

## SECTION 260533

### RACEWAYS

#### PART 1 GENERAL

##### 1.1 STIPULATIONS

- A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

##### 1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
  - 1. Requirements of the following Division 26 Sections apply to this Section:
  - 2. Section 260000 - Basic Electrical Requirements.
  - 3. Section 260001 - Basic Electrical Materials and Methods.
  - 4. Section 270526 - Grounding.

##### 1.3 SUMMARY

- A. This Section includes raceways for electrical wiring. Types of raceways in this section include the following:
  - 1. Rigid galvanized steel conduit (RGS).
  - 2. Intermediate metal conduit (IMC).
  - 3. Electrical metallic tubing (EMT).
  - 4. Rigid nonmetallic conduit (RNC).
  - 5. Flexible metal conduit.
  - 6. Liquid tight flexible conduit.
  - 7. Conduit bodies.
  - 8. Conduit fittings.
  - 9. Surface raceways.
  - 10. Wireway and auxiliary gutters.
- B. Related Sections: The following Division 26 Sections contain requirements that relate to this Section:
  - 1. Section 260519 - Low Voltage Wires and Cables for other wiring methods.
  - 2. Section 260529 - Supporting Devices for raceway supports.
  - 3. Section 260534 - Boxes and Cabinets, for boxes used with conduit and tubing systems.

##### 1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
  - 1. Product Data for the following products:
  - 2. Conduit/Tubing fittings and connectors indicating use and UL listing for applications.

3. Surface raceway and fittings.
  4. Wireway and fittings.
- B. Samples, 6 inches long of each type and size of surface raceway with required finish.
- C. Installation Instructions: Manufacturer's written installation instructions for wireway, surface raceway, and nonmetallic raceway products.

## 1.5 QUALITY CONTROL

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
1. National Fire Protection Association (NFPA):
  2. No. 70, 1996 National Electrical Code, the following Articles:
  3. 331, Electrical Nonmetallic Tubing.
  4. 345, Intermediate Metal Conduit.
  5. 346, Rigid Metal Conduit.
  6. 347, Rigid Nonmetallic Conduit.
  7. 348, Electrical Metallic Tubing.
  8. 349, Flexible Metallic Tubing.
  9. 350, Flexible Metal Conduit.
  10. 351A, Liquid tight Flexible Metal Conduit.
  11. 351B, Liquid tight Flexible Nonmetallic Conduit.
  12. 352A, Surface Metal Raceways.
  13. 352B, Surface Nonmetallic Raceways.
  14. 362, Wiring.
  15. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.
- B. National Electrical Manufacturers Association (NEMA):
1. NEMA, RN 1, 1986 PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
  2. NEMA, TC 3, 1982 PVC Fittings for Use with Rigid PVC Conduit and Tubing.
  3. NEMA, TC 5, 1983 Corrugated Polyolefin Coilable Plastic Utilities Duct.
  4. NEMA, TC 6, 1983 PVC and ABS Plastic Utilities Duct for Underground Installation.
  5. NEMA, TC 7, 1983 Smooth-Wall Coilable Polyethylene Electrical Plastic Duct for Underground Applications.
  6. NEMA, TC 8, 1983 Extra-Strength PVC Plastic Utilities Duct for Underground Installation.
  7. NEMA, TC 9, 1983 Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.
  8. NEMA, TC 10, 1983 PVC and ABS Plastic Communications Duct and Fittings for Underground Installation.
- C. American National Standards Institute (ANSI):
1. ANSI-C80.2, 1983 Specification for Rigid Steel Conduit, Enameled.
  2. ANSI-C80.3, 1983 Specification for Electrical Metallic Tubing, Zinc-coated.
  3. ANSI-C80.5, 1983 Specification for Rigid Aluminum Conduit.
  4. ANSI-C80.6, 1986 Intermediate Metal Conduit. (IMC)
- D. American Society for Testing Materials (ASTM):

