

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SYSTEM DESIGN REQUIREMENTS

- A. Provide complete raceway system required to meet project requirements in sizes as required by NEC.
- B. Utilize boxes as part of the electrical raceway system. Size boxes in accordance with NEC requirements and this standard.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Conduit: Allied
 - a. Republic
 - b. Carlon
 - 2. Fittings and Bodies:
 - a. O/Z Gedney
 - b. Regal was purchased by Bridgeport
 - c. Bridgeport
 - d. Raco
 - e. Appleton
 - 3. Conduit Seals:
 - a. Chase-Foam CTC PR-855, or approved equal
 - 4. Wire ways:
 - a. Hinged cover or screw cover complete with all necessary fittings which shall be of one manufacturer.

2.2 MATERIALS, GENERAL

- A. Metal Conduit and Tubing:
 - 1. Galvanized Steel Rigid Conduit (GRC):
 - a. Conduit: Provide rigid steel conduit, hot-dipped galvanized with threaded ends Fittings: Threaded galvanized steel, bushings shall have nylon-insulated throat.
 - 2. Electrical Metallic Tubing (EMT):
 - a. Conduit: Galvanized steel tubing, galvanized on the outside and coated on the inside with a hard smooth lacquer finish. Fittings: Steel compression fittings for rain-tight and concrete-tight applications. Steel set-screw for interior connections. Set-screw quick fit type for 2-1/2 inch and larger may be used. Bushings shall be threaded and have nylon insulated throat or nylon bushing.
 - 3. Intermediate metal conduit (IMC)
 - a. Conduit: Provide intermediate steel conduit hot-dipped galvanized Fittings: Threaded galvanized steel, bushings shall have nylon-insulated throat.
 - 4. Rigid Aluminum Conduit:
 - a. Not allowed unless otherwise noted.
 - 5. Flexible Metal Conduit:
 - a. Conduit: Continuous spiral wound, interlocked, zinc-coated steel, NEMA/UL approved for grounding.
 - b. Fittings: Cadmium plated, malleable iron. Straight connector shall be one-piece body, female end with clamp and deep slotted machine screw for securing conduit, and threaded male end provided with a locknut. Angle connectors shall be two-piece body with

- removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and threaded male end provided with a locknut. All fittings 1 inch and larger shall be terminated with threaded bushings having nylon insulated throats.
 - c. Maximum length of 6 feet.
 - d. Minimum size of 1/2 inch.
 - 6. Liquid-Tight Flexible Metal Conduit:
 - a. Conduit: Continuous spiral wound, interlocked zinc-coated steel with polyvinyl chloride (PVC) jacket, NEMA/UL approved for grounding.
 - b. Fittings: Cadmium plated malleable iron. Straight and angle connectors shall be the same as used with flexible metal conduit but shall be provided with a compression type steel ferrule and neoprene gasket sealing rings.
 - 7. Non-metallic Rigid Conduit
 - a. PVC plastic schedule 40
 - B. Conduit Bodies:
 - 1. General: Types, shapes and sizes, as required to suit individual applications and National Electric Code (NEC) requirements. Provide matching gasket covers secured with corrosion-resistant screws.
 - 2. Metallic Conduit and Tubing: Use metal conduit bodies. Use bodies with threaded hubs for threaded raceways and in hazardous locations.
 - 3. Telephone EL's are not acceptable.
- 2.3 MATERIALS, GENERAL
- A. Sheet Steel: Flat rolled, code-gage, galvanized steel.
 - B. Fasteners for General Use: Corrosion resistant screws and hardware including cadmium and zinc plated items.
 - C. Fasteners for damp or wet locations: Stainless steel screws and hardware.
 - D. Exterior Finish: Gray baked enamel for items exposed in finished locations except as otherwise indicated.
 - E. Metal outlet, device, and small wiring boxes:
 - 1. General: Boxes shall be of type, shape, size, and depth to suit each location and application.
 - 2. Steel Boxes: Boxes shall be sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs.
 - F. Outlet Boxes, Pull and Junction Boxes (J-Boxes):
 - 1. General: Boxes shall have screwed or bolted-on covers of material same as box and shall be of size and shape to suit application.
 - 2. Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing.
 - 3. Hot dipped galvanized steel boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing. Hot-dip galvanized after fabrication. Cover shall be gasketed.
 - 4. Outlet Boxes: Hot-dipped galvanized of required size, 4 inch square, 2" depth minimum or octagonal and of depth required for flush mounted devices and lighting fixtures. Cast-type with gasketed covers for surface-mounted devices. All outlets for exterior application shall be cast, weatherproof type with gasket and cast cover plate.
 - 5. Junction and Pull Boxes: Use outlet boxes as J-boxes wherever possible. Larger J-boxes pull boxes shall be accessible and shall be fabricated from sheet steel, sized according to code.
 - G. Non metallic boxes are not permitted.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Conduit Sizes:

