# GENERAL

## RELATED DOCUMENTS

### Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this Section.

### This Section is a Division 26 "Basic Materials and Methods" section, and is part of each Division 26 section making reference to electrical raceways specified herein.

## DESCRIPTION OF WORK

### Extent of raceways is indicated by drawings and schedules.

### **NOTE TO SPECIFIER: REVISE TYPES OF RACEWAYS ACCORDING TO PROJECT REQUIREMENTS.**

### Types of raceways in this Section include the following:

#### Electrical metallic tubing.

#### Flexible metal conduit.

#### Intermediate metal conduit.

#### Liquid-tight flexible metal conduit.

#### Rigid metal conduit.

#### Rigid nonmetallic conduit.

#### Surface metal raceways.

## REFERENCES

### NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.

### UL Compliance and Labeling: Comply with provisions of UL safety standards pertaining to electrical raceway systems; and provide products and components which have been UL-listed and labeled. Each length of raceway shall bear the Underwriters Laboratories label.

### NEC Compliance: Comply with NEC requirements which are applicable to the construction and installation of raceway systems.

### NECA Compliance: Comply with NECA's "Standard of Installation".

### ANSI Compliance: Comply with ANSI Standards pertaining to Conduit.

### ETL Verification: Comply with ETL PVC-001 for adhesion performance.

## SUBMITTALS

### Product Data: Submit manufacturer's data including specifications, installation instructions and general recommendations, for each type of raceway required.

# PRODUCTS

## STEEL CONDUIT

### Steel Conduit: Rigid steel conduit, intermediate metal conduit and steel electrical metallic tubing shall be hot-dipped, galvanized or sherardized as manufactured by Youngstown Sheet and Tube Company, National Electric, General Electric, or equal.

### Joints: Rain tight non-insulated throat type steel compression fittings (connectors and couplings) shall be provided for electrical metallic tubing systems. All fittings shall be of the steel type with steel locknuts equal to Appleton 95 Series. In dry locations steel set screw connectors/couplings are acceptable.

### Expansion Joints: Provide expansion fittings, O.Z. Type AX with bonding jumper for rigid conduit and O.Z. Type TX with bonding jumper for electrical metallic tubing. Where embedded raceways cross building expansion joints, provide combination deflection/expansion fittings, O.Z. Type AXDX, or equal.

NOTE TO SPECIFIER: DELETE ALUMINUM CONDUIT SECTION FOR MOST PROJECTS. LEAVE THIS SECTION ONLY IF THERE IS A SPECIFIC NEED FOR ALUMINUM CONDUIT ON A PROJECT.

## ALUMINUM CONDUIT

### Aluminum Conduit: Rigid aluminum conduit and elbows shall be extruded from primary 6063 aluminum alloy to a T42 temper. The maximum copper content shall not exceed one-tenth of one percent. A petroleum base lubricant containing powered zinc shall be factory applied to the threads at both ends of the conduit. The interior surfaces of conduit and elbows shall be coated at the factory with silicone or an equally effective lubricant to facilitate fishing and wire pulling. Couplings shall be forged from primary 6063 aluminum alloy, threaded, and chamfered. Rigid aluminum conduit, elbows, and couplings shall be Kaiser KINGFISHER as manufactured by Kaiser Aluminum & Chemical Corporation, Aflex Corporation, Reynolds Metals Company, or equal. Unless otherwise noted or specified, aluminum conduit may only be used for raceways 2 inches in diameter, or larger.

## RIGID NON-METALLIC (PVC) CONDUIT

### PVC (polyvinyl chloride) Conduit: Heavy wall rigid PVC conduit shall be composed of high impact PVC and shall conform to industry NEMA Standards and to Federal Specification WC-1094. Conduits shall be Carlon Schedule 40 type, or approved equal.

