

SECTION 26 05 33 – ELECTRICAL RACEWAY SYSTEMS

PART 1 - GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide electrical raceway systems, complete and in place, in accordance with the Contract Documents.
- B. Local amendments to NEC require:
 - 1. The equipment grounding conductor run with or enclosing the circuit conductors shall be one or more or a combination of the following:
 - a. A copper, aluminum, or copper-clad aluminum conductor.
 - b. This conductor shall be solid or stranded; insulated, covered, or bare; and in the form of a wire or a bus bar of any shape.

1.2 DEFINITIONS

- A. Raceway System – raceway system consist of conduits, wireways, fittings, junction and pull boxes, supports, labels complete and ready for conductors.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Conduits, wireways, fittings, supports, labels, junction and pull boxes, and other indicated enclosures which are dedicated to the raceway system, shall comply with the requirements of this Section.

2.2 CONDUIT

- A. Galvanized Rigid Steel Conduit (GRC)
 - 1. Rigid steel conduit shall be mild steel, hot-dip galvanized inside and out.
 - 2. Rigid steel conduit shall be manufactured in accordance with ANSI C80.1 - Rigid Steel Conduit, Zinc Coated, and UL-6.
 - 3. Manufacturers, or Equal
 - a. **LTV Steel;**
 - b. **Triangle;**
 - c. **Wheatland Tube.**
 - 4. GRC shall be used in all locations except outdoor locations or NEMA-4X locations.
- B. PVC-Coated Galvanized Rigid Steel Conduit (PVC-coated GRC)

1. The conduit, prior to PVC coating, shall meet the requirements for GRC conduit above.
 2. A PVC coating shall be bonded to the outer surface of the galvanized conduit. The bond between the coating and the conduit surface shall be greater than the tensile strength of the coating.
 3. PVC coating thickness shall be not less than 40 mils.
 4. PVC-coated GRC shall be manufactured in accordance with the following standards:
 - a. UL-6
 - b. ANSI C80.1
 - c. NEMA RN1 - PVC Externally Coated Galvanized Rigid Steel Conduit, Intermediate Metal Conduit, and where shown on the plans
 5. Manufacturers, or Equal
 - a. **Robroy**;
 - b. **Ocal**.
 6. PVC-coated GRC shall be used in all direct-bury installations, outdoor locations, below-ground facilities, NEMA 4X designated areas, and where shown on the drawings.
- C. Liquidtight Flexible Conduit (LFMC)
1. Liquidtight flexible conduit (LFMC) shall be constructed of a flexible galvanized metal core with a sunlight-resistant thermoplastic outer jacket.
 2. LFMC shall be manufactured in accordance with UL-360 - Steel Conduits, Liquid-Tight Flexible.
 3. Manufacturers, or Equal
 - a. **Anaconda, "Sealtite"**;
 - b. **Electriflex, "Liquatite"**.
- D. Electrical Metallic Tubing (EMT) or Intermediate conduit (IMC) will not be accepted.

2.3 FITTINGS AND BOXES

- A. General:
1. Cast and malleable iron fittings for use with metallic conduit shall be the threaded type with 5 full threads.
 2. Fittings and boxes shall have neoprene gaskets and non-magnetic stainless steel screws. All covers shall be attached by means of holes tapped into the body of the fitting. Covers for fittings attached by means of clips or clamps will not be acceptable.
 3. Non-explosion-proof boxes larger than standard cast or malleable types shall be 304 stainless steel, NEMA 4X.
 4. Boxes larger than standard cast or malleable types shall be 304 stainless steel, NEMA 4X.
 5. In outdoor areas, raceways shall be terminated in raintight hubs as manufactured by **Myers, O.Z. Gedney**, or equal. In other than outdoor areas, sealed locknuts and bushings shall be used.