1. ASTM F 512-84 Standard Specification for Smooth Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation.
2. UL Compliance and Labeling: Comply with applicable requirements of UL standards pertaining to electrical raceway systems. Provide raceway products and components listed and labeled by UL, or ETL.
3. UL 1, 1985 Flexible Metal Electrical Conduit.
4. UL 3, 1984 Flexible Nonmetallic Tubing for Electric Wiring.
5. UL 5, 1985 Surface Metal Electrical Raceways and Fittings.
6. UL 6, 1981 Rigid Metal Electrical Conduit.
7. UL 360, 1986 Liquid tight Flexible Steel Conduit, Electrical.
8. UL 514B, 1982 Fittings for Conduit and Outlet Boxes.
9. UL 651, 1981 Schedule 40 and 80 PVC Conduit.
10. UL 651A, 1981 Type EB and A Rigid PVC Conduit and HDPE Conduit.
11. UL 797, 1983 Electrical Metallic Tubing.
12. UL 870, 1985 Electrical Wireways, Auxiliary Gutters, and Associated Fittings.
13. UL 1242, 1983 Intermediate Metal Conduit.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following, or equivalent manufacturer as approved by the Professional:

1. Rigid Metallic Conduit:
2. Allied
3. LTV Steel
4. Steelduct
5. Triangle
6. Wheatland

- B. PVC Coated Rigid Steel Conduit and Fittings:

1. Occidental Coating Company
2. Perma-Cote Industries
3. Rob-Roy
4. Wheatland

- C. Rigid Nonmetallic Conduit and Fittings:

1. Canadian General Electric
2. Carlon
3. CertainTeed
4. Condux
5. National
6. Olin

- D. Flexible Metal Conduit:

1. American Flexible Conduit
2. Carol
3. Columbia Cable and Electric
4. Ettco
5. O-Z/Gedney

E. Liquid Tight Flexible Metal Conduit and Fittings

1. American Flexible Conduit
2. Anamet, Inc.
3. Columbia Cable and Electric
4. Ettco
5. Flexible Technology Corp.
6. Liquatite

F. Conduit Bodies

1. Appleton Electric Co.
2. Carlon
3. Crouse-Hinds Division, Cooper Industries, Inc.
4. Killark Electric Mfg. Co.
5. O-Z/Gedney
6. Spring City Electrical Mfg. Co.

G. Conduit Fittings

1. Bridgeport Fittings, Incorporated
2. ETP (Berger Industries, Inc.)
3. Midwest Electric
4. Neer
5. O-Z/Gedney
6. RACO
7. Steel City
8. Thomas and Betts

H. Wireways and Auxiliary Gutters

1. Hoffman Engineering Co.
2. Keystone/Rees, Inc.
3. Lee Products Co.
4. Square D Co.
5. Walker-Parkersburg

I. Surface Metal Raceway

1. The Wiremold Co. 500 Series

J. Surface Nonmetallic Raceway

1. Panduit Corp.
2. The Wiremold Co.

K. Surface Metal Duct

1. Isolduct Energy Systems 300 and 400 series.
2. Walker-Parkersburg 3400 series.
3. The Wiremold Co. G3000, AL3100, and V4000 series.

2.2 METAL CONDUIT AND TUBING

- A. Intermediate Steel Conduit: UL 1242.
- B. Electrical Metallic Tubing and Fittings: ANSI C80.3.

## 2.3 NONMETALLIC CONDUIT AND DUCTS

- A. Rigid Nonmetallic Conduit: NEMA TC 2 and UL 651, Schedule 40 or 80 PVC.
- B. PVC Conduit and Tubing Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.
- C. Conduit and Duct Accessories: Types, sizes, and materials complying with manufacturer's published product information. Mate and match accessories with raceway.

## 2.4 CONDUIT BODIES

- A. General: Types, shapes, and sizes as required to suit individual applications and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.
- B. Metallic Conduit and Tubing: Use metallic conduit bodies. Use bodies with screw type connectors for EMT.
- C. Conduit Bodies 1 Inch and Smaller: Use bodies with screw type EMT connectors.

## 2.5 CONDUIT FITTINGS

- A. General: Types, shapes, and sizes as required to suit individual applications and NEC requirements.
- B. Rigid Galvanized Steel, Intermediate Steel and Rigid Aluminum Conduit: Use threaded type with bushed connections.
- C. Electrical Metallic Tubing Conduit: Use nylon insulated, concrete or raintight, mechanical screw type connectors.
- D. Rigid Nonmetallic or Coated Conduit: Use fittings designed specifically for conduit type of same manufacturer.
- E. Flexible Metal Conduit: Use nylon insulated throats of the following type:
  - 1. Wedge and screw type.
- F. Liquid Tight Flexible Conduit: Use threaded grounding cone with steel compression ring and tightening gland, steel body with insulated throat.
- G. Unlike Conduit: All junctions to be of same size and type conduit.
- H. Expansion and Deflection Fittings:
  - 1. Conduit movement in straight line direction.
  - 2. O-Z/Gedney type AX series.
  - 3. Up to 3/4 inch deflection and movement in all directions.
  - 4. O-Z/Gedney type DX series.
  - 5. Deflection and movement beyond 3/4 inch in all directions.

