SECTION 26 0533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Northwestern IT/IS Standards for raceways and cable trays for Telecommunications cabling.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetallic conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Poke Thru Assemblies.
6. Boxes, floor boxes, enclosures, and cabinets.

B. Related Requirements:

1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Northwestern University IT/IS Standards for pathways for Electronic Safety, Communications and Security Systems.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

C. EMT: Electrical Metallic Tubing.

D. PVC: Polyvinyl Chloride

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. ***(Delete If Not Required)*** [**LEED Submittals:]**

1. [Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

D. [**Samples: For wireways, nonmetallic wireways and surface raceways and for each color and texture specified, 12 inches (300 mm) long**.]

1.5 QUALITY ASSURANCE

A. All products shall be UL labeled for their intended use.

B. Comply with NFPA 70.

C. Comply with City of **[Chicago] [Evanston]** Electrical Code.

1.6 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

1.7 Special Warranty for PVC coated GRC and fittings: Manufacturers standard form in which manufacturer of the conduit and fittings agrees to replace components that fail in materials or workmanship within specified warranty period.

A. Five years after beneficial occupancy by University.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, products of all manufacturers are acceptable provided they have a smooth interior, are UL listed and labeled as defined in NFPA 70 for the intended location and application and are electro-galvanized steel (EMT) or hot dipped galvanized steel inside and out (GRC). For PVC coated GRC, conduit and fittings shall be obtained from the same manufacturer:

B. GRC: Comply with ANSI C80.1 and UL 6.

C. PVC coated GRC: Comply with ANSI C80.1, UL 6 and NEMA RN – 1.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. EMT: Comply with ANSI C80.3 and UL 797.

F. FMC: Comply with UL 1; zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

H. Multi-conductor Cable type MC and AC: Use of MC or AC cable is not permitted under any circumstances unless specifically approved in writing by the University's Chief Electrician.

I. Electrical nonmetallic tubing (ENT or "blue tube") and liquid-tight flexible nonmetallic conduit (LFNC) are not acceptable for use on any Project.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for GRC:

    a. Material: Steel.
    b. Type: threaded.

3. Fittings for PVC coated GRC:

    a. Urethane coating of nominal 2 mil thickness shall be uniformly and consistently applied to the interior of all fittings.
    b. All female threads on fittings and couplings shall be protected by urethane coating.

4. Fittings for EMT:

    a. Material: Steel.
    b. Type: compression – indoors; compression - outdoors.
    c. Set screw fittings are prohibited.

5. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

K. Joint Compound for IMC or GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, products of all manufacturers are acceptable provided they are sunlight resistant and UL listed and labeled as defined in NFPA 70 and marked for intended location and application. Conduit and fittings shall be obtained from the same manufacturer.

B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

C. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

D. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman; a Pentair company.
3. Square D; a brand of Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways shall be UL listed and labeled as defined in NFPA 70 and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finishes in color selected by Architect. Provide dividers as required to separate systems of different voltages.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Panduit Corp.
b. Wiremold / Legrand #700 or better.

2.5 POKE THRU ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Pass & Seymour/Legrand; Wiring Devices & Accessories.
3. Thomas & Betts Corporation.
4. Wiremold Company (The).

B. Poke-Thru Assemblies:

1. Factory-fabricated and - wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
2. Steel service head and junction box.
3. Poke-thru box fittings shall maintain a minimum two-hour fire rating.
4. Comply with UL 514 scrub water exclusion requirements.
5. Service Outlet Assembly: Flush type with services indicated.
6. Selected to fit nominal 4-inch (100-mm) cored holes in floor and matched to floor thickness.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Crouse-Hinds.
2. EGS/Appleton Electric.
3. FSR Inc.
4. Hoffman; a Pentair company.
5. Hubbell Incorporated; Killark Division.
6. O-Z/Gedney; a brand of EGS Electrical Group.
7. RACO; a Hubbell Company.
8. Thomas & Betts Corporation.
9. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

1. Minimum depth shall be 2-1/8 inches.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Metal Floor Boxes:

1. Material: Sheet metal, 11 gauge.
2. Type: Flush. Cover with 0.25”square aluminum flange rated for carpet/tile installations. Provide pour pan accessory for on grade installations.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled UL 514A.