6. Fittings and boxes in hazardous locations shall be suitable for the Class and Division indicated or required by code.
- B. Cast Aluminum Fittings and Boxes
1. Cast aluminum boxes and fittings shall have less than 0.40 percent copper content.
 2. Manufacturers, or Equal
 - a. **O.Z. Gedney;**
 - b. **Appleton;**
 - c. **Crouse-Hinds.**
- C. Malleable Iron Fittings and Boxes
1. Fittings and boxes for use with galvanized steel conduit shall be of malleable iron or gray-iron alloy with zinc plating.
 2. Manufacturers, or Equal
 - a. **O.Z. Gedney;**
 - b. **Crouse-Hinds;**
 - c. **Appleton.**
- D. PVC-Coated Fittings and Boxes
1. Fittings and boxes for use with PVC-coated GRC shall be PVC-coated and shall be products of the same manufacturer as the conduit.
 2. Fittings used for LFMC and PVC-coated systems are to be PVC-coated.
- E. Stainless Steel Boxes
1. Stainless steel boxes shall be used with PVC-coated GRC raceway systems and where indicated on the Drawings.
 2. Stainless steel boxes shall be NEMA 4X, Type 304.
 3. Stainless steel shall be a minimum 14-gauge thickness, with a brushed finish.
 4. Doors shall have full-length stainless steel piano hinges. Non-hinged boxes are not acceptable.
 5. Manufacturers, or Equal
 - a. **Hoffman;**
 - b. **Rohn;**
 - c. **Hammond.**

2.4 WIREWAYS

- A. All wireways shall be painted ANSI 61 gray, galvanized 14-gauge steel with screw covers and a steel divider to separate the discrete signals from the analog signals. Wireways shall be **Hoffman**, or equal.
- B. Wireway shall be NEMA 12 and used only in above ground indoor locations.
- C. Wireway systems not shown on the plans shall be submitted for approval.

2.5 CABLE TRAYS

- A. Cable trays are not to be used.

2.6 IDENTIFICATION TAPE

- A. Continuous lengths of warning tapes shall be installed 12 inches above and parallel to all underground conduits. Tape shall be 6-inch-wide polyethylene film imprinted, "CAUTION – ELECTRIC UTILITIES BELOW." Tape shall be as manufactured by **Brady**, or equal.

2.7 EXPLOSION-PROOF BOXES

- A. Explosion-proof boxes shall be used to house control stations, switches, any arc producing device, and terminal for splicing in hazardous locations. The boxes shall be made from copper-free aluminum with stainless steel hardware, have a hinged cover, and use O-ring gaskets for watertight integrity. The boxes shall be factory painted with epoxy gray paint. Boxes 12" x 12" and larger shall have (1) 2" hole and (2) 1.5" holes, and (2) 1" holes drilled, tapped, and plugged on the bottom of the box. The boxes shall be **Appleton Electric AJBEW**, or equal.

2.8 EXPLOSION-PROOF CONDUIT FITTINGS AND UNIONS

- A. Explosion-proof conduit fittings and unions shall be made from zinc electroplated malleable iron. Fittings shall include gasketed water-tight connections, be UL-listed for use in Class 1 Division 1 areas. Fittings shall be **Appleton Electric**, or equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. All wiring shall be run in raceway unless indicated otherwise.
- B. Raceways shall be installed between equipment as indicated. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical, and shall be accomplished with tools designed for this purpose. Field bends are required on conduits up to 2". Factory elbows may be utilized on raceways over 2". All fittings and connections shall be made tight.
- C. Separate raceway systems shall be provided for:
 1. Analog signals
 2. 24 VDC discrete signals and instrument power supply conductors
 3. 120 VAC and higher wiring

When non-loop powered instruments have only one raceway port, the CONTRACTOR may run both the analog and 24 VDC wiring in a short length of ½” LFMC to a splitter box where the wiring must then be separated into the required raceway system. The length of LFMC must be kept to the absolute minimum and must not exceed 3 feet unless written approval has been given by the ENGINEER.

- D. Where raceway routings are indicated on plan views, follow those routings to the extent possible. See SECTION 26 05 00 – ELECTRICAL WORK, GENERAL Article 3.1 Para B for additional installation requirements.
- E. Routings shall be adjusted to avoid obstructions. Coordinate between trades prior to installation of raceways. Lack of such coordination shall not be justification for extra compensation, and removal and re-installation to resolve conflicts shall be by the CONTRACTOR as part of the WORK.
- F. Support rod attachment for ceiling-hung trapeze installations shall meet the seismic requirements.
- G. Exposed raceways shall be installed parallel or perpendicular to structural beams.
- H. Install expansion fittings with bonding jumpers wherever raceways cross building expansion joints.
- I. Exposed raceways shall be installed at least 1/2-inch from walls or ceilings except that at locations above finished grade where damp conditions do not prevail, exposed raceways shall be installed 1/4-inch minimum from the face of walls or ceilings by the use of clamp backs or struts.
- J. In underground facilities or NEMA 4X areas, all raceway penetrations in panels shall be bottom entry.
- K. Wherever contact with concrete or dissimilar metals can produce galvanic corrosion of equipment, suitable insulating means shall be provided to prevent such corrosion.
- L. To facilitate future expansion, boxes and fittings are to be installed when indicated on the drawings. Unused hubs are to be plugged with proprietary devices. Raceways that include future expansion provision are to be sized to accommodate any such specified wiring without exceeding the requirements of this specification.
- M. The maximum allowable conduit fill for instrumentation and control wiring is given by the following table:

Conduit Diameter	No. of 14-Gauge Wires	No. of 18-Gauge TWS
3/4"	8	2
1"	16	4
1-1/4"	32	7
1-1/2"	48	10

2"	72	17
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Note: No instrumentation or control wiring conduit is to be larger than 2 inches in diameter.

