

Design Standard Conduit for Electrical Systems

Purpose:

This design standard has the purpose of creating a consistent application for the installation of conduits throughout the East Side Union High School District, therefore achieving a standard of quality for maintenance, reliability, and operational efficiency throughout all renovation and new building projects.

Design Standard:

Design layouts, specify and provide raceways, wires, cables, connector, boxes, devices, identification, finish plates and the like for a complete and operational electrical system.

- Sequencing and Scheduling: Conduit System includes but is not limited to conduit, tubing or duct and fittings including but not limited to connectors, couplings, offsets, elbows, bushings, expansion and deflection fittings and other components and accessories. Specify completion of the electrical raceway installation before starting the installation of conductors and cables.
- Conduits:
 - i) Galvanized Rigid Steel Conduit (GRC):
 - a. Hot-dip galvanized after thread cutting.
 - b. Manufacture in conformance with Federal Specification WWC-581 and ANSI C80.1.
 - c. Uniform finish coat with chromate for added protection.
 - ii) Rigid Aluminum Conduit: Alloy 6063, threaded at each connection.
 - iii) Intermediate Metal Conduit (IMC):
 - a. Hot-dip galvanized after thread cutting.
 - b. Manufacture in conformance with Federal Specification WWC-581.
 - c. Uniform finish coat with chromate for added protection.
 - iv) Electrical Metallic Tubing (EMT):
 - a. Hot-dip galvanized and chromate coated.
 - b. Manufacture in conformance with Federal Specification WWC-563 and ANSI C80.3.
 - v) Flexible Conduit:
 - a. Reduced wall flexible steel conduit.
 - b. Hot-dip galvanize steel strip prior to forming and joining.
 - c. Manufacture in conformance with Federal Specification WWC-566.
 - vi) Flexible Conduit, PVC Coated:
 - a. Hot-dip galvanize steel strip prior to forming and joining.
 - b. PVC chemical resistant jacket extruded to core, up to 1 inch trade size.
 - c. PVC chemical resistant jacket, tubed over core, up to 4 inch trade size.
 - vii) PVC:

- a. Class 40 heavy wall rigid PVC.
 - b. Rated for use with 90C conductors.
 - c. Manufacture in conformance with Federal Specification WC1094A and NEMA TC-2.
- Conduit Fittings:
 - i) Bushings:
 - a. Insulated Type for Threaded Rigid, IMC Conduit or Raceway Connectors without Factory Installed Plastic Throat Conductor Protection: Thomas & Betts 1222 Series or O-Z Gedney B Series.
 - b. Insulated Grounding Type for Threaded Rigid, IMC Conduit and Conduit Connectors: O-Z Gedney BLG Series.
 - ii) Raceway Connectors and EMT Couplings:
 - a. Steel conductor and coupling bodies, with zinc electroplate or hot-dip galvanizing.
 - b. Connector locknuts are steel, with threading meeting ASTM tolerances. Locknuts are zinc electroplated or hot-dip galvanized.
 - c. Connector throats (EMT, flexible conduit, metal clad cable and cordset connectors) have factory installed plastic inserts permanently installed. For normal cable or conductor exiting angles from the raceway, the cable jacket or conductor insulation bears only on the plastic throat insert.
 - d. Steel gland, Tomic or Breagle connectors and couplings are recognized for this Contract as having acceptable raceway to fitting electrical conductance.
 - e. Set screw connectors and couplings, without integral compression glands, are recognized for this Contract as not having acceptable raceway to fitting electrical conductance. A ground conductor sized per this Specification must be included and bonded within a raceway assembly utilizing this type connector or coupling.
 - iii) Expansion/Deflection Fittings:
 - a. EMT, O-Z Gedney Type TX.
 - b. RMC, O-Z Gedney Type AX, DX and AXDX, Crouse & Hinds XD.
- Conduit Joints: Assemble conduits continuous and secure to boxes, panels, luminaires and equipment with fittings to maintain continuity. Provide watertight joints where embedded in concrete, below grade or in damp locations. Seal PVC conduit joints with solvent cement and metal conduit with metal thread primer. Rigid conduit connections to be threaded, clean and tight (metal to metal). Threadless connections are not permitted for GRC and IMC.
- Conduit Placement:
 - i) Install continuous conduit and raceways for electrical power wiring and signal systems wiring.
 - ii) Conceal conduits. Exposed conduits are permitted only in the following areas:
 - a. Mechanical rooms, electrical rooms or spaces where walls, ceilings and floors will not be covered with finished materials.
 - b. Existing walls that are concrete or block construction.

