

**SECTION 16730
TELECOMMUNICATIONS - UNDERGROUND STRUCTURES**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Publications and Standards
- B. Work Sequencing and Coordination
- C. Telecommunications Submittals
- D. Quality Assurance

1.2 RELATED SECTIONS

- A. Contract Terms and Conditions
- B. Section 16710 – Telecommunications - General Requirements
- C. Section 16715 - Telecommunications - Acceptance Testing
- D. Section 16720 - Telecommunications - Basic Materials and Methods
- E. Section 16721 - Telecommunications – Air Blown Fiber Basic Materials and Methods
- F. Section 16725 - Telecommunications – Cable
- G. Section 16740 - Telecommunications - Building (RF) CATV / MATV System
- H. Section 16760 - Telecommunications - Grounding and Bonding

1.3 APPLICABLE PUBLICATIONS AND STANDARDS

- A. National Electrical Code (NEC) (ANSI/NFPA 70):
 - (1) Chapter 8: “Communications Systems”
 - (2) Article 250: “Grounding”
- B. Electronics Industry Alliance/Telecommunications Industry Association (EIA/TIA): EIA/TIA 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications
- C. Federal Communications Commission (FCC) Part 15 and Part 68
- D. Rural Utilities Services (RUS), formally REA
- E. Lightning Protection Code - ANSI/NFPA 780

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- F. American Society for Testing Materials (ASTM) Publications
- G. National Electrical Manufacturer's Association (NEMA) Publications
- H. State of California Administrative Code, Title 24, Part 3, CCR, 1994 California Electrical Code
- I. State of California Public Utilities Commission (Cal. P.U.C.) Publication: G.O. 128 Rules for Construction of Underground Electrical and Communications Systems
- J. Underwriter's Laboratories Inc. (UL) Publications
 - (1) 6-1981 (R86) Rigid Metallic Conduit
 - (2) 514B-1982 Fittings for Conduit and outlet Boxes
 - (3) 651-1981 Schedule 40 and 80 Rigid PVC Conduit
 - (4) UL 467 "Grounding and Bonding Equipment"
 - (5) UL 497,497A, and 497B "Communications Circuit Protectors"
- K. California State University, Office of the Chancellor - Telecommunications Infrastructure Planning (TIP) Guidelines - September 1993, plus the latest TIP updates
- L. North Orange County Community College District TELECOMMUNICATION INFRASTRUCTURE STANDARDS dated January 2007.

1.4 SUBMITTALS

- A. Submittals shall be made as defined in Section 16710.

1.5 QUALITY ASSURANCE

- A. For products or workmanship specified by association, trade, Federal, or State Standards, the Contractor shall comply with the requirements of the standard. When more rigid requirements are specified or required by applicable codes, the Contractor shall comply with the more stringent codes.
- B. The Contractor shall conform to reference standard by date of issue current on final design documents.

PART 2 - PRODUCTS

2.1 COMMUNICATIONS MANHOLES

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ALL MANHOLES TO BE PLACED ARE TO BE SPECIFICALLY DESIGNED FOR TELECOMMUNICATIONS APPLICATIONS, WITH NO EXCEPTIONS.

A. Materials

- (1) Pre-cast manholes meeting ASTM C 478 with 28 day 5500 p.s.i. minimum compressive strength concrete and designed for AASHTO H-20 loading per AASHTO HB 14. The Contractor and University's representative shall determine the dimensions for each manhole during the design phase, based on the CSU TIP Standards.
- (2) Tongue-and-groove double sealed joints on mating edges of pre-cast components. The joints shall firmly interlock adjoining components and provide waterproof junctions and adequate shear transfer. Joints shall be sealed with approved watertight joint sealant as prescribed in the manufacturer's installation specifications and conforming to AASHTO M198, Type B. Sealing material shall be installed in strict accordance with manufacturer's printed instructions.
- (3) Conduit Entrances
 - a. For conduit installed on a CSUN project, knockout panels or pre-cast individual conduit openings may be used.
 - b. On sides where no conduit is installed, 12-inch high by 12-inch wide (minimum) knockout panels for future raceway installation shall be provided.
 - c. For existing manholes, new ducts shall enter the manhole with factory-formed bell end of the conduit, and a seal around the conduit shall be applied after installation. Existing manholes shall be retrofitted with the required racking, and grounding and bonding per the TIA/EIA 607 Bonding and Grounding Standards.
- (4) Covers
 - a. The Contractor shall provide solid covers (traffic rated), with a 76.2 cm (30 in.) diameter clear opening.
 - b. Heavy-duty type frames and covers made of cast iron, suitable for H-20 loading, and having machined bearing surfaces shall be used.
 - c. The covers shall be of indented type with solid top design.
 - d. The upper side of each cover shall have the letters "Communications" cast or burned by welder, in integral letters no less than 2 inches high. Either the covers or the ring of the casting shall be field stamped with manhole or handhole numbers provided by the campus.