3.2 RACEWAYS

- A. Exposed raceway systems shall be rigid galvanized steel except as follows, unless indicated otherwise:
 - 1. In outdoor areas, all underground vaults, and NEMA 4X areas, PVC-coated GRC shall be utilized.
- B. Raceways concealed, buried, or encased in concrete, shall be PVC-coated GRC. Where conduit emerges from concrete encasement, a PVC-coated RGS elbow shall be utilized for transition from the concrete. Conduit shall emerge from the concrete perpendicular to the surface whenever possible.
- C. Exposed conduit shall be 3/4-inch minimum trade size. Supports shall be installed at distances required by the NEC.
- D. Conduit shall not be encased in the bottom floor slab below grade.
- E. Concrete cover for conduit and fittings shall not be less than 1-1/2 inches for concrete exposed to earth or weather, or less than 3/4-inch for concrete not exposed to weather or in contact with the ground.
- F. Raceways passing through a slab, wall, or beam shall not impair significantly the strength of the construction.
- G. Raceways embedded within a slab, wall, or beam (other than those merely passing through) shall satisfy the following:
 - 1. Conduits with their fittings embedded within a column shall not displace more than 4 percent of the gross area of cross section.
 - 2. Conduits shall not be larger in outside dimension than one third the overall thickness of slab, wall, or beam in which embedded.
 - 3. Raceways shall not be spaced closer than 3 outside diameters on centers.
- H. Raceways shall be placed so that cutting, bending, or displacing reinforcement from its proper location will not be required.
- I. Threads shall be coated with a conductive lubricant before assembly.
- J. Joints shall be tight, thoroughly grounded, secure, and free of obstructions in the pipe. Conduit shall be adequately reamed to prevent damage to the wires and cables inside. Strap wrenches and vises shall be used to install conduit to prevent wrench marks on conduit. Conduit with wrench marks shall be replaced.

- K. Wherever raceways enter substructures below grade, the raceways shall be sloped to drain water away from the structure. Extreme care shall be taken to avoid pockets or depressions in raceways.
- L. Connections to lay-in type grid lighting fixtures shall be made using LFMC not exceeding 4-feet in length. Connections to motors and other equipment subject to vibration shall be made with LFMC not exceeding 3-feet in length. Equipment subject to vibration that is normally provided with wiring leads shall be provided with a cast junction box for the make-up of connections. The junction box is to be independently supported and not left free to hang from the equipment.
- M. Raceways passing through walls or floors shall have plastic sleeves. Core drilling shall be performed in accordance with Section 26 05 00.
- N. Provide raceway seal fittings at the following locations:
 - 1. In hazardous classified locations, in strict accordance with the NEC.
- O. Conduit, fittings, and boxes required in hazardous classified areas shall be suitably rated for the area and shall be provided in strict accordance with NEC requirements.
- P. Empty raceways shall be tagged at both ends to indicate the final destination. Where it is not possible to tag the raceway, destination shall be identified by a durable marking on an adjacent surface. A pull-cord shall also be installed in each empty conduit. This shall apply to conduits in floors, panels, manholes, equipment, etc.
- Q. Where an underground raceway enters a structure through a concrete roof or a membrane waterproofed wall or floor, core-drill the entrance and provide a Link-Seal, or equal, sealing device. The sealing device shall be utilized with rigid steel conduit.
- R. Final connections to heaters, instruments, motors, limit switches, and any equipment subject to vibration shall be made with LFMC and approved fittings. Maximum length of LFMC shall be 3 feet.
- S. Connections to solenoid valves, pilot actuators, and flood sensors shall be made with LFMC and approved fittings to a cast box with screw cover (GUA type), independently and securely supported. In no case is the device to support the cast box.

3.3 CABLE TRAYS

- A. Cable trays are not to be used.

END OF SECTION 26 05 33