F. Luminaire Outlet Boxes: Brass or Steel, Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

G. Sheet Metal Pull and Junction Boxes 100 cu. in. and smaller: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

K. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards: Corbin #4T3142. Confirm with NU Electric Shop.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC, IMC, or RNC, Type EPC-80-PVC.
2. Concealed Conduit, Aboveground: IMC, EMT, or RNC, Type EPC-40-PVC.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried or concrete encased as indicated.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage (Mechanical rooms and similar): IMC.
3. Exposed and Subject to Severe Physical Damage (Parking Garages or where indicated): GRC.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Feeders over 600 V: GRC.
7. Damp or Wet Locations: GRC or IMC.
8. Pools, Corrosive and Similar Locations: PVC coated GRC.
9. Basements, mechanical and electrical rooms: IMC
10. Tunnels: GRC.
11. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
12. In concrete slabs: Type EPC-40-PVC.
13. PVC conduit shall not be run in wall spaces or building cavities.

C. Minimum Raceway Size: 3/4-inch trade size for branch circuits, *one-inch embedded in slabs*, and *five-inch for primary services*. Maximum fill for branch circuit conduits: 30%. Maximum fill for feeder conduits: per code.

D. Mixing different types of conduits indiscriminately in the same system is prohibited.

E. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use watertight compression type steel fittings with insulated throat. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Installers of the PVC-coated galvanized rigid conduit system shall be certified by the manufacturer and be able to present a valid, unexpired certified installer card prior to starting installation. All manufacturer's clamping, cutting, threading, bending, and assembly instructions shall be followed

C. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

D. Where two or more conduits are run together they shall be racked. Use minimum ¼"x20 threaded rod to support "'trapeze" type racks.

E. Installation of all new conduits must be minimum 12 inches from ceiling grid except where approved by the Chief Electrician.

F. Complete raceway installation before starting conductor installation.

G. Comply with requirements in Northwestern University Design Standards for hangers and supports.

H. Arrange stub-ups so curved portions of bends are not visible above finished slab.

I. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

J. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches (300 mm) of enclosures to which attached.

L. All suspension systems must be hung independently from structure; “piggyback” suspension systems for raceways are prohibited.

M. PVC Raceways Below Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum10-foot (3-m) intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 3 inches (75 mm) of concrete encasement in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by the Chief Electrician for each specific location. Fittings shall be concrete tight.

N. PVC Large Diameter Raceways Bending Radius:

1. Four-inch conduit: 35” minimum.
2. Five-inch: 50” minimum.
3. Six-inch: 61” minimum.

O. Stub-ups to Above Recessed Ceilings:

1. Use EMT for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

P. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

Q. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

R. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

S. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

T. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

U. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

V. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

W. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

X. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

Y. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

Z. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

AA. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
    d. Attics: 135 deg F (75 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

BB. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations.
2. Use a maximum of 72 inches (1830 mm) of ½" FMC for recessed and semi-recessed luminaires. Use of 3/8"FMC is permitted subject to review by the Chief Electrician.
3. Final connections to motors or equipment subject to vibration, noise transmission, or movement shall use FMC not exceeding four feet in length.
4. Short lengths of FMC shall be used for final primary and secondary connections to Low Voltage transformers (<600V).

CC. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

DD. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between boxes and cover plate or supported equipment and box.

EE. Do not install boxes back-to-back in walls. Provide minimum 6-inch separation in non-fire-rated walls. Provide minimum 24-inch horizontal separation in acoustic-rated walls.

FF. Boxes shall be secured between two studs. Boxes connected to one stud are not permitted.

GG. Locate boxes so that cover or plate will not span different building finishes.

HH. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

II. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

JJ. Set metal floor boxes level and flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.4 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Sections and Northwestern Fire Protection Standards.

1. Products: Cooper B –Line, 3M, Hilti, Specified Technologies, Inc.

3.5 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

B. Junction boxes of different systems shall be identified by colors indicated below. Box and cover shall be painted prior to attaching identification labels.

C. Provide permanent nameplates for all pull and junction boxes identifying circuits, voltage, and source.

D. Where conduit is exposed in public or finished areas, the conduits shall be painted to match the adjacent wall or ceiling color. Associated junction boxes and covers shall be painted inside to match Northwestern standard conduit color code below.

E. Raceways and couplers of different systems shall be identified by color. Raceways up to 4" shall have **factory applied finish**.

1. Raceways up to 4" shall have solid color within electrical rooms and vaults.
2. Raceways larger than 4" shall be identified by permanent snap-on color bands installed within six inches of any pull or junction box, enclosure, fitting, and every twenty feet of run.

F. Colors: System:

1.	Red	Fire Alarm.
2.	Yellow	Feeders: 600V and above.
3.	Orange	Feeders: 277V and < 600V.
4.	White	Feeders: 120V to 240V.
5.	Blue	Building Automation.
6.	Green	Grounding and "Hogan" systems
7.	Yellow w/Red stripe	Gas monitoring

3.6 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to paint finishes with matching touchup coating recommended by manufacturer.
3. Repair damage to PVC coatings with matching touchup coating recommended by manufacturer

END OF SECTION 26 0533

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