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**PART 1 GENERAL****1.1 RELATED DOCUMENTS**

- A. The requirements of the General Conditions, Supplementary Conditions and the following specification sections apply to all Work herein:
1. Section 26 00 10 - General Requirements
  2. Section 26 00 20 - Scope of Work
  3. Section 26 05 43 - Underground Ducts and Raceways
  4. Section 26 05 19 - Electrical Conductors - 600 Volt
  5. Section 26 05 26 - Grounding and Bonding
  6. Section 26 08 13 - Testing
  7. Section 26 51 13 - Lighting Fixtures and Lamps
  8. Section 26 55 13 - Architectural Lighting Fixtures
  9. Section 26 70 00 - Telecommunication System

**1.2 SUMMARY**

- A. Furnish and install all conduits as specified herein and as required for proper distribution of all wire, cable and electrical conductors throughout the Project as indicated on the Drawings.
- B. Furnish and install wall and ceiling outlet boxes, junction boxes, pull boxes and other such items where required by the Code, indicated on the Drawings or required to facilitate pulling wires, installing lighting fixtures and other such needs.
- C. All electric conductors shall be installed in nonflexible or flexible metal conduit as allowed in these Specifications, except where Type "MC" metal clad cable is specifically permitted, where plenum conductor cable is permitted for horizontal branch wiring to individual fire alarm system devices, where surface metal raceway is specifically permitted and as specified in Section 26 05 19 titled "Electrical Conductors – 600 Volts".

**1.3 REFERENCE STANDARDS**

- A. All raceways and boxes and all components shall be designed, manufactured and tested in accordance with the latest applicable industry standards including the following:
1. UL Standard 1 - Flexible Metal Electrical Conduit
  2. UL Standard 6 - Rigid Galvanized Conduit
  3. UL Standard 467 - Electrical Grounding and Bonding
  4. UL Standard 651 - Rigid Nonmetallic Electrical Conduit
  5. UL Standard 797 - Electrical Metallic Tubing
  6. UL Standard 1242 - Intermediate Metal Conduit
  7. ANSI C80.1 - Rigid Galvanized Conduit
  8. ANSI C80.3 - Electrical Metallic Tubing
  9. UL Standard 50 - Electrical Cabinets and Boxes
  10. UL Standard 514 - Electrical Outlet Boxes and Fittings
  11. NFPA 70 - National Electrical Code (NEC)
- B. All equipment and material to be furnished and installed on this Project shall be UL or ETL listed, in accordance with the requirements of the authorities having jurisdiction, and suitable for its intended use on this Project.

**1.4 SUBMITTALS**

- A. The following submittal data shall be furnished according to the General Conditions and Section 26 00 10 and shall include, but not be limited to:
1. Conduit complete with fittings, materials, connector details, etc.
  2. Outlets and Boxes complete with physical dimensions, materials, connector details, installation details, etc.

- B. The Subcontractor shall submit to the Engineer for review all manufacturers of conduit, fittings, outlets, and boxes that the Subcontractor wishes to be considered, from the acceptable manufacturers listed herein. If approved, the Subcontractor may install conduit, fittings, outlets, and boxes furnished by any manufacturer listed on the approved submittal. See Section 26 00 10 for requirements.
- C. All items or equipment listed above with asterisks (\*) shall be certified by the manufacturer using Manufacturer Certification "MCA" as set forth in Section 26 00 10. See Section 26 00 10 for certification requirements.

## 1.5 WARRANTY

- A. Comply with the requirements of the General Conditions and Section 26 00 10.

## PART 2 PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. If it complies with these Specifications, conduit and fittings manufactured by one of the following manufacturers will be acceptable:
1. Rigid Steel and Intermediate Metal Conduit:
    - a. Allied
    - b. Republic
    - c. Western
    - d. Wheatland
  2. Rigid Steel and Intermediate Metal Conduit Fittings:
    - a. Appleton
    - b. Crouse-Hinds/Midwest
    - c. O. Z./Gedney
    - d. Raco
    - e. Steel City/Thomas and Betts
  3. Rigid Steel Conduit and Fittings (exposed to the weather):
    - a. Occidental Coating Company
    - b. Perma-Cote
    - c. Robroy Industries "Plasti-Bond-Red"
  4. Rigid Aluminum Conduit and Fittings:
    - a. Allied
    - b. Indalex
    - c. American Conduit by Sapa
    - d. Patriot Aluminum Products
  5. Electrical Metallic Tubing (EMT):
    - a. Allied
    - b. Republic
    - c. Western
    - d. Wheatland
  6. Flexible Metal Conduit:
    - a. AFC
    - b. ALFLEX
    - c. Anaconda
    - d. Electri-Flex
  7. Flexible Metal Conduit Fittings:
    - a. Appleton
    - b. Crouse-Hinds/Midwest
    - c. OZ/Gedney
    - d. Raco
    - e. Steel City/Thomas and Betts
  8. Liquid Tight Flexible Metal Conduit:
    - a. AFC
    - b. ALFLEX
    - c. Anaconda (Type "UA")
    - d. Electri-Flex Company

