SECTION 16130
RACEWAYS

PART 1 - GENERAL

1.01 PROVISIONS INCLUDED

A. The general provisions of the Contract, including General and Supplementary General Conditions, and Division 1 General Requirements, apply to work specified in this Section.

B. Requirements of Section 16050, "Basic Electrical Materials and Methods," apply to this Section.

1.02 SUMMARY

A. Work Included: Furnishing and field installation of the complete raceway system in accordance with these specifications and as indicated on the drawings. Furnish raceways in quantities sufficient for a complete installation. The raceway system includes conduit, boxes, cabinets, and all materials and devices required to install, support, secure, and provided a complete system for support and protection of electrical conductors.

B. Related Work Specified in Other Sections:
1. Wireways and Surface Raceways Section 16132.
2. Conductors: Section 16120.
3. Boxes: Section 16135.
4. Hangers and supports: Section 16070.
5. Electrical identification: Section 16075.
6. Grounding: Section 16060.

1.03 REFERENCES

A. National Fire Protection Association: NFPA 70, National Electrical Code (NEC)

B. American National Standards Institute (ANSI):
1. ANSI C80.1, Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3, Electrical Metallic Tubing, Zinc Coated.

C. National Electrical Contractors Association (NECA): NECA Standard of Installation.

D. National Electrical Manufacturer's Association (NEMA): NEMA FB 1, Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

E. Federal Specifications:
1. Fed. Spec. WW-C-563: Conduit Metal, Rigid, Electrical, Thin-Wall Steel Type (EMT); straight lengths, elbows, and bends.
2. Fed. Spec. WW-C-581: Conduit, Metal, Rigid, and Intermediate; and Coupling, Elbow, and Nipple, Electrical Conduit; Steel Zinc Coated.

F. Underwriters Laboratories:
   1. UL 1, Flexible Metal Conduit
   2. UL 6, Rigid Metal Conduit.
   3. UL 797, Electrical Metallic Tubing.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's illustrated product literature and technical specifications for each type of raceway provided on this project.

1.05 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Company specializing in manufacturing the products specified in this section with at least three years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with at least three years experience.

1.06 JOB CONDITIONS

A. Coordinate the work specified in this section with other work of the Contract. Coordinate the placement of raceways with HVAC, Plumbing and Fire Protection Piping equipment prior to installation. If required for proper coordination, prepare Coordination Drawings.

PART 2 - MATERIALS

2.01 MANUFACTURERS

A. Rigid steel conduit, electrical metallic tubing: Allied Tube and Conduit, Triangle or Wheatland.

B. Flexible metal conduit, including liquid-tight: AFC, Electriflex or Universal.

C. Couplings and fittings: Appleton, Carlon, Crouse-Hinds, Killark, O-Z Gedney, Steel City, or Thomas and Betts.

2.02 RACEWAYS

A. Rigid Steel Conduit (RSC), couplings and elbows: ANSI C80.1 and UL 6; hot-dip galvanized, rigid mild steel, zinc-coated on interior and exterior surfaces.

B. Electrical Metallic Tubing (EMT): Zinc-coated steel conforming to ANSI C80.3 and UL 797. Fabricate tubing, elbows and bends from steel, coated on interior and exterior surfaces with a continuous zinc coating.

C. Flexible Conduit: Galvanized, interlocking steel construction (Greenfield), meeting the requirement of UL 1.

2.03 COUPLINGS AND THREAD PROTECTORS

A. Threaded Conduit: Finish each length of threaded conduit with a coupling on one end and a thread protector on the other. The thread protector shall have sufficient mechanical strength to protect the threads during normal handling and storage.

2.04 FITTINGS

A. Metal conduit fittings: Conform to the requirements of UL 514 where these standards apply. Use galvanized iron or galvanized steel threaded fittings with steel conduit; die-cast fittings may be used for conduits 1 inch and larger. Do not use compression fittings with RSC.

