

SECTION 27-05-33 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The work covered by this section of the Specifications includes all labor necessary to perform and complete such construction, all materials and equipment incorporated or to be incorporated in such construction and all services, facilities, tools and equipment necessary or used to perform and complete such construction. The work of this section shall include, but is not limited to, the following:
 - 1. Conduit and boxes in accordance with the Contract Documents.

1.02 QUALITY ASSURANCE

- A. Refer to Section 27-00-00 for general details.

1.03 CODES AND STANDARDS

- A. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations in Section 27-00-00.
- B. Cal Poly ITS Telecomm group, Telecommunications Standards Document and the Labeling, Design and Syntax Standard in Appendix B.

1.04 SUBMITTALS

- A. Refer to Section 27-00-00 for general details.
- B. Shop Drawings:
 - 1. Coordinated conduit layout drawings, 1/8 inch scale, minimum. Show routing of all telecommunications conduits.
 - 2. Show locations of all telecommunications pull or termination (faceplate) back boxes.
- C. Submit Manufacturer's Cut Sheets for the following:
 - 1. Any products not specifically listed in the PRODUCTS section shall require a submittal of the manufacturer's cut sheets and approval by Cal Poly ITS Telecomm group.

1.05 IDENTIFICATION

- A. Label both ends of any conduit 2" or larger noting destination.
- B. Refer to Section 27-05-53 for additional details.
- C. Cal Poly ITS Telecomm group Labeling, Design and Syntax Standard in Appendix B.

1.06 DEFINITIONS

- A. All conduit and pull boxes shall be sized to allow for a future cable plant expansion of 25%.
- B. All pathways are to be continuous, accessible, viable and useable upon completion of construction.

- C. Minimum conduit size for communications conduit is 1 ¼ “.

1.07 WARRANTY

- A. Refer to Section 27-00-00 for general details.

PART 2 – PRODUCTS

2.01 PRODUCT CONSISTENCY

- A. Product Consistency: Any given item of equipment or material shall be the product of one manufacturer throughout the facility. Multiple manufacturers of any one item will not be permitted.

2.02 CONDUIT AND FITTINGS (with bushings on all ends)

- A. Rigid Metal Conduit (RMC):
 - 1. Rigid conduit, heavy wall, threaded ends.
 - 2. Threaded type fittings.
- B. Intermediate Metallic Conduit (IMC):
 - 1. Rigid conduit, thinner wall, threaded ends.
 - 2. Threaded type fittings.
- C. Electrical Metallic Tubing (EMT):
 - 1. Continuous, seamless steel tubing galvanized or sherardized on exterior, coated on interior with smooth hard finish of lacquer, varnish or enamel.
 - 2. Steel, set screw or compression type fittings. Provide concrete type fittings where required.
- D. Rigid Non-metallic Conduit (PVC):
 - 1. Schedule 40 polyvinyl chloride suitable for 90° C.
 - 2. Solvent cemented type fittings.
- E. Insulated Grounding Bushings for Rigid Metal Conduit and Intermediate Metallic Conduit and Electrical Metallic Tubing:
 - 1. Shall be constructed of malleable iron.
 - 2. Shall have a plastic insulated throat.
 - 3. Shall have set screws.
 - 4. Shall have a bronze lay-in type lug.
 - 5. Approved Manufacturer (Threaded): Appleton or Cal Poly ITS Telecomm group approved equal
 - 6. Approved Manufacturer (Threadless): Appleton or Cal Poly ITS Telecomm group approved equal
- F. Fittings for Threadless Rigid Metal Conduit (RMC) or Intermediate Metallic Conduit (IMC):
 - 1. Shall be constructed of malleable iron, zinc plated.
 - 2. Shall have an plastic insulated throat.
 - 3. Shall be compression type.
 - 4. Shall be UL listed water and concrete tight.

5. Approved Manufacturer: American Fittings Corp or Cal Poly ITS Telecomm group approved equal
- G. Fittings for Electrical Metallic Tubing (EMT):
 1. Shall be constructed of steel, zinc plated.
 2. Shall have a plastic insulated throat.
 3. Shall be compression type.
 4. Shall be UL listed water and concrete tight.
 5. Approved Manufacturer: American Fittings Corp or Cal Poly ITS Telecomm group approved equal

