

SECTION 26 05 33 - RACEWAY 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.

1.2 SUMMARY

- A. Section Includes:

1. Metallic and non-metallic raceways.
2. Fittings for conduit, tubing, and cable.
3. Surface nonmetallic raceways.
4. Boxes, enclosures, and cabinets.

- B. Related Requirements:

1. Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks and underground utility construction.
2. Section 27 05 28 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:

1. Surface nonmetallic raceways.
2. Cabinets, cutout boxes, and miscellaneous enclosures.

1.4 INFORMATIONAL SUBMITTALS

- A. 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.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Allied Tube & Conduit; a part of Atkore International.
2. Champion Fiberglass, Inc.
3. Cooper Crouse-Hinds.
4. O-Z/Gedney; a brand of Emerson Industrial Automation.
5. Patriot Aluminum Products, LLC.
6. RACO, by Hubbell.
7. Southwire Company.
8. Thomas & Betts Corporation; A Member of the ABB Group.
9. Western Tube and Conduit Corporation.
10. Wheatland Tube Company.

2.2 TYPE EMT-S RACEWAYS AND ELBOWS

- A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 797 and UL Category Control Number FJMX.

- B. Steel Electrical Metal Tubing (EMT-S) and Elbows:

1. Material: Steel.
2. Options:
 - a. Exterior Coating: Zinc.
 - b. Interior Coating: Zinc with organic top coating.
 - c. Colors: As indicated on Drawings.

2.3 TYPE EPEC RACEWAYS AND FITTINGS

- A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651A and UL Category Control Number EAZX.

- B. Schedule 40 Electrical HDPE Underground Conduit (EPEC-40):

1. Dimensional Specifications: Schedule 40.

2.4 TYPE ERM-C-S RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 6 and UL Category Control Number DYIX.

B. Galvanized-Steel Electrical Rigid Metal Conduit (ERM-C-S-G), Elbows, Couplings, and Nipples:

1. Exterior Coating: Zinc.
2. Interior Coating: Zinc with organic top coating.

2.5 TYPE FMC RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 1 and UL Category Control Number DXUZ.

B. Steel Flexible Metal Conduit (FMC-S):

1. Material: Steel.

2.6 TYPE LFMC RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 360 and UL Category Control Number DXHR.

B. Steel Liquidtight Flexible Metal Conduit (LFMC-S):

1. Material: Steel.

2.7 TYPE PVC RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651 and UL Category Control Number DZYR.

B. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Dimensional Specifications: Schedule 40.
2. Options:

C. Type EB Rigid PVC Concrete-Encased Underground Conduit (PVC-EB) and Fittings:

1. Dimensional Specifications: Type EB.
2. Options:
 - a. Minimum Trade Size: Metric designator 103 (trade size 4).

2.8 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listed and labeled for type of conduit, location, and use.
3. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.

B. Metal Fittings:

1. Comply with NEMA FB 1 and UL 514B.

C. Fittings for Type EMT Raceways:

1. General Characteristics: UL 514B and UL Category Control Number FKA V.
2. Options:
 - a. Material: Steel.
 - b. Coupling Method: Compression coupling.
 - c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
 - d. Insulated throat for box connectors.

D. Fittings for Type FMC Raceways:

1. General Characteristics: UL514B and UL Category Control Number 1LNR.
2. Options:
 - a. Type: Steel or malleable iron.
 - b. Insulated throat for box connectors.

E. Fittings for Type LFMC Raceways:

1. General Characteristics: UL 514B and UL Category Control Number DXAS.
2. Options:
 - a. Insulated throat for box connectors.

F. Expansion and Deflection Fittings: Match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

G. Conduit Bodies

1. Malleable iron bodies finished with zinc or cadmium, inside and outside.
2. Screw-on type covers.

3. Neoprene gaskets and stainless steel screws where installed in damp or wet locations.
4. Size and type as required.

H. End Bells

1. Malleable iron, galvanized finish.

I. Conduit Seals

1. Malleable iron or copper-free aluminum.
2. Drain fittings where installed in vertical runs between different temperature zones.
3. Fiber filler and sealing cement.

J. Bushings

1. Malleable iron.
2. Insulated throat.
3. Ground lug, where required.

2.9 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 2419 and UL Category Control Number FOIZ.