9. Liquid Tight Flexible Metal Conduit Fittings:
  - a. Crouse-Hinds/Midwest
  - b. O.Z./Gedney
  - c. Steel City/Thomas and Betts
10. Rigid Nonmetallic Electrical Conduit and Fittings:
  - a. Cantex
  - b. Carlton
  - c. JM Manufacturing
11. Outlet Boxes:
  - a. Appleton Electric Company
  - b. Crouse Hinds
  - c. Raco
  - d. Thomas and Betts/Steel City
12. Junction Boxes:
  - a. Hoffman
  - b. Unity
  - c. Wigman
13. Floor Boxes:
  - a. Hubbell
  - b. Thomas and Betts/Steel City
  - c. Walker

## 2.2 NONFLEXIBLE METAL CONDUIT

- A. Rigid Steel Conduit:
  1. Rigid steel conduit shall be used where conduit is underground, exposed to the weather, in concrete slabs, in hazardous locations, used for systems operating at over 600 volts, or greater than 4" in diameter. Conduit shall have a cross section formed with a sufficient degree of accuracy to permit the cutting of clean, true, full threads. Conduit shall be joined with pipe couplings and shall be secured in cabinets, outlets, etc. with double locknuts. Conduits terminating in cabinets, outlets, etc., shall be provided with Midwest Catalog Number 931 to 942 or approved equal steel insulating bushings. Cast metal or pot metal fittings are not acceptable. Couplings, etc. shall be threaded.
    - a. Rigid steel conduit shall be hot dipped galvanized inside and out.
    - b. Where exposed to weather, rigid steel conduit shall be Robroy Industries "Plasti-Bond-Red" complete with "Plasti-Bond-Red" fittings or approved equal plastic coated nonflexible metal conduit and fittings. Exposed threads, damaged coatings, etc. shall be field coated with Robroy Industries "Plasti-Bond-Red Touch Up" or approved equal.
    - c. Full lengths of pipe shall have galvanized or zinc coated threads on both ends.
    - d. Running threads shall not be used. Where such a device is required, use T&B "Erickson" Type union or O.Z./Gedney Type SSP split coupling or approved equal.
- B. Rigid Aluminum Conduit:
  1. At the option of the Subcontractor, aluminum rigid conduit may be used instead of rigid steel conduit except where conduit is underground, in concrete slabs, exposed to the weather or encased in concrete. Aluminum couplings, elbows, etc., shall be used and installed as recommended by the manufacturer using Crouse-Hinds STL-6 compound or approved equal.
- C. Electrical Metallic Tubing (EMT):
  1. For sizes 4" in diameter and smaller, conductors may be installed in steel electrical metal conduit (EMT), except where rigid steel conduit is required.
  2. EMT shall be formed with a sufficient degree of accuracy to permit the use of connectors. EMT shall be joined with Midwest Catalog Nos. 460-469 steel couplings or approved equal. EMT and rigid steel conduit shall be joined with Midwest Catalog Nos. 420-422 steel couplings or approved equal. Conduits shall be secured with Midwest Catalog Nos. 1450-1459 or approved equal steel set screw type insulated connectors at panels, junction boxes, outlets, etc. All connectors and couplings, etc. shall be steel and set screw type. Die cast type connectors are not acceptable.
  3. At the Subcontractor's option, metallic tubing using "Unicouple" Type connectors may be used instead of tubing and individual couplings. Where "Unicouple" connectors are used in vertical conduit runs, all flared conduit ends shall be oriented downward to prevent moisture from being "funneled" into the conduit.

