SECTION 16110

RACEWAYS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Rigid metal conduit and fittings.
2. Intermediate metal conduit and fittings.
3. Electrical metallic conduit and fittings.
4. Flexible metal conduit and fittings.
5. Liquid tight flexible metal conduit and fittings.
6. PVC coated rigid metal conduit and fittings.
7. Non-metallic conduit and fittings.
8. Cable trays.
9. Under floor duct.
10. Surface wireways.

B. Related Sections:

1. Section 01045 - Cutting and Patching
2. Section 02225 - Trenching, Excavation and Backfill
3. Section 03300 - Cast-In-Place Concrete: Protective envelope for underground conduit installations.
4. Section 07620 - Sheet Metal Flashing and Trim
5. Section 02400 – Underground Utility Construction

1.02 References

A. Specify Underwriters Laboratories (UL) listed equipment, assemblies and materials.

B. Where appropriate, refer to current ANSI and NEMA Standards for material ratings.

**PART 2 PRODUCTS**

2.01 MATERIALS

A. Rigid Metal Conduit:
   1. Galvanized steel with steel threaded fittings.

B. Intermediate Metal Conduit:
   1. Galvanized steel with steel threaded fittings.

C. Electrical Metallic Tubing
   1. All steel set screw fittings for interior locations.
   2. All steel set compression fittings for exterior locations.

D. Flexible Metal Conduit:
   1. Galvanized steel with all steel fittings. Compression type fittings (squeeze types).

E. Liquid Tight Flexible Metal Conduit:
   1. Galvanized steel with plastic jacket.
   2. Liquid Tight Flexible Metal Conduit: Specify fittings which provide grounding continuity.

F. Non-metallic Conduit and Fittings:
   1. PVC plastic Schedule 40.
   2. Impregnated fiber duct (underground).

G. Prohibited Materials:
   1. Use of aluminum conduit is specifically prohibited unless special permission is given by Department of Facilities Management.
   2. Use of extra-flexible, non-labeled conduit is prohibited.
   3. ENMT (or Electrical Non-Metallic Tubing) is prohibited.
   4. MC Cable is prohibited.
5. Use of caddy 8/ZMB/8 to support conduit is prohibited.

H. Cable Trays:
   1. Galvanized steel or aluminum, ladder type, electrically continuous grounding type.

I. Under floor Duct:
   1. Steel with corrosion resistant finish.
   2. Specify manufacturers with minimum of five (5) years service and installation representation in the area. Require proof of suitable representation. Specify entire assembly of one Manufacturer.
   3. System may be of either trench or duct header type. Review selection with Department of Facilities Management prior to design.
   4. Coordinate type of service fitting (flush, surface, etc.) and type of trim ring and fitting material (plastic, brass, aluminum, etc.) with Department of Facilities Management.

J. Surface Wireways:
   1. Steel with factory applied paint finish or natural brushed or stainless steel finish. Coordinate finish selection with Department of Facilities Management prior to final design.
   2. Identify all raceways with voltage over 1,000 volts with warning signs.

PART 3 EXECUTION

3.01 INSTALLATION APPLICATION

A. Conduit Sizing, Arrangement and Support:

1. Conduit Size:
   a. For “power” receptacle circuits, the minimum conduit size shall be 3/4” in all buildings. For lighting circuits the minimum conduit size shall be 3/4”.
   b. Size conduit (for receptacle circuits, motor circuits, other circuits delivering power to devices who’s utilization is not producing light, and panelboard feeders only) to meet requirements of National Electric Code insulation type RH, RHW, RHH. Lighting circuits shall comply with appropriate insulation fill tables.
2. Flexible Conduit Size:
   a. Minimum flexible conduit size shall be 3/4” with exception for a 6’ maximum length whip from j-box to light fixture may be ½”.
   b. For power circuits, in compliance with 3.01.A.1.
   c. Maximum length of flexible conduit is 3’ except for connections to lighting equipment which may be up to 6’ maximum length.
   d. 3/8” flexible conduit is permitted if furnished as part of a manufactured equipment connection (including lighting equipment).

3. Conduit Straps and Hangers:
   a. Heavy-duty malleable iron or steel.
   b. For locations above grade which are subject to moisture or corrosion, specify corrosion resisting steel.
   c. Perforated pipe strap or wire hangers are not permitted.
   d. Support conduits above suspended ceilings from building structure by suitable hangers. Supporting conduits from ceiling suspension wires is not permitted.
   e. Use of caddy for conduit support is not permitted.