- B. Manufacturers: Associated Concrete Products, Brooks Products, & Utility Vault Company or approved equivalent product.

2.2 COMMUNICATIONS HANDHOLES

- A. Pre-cast handholes shall meet the standards defined in Subsection 2.1.A.(1).

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- B. Joints and seals shall be provided and installed as defined in Subsection 2.1.A.(2).
- C. Conduit entrances shall be provided as defined in Subsection 2.1.A.(3).
- D. Handholes shall be equipped with a minimum of approved cable racking on one long wall suitable to support large copper cables as called for on the design documents.
- E. All handholes shall be equipped with traffic rated double hinged lids with a locking mechanism. All lids shall have the identification marking of "Communications" permanently affixed to the cover. The pull box number identification shall be stamped or welded on the cover per the District's specified numbering plan.

2.3 COMMUNICATIONS MANHOLE / HANDHOLE HARDWARE

A. Materials

- (1) Pulling irons shall be provided, as required for the size of manhole/handhole (minimum of 4 per manhole: 2 placed on each end wall, top and bottom). Pulling irons shall be placed opposite the terminators. All pulling irons shall be constructed of 2.2 cm (7/8 inch) hot-dip galvanized steel.
- (2) A sump of 30 cm (12 in.) in diameter shall be provided in each manhole, per the manufacturer's specifications.
- (3) Heavyweight cable racks with adjustable arms shall be provided for all cables in each manhole. The racks shall be attached with adjustable inserts set in the concrete walls (bolts or studs embedded in concrete will not be used). Racks and inserts shall be centered on the side walls that are utilized for the racking of splice cases in the manhole, arranged so that all spare conduit ends are clear for future cable installation. The racks shall have a sufficient number of arms to accommodate cables for each conduit entering or leaving the manhole.
- (4) Corner standoff brackets 15cm to 20cm (6 in. to 8 in. from wall) shall be provided if the manhole is equipped with center exit conduits. The bracket shall extend from 15cm (6 in.) off floor to 15cm (6 in.) below roof.
- (5) All manhole and handhole hardware shall be steel that is hot dip galvanized after fabrication.
- (6) Each manhole shall have a detachable galvanized steel ladder that can be removed to facilitate future work in the manhole. The ladder shall be secured to a top support arm in the manhole opening or chimney.
- (7) Each manhole shall be equipped with a manhole entrance security / sealing device. Said device is to be a Lock-down / Lock-dry manufactured by BartonSouthern.
- (8) Each manhole / handhole shall have a concrete apron, of standard dimensions and approximately 4" thick, poured around the ring which surrounds the lid. The

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dimensions of this apron shall be 12 " on each side running parallel to the length of the manhole and 18" on each side running parallel to the width of the manhole.

B. Manufacturers

- (1) Hardware: Alhambra Foundry (model No. A-3382 ladder with A-3383 support bar) or Inwesco Products, or an approved equivalent product.
- (2) Manhole: Brooks, Utility Vault, or Associated Concrete Products, or an approved equivalent product.

2.4 COMMUNICATIONS DUCT-BANKS

A. Materials

- (1) Conduit
 - a. Schedule 40 PVC - 4 inch inside diameter or type C telephone conduit - 4 inch inside diameter (if concrete encased).
- (2) Conduit shall have a factory formed bell on one end for interconnecting segments.
- (3) Conduit located under heavy use highways or railroad rights-of-ways shall be encased in a steel casing consistent with the AASHTO or AREA specifications. The thickness of the steel casing shall be engineered for each specific application. This may vary based on campus codes.
- (5) Spacers: High impact spacers shall be used in all multi-duct systems, for both solely owned or joint telecommunications/power construction. They shall conform to NEMA TC-2, TC-6, TC-8, and ASTM F 512 dimensions.
- (6) All fittings shall be designed specifically for use with the type of conduit placed.
- (7) All conduits shall be equipped with seal plugs in all manholes / handholes and expansion rubber seal plugs within all buildings.

B. Manufacturer: CARLON, ARNCO, or approved equivalent.

2.5 COMMUNICATIONS ENTRANCE CONDUIT

- A.** To prevent shear, all conduit entering a building shall transition from PVC to metal or shall be contained in a metal sleeve from a distance of 24 inches beyond the exterior of the foundation to six inches within the building. These conduits shall slope downward away from the building to reduce the potential of water entering the building.

