

SECTION 27-00-00 COMMUNICATIONS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This document contains the General and Supplementary Conditions that are a part of the requirements for the work under this Division of the Specifications.
- B. The term “Telecommunications” systems/components is understood to include TELEPHONE, DATA, CATV systems/components and Radio (RF) systems and components when such systems and/or components are part of the Cal Poly Campus Project.

1.02 QUALITY ASSURANCE

- A. Comply with the current applicable codes, ordinances, and regulations of the authority or authorities having jurisdiction, the rules, regulations and requirements of the utility companies serving the project and the campus’ insurance underwriter.
- B. Drawings, specifications, codes and standards are minimum requirements. Where requirements differ, the most stringent apply.
- C. All equipment and installations shall meet or exceed minimum requirements of ADA, ANSI, ASTM, IEEE, TIP, NEC, NEMA, NFPA, OSHA, UL, ITS Telecommunications Standards Document (TSD), the Manufacturer and the State Fire Marshall.
- D. Should any change in drawings or specifications be required to comply with governing regulations, notify and receive written approval from the Cal Poly ITS Telecom group representative prior to submitting your bid.
- E. *Execute work in strict accordance with the best practices of the trades in a thorough, substantial, workmanlike manner by competent workmen. Provide a competent, experienced, full-time Superintendent and Project Manager who are authorized to make decisions on behalf of the Contractor.***
- F. All telecommunications technicians must have a manufacturer’s certification for the Structured Cable System (SCS) components that they are installing.
- G. Provide all components of a complete system specified within all project documents, specifications and drawings.
- H. All unused component parts from all system installations shall be delivered to the Cal Poly ITS Telecomm group and shall not disposed of or thrown away.
- I. Contractors shall use the strictest manufacturer written recommendations, specifications, and the Cal Poly ITS Campus Telecommunications Standards Document.

1.03 CODES, STANDARDS, AND GUIDELINES

- A. The references to the following codes and standards are meant to represent the most current and up-to-date revisions or printing as of the issue of this document. The Contractor is responsible for following the correct revision or printing (UON).
- B. ANSI/TIA/EIA-526 (Optical Power Loss Measurements of Installed Fiber Cable Plant to include OTDR)
- C. ANSI/TIA/EIA-568-C (Commercial Building Telecommunications Standard)
- D. ANSI/TIA/EIA-569-B (Commercial Building Standards for Telecommunications Pathways and Spaces)
- E. ANSI/TIA/EIA-598-C (Optical Fiber Cable Color Coding)
- F. ANSI/TIA/EIA-604 (Fiber Optic Connector Intermateability Standard)
- G. ANSI/TIA/EIA-606-A (Administration Standard for the Telecommunications Infrastructure of Commercial Buildings)
- H. Buildings)
- I. ANSI/TIA/EIA-607-A (Grounding & Bonding Requirements for Telecommunications in Commercial Buildings)
- J. ANSI/TIA/EIA-758-A (Customer-owned Outside Plant Telecommunications Cabling Standard)
- K. ANSI/TIA/EIA-854 (Full Duplex Ethernet Specification for 1000Mbit/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling)
- L. ANSI/TIA/EIA-862 (Building Automation Cabling Standard for Commercial Buildings)
- M. International Standards Organization/International Electro-technical Commission (ISO/IEC)
- N. Underwriters Laboratories (UL) Cable Certification and Follow Up Program
- O. National Electrical Manufacturers Association (NEMA) O.American Society for Testing Materials (ASTM)
- P. Institute of Electrical and Electronic Engineers (IEEE)
- Q. UL Testing Bulletin
- R. American National Standards Institute (ANSI)
- S. Telecommunications Distribution Methods Manual 12th Edition (BICSI)
- T. CSU Telecommunications Infrastructure Planning Standards (Third Edition) – May 2007
- U. Cal Poly ITS Telecommunication Standards Document – February - 2014
- V. NFPA 101 (NFPA 101 - Life Safety Code).
- W. NFPA 258 - Standard Test Method for Measuring Smoke Generated by Solid Materials.
- X. NFPA 70 - National Electrical Code – 2010
- Y. NFPA 72 National Fire Alarm & Signaling Code – 2010
- Z. CEC 2010 California Electrical Code (Title 24, Part3) – 2010
- AA. The California Mechanical Code
- BB. IEEE's National Electrical Safety Code – 2002
- CC. ANSI C80.3 Specification for Zinc-coated Electrical Metallic Tubing

