

**SECTION 16110**

**RACEWAY AND FITTINGS**

**PART 1 - GENERAL**

1.1 GENERAL

- A. Provisions of Section 16010 General Requirements for Electrical Work apply to the work of this Section.
- B. This section includes requirements for raceway systems, including conduit, boxes, cabinets, and all materials required to install, support and secure a complete system for support and protection of electrical conductors.

1.2 CODES AND STANDARDS

- A. Products shall comply with the following codes and standards and shall be UL-listed and labeled:

ANSI C80.1	Standard for Rigid Steel Conduit
NEMA RN-1	Polyvinyl-chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing
NEMA TC-2	Electrical Plastic Tubing and Conduit
NEMA TC-3	PVC Fittings for use with Rigid PVC Conduit and Tubing
UL 1	Flexible Metal Conduit
UL 6	Rigid Metal Conduit
UL 360	Liquid Tight Flexible Steel Conduit
UL 514B	Fittings for Conduit and Outlet Boxes
UL651	Schedule 40 and 80 Rigid PVC Conduit
UL797	Electrical Metallic Tubing
UL870	Wireways, Auxilliary Gutters and Associated Fittings
UL1242	Intermediate Metal Conduit

1.3 SUBMITTALS

- A. Submit manufacturers illustrated product literature and technical specifications for each type of raceway provided on this project.

1.4 MANUFACTURERS

- A. Rigid steel conduit, electrical metallic tubing, and intermediate metal conduit: Allied Tube and conduit, Triangle, Wheatland or approved equal.
- B. Coupling and fittings: Appleton, Crouse Hinds, Killark, O-Z Gedney, Steel City, Thomas & Betts or approved equal.

**PART 2 - PRODUCTS**

## 2.1 CONDUIT

- A. Rigid steel conduit shall be of mild steel piping with a uniform protective coating of hot dipped galvanizing inside and outside, including all threads. The conduit shall be furnished in nominal 10-foot lengths, with both ends threaded and one coupling (galvanized inside and out) applied to each length. The threads opposite the coupling end shall be protected by a plastic cap.
- B. Rigid nonmetallic conduit shall be heavy wall Schedule 40 polyvinyl chloride 90 deg. C rated furnished in 10-20-, or 30-foot lengths. Plastic conduit shall be PV-DUIT as manufactured by Carlon, or approved equal.
- C. Electrical metallic tubing shall be of zinc coated steel with an interior coating of lacquer or enamel.
- D. Liquid tight flexible conduit shall be constructed with a flexible core of galvanized steel and an oil resistant PVC jacket to form a liquid tight raceway. The overall jacket shall be wrinkle free and suitable for use in temperatures from -40 deg. C to + 100 deg. C.

Flexible conduit shall be Anaconda "Sealtite" type UA or approved equal.

- E. Flexible metal conduit shall be hot dipped galvanized interlocked strip steel.

## 2.2 CONDUIT FITTINGS

- A. Bushings.
  - 1. Insulated bushings for conduit sizes 1-1/4 inches and larger shall have metal bodies and threads, with molded-on high impact phenolic thermosetting insulation to prevent conductor insulation damage. Bushings shall be Type IBC insulated bushings as manufactured by O.Z./Gedney or an approved equal. Insulated bushings for conduit sizes 1 inch and smaller may be of plastic, O.Z./Gedney Type "A", or an approved equal.
  - 2. Insulated grounding bushings shall be similar to the insulated bushings described above, except they shall have set screws to lock the bushings on the conduits and shall have mechanical type lugs attached. The lugs shall be sized to accept the ground wire sizes as set forth in the latest edition of the National Electrical Code, but in no case smaller than No. 8 AWG wire. Grounding bushings shall be Type BLG as manufactured by O.Z./Gedney or an approved equal.
  - 3. Male bushings shall be Thomas and Betts Corporation insulated throat chase nipples, or a product of equal construction. Bushings used only to pass conductors through metal partitions, etc. shall be O.Z./Gedney, Type "ABB".
  - 4. Bushings for use with EMT shall be O.Z./Gedney type SBT or approved equals.
- B. Conduit bodies for use with aluminum conduit shall be of copper free aluminum alloy. Those for use with steel conduit may be of galvanized, or cadmium plated cast iron, or of copper free aluminum alloy. All conduit fittings shall be provided with neoprene gaskets and sheet metal