1. The conduit shall be sized in accordance with NEC.
 - a. For power and lighting circuits, the minimum conduit size shall be 3/4"
 - b. Flexible and Liquid-tight Flexible Conduit: 1/2 inch for all runs. Maximum 6-foot length.
 - c. Conduits used for home runs shall contain only the conductors for the circuits indicated on the drawings. Combining unrelated multiple home runs into a single conduit would not be permitted.

B. Type of Conduit Used

1. Rigid Galvanized conduit or intermediate metallic steel conduit shall be installed in the following areas.
 - a. All outdoor non-conditioned locations concealed and exposed.
 - b. Interior exposed. Below 10 feet to floor. PVC coated 90 degree elbows underground when penetrating floor slabs.
2. Electrical Metallic Tubing (EMT):
 - a. Interior concealed spaces.
 - b. Interior exposed above 10 feet to floor.
 - c. Not permitted underground, in concrete, and in hazardous or corrosive areas.
3. Sealtite metal conduit shall be provided for: Makeup of motor, transformer or equipment, and/or raceway connections where isolation of sound and vibration transmission is required. For connections in locations exposed to weather, or in interior locations subject to moisture, watertight flexible conduit shall be used.
4. Non-metallic Rigid Conduit:
 - a. In concrete and underground.
 - b. Not permitted for interior use.

C. General: Install electrical raceway in accordance with manufacturer's written installation instructions, applicable requirements of NEC, and as follows:

1. Conceal all conduits unless indicated otherwise, within finished walls, ceilings, and floors. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes.
2. Elevation of Raceway: Where possible, install horizontal raceway runs above water and steam piping, keep close to structure.
3. Complete installation of electrical raceways before starting installation of conductors within raceways.
4. Provide supports for raceways as required per NEC. Prevent foreign matter from entering raceways by using temporary closure protection.
5. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel. All bends shall be made in an approved bending machine or factory-made. Hickey bends will not be permitted in conduits larger than 3/4 inch. Refer to Section 27 05 28 for special bending requirements for Telecommunications Systems.
6. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. Install expansion fittings across all structural construction joints and expansion/deflection couplings across all structural expansion joints and in every 200 feet of linear conduit run. A flexible bonding jumper at least three times the nominal width of the joint shall be installed.
7. Run concealed raceways parallel and perpendicular to building elements at right angles.
8. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical. Paint all exposed raceways to match surrounding area.