4. Conduit Racks:
   a. For electrical conduit use only.
   b. Multi-use suspension systems for plumbing and other piping along with electrical conduits may be used if designed for that purpose.

5. Conduit Anchors:
   a. Plastic or fiber expansion anchors are prohibited.
   b. Powder activated anchors are allowed.

B. Conduit Installation - Interior:
1. All surface mounted conduit routing must be submitted to Campus EE for review and approval prior to installation. There will be no cost to the University for rework if installed without written approval of Campus EE.

2. Rigid Metal Conduit: Shall be used or specified for the following locations:
   a. Corrosive and/or hazardous locations. Provide plastic jacket or coating in corrosive installation and coming out of slabs.
   b. Surface mounted conduits on pads or floors of mechanical rooms.
   c. All 90 degree elbows installed in the slab or underground.

3. Intermediate Metal conduit: Specify as an optional material for all rigid, galvanized installations. Obtain special permission from Department of Facilities Management prior to allowing this material to be installed.

4. Electrical Metallic Tubing: Shall be used or specified for the following locations:
   a. Interior partitions.
   b. Above ceilings.
   c. Prohibited in hazardous or corrosive areas.
   d. Exterior walls, above grade.
   e. Prohibited in concrete slabs or walls.
   f. Prohibited below grade.

5. Flexible Metal Conduit: Specify for the following locations:
   a. Motor final connections.
   b. Transformer final connections.
   c. Mechanical equipment final connections.
   d. Lighting equipment final connections.

6. Liquid Tight Flexible Metal Conduit: Specify for the following locations:
   a. Outdoor installations.
   b. Damp or wet installations.
   c. Corrosive installations.
d. Motors in wet, damp locations or subject to oil drip.
e. Final 3 foot connection to all sprinkler and preaction valves.


8. Expansion Joints: Specify suitable expansion fittings where conduits cross expansions joints. Specify steel fittings which provide grounding continuity.

9. Incompatible Materials: Do not permit use of dissimilar metal fittings on raceway systems. All fittings and conduits must be compatible.

10. All surface mounted conduit shall be painted to match surface mounted upon. Use paint appropriate for conduit application.

11. Label all conduits i.e. Power 120/208, Lighting 277, telecom, control.

C. Conduit Installation - Exterior:

1. All surface mounted conduit routing must be submitted to Campus EE for review and approval prior to installation. There will be no cost to the University for rework if installed without written approval of Campus EE.

2. Underground Raceways (Ducts) General Requirements:
   a. Cross ducts below gas piping.
   b. Slope ducts to manholes.
   c. Locate top of duct banks below frost line or at 36” below finish grade, whichever is deeper.
   d. Route ducts as straight as possible between points.
   e. Specify reinforcing rods in concrete encasement for all duct banks. Specify a rebar 4-bar cage.
   f. Specify approved nylon conduit spacers for multiple conduit runs in same trench (ductbanks).
   g. Require that each raceway be proved clean, clear and useable. A #12 solid copper pull wire shall be installed in all spare conduits. Specify duct plugs for finished raceways.
   h. Specify that backfill material used to fill in above and around duct bank be clean and free of stones with in 6 inches
i. Concrete blocks are prohibited for duct spacers.

j. Specify nylon tie downs to hold conduits to spacers.

k. Electrically conductive duct tie downs are prohibited.

l. Where duct banks enter buildings, manholes, etc., require minimum 4 #2 rebar dowels to prevent shearing of ducts. Penetrations shall be sized no more than 1 inch larger than the outside diameter of the conduit and sealed with Sikaflex 1A or equivalent.

m. Specify plastic warning tape at 18” below grade.

n. All elbows shall be rigid PVC coated.

3. Underground Primary Raceways (Ducts): Specify the following:

a. Electrical non-metallic conduit encased in red concrete. Schedule 40 PVC or fiber reinforced epoxy.

b. Transition duct to PVC coated rigid metal conduit 5’ from building outside wall.

c. Standard conduit size 6” in all ducts. Also provide one empty 2” communication conduit in all duct banks from transformer to building.

d. Provide red color additive to concrete for identification (entire duct bank shall be red).

e. Provide PVC coated rigid metal conduit or filament wound reinforced epoxy conduit with minimum 36 inch radius and for any bends 30 degrees and larger, as manufactured to comply with the specifications in the latest revisions of NEMA TC 2002 and UL 1684

f. 3” wide, yellow, polyethylene film tape for buried cable marker. Bury 1’-0” above high voltage conduit. Require wording “Danger-high voltage cable” or similar.