B. Fittings for electrical metallic tubing: For tubing up to and including 2 inch trade size, furnish galvanized steel compression type fittings. Fittings for tubing sizes larger than 2 inches may be set screw type.

C. Flexible metal conduit fittings: Galvanized malleable iron or steel.

D. Expansion fittings: Weatherproof, galvanized steel, with bonding jumpers; Crouse-Hinds or acceptable equal.

E. Special Fittings: Furnish conduit sealing, explosion proof, dust proof, and other types of special fittings as required by the drawings and these specifications, consistent with the area and equipment with which they are associated, and in accordance with the following requirements:
   1. Fittings installed outdoors: Heavy cast construction; sealed and gasketed.
   2. Fittings installed indoors in damp locations: Sealed and gasketed.

F. Combination Fittings: For connection rigid steel conduit to electrical metallic tubing, furnish fittings which have a threaded throat to receive the rigid steel conduit and a compression type throat to receive the electrical metallic tubing.

2.05 MISCELLANEOUS

A. Bushings: Provide galvanized bushings for the termination of all conduit not terminated in hubs and couplings. Provide grounding type insulated bushings with insulating inserts in metal housings for conduit 1-1/4 inches and larger.

B. Locknuts: Provide 1 interior and 1 exterior locknut for all conduit terminations not provided with threaded hubs or connectors. Provide locknuts which will securely bond the conduit to the box when tightened, and which will not be loosened by vibration.

C. Conduit Supports: Comply with the requirements of Section 16070 of these specifications.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Install work in conformance with the printed specifications and installations of each of the manufacturers, the approved shop drawings, and to the requirements of the Governing Laws and Building Code.

B. Inspect job conditions and related work and report to the Architect any conditions adversely affecting raceway work.

3.02 INSTALLATION OF RACEWAYS

A. Install all wiring, in minimum 1/2 inch size, rigid metal conduit or EMT, subject to the restrictions of the National Electrical Code, unless otherwise noted on the drawings or in the conduit schedule at the end of this section.

B. Run conduit concealed in finished areas above suspended ceilings, in wall spaces, etc. Exposed conduit runs in finished areas require Architect's approval. Properly group conduit runs. Install conduit parallel to walls and ceilings, and support with proper hangers and clamps. Check door swings before installing back boxes for switches and receptacles.

C. Where conduit passes through a building expansion joint, use weatherproof, telescopic type expansion fittings which permit at least 4 inches of movement.

D. Form bends in conduit by means of a conduit bending machine or by an approved hickey. To fasten conduit to outlet boxes, cabinets, etc., use locknuts and insulated throat bushings of compatible material.

E. Cut conduit ends square, thread conduit, and ream to remove burrs and sharp edges. Field threads shall be of the same type and have the same effective length as factory cut threads. Turns, wherever required in exposed conduit runs, shall be made by the use of factory-made bends, or field-made bends as approved. In the event of a multiplicity of conduits making the same turn, a steel junction box with a removable steel cover may be used. Offsets and bends for changes in elevation of exposed conduit runs shall be made at walls or beams and not in open spaces between walls or beams. Rout conduits as required to avoid interfere with the operation or maintenance of equipment.

F. Group related conduits. Refer to Section 16070 for conduit racks, supports and fittings.

G. Install conduit in accordance with NECA "Standard of Installation".

H. Plug or cap conduit ends as soon as conduit is installed, to prevent entrance of moisture or other debris during construction. Do not pull wire into any conduit until the conduit system is complete.

I. Drawings, in relation to the routing of conduits, are diagrammatic. Except where additional conduits may be required to avoid derating of branch circuits, as required elsewhere within this

Section, the number and size of conduits and wire shall be furnished and installed as indicated by the drawings. Coordinate routing of conduits in the field with the building structure. Run conduit in straight lines parallel and perpendicular to walls, beams, and columns and with right angle bends and threaded conduit fittings. Maintain 12 inches clearance between conduit and surface with temperatures exceeding 104 degrees F.