**2.3 NONFLEXIBLE NONMETALLIC (PVC) CONDUIT**

- A. PVC Conduit:
1. At the option of the Subcontractor, PVC conduit may be used instead of steel rigid conduit if approved by the Structural Engineer only where routed underground or in concrete ductbanks. PVC is not allowed in any other locations.
  2. The PVC conduit shall consist of UL approved Schedule 40 extruded Type II high impact virgin polyvinyl chloride conduit, similar and approved equal to Carlon PVC conduit.

**2.4 FLEXIBLE METAL CONDUIT**

- A. Flexible Metal Conduit:
1. Flexible metal conduit shall be steel and shall only be used in lengths not exceeding 6'-0" for connections to the following:
    - a. Motors.
    - b. Transformers.
    - c. Control equipment and devices.
    - d. Lighting fixtures not connected by non-flexible metal conduit. See the Section titled "Electrical Conductors-600 Volts" for requirements for the use of Type "MC" conductor cables.
    - e. Receptacles. See the Section titled "Electrical Conductors-600 Volts" for requirements for the use of Type "MC" conductor cables.
    - f. Appliances.
    - g. Equipment and devices requiring adjustment or removal for maintenance.
    - h. Busway switches.
    - i. Air terminal devices.
    - j. Raised floor boxes.
    - k. Expansion or seismic joints.

**2.5 CEILING AND WALL OUTLET BOXES**

- A. Boxes for interior ceiling, pendant or wall bracket mounted lighting fixtures shall be galvanized or sheradized steel, stamped or welded in 4" octagon or square shape.
- B. Boxes in moist locations, where exposed to the weather, or where surface mounted below 8'-0" above finished floor, shall be cast metal Type "FS" or "FD" as required with threaded hubs.
- C. Where main ceiling outlets for pendant fixtures occur, the Electrical Subcontractor shall furnish and install not less than 1/2" fixture studs securely fastened to the backs of the boxes. All such studs shall be in the centers of the boxes.
- D. Boxes shall have only the holes necessary to accommodate the conduit at the points of installation unless otherwise indicated on the Drawings. All boxes shall have lugs or ears inside to secure the covers. All unused holes in boxes shall be plugged or capped with appropriate accessories.
- E. Outlet boxes for switches and plug receptacles in finished walls shall be of proper design to accommodate the switches, receptacles and conduits required at each location and shall provide ample room for connections.
- F. All switch, plug receptacle and telephone outlet boxes shall be mounted vertically, unless otherwise noted on the Drawings.

**2.6 JUNCTION AND PULL BOXES**

- A. Furnish junction and pull boxes where required by the NEC, as indicated on the Drawings or where required to facilitate pulling conductors, regardless of whether shown on Drawings or not.