2.03 BACK AND PULL BOXES

- A. Cast Type Boxes (Weatherproof, Surface mount):
 1. Universal Box with mounting lugs, two closure plugs and ground screw.
 2. Tapered threads for hubs.
 3. Material-Die Cast Aluminum with Aluminum lacquer finish.
 4. Approved Manufacturer: Thomas & Betts or Cal Poly ITS Telecomm group approved equal
- B. Cast Type Box Cover (Weatherproof, Surface mount):
 1. Cast raised cover, size matched to contour of box.
 2. Approved Manufacturer: Thomas & Betts or Cal Poly ITS Telecomm group approved equal
- C. Galvanized Pressed Steel Type Boxes (Indoor Station Back Boxes):
 1. Pressed steel, galvanized or cadmium-plated.
 2. 4-11/16 inch square by 2/1/8 inch deep minimum with 1 1/4 " knock out.
 3. Approved Manufacturer: Thomas & Betts or Cal Poly ITS Telecomm group approved equal.
- D. Mud Ring for Galvanized Pressed Steel Type Boxes (Indoor Station Back Boxes w/ 6 or less data outlets):
 1. 4-11/16" Pre-galvanized steel square box device cover, 5/8" raised, 3 cu in.
 2. Approved Manufacturer: Thomas & Betts or Cal Poly ITS Telecomm group approved equal.
- E. Mud Ring for Galvanized Pressed Steel Type Boxes (Indoor Station Back Boxes w up to 8 data outlets):
 1. 4-11/16" Pre-galvanized steel square box device cover, 5/8" raised, 6.3 cu in.
 2. Approved Manufacturer: Thomas & Betts or Cal Poly ITS Telecomm group approved equal.
- F. Sheet Steel Boxes (Pull Boxes):
 1. No. 12 gauge sheet steel for boxes with maximum side less than 40 inches, and maximum area not exceeding 1,000 square inches; riveted or welded 3/4 inch flanges at exterior corners.
 2. No. 10 gauge sheet steel for boxes with maximum side 40 to 60 inches, and maximum area 1,000 to 1,500 square inches; riveted or welded 3/4 inch flanges at exterior corners, with hinged covers if clearance allows.
 3. No. 10 gauge sheet steel riveted or welded to 1 1/2" by 1 1/2" by 1/4" welded angle iron framework for boxes with maximum side exceeding 60 inches and more than 1,500 square inches in area, with hinged covers if clearance allows.

4. Covers:
 - a. Same gauge steel as box.
 - b. Hinged covers if clearance allows, else subdivided single covers so no section of cover exceeds 50 pounds.
 - c. Machine bolts or machine screws threaded into tapped holes.
5. Paint:
 - a. Rust inhibiting primer, ANSI 61 grey enamel finish coat.
6. Manufacturer/Product: None Specified – Make Submittal

2.04 FLOOR BOXES AND FITTINGS

- A. Recessed Floor Box:
 1. Floor boxes and fittings shall be suitable for the fire rating and thickness of the floor and for the types and quantity of telecommunications SCS to be installed through the device.
 2. Lid or cover must have the ability to close completely while allowing cables to exit the box without compression or damage.
 3. See Section 27-15-43, 2.08 for additional detail.
 4. Each box shall have a minimum of one 1 ¼" knock out.
 5. Approved Manufacturer: Legrand/Wiremold Evolution Series Floor Box (EFB) or Cal Poly ITS Telecomm group approved equal

2.05 INNERDUCT

- A. Fiber Optic Innerduct
 1. 1 ¼" Single Fiber Innerduct (For 4" OSP Conduit, 4 required) with included mule tape.
 2. Orange in color

PART 3 – EXECUTION

3.01 GENERAL

- A. Provide conduit and pull boxes for all telecommunications cabling routed outside of TRs or ERs. **All conduit and pull boxes shall be sized to include an additional 25% capacity for future expansion.**
- B. No cable hangers (J-Hooks, Bridle Rings, Bat Wings, Etc.) shall be used.
- C. Horizontal pathways shall follow building lines, and shall be accessible for future reentry.
- D. **All pathways shall be firestopped with re-enterable firestopping at rated assemblies.**
- E. Locate conduits so that the integrity of structural members is not affected and they do not conflict with the services of other trades.
- F. Except where other specific sizes are required by the Contract Documents, the minimum size for telecommunications conduits shall be:
 1. Four 4 inch (4") conduits for backbone pathways. Four inch conduits shall also be used between the telecommunications entrance facility (EF) and the equipment room (ER), and between ERs and TRs on the same floor of a multi-story building.