2.10 SOLVENT CEMENTS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: As recommended by conduit manufacturer in accordance with UL 514B and UL Category Control Number DWTT.
3. Sustainability Characteristics:

2.11 SURFACE NONMETALLIC RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
 - a. UL 5A and UL Category Control Number RJTX.
 - b. UL 94, V-0 requirements for self-extinguishing characteristics.

B. Surface Nonmetallic Raceways and Fittings with Nonmetallic Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Panduit Corp.
 - b. Wiremold; Legrand North America, LLC. (Basis of Design)
 - c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Options:
 - a. Provide texture and color selected by Architect from manufacturer's standard colors.
3. Type: Large Capacity, Dual Channel Raceway, Wiremold 5400 Series.
 - a. Dual channel. 5 1/4-inch by 1 3/4-inch cross section. 3.72 sq inch (2400 sq mm) cross sectional area per channel.
 - b. Flush receptacles and data outlets, types and locations as shown on drawings.
 - c. Furnish without devices where indicated.
 - d. Furnish with required fittings, couplings, elbows, connectors, and devices.

2.12 WIREWAYS AND AUXILIARY GUTTERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 870 and UL Category Control Number ZOYX.

B. Metal Wireways and Auxiliary Gutters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division.
 - b. B-line; Eaton, Electrical Sector.
 - c. Hoffman; nVent.
 - d. MonoSystems, Inc.
 - e. Square D; Schneider Electric USA.
 - f. Wiegmann; Hubbell Incorporated, Commercial and Industrial.
2. Additional Characteristics:
 - a. 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.
 - b. Finish: Manufacturer's standard enamel finish.
3. Options:
 - a. Degree of Protection, Indoor: Type 1, unless otherwise indicated.
 - b. Degree of Protection, Outdoor: Type 3R, unless otherwise indicated.
 - c. Wireway Covers: Hinged type unless otherwise indicated.

2.13 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 514A and UL Category Control Number QCIT.

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

1. ABB, Electrification Products Division.
2. Arlington Industries, Inc.
3. Crouse-Hinds; Eaton, Electrical Sector.
4. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
5. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
6. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
7. Pass & Seymour; Legrand North America, LLC.
8. Racal Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
9. Wiremold; Legrand North America, LLC.
10. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

C. Metallic Outlet Boxes:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Comply with NEMA OS 1 and UL 514A.
3. Type: Recessed.
 - a. Gangable, depth as required.
 - b. Galvanized steel construction.
 - c. Provide with plaster rings where installed in plaster finish areas.
 - d. Provide with masonry rings where installed in masonry construction.
4. Type: Surface.
 - a. Copper free aluminum or rust-resisting alloy construction.
 - b. Threaded hubs compatible with applicable conduit.
 - c. Gasketed, watertight covers, stainless steel screws for exterior applications.
 - d. NEMA 4X, 316 stainless steel, neoprene gasketed, watertight covers, stainless steel screws where indicated.
 - e. NEMA 7 for hazardous locations where indicated.

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

E. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.

F. Gangable boxes are allowed.

G. Metallic Extension Rings:

1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.
2. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

2.14 CABINETS, CUTOUT BOXES, JUNCTION BOXES, PULL BOXES, AND MISCELLANEOUS ENCLOSURES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
 - a. Non-Environmental Characteristics: UL 50.
 - b. Environmental Characteristics: UL 50E.
3. Sized as required based on application, unless otherwise indicated.

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

1. ABB, Electrification Products Division.
2. Arlington Industries, Inc.
3. Crouse-Hinds; Eaton, Electrical Sector.
4. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
5. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
6. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
7. Pass & Seymour; Legrand North America, LLC.
8. Racor Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
9. Wiremold; Legrand North America, LLC.
10. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

C. Indoor Sheet Metal Cabinets:

1. Description: Enclosure provided with frame, mat, or trim in which swinging door or doors are or can be hung.
2. Additional Characteristics: UL Category Control Number CYIV.
 - a. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - b. Hinged door in front cover with flush latch and concealed hinge.
 - c. Key latch to match panelboards.
 - d. Metal barriers to separate wiring of different systems and voltage.
 - e. Accessory feet where required for freestanding equipment.
3. Degree of Protection: Type 1, unless noted otherwise.

D. Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Additional Characteristics: UL Category Control Number BGUZ.
3. Degree of Protection: Type 1, unless noted otherwise.

E. Indoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Additional Characteristics: UL Category Control Number BGUZ.
3. Degree of Protection: Type 1, unless noted otherwise.

F. Indoor Sheet Metal Miscellaneous Enclosures:

1. Additional Characteristics: UL 1773 and UL Category Control Number XCKT.
2. Degree of Protection: Type 1, unless noted otherwise.

G. Outdoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Additional Characteristics: UL Category Control Number BGUZ.
3. Degree of Protection: Type 3R, unless noted otherwise.

H. Outdoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Additional Characteristics: UL Category Control Number BGUZ.
3. Degree of Protection: Type 3R, unless noted otherwise.

I. Outdoor Polymeric Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Additional Characteristics: UL Category Control Number BGUZ.
3. Degree of Protection: Type 3R, unless noted otherwise.

J. Outdoor Sheet Metal Miscellaneous Enclosures:

1. Additional Characteristics: UL 1773 and UL Category Control Number XCKT.
2. Degree of Protection: Type 3R, unless noted otherwise.

PART 3 - EXECUTION

3.1 SELECTION OF RACEWAYS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.
- B. Outdoors:
1. Exposed: ERMCM .
 2. Concealed Aboveground: ERMCM .
 3. Direct Buried: PVC-40 EPEC.
 4. Concrete Encased in Trench: PVC-40 PVC-EB.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC..

C. Indoors:

1. Installed Beneath Concrete Slabs: PVC-40, ERM C .
2. Installed Within Concrete Slabs: EMT or PVC-40.
3. Exposed, Less Than Four Feet Above Finished Floor or Subject to Physical Damage: ERM C .
4. Exposed, Greater Than Four Feet Above Finished Floor and Not Subject to Physical Damage: EMT.
5. Concealed in Ceilings and Interior Walls and Partitions: EMT.
6. Within existing furred concrete and concrete block walls: FMC.
 - a. MC may be used in lieu of FMC for this application.
7. Damp or Wet Locations: ERM C .
8. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
9. Final Connection to Recessed Lighting Fixtures: FMC.
 - a. MC or Luminary Cable may be used in lieu of FMC in lengths no longer than 6 feet for this application.

D. Minimum Raceway Size: 3/4-inch, unless otherwise indicated.

1. Minimum size for underfloor or underground applications: 1-inch.
2. Final connections to fixtures and equipment made with FMC or LFMC may be 1/2-inch.

E. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERM C : Provide threaded type fittings unless otherwise indicated.

3.2 SELECTION OF BOXES AND ENCLOSURES

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:
 - a. General: Type 3R unless otherwise indicated.
 - b. Locations Exposed to Hosedown: Type 4.
 - c. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.
2. Indoors:
 - a. General: Type 1 unless otherwise indicated.

C. Exposed Boxes Installed Less Than 4 feet Above Floor:

1. Provide cast-metal boxes or boxes without knockouts or unprotected openings.

2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.3 INSTALLATION OF RACEWAYS

A. Installation Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
3. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
4. Comply with NECA NEIS 101 for installation of steel raceways.
5. Comply with NECA NEIS 111 for installation of nonmetallic raceways.
6. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
7. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
8. Raceway Terminations at Locations Subject to Moisture or Vibration:
 - a. Provide insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

B. General Requirements for Installation of Raceways:

1. Complete raceway installation before starting conductor installation.
2. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft above finished floor.
3. Install no more than equivalent of three 90-degree bends in conduit run except for control wiring conduits, for which no more than equivalent of two 90-degree fewer bends are permitted. Support within 12 inch of changes in direction.
4. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
5. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
6. Support conduit within 12 inch of enclosures to which attached.
7. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
8. 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 interior of raceways at the following points:
 - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

- b. Where an underground service raceway enters a building or structure.
 - c. Conduit extending from interior to exterior of building.
 - d. Conduit extending into pressurized duct and equipment.
 - e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - f. Where otherwise required by NFPA 70.
- 9. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
 - 10. Keep raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
 - 11. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
 - 12. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
 - 13. Do not install aluminum raceways or fittings in contact with concrete or earth.