## 2.7 FLOOR BOXES

- A. Furnish and install water tight floor boxes, where indicated on the Drawings, of the type specified on the Drawings. Coordinate penetration location and fire rating with the Architect and Structural Engineer prior to installation.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Nonflexible Metal Conduit:
1. Nonflexible metal conduit shall be sized in accordance with the percent fill requirements of the National Electrical Code and as indicated on the Drawings and shall be of ample size to permit the ready insertion and withdrawal of conductors without abrasion. No nonflexible metal conduit shall be smaller than 1/2". Grouping of "home runs" is acceptable only where the number of conductors indicated on the Drawings is maintained and the proper National Electrical Code derating factors are applied.
  2. Nonflexible conduit, including both rigid conduit and nonmetallic (PVC) conduit, shall not be embedded in any structural slabs, unless specifically noted on the Drawings. The specifically noted nonflexible conduit to be embedded in any structural slab shall be installed strictly in accordance with the Project Structural Engineer's specific written instructions. The electrical subcontractor shall forward two (2) copies of the Project Structural Engineer's written approval and instructions for installation to the Engineer for his file prior to proceeding with the installation. Nonflexible conduits embedded in structural slabs shall have watertight joints.
  3. Conduit in finished portions of the building, except in mechanical and electrical equipment rooms or where otherwise indicated on the Drawings, shall be concealed. Concealed nonflexible metal conduits shall be run in as direct a manner and with as long a bend as possible. Exposed nonflexible metal conduit shall be run parallel to or at right angles with the lines of the building. All bends shall be made with screw jointed conduit fittings or with standard ells in which the conduit is bent to a radius not less than that shown in Table 346-10 of the National Electrical Code. All bends shall be free from dents or flattening. Not more than the equivalent of four quarter bends shall be used in any run between terminals and cabinets or between outlets and junction or pull boxes.
  4. Nonflexible metal conduit shall be continuous from outlet to outlet and from outlet to cabinets, junction or pull boxes and shall enter and be secured at all boxes in such a manner that each system shall be electrically continuous throughout.
  5. Terminals of all nonflexible metal conduits shall be furnished with bushings, locknuts, connectors, etc., as specified herein. All joints shall be cut square, reamed smooth and drawn up tight.
  6. So far as is practicable, all exposed nonflexible metal conduit shall be run without traps. Where traps or dips are unavoidable, a junction or pull box shall be placed at each low point.
  7. Where nonflexible metal conduit passes from a conditioned space to or through an un-conditioned space, provide a conduit sealing bushing within the conduit to prevent moisture and condensation from being transported through the conduit system. Bushings shall be similar or approved equal to OZ/Gedney CSB series.
  8. Nonflexible metal conduit hangers and fasteners shall be of the type appropriate in design and in dimensions for the particular applications and shall be securely fastened in place as specified herein.
  9. Each entire nonflexible metal conduit system, except prefabricated lighting grids, shall be installed complete before any conductors are drawn in. To guard against obstructions and omissions, each run of conduit shall be finished before gypsum board is installed. All nonflexible metal conduit shall be swabbed after plaster is finished and dry.
  10. As soon as nonflexible metal conduit has been permanently installed in place, conduit ends shall be capped or plugged with standard accessories.
  11. Nonflexible metal conduit for telephone, signal, communication and security systems shall be provided with pull boxes of approved sizes after two right angle bends and at intervals not exceeding 125' in addition to those shown on the Drawings. Boxes shall be in accessible locations.
  12. A 1/8" braided polypropylene rope or #14 galvanized iron fish wire shall be left in all empty nonflexible metal conduit systems. At least 12" of properly secured rope or wire shall be folded back into each end of the empty nonflexible metal conduits.
  13. Furnish and install OZ/Gedney Company expansion fittings, Type DX for rigid metal conduit, Type EX for rigid metal conduit exposed to the weather and Type TX for electrical metallic tubing (EMT) or equivalent manufactured by Appleton, Crouse-Hinds or Steel City, where nonflexible metal conduits cross building expansion joints. See Section 26 05 26 titled "Grounding and Bonding".

