on the Contract Drawings. Where types and grades are not indicated, provide proper selection determined by installer to fulfill wiring requirements, and comply with applicable portions of NEC for raceways.
- B. Electrical Metallic Tubing: Provide electrical metallic tubing (EMT), hot-dip galvanized steel, and fittings conforming to American National Standards Institute (ANSI) C80.3 and UL-797.
- C. Rigid Steel Conduit: Provide rigid steel, hot-dip galvanized, threaded-type conforming to FS WW-C-581E, ANSI C80.1 and UL 6.
- D. Rigid Steel Conduit – PVC Coated: Provide rigid steel, hot-dip galvanized, threaded-type conforming to FS WW-C-581E, ANSI C80.1 and UL 6. Provide 40 mil gray PVC exterior coating and 2 mil urethane interior coating.
- E. Flexible Metal Conduit: FS WW-C-566 and UL 1. Formed from continuous length of spirally wound interlocked galvanized strip steel.
- F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include the following:
 1. AFC.

2. Alflex Corp.
3. Allied Tube and Conduit.
4. Electri-Flex Company.
5. TV Steel Tubular Products Co.
6. Perrna-Cote Industries.
7. Robroy Industries.
8. Triangle PWC, Inc.
9. VAW of America Inc.
10. Wheatland Tube Co.
11. Or equivalent.

2.02 NONMETALLIC CONDUIT

- A. General: Provide non-metallic conduit of types, sizes, and weights for each service indicated. Where types and grades are not indicated, provide proper selection determined by installer to fulfill wiring requirements which comply with provisions of NEC for raceways.
- B. Rigid Nonmetallic Conduit: Schedule 40, 90 C, UL-rated, construct of PVC and conforming to NEMA TC-2, for direct burial, or normal above-ground use, UL-listed and in conformity with NEC Article 347.
- C. Liquid-Tight Flexible Non-Metallic Conduit: Continuous spiral of hard PVC encapsulated with flexible PVC.
- D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include the following:
 1. Cantex Industries.
 2. Carlon.
 3. Cole Flex-Corp.
 4. Electric-Flex.

5. Or equivalent.

2.03 CONDUIT FITTINGS AND ACCESSORIES

- A. General: Provide conduit accessories of types, sizes, and materials, complying with manufacturer's published product information, which mate and match conduit and tubing.
- B. Conduit Bodies: Provide galvanized cast metal conduit bodies of types, shapes, and sizes as required to fulfill job requirements and NEC requirements. Construct conduit bodies with threaded conduit entrance ends, removable covers, either cast or of galvanized steel, and corrosion resistant screws.
- C. Locknuts: Construct locknuts for securing conduit to enclosures with sharp edge for digging into metal and ridged outside circumference for proper fastening.
- D. Bushings: Bushings for terminating conduits smaller than 1-1/4 inch are to have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation. Bushings for terminating conduits 1-1/4 inch and larger shall have flared bottom and ribbed sides and shall have a phenolic insulating ring molded into the bushing. All bushings shall have a screw type grounding terminal.
- E. Conduit Hubs: Provide conduit hub assemblies complete with hub, locknut, and bushings.
- F. Rigid Metal Conduit Fittings: Provide cast malleable iron, galvanized or cadmium-plated fittings conforming to FS W-F-408. Fittings for use with PVC-coated rigid steel conduit shall also be PVC coated identical to the conduit.
- G. Flexible Metal Conduit Fittings: Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp-type.
 - 1. Straight Terminal Connectors: One-piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
 - 2. 45-Degree or 90-Degree Terminal Angle Connectors: Two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
- H. Rigid Non-Metallic Conduit Fittings: NEMA TC 3, mate and match to conduit type and material.

- I. Liquidtight Flexible Non-Metallic Conduit Fittings: PVC, one-piece body with PVC ferrule and neoprene gasket.

- J. Sealing Fittings and Products
 - 1. Provide mechanical pipe seals as specified in Division 26 Section “Supporting Devices”.
 - 2. Provide joint sealants as specified in Division 26 Section “Basic Electrical Materials and Methods”.
 - 3. Provide gland-type sealing bushings for interior conduit seals as specified in Division 26 Section “Supporting Devices”.

- K. Available Manufacturers: Subject to compliance with requirements, manufacturers offering conduit and conduit accessories which may be incorporated in the work include the following:
 - 1. Adalet/PLM.
 - 2. Appleton Electric.
 - 3. Carlon Div. of Indian Head.
 - 4. Condux International, Inc.
 - 5. Crouse-Hinds.
 - 6. Electri-Flex Company.
 - 7. Killark Electric Mfg. Co.
 - 8. O.Z. Gedney.
 - 9. Perma-Cote Industries.
 - 10. Robroy Industries.
 - 11. Unistrut Corp.
 - 12. Or equivalent.