J. Conduits passing through floors, walls and beams shall be of such size, number, and in such locations so as not to impair the strength of the construction.

K. Rout raceways in ceiling spaces in an orderly and organized manner, and in such an approved manner as to eliminate or minimize the number of junction boxes required. Support and secure conduits by means of rods, clamps and other conduit support devices approved by the Architect. Do not use wire to support conduits.

L. Where rigid metal conduit is threaded in the field, use a standard conduit cutting die providing 3/4 inch taper per foot.

M. Conduit and EMT runs shall be mechanically and electrically continuous from service entrance to outlets. Secure conduit to cabinet, junction box, pull box or outlet box with locknut outside and bushing inside, or with liquid-tight, threaded, self-locking, cold-weld wedge adapter. Locknuts and bushings or self-locking adapters will not be required where conduits are screwed into tapped connections. Before installing conductions, protect vertical conduit runs that terminate in bottoms of wall boxes or cabinets from entrance of foreign material.

N. Size rigid steel conduit, EMT and flexible metallic conduit as required by the National Electrical Code, except as otherwise specified or shown on the drawings. Check raceway sizes to determine that equipment grounding conductor fits in same raceway with phase and neutral conductors to meet National Electrical Code percentage of fill requirements.

O. Where conduit is secured rigidly on opposite sides of building expansion joints, and where runs of exposed conduit are long and subject to stress, provide expansion fittings capable of safely deflecting and expanding to twice the distance of structural movement. Provide separate external copper bonding jumper secured with grounding straps on each end of fitting.

P. Install a pull or junction box every 100 feet of straight conduit run, and wherever there is an equivalent of four 90 degree elbows or a total of 360 degree bend.

Q. Pull cords: In each empty raceway, provide nylon fishing line having tensile strength not less than 200 lbs, or provide No. 14 AWG steel wire. Label each end of each line or wire with a securely attached tag which indicates the location of the other end.

3.03 PROTECTION AND CLEANING

A. Plug conduit ends to exclude dust, moisture, plaster or mortar while building is under construction.

B. Carefully clean and dry the inside of conduit before installing conductors. When drawing conductors into raceways, do not use lubricants or cleaning agents which might have a deleterious effect on conductor coverings.

3.04 CONDUIT SCHEDULE

	Type of Conduit	Applications/Locations
A.	Rigid Steel Conduit:	Exterior exposed conduit runs. Where conduit penetrates a floor slab or foundation wall. Underground conduit within 5 feet of the foundation wall.
B.	Rigid of Intermediate Steel Conduit:	Concealed outdoor conduit runs. Interior exposed locations below 8 feet above finish floor. Interior wet locations.
C.	Non-Metallic Conduit:	Conduit installed underground to the point 5 feet from foundation wall (Minimum size 3/4 inch).
D.	EMT:	Feeders and branch circuit runs installed above ceiling, in wall spaces, and in exposed locations 8 feet above finish floor. Do not use EMT for exterior runs, runs buried in concrete, in wet locations, or where conduit may be subject to mechanical abuse.
E.	Flexible Conduit:	Connections to electrical equipment and other equipment furnished under HVAC and Plumbing Sections that are subject to movement, vibration, or misalignment, where available space dictates, and where noise transmission must be eliminated or reduced. Limit length of flexible conduit in these applications to no more than 24 inches. Flexible conduit may be used for connecting to light fixtures. Maximum length of flexible conduit allowed shall be 6'-0" from junction box to light fixture. Lighting branch circuit home runs to panelboard shall be in conduit or EMT.
F.	Liquid-Tight Flexible Conduit:	Applications specified for flexible conduit which are, in addition: 1. Exterior locations. 2. Moisture or humidity-laden atmospheres. 3. Corrosive atmospheres. 4. Locations where washdown operations are possible. 5. Locations where seepage or dripping of oil, grease or water is possible.

END OF SECTION 16130