- DD. ANSI/UL 797 Electrical Metallic Tubing
- EE. ANSI/ICEA S-83-596 - Fiber Optic Premises Distribution Cable Technical Requirements
- FF. Federal Communications Commission (FCC) Part 15
- GG. Federal Communications Commission (FCC) Part 68
- HH. NEMA VE1 Cable Tray Systems
- II. UL 497 Electrical Grounding and Bonding Equipment
- JJ. UL 1479 Fire Tests of Through-Penetration Fire Stops
- KK. ASTM E 814 Methods of Fire Tests of Through-Penetration Fire Stops
- LL. ASTM E 136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C
- MM. Rural Utility Services (RUS), Bulletin 1753F-201, Specifications for Acceptance Tests and Measurements of
- NN. Telephone Plant
- OO. BICSI TDMM (Telecommunications Distribution Methods Manual) 11th Edition

1.04 SUBMITTALS

A. General

1. Review of submittals shall be for general compliance with the design concept and Contract Documents.

Comments or absence of comments shall not relieve the Contractor from compliance with the Contract Documents. The Contractor remains solely responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of construction, for performing the work in a safe manner, and for coordinating the work with that of other trades.

2. Submittals will be stamped as follows:

| Stamp | Interpretation |
|---|---|
| No Exceptions Noted | Fabrication, manufacture, or construction may proceed providing submittal complies with the |
| Exceptions Noted <input type="checkbox"/> Resubmit for Record <input type="checkbox"/> No Resubmission Required | Fabrication, manufacture, or construction may proceed providing submittal complies with the Contract Documents and the Engineer's notations are complied with. |
| Revise and Resubmit | The submittal does not comply with the Contract Documents; do not proceed with fabrication, manufacture, or construction. The work and shop drawings are not permitted at the job site. Resubmit appropriate shop drawings. |

3. No part of the work shall be started in the shop or in the field until the shop drawings and samples for that portion of the work have been submitted and accepted by the Cal Poly ITS Telecomm group.
 4. A minimum period of five working days, exclusive of transmittal time, shall be required in the Cal Poly ITS Telecomm representative's office each time a shop drawing, product data and/or samples shall be submitted for review. This time period shall be considered by the Contractor in the scheduling of the work.
 5. Submit materials and equipment by manufacturer, trade name, and model number. Include copies of applicable brochure or catalog material.
 6. Maintenance and operating manuals shall not be acceptable substitutes for shop drawings.
 7. Identify each sheet of printed submittal pages (using arrows, underlining or circling) to show applicable sizes, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable information. Note specified features such as materials or paint finish.
 8. Maintain a complete set of reviewed and stamped shop drawings and product data on site.
- B. Samples
1. Samples as requested shall be physical examples that represent materials, equipment or workmanship and establish standards by which the work will be judged. Samples shall not be returned to the Contractor.
- C. Test Reports
1. Pre-Installation Testing Reports: Submit two sets of manufacturers' or field-testing reports for those materials identified in the individual system Specification Sections as requiring that such reports shall be submitted.
 2. Post-Installation Testing Reports: Submit a minimum of two sets of field-testing reports for those materials identified in the individual system Specification Sections as requiring that such reports shall be submitted.
- D. Vender/Contractor/Supplier Information
1. Submit a complete typed list of all telecommunications infrastructure equipment manufacturers and material suppliers for the equipment proposed to be provided on this project, as well as names of all subcontractors.
 2. Contractor must supply current manufacturer's certification for all employees involved in the installation of all materials contained as part of the Structured Cabling System.
- E. Warranty info
1. Submit a copy of all relevant warranty information.
- F. Product Documentation:
1. Documentation for submittals in the form of catalog cuts, manufacturer specifications, and other supporting printed material shall be bound in a single binder, tabbed and separated by specification section, and submitted in its entirety for review and eventual delivery to the Cal Poly ITS Telecomm group.
- G. Shop Drawings
1. After the Contract is awarded, provide complete shop drawings as requested for each relevant section. Prior to submission, certify that the shop drawings shall be in compliance with the

Contract Documents. Modify any work, which proceeds prior to receiving accepted shop drawings as required to comply with the Contract Documents and the shop drawings.