9. Run exposed and parallel raceways together. Make bends in parallel runs from the same centerline so that the bends are parallel. Factory elbows may be used only where they can be installed parallel. In other cases, provide field bends for parallel raceways.
10. Make raceway joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Joints in non-metallic conduits shall be made with solvent cement in strict accordance with manufacturer's recommendations.
11. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. RGC shall be secured with double locknuts and an insulated metallic bushing. EMT shall be secured with one locknut and shall have nylon-insulated throats or threaded nylon bushings from 1/2 inch to 1 inch. 1-1/4 inch and above shall be metal with nylon insulated throats. Use grounding type bushings for feeder conduits at switchboards, panel boards, pull boxes, transformers, motor control centers, VFDs, etc.
12. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
13. Install pull wires in empty raceways. Use #14 AWG zinc-coated steel or monofilament plastic line having not less than 200-pound tensile strength. Leave not less than 12 inches of slack at each end.
14. Telecommunications and Signal Systems Raceways: Refer to Section 27 05 28 Pathways for Communications.
15. Install raceway-sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL 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 at the following points and elsewhere as indicated:
 - a. Where conduits enter or leave hazardous locations.
 - b. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air-conditioned spaces.
 - c. Where required by the NEC.
16. Flexible Connections: Use short length (maximum of 6 feet) of flexible conduit for recessed and semi-recessed lighting fixtures, for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid tight flexible conduit in wet locations. Install separate ground conductor in all flexible connections.
17. Conduit Seals: Conduit passing through concrete walls shall be sealed.
18. Where conduits are to be installed through structural framing members, the contractor shall provide sleeves. Cut all openings in concrete with rotary type drill, or other method as approved by the University Project Manager. Holes cut with pneumatic hammer will not be accepted. For areas where sleeves have not been provided, the Engineer's written approval must be obtained prior to cutting, notching or drilling of structural framing members.
19. Ream the ends of all cut and/or threaded conduit. Ends shall be cut square.
20. Use of running threads for rigid metallic conduit are not permitted. When threaded couplings cannot be used, provide 3-piece union or solid coupling.
21. Conduits shall not cross pipe shafts or ventilation duct openings "access panel".
22. Conduit shall not obstruct full and direct access to equipment requiring maintenance. This includes but is not limited to valves, actuators and terminal box controllers.
23. Install an insulated ground conductor in all conduits.
24. Where individual conduits penetrate fire-rated walls and floors, provide pipe sleeve one size larger than conduit; pack void around conduit with fire rated insulation and seal opening around conduit with UL Listed foam silicone elastomer compound. Conduits on trapeze type support system shall require fire taping only.
25. Where conduit sleeves penetrate fire rated floors or walls for installation of system cables, AC or MC cables, or modular wiring cables, pack void around cables or empty sleeve with fire rated insulation and fill ends with fire-resistive compound. Seal opening around sleeve with UL Listed foam silicone elastomer compound.

26. Provide separate raceway systems for each of the following:
 - a. Lighting
 - b. Power Distribution
 - c. Emergency (Essential)
 - 1) Lighting
 - 2) Power distribution
 - d. Low voltage systems, including telephone and communications, EQ alarm, security, fire alarm.
 - e. Audio/Visual
27. Provide for waterproofing of all raceways, fittings, etc., which penetrate the roof to preserve the weatherproof integrity of the building. Installation of materials shall conform to the following:
 - a. General:
 - 1) Install all raceways concealed except at surface cabinets, for motor and equipment connections and in mechanical equipment rooms. Install a minimum of 6 inch from flues, steam pipes or other heated pockets for water-flashing and counter-flashing or pitch pockets for waterproofing of all raceways, outlets, fittings, etc., which penetrate roof. Route exposed raceways parallel or perpendicular to building lines with right angle turns and symmetrical bends. Concealed raceways shall be run in a direct line, and where possible, with long sweep bends and offsets.
 - 2) Provide raceway expansion joints with necessary bonding conductor at building expansion joints and where required to compensate for raceway or building thermal expansion and contraction. Terminate raceways 1-1/4 inch and larger with insulated bushing or rain tight connections with insulated throats.
28. Special areas methods for raceway installation (with appropriate seal-offs, explosion-proof fittings, etc.), in all special occupancy areas, as defined and classified in Article 500 of the National Electric Code (NEC), shall be in accordance with that Article.
29. If type MC or AC cable is used for branch circuits, the home run conduit will be EMT and must run from the panel to within 10 feet horizontally of the first device served.
30. All underground raceways, not under the building footprint, shall be installed so it slopes away from the building.

D. Raceway Installation:

1. Surface raceways, where indicated on drawings, shall be metal and of a size approved for number and size of wires to be installed, shall be installed in a neat, workmanlike manner, with runs parallel or perpendicular to walls and partitions. Raceways, elbows, fittings, outlets and devices shall be of same manufacturer, and designed for use together.
2. Wire ways, where indicated, complete with elbows, tees, connectors, adaptors, etc., with all parts factory-fabricated and of same manufacture.

3.2 INSTALLATION, GENERAL

A. Boxes:

1. Every J-box shall be secured, independent of conduit entries into the box. Boxes shall be secured to the building structure. Ceiling wire shall not be used to support (secure) J-boxes.
2. Box fill shall be governed by code requirements. Only the allowable amount of conduit entries shall be allowed into the box.
3. Box covers shall be marked so as to indicate the voltage, panel number, and circuit number of the enclosed conductors.
4. Each J-box shall have only one voltage installed.
5. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.
6. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.
7. Remove sharp edges where they may come in contact with wiring or personnel.
8. All conduits connected to a flush panel shall be concealed.