2.04 WIREWAYS

- A. General: Provide electrical wireways of types, grades, sizes, and number of channels for each type of service as indicated. Provide complete assembly of raceway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other components and accessories as required for complete system.
- B. General Purpose Wireways: NEMA 1 steel, front-accessible, totally enclosed with bolted covers. Finish with rust-inhibiting coating and gray baked enamel finish. Protect screws installed toward inside of wireway with spring nuts to prevent wire insulation damage.
- C. Oil-Tight Wireways: NEMA 12, oil-tight and dust-tight, steel with hinged gasketed cover, external latches and flanged gasketed joints. Finished with gray enamel paint inside and outside.
- D. Watertight Wireways: NEMA 4X, watertight, corrosion-resistant stainless steel with hinged gasketed cover, screw clamps and flanged gasketed joints.
- E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering wireways which may be incorporated in the work include the following:
 - 1. American Electric.
 - 2. B-Line Systems, Inc.
 - 3. Hoffman Engineering Co.
 - 4. Square D Company.
 - 5. Or equivalent.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways. Notify ENGINEER in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the ENGINEER.

3.02 COORDINATION

- A. Coordinate with other work including wires/cables, boxes, and panel work, as necessary to interface installation of electrical raceways and components with other work.

3.03 INSTALLATION – GENERAL

- A. Complete the installation of raceways before starting installation of cables and wires in raceways. All spare raceways shall be capped or plugged and include a pull wire. All metallic raceways shall be grounded.
- B. Install raceways as indicated in accordance with manufacturer's written installation instructions, and in compliance with NEC, and National Electrical Contractors Association (NECA) "Standards of Installation." Use roughing-in dimensions furnished by the supplier for all electrically operated units. Set raceways and boxes for connection to units only after the dimensions and locations clear with other trades. Install units plumb and level, and maintain manufacturer's recommended clearances.
- C. Mechanically assemble metal raceways for conductors to form continuous electrical conductor, and make connections to electrical boxes, fittings, and cabinets to provide effective electrical continuity and a rigid mechanical assembly. Avoid the use of dissimilar metals throughout the system to eliminate the possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion-inhibiting compound before assembling.

3.04 INSTALLATION – CONDUITS

- A. Size conduits to meet the NEC requirements; however, no conduit shall be smaller than 3/4 inch for interior applications or 1 inch for exterior applications. The diameter of embedded conduits shall not exceed one-third of the slab or wall thickness. Conduit shall be embedded in slabs only where specifically shown on plan.
- B. Uses Permitted
 - 1. Use flexible metal conduit in movable partitions and from outlet boxes to recessed lighting fixtures (4-foot minimum and 6-foot maximum length).
 - 2. Use liquidtight flexible non-metallic conduit for the final 24 inches of connections to motors or control items subject to movement or vibration, and in cells of precast concrete panels for conduits 4 inches and smaller.
- C. Preparation
 - 1. General: Field-bend conduit with benders designed for the purpose so as not to distort or vary the internal diameter. Cut conduits straight and properly ream.

2. Metal Conduits: Cut conduit threads deep and clean. Use of running threads at conduit joints and terminations is prohibited. Conduits installed underground, in slabs, or exterior shall have threads painted with a corrosion-inhibiting compound before couplings are assembled.
3. Non-Metallic Conduits: All PVC conduit joints shall be solvent-welded to provide a watertight seal capable of sustaining a hydrostatic pressure of 25 pounds per square inch (psi) for 12 hours. PVC conduit shall be installed in a sand bed except PVC conduit encased in concrete.
4. Install joint sealers as specified in Division 26 Section “Basic Electrical Materials and Methods”.
5. Install mechanical pipe seals as specified in Division 26 Section “Supporting Devices”.

D. Routing

1. General: Install exposed conduits and conduits above suspended ceilings, parallel or perpendicular to walls, ceilings, or structural members. Do not run through structural members. Avoid horizontal runs within partitions or side walls. Avoid ceiling inserts, lights, or ventilation ducts or outlets. Do not run conduits across pipe shafts or ventilation duct openings and keep conduits a minimum of 6 inches from parallel runs of flues, hot water pipes, or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.
2. Finished Areas: Conduits installed in finished areas of new construction shall be concealed in walls, below or in slabs, or above suspended ceilings.
3. Concrete Slabs: Conduits in concrete slabs (where shown on plan only) shall be placed between the bottom and top reinforcing steel. Separate conduits by not less than the diameter of the largest conduit to ensure proper concrete bond. Conduits crossing in the slab must be reviewed by the ENGINEER for proper cover.
4. Other Interior Areas: Conduits shall not be embedded in waterproofed or waterbearing walls. Where possible, conduits to motors or equipment more than 3 feet from walls shall be run in or under the slab and stubbed up to the junction box. For all other interior applications, conduits shall be installed, exposed, or concealed as indicated on the plans.
5. Exterior: Do not run conduits exposed on the exterior surface of buildings.