2. Shop drawings for Telecommunications Room (TR) layout, specifically including details for wall-fields and rack mounting layouts shall be approved by a representative of the Cal Poly ITS Telecomm group prior to installation.
3. For each room or area of the building containing telecommunications infrastructure equipment, submit the following:
 - a. Floor plans, at not less than 1/8" scale, showing routing of telecommunications conduits, cable trays and other pathways.
 - b. Riser diagrams showing types, quantities and schematic routing of all telecommunications backbone pathways, cabling and the TBB.
 - (1) Enlarged plan views and elevation layout drawings for the telecommunications Entrance Facility (EF) room, Telecommunications Rooms (TRs) and all other designated telecommunications Equipment Rooms (ERs) indicating the equipment in the exact location in which it is intended to be installed. These plans shall be of a scale not less than ¼ inch = 1'-0". They shall be prepared in the following manner:
 - (2) Indicate the physical boundaries of the space including door swings and ceiling heights and ceiling types (as applicable).
 - (3) Illustrate all telecommunications hardware proposed to be contained therein. Include top and bottom elevations of all telecommunications hardware. The Drawings shall be prepared utilizing the dimensions contained in the individual equipment submittals. Indicate code and manufacturer's required clearances.
 - (4) Illustrate all other equipment therein such as conduits, detectors, luminaires, ducts, registers, pull boxes, wire-ways, structural elements, etc.
 - (5) Illustrate concrete pads, curbs, etc.
 - (6) Indicate dimensions to confirm compliance with code-required clearances.
4. The work described in shop drawing submissions shall be carefully checked by all trades for clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and coordination with other trades on the job.
5. Each submitted shop drawing shall include a certification that related job conditions have been checked by the Contractor and each Subcontractor and that conflicts do not exist.
6. The Contractor shall not be relieved of the responsibility for dimensions or errors that may be contained on submissions, or for deviations from the requirements of the Contract Documents. The noting of some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the shop drawings, product data and samples, the Contract Documents govern the work and shall be neither waived nor superseded in any way by the review of shop drawings, product data and samples.
7. Inadequate or incomplete shop drawings, product data and/or samples shall not be reviewed and shall be returned to the Contractor for resubmittal.
8. Indicate the following on the lower right hand corner of each shop drawing and on the front cover of each product data brochure cover: The submittal identification number; title of the sheet or brochure; name and location of the project; names of the Architect, Engineer, Contractor, Subcontractor, manufacturer, supplier, and vendor; the date of submittal; and the

date of each correction, version and revision. Number all pages and drawings in product data brochures consecutively from beginning to end. Unless the above information is included, the submittal shall be returned for re-submission. Resubmittals of product data or brochures shall include a cover letter summarizing the corrections made in response to the review comments.

9. The telecommunications room layout submittals and the related telecommunications equipment submittals shall be submitted concurrently. Failure to submit concurrently shall result in the immediate return of the submittal marked REVISE AND RESUBMIT.

1.05 IDENTIFICATION

- A. Also refer to Section 27-05-53.
- B. Label and identify each element as required for those individual system specification sections.
- C. Use Cal Poly ITS Telecomm Labeling, Design and Syntax Standard on all Shop Drawings and Submittals.

1.06 ABBREVIATIONS AND DEFINITIONS

A. ABBREVIATIONS

1. ADA Americans with Disabilities Act
2. AFF Above Finished Floor
3. ANSI American National Standards Institute
4. ASTM American Society for Testing and Materials
5. BICSI (Building Industry Consulting Service International)
6. EIA Electronic Industries Alliance
7. ETL Electrical Testing Laboratories, Inc.
8. FCC Federal Communications Commission
9. FM Factory Mutual
10. ISO/IEC 11801 Ed.2:2002
11. IEEE Institute of Electrical and Electronic Engineers
12. LED Light Emitting Diode
13. NEC National Electric Code
14. NEMA National Electrical Manufacturers Association
15. NFPA National Fire Protection Association
16. NRTL Nationally Recognized Testing Laboratory
17. OEM Original Equipment Manufacturer
18. OSHA Occupational Safety and Health Administration
19. SCC Security Control Center
20. SCS Structured Cabling System
21. TBB Telecommunications Bonding Backbone
22. TGB Telecommunications Grounding Bus-Bar

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|-----|------|--|
| 23. | TIA | Telecommunications Industries Association |
| 24. | TMGB | Telecommunications Main Grounding Bus-Bar |
| 25. | TIP | Telecommunications Infrastructure Planning |
| 26. | UL | Underwriters Laboratories |
| 27. | UON | Unless Otherwise Noted |