6. O-Z/Gedney type AXDX series.
- I. Conduit Bushings
    1. Rigid Steel and Intermediate Steel Conduit: Threaded, grounded, insulating type with thermosetting or fiber insert in a metal body.
    2. Electrical Metallic Tubing Conduit: Identical to rigid steel or intermediate steel conduit bushing on electrical metallic tubing combination coupling.
  - J. Conduit Seals
    1. Cast in place with pressure ring and sealing grommet.
    2. O-Z/Gedney type FSK series with FSKA membrane clamp adapter.
    3. Cast in place with two pairs of pressure rings and sealing grommets.
    4. O-Z/Gedney type WSK series.
    5. For sealing conduits installed in core-drilled, sleeved, or precast holes.
    6. O-Z/Gedney type CSM series with CSMC membrane clamp adapter.
    7. Thunderline Link-Seal series.

## PART 3 EXECUTION

### 3.1 CONDUIT RACEWAY APPLICATION

#### A. Rigid Galvanized Steel Conduit

1. May be used in:
  - a. Interior locations.
  - b. Direct contact with concrete.
2. Shall be used in:
  - a. Exposed exterior locations.
  - b. Hazardous locations.
  - c. Within seven foot area around boilers, incinerators and other heat producing equipment.
  - d. Exposed interior locations within seven feet of the floor for all power and signal conductors.

#### B. Intermediate Metal Conduit

1. May be used in:
  - a. All applications noted for rigid galvanized steel conduit except hazardous locations.

#### C. Electrical Metal Tubing

1. May be used in:
  - a. Concealed interior locations above ceilings, in hollow studed partitions and in the cores of concrete masonry unit partitions.
  - b. Exposed interior locations above seven feet.
2. Shall be used:

- a. All exposed interior locations above seven feet for conductors of any type, except where MC Cable is permitted.

D. Schedule 40 or 80 Nonmetallic Conduit

- 1. May be used in:
  - a. Direct contact with earth.
  - b. Locations embedded in concrete.

E. Flexible Metal Conduit

- 1. May be used in:
  - a. Four to six feet long lengths for final connection to lighting fixtures.
  - b. Steel studwalls between outlets and from outlet to rigid raceway leaving wall.
- 2. Shall be used in:
  - a. 18 inches to 22 inch long lengths to form a slack "U" between rigid raceway system and:
    - b. Rotating equipment
    - c. Vibrating equipment
    - d. Equipment requiring adjustments in position
    - e. Transformers

F. Liquid-tight Flexible Metal Conduit shall be used as specified for flexible metal conduit as follows:

- 1. Shall be used in:
  - a. Final connection to all kitchen equipment.
  - b. Damp locations.
  - c. Wet locations.
  - d. 18 inch to 22 inch long lengths to form a slack "U" between rigid raceway system and motors.

### 3.2 INSTALLATION

A. General: Install electrical raceways in accordance with manufacturer's written installation instructions, applicable requirements of NEC, and as follows:

- 1. Minimum conduit raceway size shall be 3/4 inch except switch legs, which may be 1/2 inch.
- 2. Provide supports for raceways as specified elsewhere in Division 26.
- 3. Cut square, free of burrs due to field cutting or manufacture, and bush where necessary.

B. Conduit Raceway Routing

- 1. Conceal in finished rooms except where exposure is clearly indicated. Provide stainless steel escutcheon plates for all finished wall, floor, and ceiling penetrations.
- 2. Install raceways exposed in mechanical and electrical equipment rooms and electrical closets. Maintain a minimum 7 ft. head room.
- 3. Install raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical.

4. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel. This requires that there be a change in the plane of the run such as from wall to ceiling and that the raceways be of the same size. In other cases provide field bends for parallel raceways.
5. Route Raceways as required by job conditions unless dimensioned positions are shown on Drawings. Verify exact locations of all raceways, pull boxes, and junction boxes; resolve any conflicts before installation. Give priority in available space to large steam mains, steam lines that pitch, waste lines, drain lines, large air ducts, and all structural steel, unless indicated otherwise.
6. Elevation of Raceway: Where possible, install horizontal raceway runs above water and steam piping.
7. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
8. Install with not more than three 90 degree bends or more than 100 feet of straight conduit between pull boxes. Provide and install all additional pull boxes to meet this requirement.
9. Minimum Spacing: 3 inches between raceways and cold water or waste piping, and 6 inches between raceways and parallel steam pipes, condensate pipes, hot water pipes and air ducts.
10. Do not place raceway less than one inch apart where they cross each other.
11. Install to provide adequate grounding between all outlets and the established electrical system ground.
12. Install to prevent water pockets.