covers, except that cast covers shall be used for sized 1-1/2 inches and larger. Conduit connections shall be threaded and EMT connections shall be set screw. Cover screws shall be captive. All conduit fittings shall be Crouse Hinds, Appleton, Killark or approved equal.

- C. Hubs. Water-tight conduit connections are required on all NEMA 3R, 4, and 4X enclosures and all electrical equipment located outdoors or in damp or wet areas. Where hubs or water-tight threaded connections are not provided as part of the enclosure, water-tight hubs shall be Myers "Scru-tite", or approved equal. All other terminations shall be double locknut and bushing.
- D. Fittings for use with liquid-tight flexible conduit shall be zinc plated malleable iron O.Z./Gedney type 4Q or approved equal.
- E. Locknuts. Locknuts shall be hot dipped galvanized steel or malleable iron. Standard locknuts shall be used for connections to NEMA 1 enclosures. Sealing locknuts with integral gasket shall be used for connections to NEMA 12 enclosures.

### 2.3 JUNCTION BOXES

- A. Pull and junction boxes shall be of code gauge metal with continuously welded joints or of cast metal if called for on the Drawings. All junction boxes shall have gasketed screw covers. Boxes for use with aluminum conduits shall be of aluminum. Sheet steel boxes shall be galvanized after fabrications. Screws for galvanized steel box covers shall be made of brass. Screws for aluminum box cover shall be stainless steel.

Boxes installed in concrete shall be cast iron alloy or copper free aluminum.

Unless otherwise shown on drawings, all boxes installed indoors shall be rated NEMA 1 and all boxes installed outdoors shall be rated NEMA 3R.

### 2.4 OUTLET BOXES

- A. Outlet boxes for concealed work shall be pressed steel boxes, galvanized and not less than #12 gauge. Each ceiling outlet designated for a lighting fixture shall have a fixture support secured in place with bolts and nuts. Ceiling boxes shall be octagonal with lugs and screws for back plates.
- B. Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used and to fulfill installation requirements for individual wiring situations.

### 2.5 SUPPORTS

- A. The Electrical Subcontractor shall size and provide all supports necessary for the installation of all raceway.
- B. Supports shall be designed for seismic forces in accordance with The BOCA National Building Code, Section 1612.
- C. Channel framing shall be manufactured by Unistrut, Kindort, B-Line or approved equal.

- D. In dry, non-corrosive areas, channel framing and angle shall be galvanized steel or aluminum and all nuts, bolts and hardware shall be carbon steel, cadmium plated or hot dipped galvanized. Ream clamps shall be galvanized steel or malleable iron.
- E. In outdoor, wet or damp areas channel framing and angle shall be aluminum or 304 stainless steel and nuts, bolts and hardware shall be 304 stainless steel. Beam clamps shall be hot dipped galvanized steel or malleable iron.
- F. In corrosive areas, channel framing shall be 316 stainless steel, PVC coated steel or PVC coated aluminum. Nuts, bolts and hardware shall be 316 stainless steel. Beam clamps shall be PVC coated.
- G. Supports shall be sized with a minimum safety factor of four or 200 lbs. whichever is greater.

## 2.6 SUPPORTS

- A. The Electrical contractor shall size and provide all supports necessary for the installation of all raceway.
- B. Supports shall be designed for seismic forces in accordance with The BOCA National Building Code, Section 1612.
- B. Channel framing shall be manufactured by Unistrut, Kindort, B-Line or approved equal.
- C. In dry, non-corrosive areas, channel framing and angle shall be galvanized steel or aluminum and all nuts, bolts and hardware shall be carbon steel, cadmium plated or hot dipped galvanized. Ream clamps shall be galvanized steel or malleable iron.
- E. In outdoor, wet or damp areas channel framing and angle shall be aluminum or 304 stainless steel and nuts, bolts and hardware shall be 304 stainless steel. Beam clamps shall be hot dipped galvanized steel or malleable iron.
- F. Supports shall be sized with a minimum safety factor of four or 200 lbs. whichever is greater.