B. Outlet Boxes:

1. Exact location of outlets and equipment shall be governed by structural conditions and obstructions or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to room layout and will not interfere with other work or equipment. Verify final location of all outlets, panels, equipment, etc. with the University Project Manager.
 2. Switch Outlet and Panel board height dimensions to meet ADA requirements.
 3. Above counters, benches, special equipment, baseboards, fin tube radiators, etc., or at wainscoting, outlets shall be mounted minimum 6 inches above to prevent interferences to service equipment, or as noted on drawings.
 4. Fire rated poke-through shall be installed in areas to miss beams and ductwork in ceiling below. Floors shall be X-rayed before core drilling.
 5. Outlets at windows and doors: Locate close to window trim in an accessible location. For outlets indicated above doors center outlets above the door opening except as otherwise indicated.
 6. Column and pilaster locations: Locate outlet boxes for switches and receptacles on columns or pilasters so the centers of the columns are clear for future installation of partitions. Locate in an accessible location.
 7. Locations in special finish materials: For outlet boxes for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block marble, brick, stone or wood walls, use rectangular shaped boxes with square corners and straight sides. Install such boxes without plaster rings. Saw cut all recesses for outlet boxes in exposed masonry walls.
 8. Mounting: Mount outlet boxes for switches and receptacles with the long axis vertical or as indicated. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the strike side, close to door trim. Provide far side box supports for electrical boxes installed on metal studs.
 9. Ceiling outlets: For fixtures, where wiring is concealed, use outlet boxes 4-inches square by 1-1/2 inches deep, minimum.
 10. Protect outlet boxes to prevent entrance of plaster, and/or debris. Thoroughly clean foreign material from boxes before conductors are installed.
 11. Concrete boxes: Use extra deep boxes to permit side conduit entrance without interfering with reinforcing, but do not use such boxes with over 6-inch depth.
 12. Existing outlet boxes: Where extension rings are required to be installed, drill new mounting holes on the existing boxes where existing holes are not aligned.
 13. Back to back outlet boxes are not permitted. Separate boxes a minimum of 6 inches in standard walls and 24 inches in acoustical walls.
- C. Installation of Pull and J-Boxes:
1. Box selection: For boxes in main feeder conduit runs, use minimum 8-inches square by 4-inches deep or as needed per NEC. Do not exceed 6 entering and 6 leaving raceways in a single box.
 2. Cable supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 inches inside boxes.
 3. Mount pull boxes in inaccessible ceilings with the covers flush with the finished ceiling.
 4. Every J-box shall be secured, independent of conduit entries into the box. Boxes shall be secured to the building structure. Provide rigid supports for all J-boxes, ceiling wire supports are not acceptable.
 5. Box fill shall be governed by code requirements. Only the allowable amount of conduit entries shall be allowed into the box.
 6. Box covers shall be marked so as to indicate the voltage, panel numbers, and circuit number of the enclosed conductors. Use pre-printed labels, marking cover with permanent marker is not acceptable.
- D. Grounding:
1. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box or enclosure.
- E. Outlets:

1. Provide zinc-coated or cadmium-plated sheet steel outlet boxes not less than 4 inch octagonal or square, unless otherwise noted. Equip fixture outlet boxes with 3/8-inch no-bolt fixture studs. Where fixtures are mounted on or in an accessible type ceiling, provide a J-box and extend flexible conduit, maximum 6' to each fixture. Outlet boxes in finished ceilings or walls shall be fitted with appropriate covers, set to come flush with the finished surface. Where more than one switch or device is located at one point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes will not be permitted. Provide tile box or a 4-inch square box with tile ring where "drywall" type materials are applied.
- F. Pull and J-Boxes and Cabinets:
1. Construct J-boxes or pull boxes not over 150 cubic inches in size as standard outlet boxes, and those over 150 cubic inches the same as "Cabinets," with hinged covers of same gauge metal. Removable covers must be accessible at all times.
 2. Provide a standard access panel having a hinged metal door neatly fitted into a flush metal trim, where a J-box or equipment is located above non-accessible ceilings or behind finished walls. Coordinate location and type with the University Project Manager. Access panels shall be minimum 24"x24" or 6" larger than pull box.
 3. All cabinets shall be set rigidly in place with fronts straight and plumb, center panel board interiors in door openings.

END OF SECTION 26 05 33