B. Telecommunications Definitions

1. **BACKBOARD:** Backboard generally refers to the A-C, fire-retardant, plywood sheeting lining the walls of the telecommunications facilities. Backboards may also refer to the entire wall-mounted assembly, including wire management and termination frames.
2. **BUILDING ENTRANCE FACILITY (EF):** See ROOM TAXONOMY
3. **CATV:** Cable Antenna Television System.
4. **CABLE PLANT:** Cable, conduit raceways, vaults, junction/pull boxes, rooms, racks, equipment, patch bays/blocks, and other infrastructure required to provide physical, electrical, optical connectivity between buildings on the Campus.
5. **CABLE TRAY:** Hardware designed and manufactured for horizontal pathway distribution of cable and inside wire from the Telecommunications Room (TR) to the Information Outlet.
6. **CAL POLY ITS TELECOMM GROUP REPRESENTATIVE:** Telecommunications representative for the project shall be designated and changed as necessary by the Supervisor of Cal Poly ITS Telecomm group.
7. **DESIGNATION STRIPS:** Paper or plastic strips, usually contained in a clear or color tinted plastic carrier, designated for insertion into a termination frame. Designation strips are usually imprinted with the adjacent terminal number and are used to aid in locating a specific pair, group of pairs, or information outlet inserted into the termination frame, or for the purpose of delineating a termination field.
8. **ENTRANCE CONDUIT:** Conduit that connects the underground infrastructure with the building's EF.
9. **HORIZONTAL CABLE:** See STATION CABLE
10. **MPOE/DEMARK:** Minimum Point of Entry, Utility Partnerships/Alternate Carrier and inaccessible or non-standard customer wiring located in or connected to an EF/ TR/ER, MPER and/or MCER.
11. **WIRE MANAGEMENT HARDWARE:**
 - a. **Fiber Management:** Hardware designed and manufactured for the purpose of keeping fiber patch cords neat and orderly. Most termination frame manufacturers provide fiber management components designed to work in conjunction with their termination frames. Fiber management may also refer to other types of hardware for the purpose of securing fiber optic cable to the building.
 - b. **Wire Management (Copper, Data, Network):** Hardware designed and manufactured for the purpose of keeping cross-connect wire and patch cables neat and orderly. Most termination frame manufacturers provide wire management components designed to work in conjunction with their termination frames. Wire management may also refer to other types of hardware for the purpose of securing wire and cable to the building.

12. OUTSIDE PLANT (OSP): Communications system components outside of the buildings (typically underground conduit and vaults, exterior/underground rated wire, cable, fittings, etc.).
13. RISER CABLE: High volume cable (copper) that connects between ERs/TRs, patch panels or backboards located on the same or different floors. All riser cable is to be plenum rated.
14. RISER CONDUIT: Conduit that connects between ERs/TRs or backboards located on the same or different floors.
15. RISER FIBER CABLE: Fiber Optic Cables that connects between ERs/TRs or racks located on the same or different floors. All Fiber Optic Cable to be plenum rated.
16. ROOM TAXONOMY
 - a. ENTRANCE FACILITY (EF): The EF is where the outside plant (OSP) cables connect (through protection devices and distribution cross-connects) to the telecommunications, data and CATV "backbone". The EF should be located as close as possible to where the communications conduits enter the facility from the underground. The EF must be large enough for plywood backboards with a minimum of 36 inches of clearance in front of the entrance cross-connects and include the same door and lighting requirements as a TR. In certain project/building designs, a TR or ER could also function as an EF if sufficient additional space is provided.
 - b. TELECOMMUNICATIONS ROOM (TR): Telecommunication rooms are recognized in ANSI/TIA/EIA-569 as the transition point between the horizontal (station) pathway facilities and the backbone (riser) pathway facilities. A TR can also function as an EF provided sufficient space is added to the room. The TR generally houses telecommunications equipment, cabling, TR environmental control equipment, TR power distribution/conditioners, and uninterruptible power supply (UPS) systems. TRs must also be large enough for equipment installation/replacement without interfering with other systems (minimum 3 side-by-side equipment racks). The TR interior dimensions must be at minimum no less than 10' x 12' when planned to serve less than 200 communications faceplates. A TR shall be made larger if the communications outlet count is higher. EF/TRs/ERs shall be stacked above each other in multi-story buildings in a fire rated 2 hour shaft design.

TELECOMMUNICATIONS ROOM TYPES:

- (1) MAIN CAMPUS EQUIPMENT ROOM (**MCER**): Designation for a room serving as the **core telecommunications and data network facility for a campus** and typically acts as a gateway to the outside world.
- (2) MAIN PROJECT EQUIPMENT ROOM (**MPER**): Designation for a room serving as the main telecommunications facility serving a **project or multiple individual buildings** and typically connects directly to an MCER.
- (3) Equipment Room (**ER**): Designation for the primary telecommunications facilities **for an individual building**. ERs connect to a MPER or directly to a MCER via the building's EF.
- (4) SUPPLEMENTAL EQUIPMENT INSTALLATION (**SEI**): Designation for a tertiary or (typically) old and noncompliant telecom facility. **(Not Used in New Construction)**