C. Requirements for Installation of Specific Raceway Types:

- 1. Types ERM C :
 - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- 2. Types FMC and LFMC:
 - a. Comply with NEMA RV 3. Provide a maximum of 72 inch of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
- 3. Type PVC:
 - a. Do not install Type PVC conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
 - b. Comply with manufacturer's written instructions for solvent welding and fittings.
 - c. Do not install pull string until solvent or adhesive has fully dried.
- 4. Type EPEC:
 - a. Do not install Type EPEC conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
 - b. Comply with manufacturer's written instructions for solvent welding and fittings.
 - c. Do not install pull string until solvent or adhesive has fully dried.

D. Raceways Embedded in Slabs:

1. Run raceways larger than metric designator 27 (trade size 1) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place raceway close to slab support. Secure raceways to reinforcement at maximum 10 ft intervals.
 2. Arrange raceways to cross building expansion joints with expansion fittings at right angles to the joint.
 3. Arrange raceways to ensure that each is surrounded by a minimum of 1 inch of concrete without voids. Provide additional concrete cover where required by structural engineer to maintain integrity of slab.
 4. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.
- E. Stub-ups to Above Accessible Ceilings:
1. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- F. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
1. ERM : Provide threaded type fittings unless otherwise indicated.
 2. EMT: Comply with NEMA FB 2.10.
 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
 4. Bushings: Provide bushings for all conduits trade size 1 1/2-in and greater.
 5. Install expansion joints, conduit bodies, couplings, and hubs where required by application.
- G. Expansion-Joint Fittings:
1. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft. Install in runs of aboveground ERM and EMT conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft.
 2. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 3. Install fitting(s) that provide expansion and contraction appropriate for raceway type in accordance with NFPA 70 requirements.
 4. Install expansion fittings at locations where conduits cross building or structure expansion joints.
 5. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

3.4 INSTALLATION OF SURFACE RACEWAYS

- A. Install raceways concealed unless specifically noted otherwise. Install surface raceways only where indicated on Drawings or with approval of Owner.
- B. Install surface raceway with a minimum 2 inch radius control at bend points.
- C. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inch and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's written instructions. Tape and glue are unacceptable support methods.

3.5 INSTALLATION OF BOXES AND ENCLOSURES

A. General Requirements for Installation of Boxes and Enclosures:

- 1. Install boxes in accessible locations.
- 2. Coordinate box and enclosure locations with work of other trades.
- 3. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
- 4. Box locations shown on drawings are approximate. Coordinate final locations in relations to spaces, equipment, wall construction, and finishes surrounding each outlet.
- 5. Locate boxes for light switches on strike side of doors unless prohibited by building construction. Verify switch locations not on the strike side of the door with Architect even if shown in alternate location on drawings.
- 6. Mount boxes plumb and level. Furnish extension rings as required by wall finish.
- 7. Open no more knockouts in boxes than required. Seal unused openings.
- 8. Do not install exposed boxes in finished areas without approval of Architect.
- 9. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel. Minimum horizontal separation between boxes mounted on opposite sides of a fire rated wall is 24-inches. Back to back outlets are not permitted.
 - a. Where boxes must be installed in same vertical channel, provide a layer of expandable spray foam insulation around each box. Boxes installed in this manner shall be installed with a minimum 1-inch separation. Provide minimum 1-hour fire rated putty pad to cover outlets on one side of the partition.
- 10. Locate boxes so that cover or plate will not span different building finishes.
- 11. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
- 12. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
- 13. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
- 14. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
- 15. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.

B. Recessed Boxes in Masonry Walls:

- 1. Align either top of box with top of masonry block or bottom of box with bottom of masonry block, whichever is closest to indicated mounting height. Do not exceed ADA or code mounting height requirements.

2. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.

C. Mounting Heights:

1. Mount boxes at heights indicated. 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.
2. Coordinate location and mounting heights of all outlets with Architect before rough-in.
3. Mount boxes at heights indicated on Drawings.
4. Height of outlet boxes shall be as follows, unless noted otherwise on drawings:
 - a. Switches: 44 inches above finished floor.
 - b. Standard Receptacles: 18 inches above finished floor.
 - c. Standard Receptacles, Mounted Above Counter: 4 inches above counter backsplash, unless noted otherwise. Coordinate height with Architectural elevations before rough-in.
 - d. Receptacles on Exterior of Building: 24 inches above finished grade.
 - e. Receptacles on Rooftop: 24 inches above roof.
 - f. Other System Outlets: As indicated on drawings.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 26 84 13 "Penetration Firestopping."

3.8 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 PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.9 CLEANING

- A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

END OF SECTION