## PVC (polyvinyl chloride) COATED GALVANIZED RIGID CONDUIT

### PVC Coated Galvanized Rigid Conduit shall conform to UL6, NEMA-RN1, ANSI-C80-1 and ETL PVC-001 with fittings from same manufacturer. Ferrous fittings for general service locations must be UL Listed with PVC as the primary corrosion protection. Hazardous location fittings, prior to plastic coating must be UL listed. All conduit and fittings must be new, unused material.

## FLEXIBLE METAL CONDUIT

### Flexible metal conduit shall conform to UL1. It shall be formed from continuous length of spirally-wound, interlocked zinc-coated strip steel.

## LIQUID-TIGHT, FLEXIBLE METAL CONDUIT

### Liquid-tight flexible metal conduit shall be constructed of a single strip, flexible, continuous, interlocked, and double-wrapped steel; galvanized inside and outside; and coated with an oil-resistant, liquid-tight thermoplastic jacket.

## WIREWAYS

### General: Provide electrical wireways of types, grades, sizes, weights (wall thicknesses), and number of channels for each type service indicated. Provide complete assembly of wireways including, but not necessarily limited to couplings, offsets, elbows, expansion joints, adapters, hold down straps, end caps, and other components and accessories as needed for a complete system. Where types and grades are not indicated, provide proper selection as determined by the Installer to fulfill wiring requirements and comply with applicable provisions of NEC for electrical raceways.

### **NOTE TO SPECIFIER: THE FOLLOWING ARE TYPICAL SPECIFICATIONS FOR VARIOUS TYPES OF RACEWAYS. THOSE UNITS RETAINED BELOW FOR PROJECT SHOULD BE TAILORED TO SUIT JOB REQUIREMENTS. DELETE NON-APPLICABLE RACEWAY SYSTEMS. THIS SECION MAY BE DELETED IF THE SURFACE METAL RACEWAYS ARE SPECIFIED ON THE DRAWINGS. SEE EVALUATIONS REGARDING NONMETALLIC DUCT.**

### Surface Metal Raceways: Provide surface metal raceways of sizes and channels indicated; in compliance with FS W-C-582. Construct of galvanized steel with snap-on covers, with 1/8" mounting screw knockouts in base approximately 8" o.c. Provide fittings indicated which match and mate with raceway. Finish with manufacturer's standard prime coating suitable for painting. Provide all necessary devices as shown on the drawings for a complete installation.

### Manufacturers: Subject to compliance with requirements, provide surface metal raceways of one of the following:

#### B-Line Systems, Inc.

#### Midland-Ross Corporation

#### Power-Strut Division; Youngstown Sheet and Tube Company

#### Johnson Plastic Division; Johnson Rubber Company

#### Square D Company

#### Versa-Tech Corporation

#### Walker/Parkersburg Division; Textron, Inc.

#### Wiremold Company

# EXECUTION

## GENERAL

### Install electric raceways where indicated; in accordance with manufacturer's written instructions, applicable requirements of the NEC and NECA's "Standard of Installation" and complying with recognized industry practices.

### Raceways embedded in concrete or in earth below floor slabs shall be PVC coated rigid metal or schedule 40 PVC conduit. PVC conduit shall be provided with PVC coated rigid metal elbows when the raceway system exits the concrete topping or earth.

### Electrical metallic tubing shall not be embedded in concrete or installed in earth.

### **NOTE TO SPECIFIER: DELETE THE FOLLOWING PARAGRAPH IF ALUMINUM CONDUIT IS NOT NEEDED ON THE PROJECT.**

### Aluminum conduit shall not be embedded in concrete, or installed in earth.

### Rigid heavy wall Schedule 40 PVC conduit shall be installed in earth and concrete only.

### PVC coated rigid metal conduit can be installed in earth, concrete and wherever there is a requirement for extra corrosion protection.

### Raceways in outside walls or in refrigerated areas shall be rigid steel conduit, or intermediate metal conduit.

### Provide rigid steel conduit or intermediate metal conduit for exposed raceways from floor to eight feet above the floor in mechanical rooms and in areas designated on the plans.