17. STATION CABLE:

- a. 4 pair, unshielded uniform twisted pair, category rated wire that connects the end user information outlet/faceplate to the ER/TR. All station cable to be plenum rated.
18. TELECOMMUNICATIONS GROUNDING/BONDING SYSTEM:
- b. The Bonding Conductor for Telecommunications (BCT): The BCT shall bond the TGB to TBB, and bond the TMGB to the main facility electrical power grounding busbar.
 - c. The Telecommunications Main Grounding Busbar (TMGB): The TMGB is connected to main facility electrical grounding system and serves as the dedicated extension for the telecommunications infrastructure. The TMGB also serves as the central attachment point for telecommunications bonding backbones (TBB) and equipment, and shall be located such that it is accessible to telecommunications personnel.
 - d. The Telecommunications Grounding Busbar (TGB): The TGB is the common central point of connection for telecommunications systems and equipment for the location served by that ER/TR.
 - e. The Telecommunications Bonding Backbone (TBB): A TBB is a conductor that interconnects all TGB's with the TMGB. A TBB's basic function is to reduce or equalize potential differences between telecommunications systems bonded to it. A TBB is not intended to serve as the only conductor providing a ground fault current return path.
 - f. The Telecommunications Bonding Backbone Interconnecting Bonding Conductor (TBBIBC): Whenever two or more vertical TBBs are used within a multistory building, the TBBs shall be bonded together with a TBB interconnecting bonding conductor (TBBIBC) on the top floor (at minimum).
19. TELECOMM/DATA DEMARK: (Surface Mounted Conduit & Boxes Only and/or no Suspended Ceiling)
- A pair of separately mounted 4 11/16" square, 2 1/4" deep electrical boxes. In one box terminate a run of telecomm/data cable from the ER/TR using a single (or more if necessary) RJ45 jack, mounted in an appropriate faceplate. In the other box terminate cable(s) that shall be used to connect directly to a piece of manufactured equipment or a non-ITS supported network. To complete the cable run(s) use a "male RJ45" to "male RJ45" jumper plugged into each faceplate. **(See Fig. #166 in the Cal Poly ITS Telecomm Labeling, Design and Syntax Standard in Appendix B).**
20. TELECOMM/DATA DEMARK: (In-wall Conduit and Back Boxes with a Suspended Ceiling)
- Conduit and wiring shall be installed to a standard, ITS Telecom group in-wall 4 11/16" square, 2 1/4" deep electrical box. The port connectors for cables to be connected directly to user equipment shall be pushed back into the back box and an extension cable shall be attached and the extension cable shall be run to the area above the hung ceiling where it will be coiled for customer use. The empty faceplate holes shall be filled with snap-in blank fillers. (See Fig. #167 in the Cal Poly ITS Telecomm Labeling, Design and Syntax Standard in Appendix B.)

1.07 WARRANTY

- A. Submit a single guarantee stating that the work is in accordance with the Contract Documents. The warranty shall include all labor to replace any defective components as well as the component

- replacement at current market price. Guarantee work against faulty and improper material and workmanship for a period of one year from the date of final acceptance by the University and/or the ITS Telecom group, except where guarantees or warranties for longer terms shall be provided or specified herein, the longer term shall apply. Correct any deficiencies, which occur during the guarantee period, within 24 hours of notification, without additional cost to the University, and to the satisfaction of the Cal Poly ITS Telecom group representative. Obtain similar guarantees from subcontractors, manufacturers, suppliers and sub-trade specialists.
- B. Structured Cabling System (SCS) Manufacturers Extended Warranty
1. Installation contractor shall have current manufacturer's certification for all materials contained as part of the SCS. All employees shall have current certifications for the materials they are installing.
 2. SCS Systems shall be covered by a two-part certification program provided by a single manufacturer and that manufacturer's certified vendor. Manufacturer shall administer a follow on program through the Vendor to provide support and service to the purchaser. The first part shall be an assurance program, which provides that the certified system will support the applications for which it is designed, during the 20-year warranty of the certified system.
 3. The second portion of the certification shall be a 20-year warranty provided by the manufacturer and the vendor on all products within the system (cords, telecommunications faceplate/connectors, cables, cross-connects, patch panels, etc.).
 4. In the event that the certified system ceases to support the certified application(s), whether at the time of cutover, during normal use or when upgrading, the manufacturer and vendor shall commit to promptly implement corrective action.
 5. Documentation proving the cabling system's compliance to the End-to-End Link Performance recommendations, as listed in ANSITIA/EIA-568-B shall be provided by the Vendor prior to the structured cabling system being installed.
 6. The cabling system shall conform to the current issue of industry standard ANSI/TIA/EIA-568.

All performance requirements of this document shall be followed. As well, workmanship and installation methods used shall be equal to or better than that found in the BICSI (Building Industry Consulting Service International) ITSI (Information Transport Systems Installation) manual and the Cal Poly ITS Telecommunications Standards Document – January - 2014.
 7. Purchaser demands strict adherence to the performance specifications listed in ANSI/TIA/EIA-568- B series standards.
 8. Manufacturer shall maintain ISO Quality Control registration for the facilities that manufacture the product used in this cabling system.

PART 2 – PRODUCTS

2.01 EQUIPMENT AND MATERIALS

- A. Use only products listed for their intended use by a Nationally Recognized Testing Laboratory, except products for which no relevant standards exist.
- B. Provide products and materials that are new, clean, free of defects, and free of damage and corrosion.