- c. Where exposed conduits are permitted install parallel or at right angles to building lines, tight to finished surfaces and neatly offset into boxes.
- iii) Do not install conduits or other electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block the area's intended usage.
- iv) Do not install conduits on surface of building exterior, across roof, on top of parapet walls, or across floors without explicit approval from the Facilities Director. All services into buildings from the campus main switchboard shall be via underground ducts.
- v) Route raceway at least 6 inches from hot surfaces above 120°F, including steam lines, heat ducts, and the like.
- Below Grade Conduit and Cables:
 - i) Place a minimum 3 inch cover of sand or clean earth fill around the cable or conduit on a leveled trench bottom. Lay conduit on a smooth level trench bottom, so that contact is made for its entire length.
 - ii) Remove water from trench before electrical conduit is installed.
 - iii) When three or more conduits are in a single trench, use conduit spacers that will maintain 3 inch spacing between the conduits. Provide spacers on 5 foot centers.
- Arrange stub-ups so curved portions of bends are not visible above the finished slab. Maximum Bends: Install code sized pull boxes to restrict maximum bends in a run of conduit to 270 degrees.
- Conduit Terminations: Provide conduits shown on Drawings which terminate without box, panel, cabinet or conduit fitting with not less than five full threads. Install Sealing Bushings at conduit end.
- Flexible Conduit: Install 12 inch minimum slack loop on flexible metallic conduit and PVC coated flexible metallic conduit.
- Conduit Size: Provide conduit in minimum code permitted size for THW conductors of quantity shown. Minimum trade size 1/2 inch.
- Conduit Use Locations:
 - i) Underground: PVC.
 - ii) Wet Locations, Classified Locations, and Subject to Mechanical Damage: GRC, IMC.
 - iii) Damp Locations and Locations Exposed to Rain: GRC, IMC, and EMT up to 2 inches in diameter.
 - iv) Cast-In-Place Concrete and Masonry: GRC, IMC, and PVC. Horizontal runs of conduit in poured-in-place concrete slabs.
 - v) Dry, Protected: GRC, IMC, EMT.
 - vi) Sharp Bends and Elbows: GRC, EMT use factory elbows.
- Install 150 lb tensile strength pull wire or nylon cord in empty raceways provided for other systems. Secure wire or cord at each end. Label both ends of raceway.

- Elbow for Low Energy Signal Systems: Use long radius factory ells where linking sections of raceway for installation of signal cable. Verify minimum bending radius for signal cable.
- Motors, recessed luminaires and equipment connections subject to movement or vibration, use flexible metallic conduit. Maximum length per CBC.
- Motors and equipment connections subject to movement or vibration and subjected to any of the following conditions; exterior location, moist or humid atmosphere, water spray, oil or grease use PVC coated liquid tight flexible metallic conduit.
- Branch Circuits: Do not change the intent of the branch circuit or controls without approval. Homeruns for 20 amp branch circuits may be combined to a maximum of six conductors in a homerun. Apply derating factors. Increase conductor size as needed.
- Feeders: Do not combine or change feeder runs.
- Unless otherwise indicated, provide raceway systems for lighting, power and Class 1 remote-control and signaling circuits and Class 2 and 3 remote-control signaling and communication circuits.
- Conduit Fittings:
 - i) Use set screw type fittings only in dry locations. When set screw fittings are utilized provide insulated continuous equipment ground conductor in conduit, from over current protection device to outlet.
 - ii) Use compression fittings in dry locations, damp and rain-exposed locations. Maximum size permitted in damp locations and locations exposed to rain is 2 inches in diameter.
 - iii) Use threaded type fittings in wet locations, hazardous locations, and damp or rain-exposed locations where conduit size is greater than 2 inches.
 - iv) Use PVC coated rigid steel conduit ells for underground power and telephone service entrance conduits. Use 36-inch radius ells for power service conduits and 48-inch radius ells for telephone service conduits.
 - v) Use insulated type bushings with ground provision at switchboards, panelboards, safety disconnect switches, junction boxes and the like that have feeders 60 amperes and greater.
 - vi) Provide bushing or EMT connector for conduits that do not terminate in box, enclosure, or the like.
 - vii) Provide conduit expansion fittings at building expansion joints and at locations where conduit is exposed to thermal expansion and contraction.
 - viii) Condulets and Conduit Bodies: Do not use condulets and conduit bodies in conduits for signal wiring and in feeders 100 amp and larger.
- Sleeves and Chases - Floor, Ceiling and Wall Penetrations: Provide necessary rigid conduit sleeves, openings and chases where conduits or cables are required to pass through floors, ceiling or walls. Provide UL approved fire stopping at fire rated assemblies.
- Conduit crossing building or seismic joints:
 - i) Provide box on either side of joint and flexible conduit between the box.

- ii) Coordinate with structural engineer and/or architect to determine movement at the seismic joint.
- iii) Rigid conduit crossings at seismic joints are not acceptable.

Approved Manufacturers:

- Allied Steel
- Certainteed
- Jones & Laughlin
- Carlon
- Kraloy

Substitutes Allowed:

Yes, if performance and quality equivalency can be evidenced.

Associated Design Standards and Construction Specifications:

- Division 22 Plumbing Design Standards
- Division 23 HVAC Design Standards
- Division 25 Integrated Automation Design Standards
- Division 26 Electrical Design Standards
- Division 27 Communications Design Standards
- Division 28 Electronic Safety and Security Design Standards

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