### Rigid galvanized steel conduit or galvanized intermediate metal conduit shall be used where conduit is exposed to weather.

### Conduits in hazardous locations shall conform to the National Electrical Code. Rigid galvanized steel conduit or intermediate metal conduit shall be used in hazardous locations. PVC conduit shall not be used in hazardous areas.

### Rigid metal, intermediate metal, electric metallic tubing or PVC conduit where allowed in other section 3.1 paragraphs shall be used for feeders and branch circuits.

### Installers of the PVC-coated galvanized rigid conduit system must be certified by the manufacturer and be able to present a valid, unexpired certified installer card prior to starting installation. All clamping, cutting, threading, bending, and assembly instructions given during the manufacturer’s certified installation training should be vigorously followed.

### Flexible metal conduit may be used to connect light fixtures in accordance with NEC requirements. Provide flexible metal conduit for connections to motors, transformers, generators, and other equipment subject to vibration. Length of flexible conduit shall be a minimum of one foot for conduit diameters up to 1-1/2". A minimum of 3" of flexible conduit shall be added for every 1/2" increase in conduit diameter. Flexible metal conduit installation shall be kept to a minimum in connecting electrical equipment. In no case is flexible metal conduit allowed to be longer than six feet in length without prior UNL project manager approval. Sealtight, flexible conduit shall be used where the flexible conduit may be subject to moist or humid atmosphere, corrosive atmosphere, subject to water spray and subject to dripping oil, grease or water. In no case is sealtight, flexible conduit allowed to be longer than six feet in length without prior UNL project manager approval.

### **NOTE TO SPECIFIER: REVISE THE PARAGRAPH BELOW IF ¾” MINIMUM CONDUIT SIZE IS REQUIRED.**

### Conduits shall be 3/4" diameter, minimum. This minimum applies to all conduit, including conduit to light switch box locations, and other ‘last leg’ type situations. Raceway sizes shown on the drawing are based on type THHN/THWN conductors.

### Type Material: Except as noted otherwise all conduit shall be steel.

## INSTALLATION

### All raceways shall be installed concealed except where shown or noted otherwise.

### At the Contractor's option, concealed raceways may be embedded in concrete, except as noted otherwise, or installed in furred spaces above ceilings or behind walls.

### Continuity: Provide metallic raceways continuous from outlet to outlet, and from outlets to cabinets, junction or pull boxes. Enter and secure conduit to all boxes to provide electrical continuity from the point of service to outlets. Provide double locknut and bushing on terminals of metallic conduits.

### In duct banks a 1/4" diameter nylon rope shall be installed in all empty conduits to facilitate future installation of cabling.

### Provide accessible "seal-off" fittings for all raceways entering or leaving hazardous areas, entering or leaving refrigerated areas and as otherwise required by the National Electrical Code.

### Where conduits penetrate the roof seal, they shall be installed in curbs provided for mechanical equipment. When this is not possible, suitable pitch pockets, lead flashing, or approved fittings shall be provided. Details for special conduit installations shall be as shown on the drawings.

### Reinforced Concrete: No reinforcing steel shall be displaced to accommodate the installation of raceways and outlet boxes. Outlet boxes shall not be installed in beams or joists. In general, all embedded conduits shall be located in the physical center of the particular section of concrete. Unless otherwise indicated, raceways embedded in reinforced concrete shall conform to the following usual types of conditions. Particular attention is called to the fact that there are many extenuating conditions where the Contractor may be instructed in writing during the course of the project not to place embedded conduits in certain areas, generally due to the possibility of unsightly cracking or for structural reasons. This instruction shall not entitle the Contractor to extra compensation. Any condition not covered by the following usual conditions shall require special clarification.

Location Maximum Allowance

#### Columns Displacement of 4 percent of plan area of column.

#### 2. Floors and Walls Displacement of 1/3 of thickness of concrete spaced less than three diameters on center.

#### 3. Beams and Joists Displacement of 1/3 of least dimension, spaced not less than three diameters on center.

#### 4. Sleeves thru Floors 2" maximum pipe size, not less than and walls three diameter on center.

### Plain Concrete: Raceways shall not be placed in plain concrete, such as cement toppings on structural floors without special instructions.