- C. Products and materials shall not contain asbestos, PCB, or any other material, which shall be considered hazardous by the Department of Environmental Protection or any other authority having jurisdiction.
- D. Maintain uniformity of manufacturer for equipment used in similar applications and sizes.
- E. Follow manufacturer's instructions for installing, connecting, and adjusting equipment. Provide a copy of such instructions at the equipment during installation.
- F. Enclosures for telecommunications/data/CATV/radio infrastructure equipment installed in mechanical equipment rooms shall be NEMA type 1 with gasket. Enclosures for telecommunications infrastructure equipment installed outdoors shall be NEMA type 4.
- G. Ship and store all products and materials in a manner that will protect them from damage, weather and entry of debris. If items are damaged, do not install, but take immediate steps to obtain a replacement. Repairs of damaged goods shall only be permitted with prior written permission of the Cal Poly ITS Telecomm group representative.
- H. Part numbers and product codes in these specifications shall be correct as of the time of writing. Manufacturers may, however, change part numbers and product codes on short notice. In cases where part numbers or product codes differ from technical specifications for a particular product, provide products meeting the minimum technical specifications of the products in the specifications. The contractor shall notify the Cal Poly ITS Telecomm representative of any product code and or part number changes on the material list submittal.
- I. 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, unless specifically noted otherwise on approved drawings or contract documents.

2.02 SPECIAL TOOLS

- A. Deliver to Cal Poly ITS Telecomm group representative 2 complete sets of all special tools and small equipment items needed for proper operation, adjustment and maintenance of cabling and equipment installed under this work.
- B. All tools to be new and still in manufacturers packaging. The cost for these tools is to be included within the bid price for this work.
- C. The terms "special tools" and "small equipment items" *is* meant to include such items as punch down tools, connector assembly tools, etc. with each individual item having a retail replacement cost not exceeding five hundred dollars (\$500.00). It is NOT meant to include common hand tools such as standard screwdrivers, pliers, wrenches, etc.
- D. Submit the tool list along with the bid for this work. Include add/delete unit pricing for all tools on the list.

2.03 SUBSTITUTIONS

- A. Contract Documents shall be based on equipment manufacturers as called out in the Specifications and indicated on the Drawings. Acceptance of substitute equipment manufacturers shall not relieve Contractor of the responsibility to provide equipment and materials, which meet the performance as stated or implied in the Contract Documents.
- B. Submit proposals to provide substitute materials or equipment, in writing, with sufficient lead-time for review prior to the date equipment is ordered to maintain project schedule.
- C. Substitutions that increase the cost of the work and related trades shall not be permitted.

- D. Proposals for substitutions shall include the following information:
1. A description of the difference between the Contract Document requirements and that of the substitution, the comparative features of each, and the effect of the change on the end result performance. Include the impact of all changes on other contractors and acknowledge the inclusion of additional costs to the other trades.
 2. Schematic drawings and details.
 3. List of revisions to the Contract Documents that must be made if the substitution is accepted.
 4. Estimate of costs the University may incur in implementing the substitution, such as test, evaluation, operating and support costs.
 5. Statement of the time by which a Contract modification accepting the substitution must be issued, noting any effect on the Contract completion time or the delivery schedule.
 6. A statement indicating the reduction to the Contract price if the Cal Poly ITS Telecomm group representative accepts the substitution. Include required modifications to all related trades.
- E. Final acceptance of Telecomm/Data/CATV/RF designs and substitutions shall be as follows:
1. Final acceptance/approval of all Telecomm/Data/CATV/RF designs and substitutions shall be at the sole discretion of the Cal Poly ITS Telecomm group.

PART 3 – EXECUTION

3.01 GENERAL

- A. Work Included
1. Provide labor and materials required to install, test and place into operation the telecommunications infrastructure systems as called for in the Contract Documents, and in accordance with applicable codes and regulations.
 2. Provide labor, materials, and accessories required to provide complete, operating telecommunications infrastructure systems.
 3. Labor, materials or accessories not specifically called for in the Contract Documents, but required to provide complete, operating infrastructure systems shall be provided without additional cost to Cal Poly.
- B. Fees and Permits
1. Pay all required fees and obtain all required permits related to the telecommunications infrastructure installation.
 2. Pay royalties or fees in connection with the use of patented devices and systems.
 3. Provide controlled inspection where required by the authority having jurisdiction or by these specifications.
- C. Coordination of work
1. The Contract Documents establish scope, materials and quality but are not detailed installation instructions. Drawings are diagrammatic.
 2. Coordinate work with related trades and furnish, in writing, any information necessary to permit the work of related trades to be installed satisfactorily and with the least possible conflict or delay.