g. Pull mandrel through all primary ducts to verify duct integrity.

h. Provide 50% spare conduits. (Verify quantity with UCB Utility Services.)

i. Provide direct burial #12 solid copper insulated copper tracer wire.

j. Provide snakepit magnetised tracer box. See section 02400
4. Underground Primary Raceways (Ducts): Grounding requirements
   
a. **Primary duct banks** shall be grounded with a No. 4/0 AWG bare stranded copper ground wire that is run within the duct bank and is bonded and grounded at both ends. Conduit shall not be used as the ground conductor. Refer to EO-105-A (or latest Revision).

   b. **Primary manholes** shall be grounded by 10' long ground rods. Connect the ground rods with a No. 4/0 AWG bare, stranded copper ground wire loop. A No. 2 AWG bare stranded copper pigtail from the ground wire loop shall be used to bond together and ground the manhole cover frame, ladder support bracket, concrete inserts, metallic cable racks, duct bank ground conductors, and the shields of any primary cables that are spliced using bolts, nuts and washers, cadmium plated steel or other non corrosive material.

   c. **Grounding Connection Requirements**
      
i. Provide exothermic weld type, or Burndy Hyground, ground connections for exposed, concealed, underground, and concrete encased ground connections. Provide compression type termination for No 2 AWG bare stranded pigtail to bond metal frames to ground. Split bolt connector method will not be approved in manholes, vaults or other locations.

5. Underground Secondary Raceways: Specify the following:
   
a. Electrical non-metallic conduit.

   b. Transition duct to PVC coated rigid metal conduit 5’ from building outside wall and sealed per section 16110-3.01-C-L.

   c. Provide steel bends with PVC coating.

6. Underground Communication Raceways. Telecom raceway shall comply with 16700. Specify the following:
   
a. Electrical non-metallic conduit.

   b. Transition to PVC coated rigid metal conduit 5’ from building outside wall.

   c. Standard conduit size 4”.

   d. Provide steel bends (minimum 36” radius) with PVC coating.

7. Small Underground Raceways: Specify the following:
a. Schedule 40 PVC non-metallic conduit.

b. PVC non-metallic conduit fittings must be installed with solvent applied couplings.

c. Conduit shall be minimum 24” below finish grade.

8. Manholes: Where manholes are required in underground raceway systems, the following general requirements apply:

a. Locate manholes to provide workable pulling tensions.

b. Size manholes to provide suitable working clearances for pulling, termination, and splicing. Minimum size manhole is 10’ x 10’ x 6’-6” high.

c. Specify round 36” diameter, heavy duty, manhole covers with “Electric” or “Telephone” cast in cover as required. Cover shall have welded manhole identification numbers as directed by utility services.

d. Specify 36” round access chimney with climbing rings.

e. Specify appropriate manhole hardware, including galvanized pulling eyes, inserts, cable racks and driven copper clad ground rod. Seal ground rod penetration in manhole with epoxy grout.

f. Require grounding of all metal parts in manhole and ground rod to 1/0 AWG primary ground system.

g. Provide minimum 12” diameter x 2’ deep sealed sump well in floor of manhole to collect water seepage.

h. Provide a 10’ driven accessible ground rod in manhole and seal penetration.

Do not install ground rod in sealed pumpwell
With the intent of maintaining a closed water resistant duct and manhole system all manholes shall have a 12” X 12” by 2’ concrete pump pit located in the center of the vault floor. This pit shall be completely encased in concrete and integral to the vault. All duct penetrations shall be sealed on the outside with Sikaflex 1A sealant or equivalent. Spare penetrations and ground rods shall also be sealed with the same. These requirements are for both poured in place and precast vaults. Sealing compound shall be used between all concrete joints, cap and chimney.

D. Cable Tray Installation:
1. Require cable trays to be supported by threaded rod hangers. Where lateral stresses are likely to be present, require lateral threaded rod braces.

2. Specify cable trays supports a minimum of 8’ on center and at all intersections and angles.

3. Ground all cable tray components and fittings.

E. Under floor Duct Installation:

1. Require marker screws at the end of all duct runs.

2. Schedules shall be provided on insides of covers of junction boxes indicating distance from junction box to first insert in each run.

3. Specify coupler supports which provide electrical continuity of duct. Locate such supports not more than 5’ on center and no farther than 30” from each junction box or elbow.

4. Where ducts cross expansion joints, require expansion fittings with bonding jumpers.

F. Surface Raceways:

1. Require electrical continuity of all raceway components throughout length of system.

END OF SECTION 16110