2. One and a quarter (1-1/4") inch where a conduit serves a maximum of one typical faceplate.

G. CONDUIT FILL

1. Maximum cable count in conduit (conduit fill) to avoid exceeding maximum pull tension limitations:

(Sleeve < 2') / (Straight < 100') / (Two 90° Bends & > 100')

Conduit Size	Cat5e .205"	CAT 6 .231"	CAT 6A .285"
3/4"	N/A	N/A	N/A
1 1/4"	19 / 12 / 9	13 / 8 / 6	10 / 6 / 5
2"	48 / 32 / 24	32 / 21 / 16	25 / 16 / 12
4"	190 / 127 / 95	128 / 86 / 64	98 / 65 / 49

3.02 QUANTITIES

- A. Quantities of conduits, pull boxes, etc. shown on the drawings shall be illustrative only and are meant to indicate the general configuration of the work. The Contractor shall be responsible for providing the correct quantities of materials to construct a system that meets the intent of these Specifications and the relevant codes.

3.03 INSTALLATION

A. Conduit

1. **Where accessible cable tray is installed, conduit must extend continuously to and must mechanically attach, or be bonded to, the cable tray.**
2. Conduit must extend no further than 2 inches into the cable tray.
3. **All conduits are to have insulated throat bushings.**
4. **Throat bushings shall have grounding lugs unless mechanically attached to cable tray.**
5. **All conduits are to be continuously bonded back to the TGBB in the EF/ER/TR.**
6. Draw up couplings and fittings full and tight. Protect threads from corrosion after installation with zinc chromate or equivalent protection.
7. Conceal conduits except at surface mounted cabinets and freestanding equipment. Install minimum of 6 inches from flues, steam pipes, or other heated lines. Provide flashing and counter-flashing for waterproofing of raceways that penetrate the roof. Do not penetrate waterproof membranes unless proper seal is provided and permission is given.
8. Install telecommunications conduit a minimum of 24 inches from parallel power raceways; avoid long parallel runs of telecommunications and power conduits to the extent practicable. When crossing power raceways, cross at a 90° angle.
9. Install telecommunications conduit a minimum of 12 inches from florescent lighting fixtures.
10. Route exposed conduits and conduits above suspended ceilings parallel or perpendicular to building lines with right angle turns and symmetrical bends. Provide sleeves in concrete walls, floor slabs and partitions. Waterproof sleeved conduits where required.

11. **Provide conduit expansion joints for exposed and concealed conduits at expansion joints between structures to compensate for differential movement and where necessary to compensate for thermal expansion/contraction. Provide bonding conductor.**
 12. Provide conduit seal-offs where portions of an interior raceway system pass through walls, ceilings or floors which separate adjacent rooms having substantially different maintained temperatures, refrigeration, or being used as cold storage rooms.
 13. Provide conduit seal-offs where portions of an exterior raceway system pass into a building.
 14. Conduit seals shall be vapor proof.
 15. **Provide ¼" nylon pull rope with 600 lb. pulling tension in every conduit 2" or larger.**
 16. **Provide pull string with 210 lb. pulling tension in every conduit smaller than 2".**
 17. **All conduits must have a pull string/rope, including after placement of cabling.**
 18. Secure conduit clamps or supports to masonry materials with toggle bolts, expansion bolts, or steel inserts. Install conduit on steel construction with approved clamps which do not depend on friction or set-screw pressure alone.
 19. The minimum 90-degree bend radius for conduit is 6 times the internal diameter of the conduit (10 times the internal diameter if conduit larger than 2 inches).
- B. Conduit above Suspended Ceilings
1. Provide independent support of all conduits. Provide UNISTRUT support and threaded rod to structure above. **Attachment to ceiling support wires is not permitted.**
 2. **Install conduit a minimum of 1 foot above top of suspended ceiling.**
- C. Conduit in floor slabs
1. Conduits runs for horizontal cabling shall not be installed below a building's slab, however they may be installed within the slab with the approval of the Structural Engineer.
 2. Conduits shall not interfere with placement of floor slab reinforcement components.
 3. Install conduits between the upper and the lower layers of reinforcing steel.
 4. **Space conduits not less than 8 inches on centers except where they converge at telecommunications backboards, equipment cabinets or junction boxes.**
 5. Conduits running parallel to slabs supports, such as beams, columns and structural walls, shall be installed not less than 12 inches from such supporting elements.
 6. Elbows used for stub ups on conduit installed below grade or embedded within floor slabs shall be rigid steel conduit with two coats of corrosion resistant paint or tape wrap.
 7. Tie embedded conduits securely in place prior to concrete placement. **Conduits installed within floor slabs shall extend a minimum of 4 inches above the finished slab to a maximum of 6 inches above the finished slab or housekeeping pad to the first connector.**
 8. **Conduits embedded in a slab shall have a dedicated pull box within 1' of their stub up.**
 9. Pathways embedded below the slab must be continuous from the faceplate location to the EF/TR/ER.
 10. **Conduit stub ups must enter the room no more than 3" from a finished surface of a wall.**
- D. Conduit in hazardous locations