C. Conduit Raceway Installation

1. Prevent foreign matter from entering raceways by using temporary closure protection.
2. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
3. No raceways in above grade slab. Install in subgrade or in above grade in ceiling below

D. When installed embedded in concrete, or, in direct contact with the earth:

1. Provide rigid galvanized steel elbows for vertical rise through the concrete.
2. Provide rigid galvanized steel conduit for the first ten foot section when leaving a building.
3. Make watertight with asphaltum or other approved compound applied to conduit joints before assembled.
4. Join raceways with fittings and make joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors.

E. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside the box.

F. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

G. Complete installation of electrical raceways before starting installation of conductors within raceways.

H. Install a grounding wire in all flexible metal conduits.

- I. Install pull wires in empty raceways. Use monofilament plastic line having not less than 200 lbs. tensile strength. Leave not less than 12 inches of slack at each end of the pull wire. Tag at each end identifying other end location.
- J. Telephone and Signal System Raceways 2-Inch Trade Size and Smaller: In addition to the above requirements, install raceways 2-inch and smaller trade size in maximum lengths at 150 feet and with a maximum of two, 90 deg bends or equivalent. Install pull or junction boxes where necessary to comply with these requirements.
- K. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid galvanized steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver-operated threaded flush plugs with floor.
- L. If it is necessary to cut holes through webs of beams or girders, call such points to the attention of the Professional with size of hole before proceeding with work. All holes shall be cut no larger than absolutely necessary.
- M. Whenever conduit is installed on exposed steel columns, the conduit shall be installed on the column web, and not on the flange.
- N. All penetrations through existing floors shall be core drilled and sleeved.
- O. All conduit knockouts or holes on electrical apparatus which are not used shall be provided with new plugs to match the NEMA rating of the enclosure.
- P. Conduit Fittings:
  - 1. Run with couplings approved for the conduit being used. Running threads and chase nipples will not be accepted in runs of threaded conduit.
  - 2. Use screw type fitting on 1 inch EMT conduit and smaller.
- Q. Expansion-Deflection Fittings:
  - 1. Install in all raceways at the expansion joints of the building in such a manner that the expansion joints of the building will function properly and not stress any electrical raceways. Movement will be required in all directions. Refer to "A" series Drawings for facility expansion joint locations.
  - 2. Install on all straight conduit runs 1 inch trade size or larger in excess of 100 feet. Movement will be required in straight line direction only.
  - 3. Maintain grounding continuity at each expansion-contraction fitting.
- R. Conduit Seals:
  - 1. Use type "FSK" cast-in-place where conduit passes through foundation walls less than 60 inches below finished grade.
  - 2. Use type "WSK" cast-in place where conduit passes through foundation walls at 60 inches or more below finished grade.
  - 3. Install watertight seals at all conduits passing through horizontal barriers. These seals may be types "FSK", "WSK", or "CSML". Sleeves shall extend at least two inches above the finished floor with 1/2 inch space around the conduit and this space sealed permanently watertight with a removable material (concrete not acceptable).
  - 4. Install where conduits pass through barriers having a 30 degree F or greater temperature differential in the spaces on either side at anytime, and in conduits entering or leaving supply and return air plenums. Install pliable removable plastic compounded the nearest box at the top end of vertical runs and at the hot end of horizontal runs.

S. Wireways and Auxiliary Gutters:

1. Support horizontally with expansion shields, concrete inserts or masonry shields, as required for wall where wireway is mounted. Provide supports at 5 foot centers.
2. Provide at least 42 inch clear in front of all wireways with front covers.

T. Multi-Outlet Assemblies:

1. Support assemblies at 18 inch centers maximum, at each end, branch, and box. Provide blank cover sections at sinks and basins extending 6 feet on either side of basin. Make transition to other wiring method with proper fittings.

3.3 ADJUSTING AND CLEANING

- A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt, and construction debris before installing or pulling conductors.

END OF SECTION 260533