### Furred Spaces: Raceways installed in furred spaces shall be installed in accordance with the requirements of the National Electrical Code. Do not anchor or strap conduits to the ceiling furring channels or attach to furred ceiling hanger wires.

### Above Suspended Ceilings: Raceways may be attached to an independent suspension system (wire hangers) above drop ceilings if installed in such a manner that the ceiling panels may be removed without interference with the raceway. The independent wire hangers supporting the raceway shall be sized to carry the raceway load, support only the raceway, and shall be secured both above and below the raceway connection point (at both ends). In all cases, raceways shall be securely fastened in place such that both vertical support and horizontal support is provided.

### Stub Ups: Extend conduit stubs at least one foot above slab or fill, before connection is made to electrical metallic tubing.

### Exterior Conduits: Install raceways a minimum of18” below finished grade. Encase service conductors and medium voltage duct banks in concrete. All ducts installed in concrete shall be 4” diameter unless otherwise noted. NEC minimum cover requirements are generally acceptable unless otherwise noted.

### Provide marking of conduit and junction boxes to indicate which distribution system they are serving. Color coded conduits are recommended if acceptable to project architect and UNL project manager. The markings could be colored tape on conduit at or near junction boxes with different colored tapes indicating different distribution systems. Concealed junction boxes shall be legibly marked with a magic marker to indicate the panel and circuit number that junction box serves.

**NOTE TO SPECIFIER: REVISE THE LIST BELOW TO CORRESPOND TO THE SYSTEMS USED IN THE PROJECT.**

#### The distribution systems shall be color coded as follows:

##### Fire Alarm - Red

##### Healthcare - Green

##### Black and White – Architectural Use

##### Blue – Data Communications Systems

##### Yellow – High Voltage (>600V) Systems

##### Orange – Fiber Optics Systems

##### Purple – Security Systems

### Steel Conduit (galvanized rigid steel, IMC or EMT):

#### Cutting: Cutting shall be done with hand or power hacksaws. All cut ends shall be reamed to remove burrs and sharp edges.

#### All threaded joints shall be made up wrench-tight and all compression joints shall be made up mechanically secure and snug so as to make continuous current-carrying electrical contact.

#### All metallic conduits buried or otherwise in contact with earth shall be painted using one heavy continuous coat of asphalt varnish after assembly of conduit and fittings.

#### Expansion joints shall be installed in steel conduit systems in structures as follows expansion joints are specified elsewhere in the specification):

##### Where conduit run crosses a building expansion joint in unconditioned space(s) or where conditioned spaces fluctuate by more than 40 degrees.

##### Where shown on the drawings.

### Threads: Clean all threads of rigid or intermediate metal conduit. Coat all male threads of all steel conduit installed in concrete with red or white lead immediately before being coupled together.

### Running Threads: Use "Erickson" type couplings in lieu of running threads.

### **NOTE TO SPECIFIER: DELETE THE FOLLOWING PARAGRAPHS WHERE ALUMINUM CONDUIT IS NOT USED ON THE PROJECT.**

### Aluminum Conduits:

#### Cutting: Cutting shall be done with hand or power hacksaws. All cut ends shall be reamed to remove burrs and sharp edges.

#### Joints: All joints shall be made up wrench-tight so as to make continuous current-carrying contact. Lubricate all joints before assembly. Use a standard aluminum lubricant recommended by the raceway manufacturer.

#### Wire Pulling: Wire pulling shall be accomplished with round metal tapes, polyethylene ropes or nylon manila ropes.

#### Expansion Joints: Expansion joints shall be installed in structures as follows:

##### Where conduit run crosses a building expansion joint.

##### In any conduit run exceeding 75 feet in length.

##### Where shown on the drawings.

#### Bending: Use hydraulic benders for all sizes of aluminum conduit.

#### Support Spacing: Support conduit, size 2 through 4 inches, a maximum of 7 feet, 6 inches on center. Support conduits 5 inches and larger not less than 5 feet on center.