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2.6 DUCT-BANK LOCATING CABLE (ELECTRONICALLY DETECTABLE WARNING TAPE)

- A. Warning tape shall be a minimum of 3" wide, orange in color, and shall have a nondegradable imprint as follows:
 - (1) "Caution Fiber Optic Cable Buried Below"
 - (2) "Caution Telephone Cable Buried Below"
- B. The tape shall be electronically detectable.
- C. Manufacturer:
 - (1) Carlon, Harris, etc..
 - a. MAT3061 "Caution Fiber Optic Cable Buried Below"
 - b. MAT3T61 "Caution Telephone Cable Buried Below"
 - (2) Equivalent manufacturer's type and style is acceptable.

2.7 PULL ROPE

- A. Pull rope shall be new ¼" polypropylene over polyester rope with a minimum 1700 lb. tensile strength.
- B. Manufacturers: CARLON: Part No.SB14105, or approved equivalent.

2.8 BONDING/GROUNDING

- A. The reinforcing steel in the walls of the manhole shall be bonded together and brazed to the bronze inserts of each section of the manhole per the manufacturer's manhole specifications. The ground inserts shall be attached to the steel rebar to provide a point of attachment for the ground wires or bonding ribbon. The inserts shall be bronze, flush mounted, and brazed to the rebar cage of all the sections of the manhole (bottom, intermediate, and roof sections).
- B. Materials
 - (1) Bonding Ribbon: Shall be made of annealed solid copper 3/8 inch wide x 1/16 inch thick, tin plated. Manufacturer: INWESCO Cat.12A55
 - (2) Bonding Ribbon Clamp: Shall be made of soft lead ½ inch wide by 1/16 inch thick, and accept ¼ inch diameter bolt. Manufacturer: INWESCO Cat. 12A56
 - (3) Fargo Clamp: Shall be cast from copper, silver plated, furnished with copper bolt. Manufacturer: INWESCO Cat.12A57

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- (4) Ground Rod: Shall be manufactured of high strength high carbon steel, with electrolytically bonded jacket of copper on surface, and meet UL spec. 467 and ANSI C-33.8-1072. Manufacturer: INWESCO Cat.12A60
- (5) Ground inserts: Shall be made of Cast Bronze W/1/4 Copper Rod. Manufacturer: INWESCO Cat.12H69

2.9 RACEWAY TAGS

- A. Permanent markers with raceway designations engraved onto the tag shall be provided. Tags relying on adhesives or taped-on markers will not be used. The tags shall attach to raceways with nylon ties.

PART 3 - EXECUTION

3.1 COMMUNICATIONS MANHOLES AND HANDHOLES

- A. General
 - (1) The Contractor shall obtain all required permits and notifications before commencing any work operations.
 - (2) All state and local ordinances shall be complied with at all times.
 - (3) All federal, state, and local safety rules, including OSHA, will be enforced at all times during the duration of a CSU project. It is the responsibility of the Contractor to inspect the job site to ensure compliance.
- B. The final location of all communications manholes and handholes shall be determined by the Contractor and the District's representative (ITR).
- C. All conduits entering a manhole or handhole shall be placed at right angles to the short walls and shall be sealed to prevent seepage unless otherwise specified on the construction documents.
- D. Excavation dimensions shall be verified with the manhole supplier in advance so as to prevent delays in setting schedule.
- E. Shoring shall be in accordance to prevailing underground construction codes, i.e., OSHA, G. O. 128, NESC, and all applicable local, state, and federal statutes.
- F. All manholes and pull boxes shall be equipped with pulling irons.
- G. Finish grade shall be established prior to placing structures. The exact dimensions and orientation of the concrete apron shall be determined prior to placing the structure.
- H. All manholes and pull boxes shall be inspected by the Contractor and the District's representative prior to backfilling.

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- I. Backfill materials shall have been sifted to provide a sand equivalent of not less than 20, and a sieve size of No.4 Backfill material shall be mechanically compacted to a minimum relative compaction of 90 percent to a level six (6) inches above final grade. The excess material shall be excavated to the final grade upon acceptance of compaction.
- J. Existing and/or new communications manholes / handholes may be placed near the existing power and signal vault system. The Contractor shall place new and/or enlarge existing manholes / handholes and conduits in such a manner as to not disturb existing utilities while maintaining specified clearances from all obstructions. This may require clearing much of the area around the vaults by hand. The final placement and depth shall be determined by the Contractor and District's representative.
- K. The Contractor shall locate all existing utilities within 20 feet of the new and/or enlarged manhole/handhole system. The Contractor and District's representative shall review and approve any revised coordination schematics. Caution shall be used when working in this area. The District's existing high power electrical conductors may be transported in the primary electrical duct structure directly adjacent to the secondary electrical and signal ducts.
- L. The Contractor shall excavate around existing vaults using caution to identify and preserve all utilities in the area.