## **PART 3 - EXECUTION**

### 3.1 GENERAL

- A. Wiring methods are specified in Section 16010 General Requirements for Electrical Work.

### 3.2 INSTALLATION

- A. Conduit, EMT, boxes & enclosures shall be installed so that they are mechanically secure, electrically continuous and neat in appearance.
- B. Exposed runs shall be installed to conform to the shape of the surface over which they are run. Where they are run over a plane surface, they shall be straight and true. All exposed conduits shall be run parallel and perpendicular to building column lines and walls. Diagonal run will not be permitted. Conduit runs in groups shall be supported by means of common members made of

channel framing. Group mounting is not required where the group consists of only two conduits. Fastening to solid masonry or concrete shall be machine bolts with expansion shields. Fastening to hollow masonry shall be with toggle bolts.

Unless otherwise approved, spacing between conduit supports shall not exceed ten feet. Conduits shall not be supported from structural members marked Removable on the structural drawings. Conduit hangers and supports shall be fastened to buildings and structural members only and not to any equipment or piping. Separate conduits a minimum 6 inches from flues, steam and hot water lines. Install conduit above mechanical piping wherever possible.

- C. All conduit supports other than structural members shall be galvanized. The use of perforated strap or plumber straps will not be permitted.
- D. Conduit up to 1-1/2 inches may shall be supported by one-hole malleable iron straps with clamp backs. Conduit 2 inches and larger shall be supported by two hole straps.
- E. Conduit runs shall not exceed 100 feet between boxes, fittings or devices.
- F. All conduit crossing building or structure expansion joints shall be provided with approved expansion fittings.

### 3.3 BENDS

- A. Field bends shall be made with approved bending tools. All field-formed bends shall be of maximum radius permitted by the design and construction conditions.
- B. Where a group of exposed conduits change direction, the bends shall have a common center in order to maintain the uniformity and neat appearance of the group, having regard for the minimum bending radius of the largest conduit in the group.
- C. Bends shall be uniform radius and free from cracks, crimps or other damage to the conduit or its coating and shall not unduly flatten the conduit section.

### 3.4 JOINTS AND TERMINATIONS

- A. All joints in rigid conduit shall be threaded, using standard couplings. The use of running threads, threadless or split couplings is prohibited. When reaming out of conduit ends to remove burrs and rough edges, care shall be exercised to avoid excessive reaming which results in the weakening of the conduit wall at the end.
- B. All joints shall be made up wrench tight and with a minimum of wrench work in order to avoid wrench cuts.
- C. All cut threads shall be thoroughly painted with a coating of a rust inhibiting primer.
- D. EMT couplings and fittings shall be compression type up to 1 -1/4 inch and double set screw type 1-1/2 inch and larger.
- E. All conduit terminations in panels, enclosures, outlet boxes and equipment shall be provided with bushings.

**3.5 FLEXIBLE CONDUIT**

- A. Flexible conduit shall be use to terminate all, lighting, motors, unit lanterns, transformers, pilot devices and vibrating equipment.
- B. All flexible conduit shall be liquid-tight except connections to lighting fixtures and equipment installed in ceiling spaces.
- C. Connections to lighting fixtures shall be maximum length of 6 feet. All other flexible connections shall be maximum 18 inches.

**3.6 PENETRATIONS**

- A. All penetrations through concrete slabs, masonry walls or roofs shall be provided with sleeves.
- B. All sleeves shall be sealed to maintain the integrity of the structure. Fire resistant walls and floors shall be sealed with approved material, and shall maintain the original fire rating. All seals below grade shall be watertight, O.Z./Gedney type WSK or approved equal.

**END OF SECTION 16110**