1. Provide conduit with appropriate seal-offs, explosion-proof fittings, etc. in special occupancy areas as required.
 2. Conduits and fittings installed in hazardous (classified) locations shall conform to NEC Article 500 requirements for the associated Class and Division.
- E. Non Metallic Conduit
1. Joints shall be made using the material recommended by the conduit manufacturer. Components shall be cleaned prior to assembly.
 2. Conduit cutoffs shall be square and shall not deform conduit. Ream rough surfaces.
 3. Provide male box adapters to terminate conduits.
 4. Where separable terminations are required, provide PVC threaded adapters with locknuts or bushings. Provide "O" rings for watertight installations.
 5. **All bends must be factory manufactured.**
 6. **Provide expansion fittings where required.**
 7. **Conduit supports shall be installed to allow non-metallic conduit to slide through the supports.**
- F. Back-Boxes
1. Provide back boxes and pull boxes as indicated and as required for a complete installation and to facilitate proper pulling of wires and cables.
 2. Boxes shall be sized per ANSI/TIA/EIA-569-A as minimum. (For single conduits trade size 1-1/4 inch, or smaller, a back-box sized 4-11/16 inch square by 2-1/4 inch deep may be used as a pull box, UON.) **Plug open knock outs.**
 3. The exact location of back boxes and equipment is governed by field conditions. Where necessary, relocate back boxes so that fixtures and equipment are symmetrically located in accordance with the room layout and will not interfere with other work or equipment. Verify final location of back boxes, fixtures, and equipment with Architect.
 4. **Back-to-back back boxes in the same wall, or "through-wall" type boxes are not permitted. (See Fig. #158 in Appendix B)**
 5. Fit back boxes in finished ceilings or wall with appropriate covers, set flush with the finished surface. Provide box with tile ring in masonry walls not plastered or furred. Where drywall material is utilized, provide a plaster ring.
- G. Pull Boxes
1. Pull boxes shown in the Drawings are generally a minimum requirement that assumes the conduit run shall be the length indicated and there shall be no more bends than indicated. Actual site conditions and field coordination with other trades usually result in additional bends in the conduit and sometimes cause the length of the run to be greater than shown. Therefore, install pull boxes in all telecommunications conduit runs so that the following conditions are met:
 - a. **Install pull boxes as required in conduit runs so that the distance between pull points is less than 100 feet.**
 - b. **Install pull boxes in conduit runs so that a run of conduit does not contain more than the equivalent of two (2) ninety degree bends (180 degrees total) between pull points.**
 - c. For reverse bends (between 100 and 180 degree), Insert a pull box at each bend.

- d. Pull boxes shall only be installed in straight sections of conduit, not in lieu of a bend.
 - e. **Each conduit entering and exiting a pull box shall be in direct alignment. (See Fig. #158 in Appendix B)**
 - f. **Do not use "Condulet" type fittings in runs of telecommunications conduit.**
 - g. Pull boxes shall not be installed in restrooms, locker rooms or other similar facilities.
 - h. Pull boxes larger than 18" square shall not be installed above hard ceilings.
 - i. Pull boxes less than 18" square can be installed above hard ceilings provided an appropriately sized access hatch is installed.
 - j. Pull boxes shall not be located in floors.
 - k. Pull boxes shall include screws for each cutout in the cover plate
 - l. Pull boxes larger than 24" in any dimension shall have a hinged lid(s).
 - m. **When a Structured Cable System cable bundle enters a pull box from a conduit, the same bundle shall exit the box in a single conduit without splitting off any cables from or adding any cables to, the bundle. NO DAISY-CHAINING OF PULL BOXES SHALL BE ALLOWED. (See Fig. # 159 in Appendix B)**
- H. Pull Box Sizing
- 1. Pull Box serving a Single Faceplate
 - a. For a pull box serving a single faceplate, a 4 11/16" box, 2 1/4" deep box is required.
 - 2. Pull Box serving Horizontal Cabling
 - a. For a pull box serving a single conduit the length shall be 8 times the diameter of the conduit, width shall be 4 times the diameter and the depth shall be 2.5 times the diameter of the conduit. For each additional conduit of the same size, increase the width of the pull box by 2.5 times the diameter of the conduit.
 - b. For a single 1 1/4" conduit, minimum pull box size shall be 10" x 6" x 3" (LxWxD)
 - c. For two 1 1/4" conduits, minimum pull box size shall be 10" x 9" x 3"
 - 3. Pull Box serving Backbone Cabling
 - a. For a pull box serving a single conduit the length shall be 10 times the diameter of the conduit, width shall be 4 times the diameter of the conduit and the depth shall be 2.5 times the diameter of the conduit. For each additional conduit of the same size, increase the width of the pull box by 2.5 times the diameter of the conduit.
 - b. For a single 2" conduit, minimum pull box size shall be 20" x 8" x 5"
 - c. For a single 4" conduit, minimum pull box size shall be 40" x 16" x 12"
 - d. For two 4" conduits, minimum pull box size shall be 40" x 26" x 12"
- I. Appropriate Application of Conduit
- 1. Rigid Metal Conduit or Intermediate Metal Conduit:
 - a. Where potentially exposed to physical damage.
 - b. Indoors where exposed to damp or moist environments such as crawlspaces.
 - c. Where outside plant cable enters the building to the point where it terminates.