3. The telecommunications infrastructure drawings show the general arrangement of equipment and appurtenances. Follow the appropriate drawings as closely as the actual construction and the work of other trades, will permit. Provide offsets, fittings, and accessories, which may be required but not shown on the Drawings. Investigate the site, and review drawings of other trades to determine conditions affecting the work, and provide such work and accessories as may be required to accommodate such conditions.
4. The locations of cable termination fields, faceplates, patch panels, equipment racks and other equipment indicated on the Drawings are approximately correct, but they are understood to be subject to such revision as may be found necessary or desirable at the time the work is installed in consequence of increase or reduction of the number of faceplates, or in order to meet field conditions, or to coordinate with modular requirements of ceilings, or to simplify the work, or for other legitimate causes. The final designs shall be accepted by the Cal Poly ITS Telecomm group prior to installation.
5. ***Exercise particular caution with reference to the location of outlets/faceplates, racks, blocks, patch panels, control panels, switches, etc., and have precise and definite locations accepted by the Cal Poly ITS Telecomm group representative before proceeding with the installation.***
6. The Drawings show only the general run of raceways and approximate locations of faceplates. Any significant changes in location of faceplates, cabinets, etc., necessary in order to meet field conditions shall be brought to the immediate attention of the Cal Poly ITS Telecomm group representative for review before such alterations are made. Modifications shall be made at no additional cost to the University.
7. Verify with the Cal Poly ITS Telecomm group representative the exact location and mounting height of faceplates and equipment not dimensionally located on the Drawings. For power distribution to equipment located in equipment racks see the Cal Poly Labeling, Design and Syntax Standard in Appendix B.
8. Faceplate/cable labels in the form of alpha/numeric characters are used where shown to indicate the faceplate and cable designation numbers in cable termination fields (terminal blocks and/or patch panels). Show the actual faceplate/cable numbers on the as-built Record Drawings, on the associated typed termination field labels and in the printed and computer readable cabling schedules. Where faceplate/cable-numbering information is not indicated, request clarification from the Cal Poly ITS Telecomm group representative.
9. Wherever work interconnects with work of other trades, coordinate with other trades to insure that they have the information necessary so that they may properly install the necessary connections and equipment. Identify items (remote ballast, pull boxes, etc.) requiring access in order that the Ceiling Trade will know where to install access doors and panels.
10. Furnish and set sleeves for passage of telecommunications risers through structural masonry and concrete walls and floors and elsewhere as required for the proper protection of each telecommunications riser passing through building surfaces.
11. Provide appropriate firestop materials around all pipes, conduits, ducts, sleeves, etc. which pass through rated walls, partitions and floors.
12. Provide detailed information on openings and holes required in precast members for telecommunications work.
13. Provide required supports and hangers for conduit and equipment, designed so as not to exceed allowable loadings of structures.
14. Examine and compare the Contract Drawings and Specifications with the Drawings and Specifications of other trades, and report any discrepancies between them to the Cal Poly ITS

Telecomm group representative and obtain written instructions for changes necessary in the work. Install and coordinate the work in cooperation with other related trades. Before installation, make proper provisions to avoid interferences.

15. Before commencing work, examine adjoining work on which this work is in any way affected and report conditions, which prevent performance of the work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.
16. Adjust location of conduits, panels, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each conduit prior to fabrication.
 - a. Right-of-Way: Lines which pitch shall have the right-of-way over those which do not pitch.
 - b. For example: condensate, steam, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
 - c. Provide offsets, transitions and changes in direction of conduit as required to maintain proper headroom and pitch on sloping lines.
17. In cases of doubt as to the work intended, or in the event of need for explanation, request supplementary instructions from the Cal Poly ITS Telecomm group.
18. Coordinate with Cal Poly ITS Telecommunications group representative for access into existing campus telecommunication spaces.

D. Cutting and Patching

1. Where cutting, channeling, chasing or drilling of floors, walls, partitions, ceilings or other surfaces shall be necessary for the proper installation, support or anchorage of conduit or other equipment, layout the work carefully in advance. Repair any damage to the building, piping, equipment and/or defaced finished plaster, woodwork, metalwork, etc. using skilled tradespeople of the trades required at no additional cost to the campus.
2. Do not cut, channel, chase or drill unfinished masonry, tile, etc., unless permission from the Cal Poly ITS Telecomm group representative is obtained. If permission is granted, perform this work in a manner acceptable to the Cal Poly ITS Telecomm group representative.
3. Where conduit or equipment is mounted on a painted finished surface, or a surface to be painted, paint to match the surface. Cold galvanize bare metal whenever support channels are cut.
4. Provide slots, chases, openings and recesses through floors, walls, ceilings, and roofs as required.

Where these openings are not provided, provide cutting and patching to accommodate penetrations at no additional cost to the campus.