14. Nonflexible metal conduit installed in the ground shall have watertight joints and shall be painted the entire length with two coats of protective finish. All coating shall be applied in accordance with the manufacturer's recommendations. The entire length of nonflexible metal conduit, including fittings, in contact with the ground, to a point 6" above the ground (or concrete slab) shall be completely coated subject to the Engineer's approval. Refer to Section 26 00 10 for requirements related to conduit penetrating walls below grade.
  15. In areas designated as Class 1, Division 2 hazardous areas, rigid metal conduit (or liquid tight flexible metal conduit for motor terminations) with approved terminations and fittings shall be used. The Class 1, Division 2 hazardous areas shall be as defined by the authorities having jurisdiction for this Project.
  16. Prior to the installation of any plastic coated nonflexible metal conduit, the Subcontractor shall submit a 12" Sample of the proposed conduit and miscellaneous materials for review by the Engineer. Samples of standard galvanized conduits are not required.
- B. Flexible Metal Conduit:
1. Continuity of the equipment ground across flexible metal conduit connections shall be maintained for all systems that are over 150 volts to ground. The continuity shall be maintained by installing a grounding conductor sized in accordance with the current National Electrical Code. The grounding conductor shall be inside the flexible conduit and shall be connected on one end of the flexible metal conduit by a suitable binding post and similarly connected on the opposite end with another suitable binding post. All grounding conductors shall be solid copper conductors.
  2. For flexible metal conduit sizes 1-1/4" and smaller and lengths of 6' or less, UL listed liquid tight flexible conduit with grounding provisions and watertight fittings may be used in lieu of a flexible metal conduit and separate grounding conductor described above in accordance with Article 351 of the National Electrical Code, "Liquid Tight Flexible Conduit".
  3. Flexible metal conduit shall be secured with Midwest Catalog Nos. 1708-1715 or approved equal insulated throat clamps. Liquid tight flexible metal conduit shall be secured with Midwest Catalog Nos. LTB-38 through LTB-300 or approved equal insulated throat watertight fittings and shall be used where subject to weather or moisture conditions. Connectors shall be steel type. Die cast connectors will not be acceptable.
- C. PVC Conduit:
1. All types of PVC conduit joints shall be made up using plastic couplings in accordance with the manufacturer's recommendations. The tapered ends of joints shall be swabbed with bituminous or joint sealing compound to provide a watertight joint before the coupling is applied.
  2. A 1/8" braided polypropylene rope or #14 galvanized iron fish wire shall be left in all empty conduit systems. At least 12" of properly secured rope or wire shall be folded back into each end of the empty conduits.
  3. Where PVC conduit emerges from underground or concrete, a transition from PVC to nonflexible metal conduit must occur allowing no PVC conduit to be installed within any space inside the Project.
- D. Boxes:
1. The approval of the Architect shall be obtained for any outlet location about which there may be the least question. Outlets previously placed without specific approval in locations not suitable to the finished room or area shall be removed and relocated without additional cost to the Owner when so directed by the Architect. This shall include the cutting and patching of Work of others as may be necessary. Refer to Section 26 00 10 Subsection titled "Coordination Drawings" for additional requirements.
  2. All boxes shall be rigidly secured in position to building structure. Boxes larger than 4" shall be secure at two points. All boxes, except for recessed lighting fixtures and except on unfinished ceilings and walls, shall be so set that the front of each box or cover shall be flush with the finished wall or ceiling line or not more than 1/4" back of same. Boxes for recessed lighting fixtures shall be located at a minimum elevation of 8-1/2" above the bottom of the finished ceiling and shall be secured to the structure. Lighting and telephone grid box elevations and locations shall be coordinated in the ceiling space with the mechanical installations. No box for any conduit system shall be secured to the ceiling suspension system, to air conditioning ducts or to mechanical piping. Wall boxes shall not be mounted back-to-back, but shall be separated by a wall stud.
  3. ??Mounting Heights:
    - a. Unless otherwise shown, specified or directed, wall outlet boxes shall be located with their center lines at the following elevations above the finished floor line.
      - 1) Wall switches: 3'-6".
      - 2) Wall receptacles (duplex type): 1'-6".

- 3) Receptacles above counters (duplex type): Refer to Drawings.
  - 4) Wall telephone outlets (desk type): 1'-6".
  - 5) Wall telephone outlets (pay station): 3'-6".
  - 6) Clock hanger outlets: 8'-0".
4. Other special outlets shall be installed as shown or specified on the plans, details or in the symbol list on the Drawings.

### 3.2 CONDUIT HANGERS AND SUPPORTS

- A. All horizontal conduits throughout the building shall be thoroughly and substantially supported with individually approved expansion ring hangers or supported in groups using Unistrut or Kindorf channels and suitable hangers. Hangers shall not be spaced more than 10' apart. Perforated extension bar hangers will not be accepted in any part of the Work. All vertical conduits shall be substantially supported at floor lines to carry the weight of the conduit and cable in a satisfactory manner with allowance for expansion and contraction. Special hangers and supports shall be provided where they may be required because of any peculiarities of construction. Where exposed to weather, conduit hangers and supports shall be Robroy Industries "Plasti-Bond-Red" or approved equal. Damaged hangers and supports shall be field coated with Robroy Industries "Plasti-Bond-Red Touch Up" or approved equal. Hanger rod sizes shall be as recommended by the hanger manufacturer for the service intended.
- B. At the Subcontractor's option, subject to the approval of the local authorities having jurisdiction, branch circuit and equipment conduit systems and lighting grid conduit systems up to a maximum conduit size of 3/4" may be substantially and individually supported in accordance with NEC spacing using #12 gauge galvanized tie wire and other supplementary braces as required by the National Electrical Code to provide rigid support. Multiple conduits fastened to individual tie wires are not acceptable. Suspending or supporting conduits from any ceiling support system shall not be acceptable.

### 3.3 FACTORY TESTING

- A. All outlets and boxes shall be tested in accordance with the latest applicable industry standards.

### 3.4 FIELD TESTING

- A. Refer to Section 26 08 13 for additional testing requirements for conduit systems.

**END OF SECTION**