### PVC Conduit:

#### Joints: Conduits shall be joined by using couplings and solvent cement furnished or recommended by the raceway manufacturer. Finished joints shall be secure and watertight.

#### Cutting: Cutting shall be done with hacksaws and ends shall be reamed to remove burrs and sharp edges.

#### Expansion Joints: Expansion joints shall be installed:

##### Where conduit run crosses a building expansion joint.

##### As recommended by the manufacturer or as shown on the drawings.

#### Bends for PVC conduit sizes 2" and smaller may be made "hot" in the field. Inside dimension shall be thereby undistorted. For PVC sizes larger than 2", provide only factory bends.

* + 1. PVC Coated Rigid Conduit:

#### Coating: Coating shall not be damaged during the installation of the product.

#### Cutting: Cutting shall be done with hand or power hacksaws. All cut ends shall be reamed to remove burrs and sharp edges.

#### Threading: Conduit shall be threaded by utilizing proper tools recommended by the manufacturer.

#### Joints: All joints shall be made up wrench-tight with the proper tools so as to make continuous current-carrying contact. Lubricate all joints before assembly. Use a lubricant recommended by the manufacturer.

#### Wire Pulling: Wire pulling shall be accomplished with round metal tapes, polyethylene ropes or nylon manila ropes.

#### Bending: Use hydraulic benders for all sizes of conduit with proper shoes for PVC Coated conduit.

#### Touch-Up: Use touch-up compound in accordance with manufacturer’s instructions. For added protection, touch-up compound is to be used around all sleeves in wet locations.

* + 1. Concrete Encased Ducts.

#### Provide only where specifically indicated on the drawings or otherwise required by Code.

#### Grade trenches and ducts to provide a minimum of 3 inch slope for each 100 feet of duct.

#### Multiple conduit runs or banks shall be supported on preformed, nonmetallic separators. Any separator containing metal shall have the metal non-continuous and shall not form a magnetic loop in any manner. Spacing between separators shall be close enough to prevent sagging of conduits and breaking of couples and watertight seals. Separators shall also be spaced to keep deformation of conduit at the separators to 0.10 inch or less. Separators shall be secured with cords where necessary and no tie wires, reinforcing rods, or other metallic materials shall be placed around the conduits, either individually or in groups, in such a manner as to form a magnetic loop.

#### Enclose ducts in a minimum 3 inch concrete envelope. Concrete shall be 4000 psi of mixture acceptable to the Architect.

#### Reinforce the concrete envelope at all points where ducts cross fill or loose soil, water, gas sewage mains, under roadways and sidewalks, or elsewhere shown on the drawings. See Duct Bank Detail 26 05 33-01 for more information on minimum reinforcing requirements.

#### Hand "rod" concrete to provide complete encasement of all conduits.

#### After the duct line has been completed, a standard flexible mandrel not less than 12 inches long, having a diameter approximately 1/4 inch less than the inside diameter of the conduit, shall be pulled through each conduit, after which a brush with stiff bristles shall be pulled through each conduit to make certain that no particles of earth, sand, or gravel have been left in the line. Pneumatic rodding may be used to draw in the lead wire. A No. 9 galvanized-iron pull wire free of kinks and splices shall be installed in all unused ducts and shall extend a minimum of three feet into each manhole.

#### All conduits or ducts, active or spares, entering a building or manhole shall be completely and adequately sealed at first termination with oakum or suitable plastic expansible compound to prevent the entrance into the building of rodents, gases, or vapors.

#### Concrete used for encasement of power conduits shall be red in colored to help distinguish the concrete surrounding power conduits from other underground infrastructure.

#### All ducts installed in concrete shall be 4” diameter unless otherwise noted.

END OF SECTION 260533