6. Underground: Install underground conduits a minimum of 24 inches below finished grade for circuits 600 volts or less and 36 inches for circuits above 600 volts. All underground conduits in roadway and parking areas shall be concrete-encased, unless specifically shown otherwise. Concrete-encased conduits shall have a minimum of 3 inches of concrete cover for circuits 600 volts and less and 4 inches for circuits above 600 volts. Wherever possible, make changes of direction with long sweep bends having a minimum radius of 2.5 feet. Conduits shall slope toward manholes or pullboxes and away from building with a pitch of not less than 3 inches in 100 feet. All trenches under roads, walkways, and drives shall be backfilled with compacted granular material to subbase. Conduits passing through backfilled areas shall be supported. Provide a metal-backed yellow polyethylene marker tape in the trench overall conduit runs. Provide spacers for multiple conduit runs.

E. Penetrations

1. Exterior Walls: Conduits penetrating exterior walls of any structure (other than handholes, manholes, or pullboxes) below grade, at grade floors, or below grade floors shall be sealed to prevent moisture migration. The exterior of the conduit shall be sealed with a mechanical pipe seal as described in Division 26 Section "Supporting Devices". As close as practical to the penetration, install a junction box to allow for the installation of the interior conduit seal. The interior conduit seal shall be a gland-type sealing, bushing, or RTV closed-cell silicone foam. Ensure that conduits do not retain water against these seals.
2. Fire-Rated Walls: Conduits penetrating fire-rated walls, floors, and partitions shall be sealed with a fire-rated sealant as described in Division 26 Section "Basic Electrical Materials and Methods".
3. Roofs: Conduits shall penetrate roofs only where specifically shown on the plans and shall be coordinated with Division 07 of the Specifications. Provide all required flashing.
4. Supports: All conduits must be supported with materials specifically made for this purpose. Do not use wire hangers. Do not attach any parts of the conduit system to ventilation ducts. Conduit supports shall be attached to the building. Support conduits on each side of bends and on a spacing not to exceed the following: 6 feet for conduits smaller than 1-1/4 inches and 8 feet for conduits 1-1/4 inches and larger. Support riser conduits at each floor level with clamp hangers. Set conduit anchors in waterbearing or waterproofed walls with waterproof cement. All underground conduits shall be securely anchored to prevent movement during placement of concrete or backfill. Use precasted separators and heavy gauge wire ties or other approved fasteners.

- F. Fittings: Install miscellaneous fittings, such as reducers, chase nipples, three-piece unions, split couplings, and plugs that have been specifically designed and manufactured for their particular application. Install grounding-type expansion fittings in raceways every 200 feet of linear run or wherever structural joints are crossed to allow for expansion and contraction. Draw up couplings and conduit sufficiently tight to ensure watertightness. Fasten conduit terminations to NEMA 1 and NEMA 12 enclosures with two locknuts, one inside and one outside, and terminate with a bushing. Fasten conduit terminations to NEMA 3R, NEMA 4, and NEMA 4X enclosures and weatherproof equipment enclosures with conduit hub assemblies.

- G. Cleaning: During construction, protect partially completed raceway runs from entrance of dirt, moisture, and debris by means of suitable factory-made duct plugs. After completion of installation, pull a mandrel through every conduit to check for alignment and clear passage. Use an iron shot mandrel with a diameter of 1/4 inch less than the nominal size of the conduit and with a length equal to the conduit diameter. The mandrel shall have a leather or rubber gasket slightly larger than the conduit opening. After testing the conduits with the mandrel, pull a stiff brush through each duct until it is clear of any particles of earth, sand, or gravel, then install plugs until wire is to be pulled. Clean existing ducts to be used for new cable in the same manner as noted above.

3.05 INSTALLATION – WIREWAYS

- A. Uses Permitted
 - 1. Use watertight wireways in damp or wet interior areas and for all exterior areas.
 - 2. Use oiltight wireways in dry process areas.
 - 3. Use general purpose wireways in non-process areas.

- B. Routing: Install wireways parallel or perpendicular to wall, floors, ceilings, or structural members.

- C. Supports: All wireways must be supported with materials specifically made for this purpose. Do not use wire hangers. Do not attach any parts of the wireway system to ventilation ducts. Properly support and anchor wireways for their entire length by structural materials. Wireways shall not span any space unsupported. Set wireway anchors on waterbearing or waterproofed walls with waterproof cement.

- D. Fittings: Install fittings that have been specifically designed and manufactured for their particular application.

END OF SECTION