Section 16150
Raceway and Fittings

Part One: General

1.1 General Requirements

1.1.1 Provisions

Provisions of Section 16000 General Requirements for Electrical Work apply to the work of this Section.

1.2 Applicable Codes and Standards

1.2.1 Products

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

ANSI C80.3	Standard for 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 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 Required

Manufacturers' product data sheets

1.4 Manufacturers

In compliance with the Specification Requirements:

- Allied Tube and Conduit (Conduit)
- Wheatland (Conduit)
- Thomas and Betts (Fittings)
- Appleton (Fittings)
- Crouse Hindes/Cooper (Fittings)
- OZ Gedney (Fittings)
- Killark (Fittings)
- Carlon (PVC)
- National Pipe and Plastics (PVC)
- AFC Cable Systems (MC/LFMC)
- Southwire (MC/LFMC)
- Other manufacturers listed in the specification descriptions
- Approved equals

Part Two: Products

2.1 Conduit

2.1.1 Rigid Nonmetallic Conduit (PVC)

Rigid nonmetallic conduit shall be polyvinyl chloride, rated for use with 90°C conductors and furnished in 10-20-, or 30-foot lengths.

2.1.2 Electrical Metallic Tubing (EMT)

Electrical metallic tubing shall be constructed of zinc coated steel with an interior coating of lacquer or enamel to permit easier wire pulling.

2.1.3 Liquid Tight Flexible Metal Conduit (LFMC)

Liquid tight flexible conduit shall be constructed with a flexible core of galvanized steel and an oil and sunlight resistant PVC jacket to form a liquid tight raceway. The overall jacket shall be wrinklefree and suitable for use in temperatures from -25°C to +80°C.

2.1.4 Flexible Metal Conduit (MC)

Flexible metal conduit shall have an outer armor constructed of be hot dipped galvanized interlocked strip steel.

2.2 Conduit Fittings

2.2.1 Bushings

2.2.1.1 Insulated Bushings

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 OZ Gedney or an approved equal. Insulated bushings for conduit sizes 1 inch and smaller may be of plastic, OZ Gedney Type "A", or an approved equal.

2.2.1.2 Insulated Grounding Bushings

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 OZ Gedney or an approved equal.

2.2.1.3 Male Bushings

Bushings for use with EMT shall be OZ Gedney type “SBT” or approved equals.

2.2.2 Conduit Bodies

Conduit bodies for use with aluminum conduit shall be of copper free aluminum alloy. EMT connections shall be set screw type. Cover screws shall be captive. All conduit fittings shall be as manufactured by Crouse Hinds, Appleton, Killark or approved equal.

2.2.3 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 "Scrutite", or approved equal. All other terminations shall be double locknut and bushing.

2.2.4 Fittings

Fittings for use with liquid-tight flexible conduit shall be zinc plated malleable iron Crouse Hinds type “CGB” or approved equal.

2.2.5 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

2.3.1 Pull and Junction Boxes

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. 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.

2.3.2 Rating of Boxes

Unless otherwise shown on drawings, all boxes installed indoors shall be rated NEMA 1 and all boxes installed outdoors shall be rated NEMA [3R][4][4X].

2.4 Outlet Boxes

2.4.1 Outlet Boxes for Concealed Work

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.

2.4.2 Outlet Boxes Installed Outdoors

Outlet boxes installed outdoors, in concrete or exposed, shall be cast iron alloy or copper free aluminum with gasketed covers.

2.4.3 Outlet Box Accessories

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

2.5.1 Sizing

The Electrical Subcontractor shall size and provide all supports necessary for the installation of all raceway.

2.5.2 Channel Framing

Channel framing shall be manufactured by Unistrut, Kindort, B-Line or approved equal.

2.5.3 Indoor Locations

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.

2.5.4 Outdoor, Wet or Damp Locations

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.

2.5.5 Corrosive Locations

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.

2.5.6 Supports

Supports shall be sized with a minimum safety factor of four or 200 lbs. whichever is greater.

Part Three: Execution

3.1 General

3.1.1 Requirements

Unless otherwise noted, all wiring shall be installed in conduit.

3.1.2 Wiring Methods

See section 16000 for wiring methods.

3.2 Installation

3.2.1 Conduit, EMT, Boxes and Enclosures

Conduit, EMT, boxes & enclosures shall be installed so that they are mechanically secure, electrically continuous and neat in appearance.

3.2.2 Exposed Runs

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 runs 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. Machine bolts with expansion shields shall be used when fastening to solid masonry or concrete. Toggle bolts shall be used to fasten to hollow masonry.

3.2.3 Spacing

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 of 6” from flues, steam and hot water lines. Install conduit above mechanical piping wherever possible.

3.2.4 Conduit Supports

All conduit supports other than structural members shall be galvanized. The use of perforated strap or plumber straps will not be permitted.

Conduit up to 1-1/2 inches may be supported by one-hole malleable iron straps with clamp backs.

Conduit 2 inches and larger shall be supported by two-hole straps.

3.2.5 Conduit Run Lengths

Conduit runs shall not exceed 100 feet between boxes, fittings or devices.

PVC conduits run above grade shall be sufficiently supported to prevent sagging.

MC cables shall be neatly bundled and tie wrapped and sufficiently supported.

3.2.6 Use of Expansion Joints

All conduit crossing building or structure expansion joints shall be provided with approved expansion fittings.

3.3 Bends

3.3.1 Field Bends

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.

3.3.2 Exposed Conduit Changing Direction

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.

3.3.3 General

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

3.4.1 EMT Couplings and Fittings

EMT couplings and fittings shall be compression type on conduits up to 1–1/4 inch and double set screw type for conduits 1-1/2 inch and larger.

3.4.2 Conduit Terminations

All conduit terminations in panels, enclosures, outlet boxes and equipment shall be provided with bushings.

3.5 Flexible Conduit

3.5.1 Terminations

Flexible conduit shall be use to terminate all, lighting, motors, unit lanterns, transformers, pilot devices and vibrating equipment.

3.5.2 Liquitite Flexible Conduit

Liquitite flexible conduit and fitting shall be used outdoors and in all damp or wet areas, or where exposed to grease or oil.

3.6 Penetrations

3.6.1 Penetrations through Slabs, Walls, Roofs

All penetrations through masonry walls or roofs shall be provided with sleeves.

3.6.2 Sleeves

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 16150