3.2 DUCT-BANKS AND CONDUITS

- A. All communications conduit bank shall be encased with a minimum of 2500 p.s.i. concrete with at least 3 inches of concrete at the top and bottom and 2 inches on each side. A horizontal and vertical separation of 1 inch shall be maintained between the ducts by installing high impact spacers with horizontal and vertical locking intervals of ten feet.
- B. All manhole and handhole entrances shall be shear-blocked with 1 1/2 sack slurry extending no less than 15 feet from the entry wall. All entering ducts shall be completely encased. All duct structures are to be reinforced with two (2) 3/8" rebar placed longitudinally on both corners at the top of the structure and encased in the slurry envelope. This is required to provide additional rigidity in the case of seismic movement, settlement, or excavation work that could expose the ductbank.
- C. All communications conduits shall be placed in a uniform manner between vaults. Conduit in position #1 at one manhole shall maintain its position within the duct run and terminate in the #1 position at the next manhole. The position of all conduits between manholes shall be maintained.
- D. Long radius bends (over 30 feet) shall be used whenever possible to make changes in direction. If it is found to be necessary to place a 90 degree bend in the conduit run, a factory-made sweep of no less than 60 inch radius shall be used. No conduit run shall exceed a total of 180 degrees of bend between any two points (such as manholes or buildings) considering both vertical and horizontal sweeps. Cold formed trench bends shall have a radius of not less than 60 inches and shall pass mandrel integrity. Bend radius criterion is 2" or less 6 times the diameter of the conduit and any conduit larger than 2" is 10 times the diameter of the conduit.

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- E. The length and destination of all conduits shall be identified in each manhole, handhole, and building. Embossed metal or heavy plastic tags strapped to each conduit shall be used.
- F. After installation of communications conduits and after the concrete encasement has cured, the Contractor shall prove all conduits by pulling a mandrel with a diameter $\frac{1}{4}$ inch smaller than the conduit and 6 inches long through each conduit end-to-end. An inspector designated by the Contractor and the District's representative shall be notified 24 hours before this procedure. Each conduit shall be cleaned with a bristle brush to remove any debris.
- G. Utility marking tape (see 3.4.A) shall be buried 12 inches below the surface directly above the conduit.
- H. All conduit structures shall be built with the telecommunications conduits placed above the power conduits unless otherwise called out on the construction drawings and approved by the campus. If this type of construction is required, it shall receive the prior approval of the Contractor, the District's representative and the Local Exchange Carrier.

3.3 ENTRANCE CONDUIT

- A. The Contractor and the District's representative shall determine the placement of all entrance conduit. All Applicable standards shall be adhered to, i.e., NEC, BICSI, AT&T, and GTE, or G.O. 128.

3.4 LOCATING DUCT BANK CABLE

- A. Underground electronically detectable warning tape shall be placed in all trenches at one foot below the final grade after the conduit and encasement is complete. The tape shall indicate the type of cable that will utilize the substructure system, e.g., fiber optic or copper cables. The detectable warning tape shall be installed according to manufacturer's specifications to ensure access to the tape for locating purposes.

3.5 PULL ROPE

- A. Pull rope shall be new material that is free of knots, kinks, and abrasions.
- B. Pull rope shall be placed as a single continuous length in every new duct section.
- C. Pull rope shall be secured at each end.

3.6 BONDING/GROUNDING

- A. Two ground rods shall be installed in each new manhole and handhole. All non-current-carrying metal parts in the manhole and any metallic raceway grounding bushing shall be connected to this ground rod with a No. 4/0 bare copper ground conductor and approved ground clamp, as required per NEC. The ground rods shall be a minimum of 8 feet long by $\frac{5}{8}$ inches in diameter. The ground rods are to be placed in two corners diagonally across from each other.

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- B. The grounding system shall not rely on plumbing systems.
- C. Bonding conductors shall be routed with a minimum number of bends. The bends placed in the conductor should be sweeping.
- D. All bonding connections shall utilize listed bolts, crimp pressure connectors, clamps, or lugs. Exothermic welding may be used.
- E. Multiple bus bars shall be directly bonded together with a No. 4/0 copper conductor.
- F. Backbone cabling shall be bonded at each sheath opening with, minimally, a 6-AWG copper conductor.

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