- d. Exposed installations within 10 feet above finished grade.
- e. Where required by code, particularly Section 800-40 of the NEC
2. Electrical Metallic Tubing:
 - a. General purpose distribution of telecommunications cabling, except where another conduit type is specifically required.
3. Rigid Non-Metallic Conduit:
 - a. Embedded in floor slabs.
- J. Appropriate Application of Back Boxes and Pull Boxes
 1. Cast Type Boxes:
 - a. Where connected to rigid metal conduit or intermediate metal conduit, 1¼ inches and smaller.
 - b. Exposed conduit installations within 10 feet above finished floor.
 - c. Where exposed to moisture and outdoors.
 2. Galvanized Pressed Steel Type Boxes:
 - a. Where connected to electrical metallic tubing, 1¼ inches and smaller.
 - b. Dry locations.
 - c. Where concealed in walls and above suspended ceilings.
 - d. ***The size for the typical back-box for wall mounted telecommunications faceplates shall be 4-11/16 inch square by 2-1/4 inch deep with a single gang plaster ring, UON.***
 3. Sheet Steel Boxes:
 - a. Where connected to conduit for use as a pull box.
 - b. Where used as a termination point for future cabling.
 - c. Where readily accessible.
- K. Innerduct
 1. All conduits where fiber optic cables are installed, with the exception of station fiber, are to use innerduct.
 2. Plastic Innerduct
 - a. Use plastic innerduct for any situations where a fiber optic cable is exposed within a building. Examples are to include transit from a cable tray or ladder racking.
 - b. Follow all manufacturers' written instructions, specifically as regarding use of a swivel.
 - c. Refer to drawings and conduit schedules for conduits designated to be used for fiber optic cables.
 - d. ***Each plastic innerduct is to carry a maximum of one fiber optic cable.***
 - e. Use terminal adapters to connect to fiber distribution cabinets, and other endpoints.
 - f. ***Any break in continuous innerduct shall be joined using a coupler.***
 - g. Follow all manufacturers' written instructions.

3.04 GROUNDING & BONDING

- A. *All metallic conduits are to be continuously bonded back to the TGBB in the EF/ER/TRs.*
- B. Refer to Section 27-05-26 for additional details.

3.05 TESTING

- A. *For all conduits placed in the slab, use ball mandrel (diameter approximately 85% of conduit inside diameter) followed by close fitting wire brush and wad of felt or similar material to insure no blockages. This assembly shall be pulled with or ahead of cable being installed. Clean empty raceways similarly. Clear or replace any raceway which rejects ball mandrel.*
- B. Testing must be done in the presence of the Cal Poly ITS Telecomm group representative.

3.06 ACCEPTANCE

- A. Once the installation and testing has been completed and the Cal Poly ITS Telecomm group representative is satisfied that all work is in accordance with the Contract Documents, the ITS Telecomm group representative shall notify the Contractor and/or Cal Poly Project Manager in writing or via email.

3.07 RECORD (AS-BUILT) DRAWINGS

- A. The Project Record Drawings shall show the types and locations of all conduit 2" and larger, and their associated pull boxes.

END OF SECTION

DOCUMENT VERSION CONTROL

REVISION	DATE	AUTHOR	REASON
1	02/20/2014	R. Volk	INITIAL DOCUMENT DEVELOPMENT
	02/20/2014	DW & MH	PRIMARY REVIEW COMPLETE