E. Cleaning Up

1. Avoid accumulation of debris, boxes, loose materials, crates, etc., resulting from the installation of this work. Remove from the premises each day all debris, boxes, etc., and keep the premises clean and free of dust and debris.
2. Clean all fixtures and equipment at the completion of the project. Wipe clean exposed lighting fixture reflectors and trim pieces with a non-abrasive cloth just prior to occupancy.

3. All telecommunications infrastructure equipment spaces shall be thoroughly vacuumed and wiped clean prior to bringing online and at the completion of the project. Equipment shall be opened for observation by the Cal Poly ITS Telecomm group representative as required.
- F. Delivery, Drayage and Hauling
1. Provide drayage, hauling, hoisting, shoring and placement in the building of equipment specified and be responsible for the timely delivery and installation of equipment as required by the construction schedule. If any item of equipment is received prior to the time that it is required, the Contractor shall be responsible for its proper storage and protection until the time it is required. Pay for all costs of demurrage or storage.
 2. If equipment is not delivered or installed at the project site in a timely manner as required by the project construction schedule, the Contractor shall be responsible for resulting disassembly, re-assembly, manufacturer's supervision, shoring, general construction modification, delays, overtime costs, etc. at no additional cost to the University.
- G. Equipment and Material Protection
1. Protect the work, equipment, and material of other trades from damage by work or workmen of this trade, and correct damaged caused without additional cost to the University.
 2. It is the contractor's responsibility for work, materials, and equipment until finally inspected, tested and accepted. Protect work against theft, injury, or damage, and carefully store material and equipment received on site, which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material. Cover and protect equipment and materials from damage due to water, spray-on fireproofing, construction debris, etc.
 3. Provided adequate means for fully protecting finished parts of materials and equipment against damage from whatever cause during the progress of the work until final acceptance. Protect materials and equipment in storage and during construction in such a manner that no finished surfaces will be damaged or marred, and are kept clean and dry. Do not install damaged items; take immediate steps to obtain replacement or repair.

3.02 QUANTITIES

- A. N/A

3.03 INSTALLATION

- A. Mounting Heights
1. Mounting heights shall conform to ADA requirements.
 2. Contractor responsible for the physical mounting of devices must have knowledge and understanding of ADA requirements.
 3. Mounting heights shall be from floor to center of outlet, unless otherwise noted. Verify exact locations and mounting heights with the Project Manager before installation.
 4. Wall mounted devices requiring operational access shall be mounted a minimum of 15 inches above finished floor to bottom of device and a maximum of 48 inches above finished floor to the operating mechanism.
- B. Waterproofing

1. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, make penetration prior to the waterproofing and furnish all sleeves or pitch-pockets required. Contact the Cal Poly ITS Telecommunications group representative and the Cal Poly Facilities Project Manager and obtain written permission from the Cal Poly Facilities Project Manager before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.
 2. Restore waterproofing integrity of walls or surfaces after they have been penetrated without additional cost to the University.
- C. Supports
1. Support work in accordance with the strictest manufacturer written recommendation per code or the best industry practice. Provide supports, hangers, auxiliary structural members and supplemental hardware required for support of the work.
 2. Provide supporting frames or racks extending from floor slab to ceiling slab for work indicated as being supported from walls where the walls are incapable of supporting the weight. In particular, provide such frames or racks in telecommunications closets and equipment rooms.
 3. Provide supporting frames or racks for equipment, which is installed in a freestanding position meeting Seismic Zone 4 requirements.
 4. Supporting frames or racks shall be plumb and square with parallel side rails of standard angle, standard channel or specialty support system steel members, rigidly bolted or welded together and adequately braced to form a substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of all equipment mounted on them.
 5. Adequate support of equipment (including faceplate, back, pull and junction boxes and fittings) shall not depend on electric conduits, raceways, or cables for support.
 6. Telecommunications equipment shall not rest on or depend for support on suspended ceiling media. Provide independent support of telecommunications equipment. Do not attach to supports provided for ductwork, piping or work of other trades.
 7. Provide required supports and hangers for conduit, equipment, etc., so that loading will not exceed allowable loadings of structure. Telecommunications equipment and supports shall not come in contact with work of other trades.
- D. Fastenings
1. Fasten equipment to building structure in accordance with the strictest manufacturer written recommendation, per code or the best industry practice and while meeting Seismic Zone 4 requirements.
 2. Where weight applied to the attachment points is 100 pounds or less, conform to the following as a minimum:
 - a. Wood: Wood screws.
 - b. Concrete and solid masonry: Bolts and expansion shields.
 - c. Hollow construction: Toggle bolts.
 - d. Solid metal: Machine screws in tapped holes or with welded studs.
 - e. Steel decking or sub-floor: Fastenings as specified below for applied weights in excess of
 - f. 100 pounds.

3. Where weight applied to building attachment points exceeds 100 pounds, but is 300 pounds or less, conform to the following as a minimum:
 - a. At concrete slabs provide 24 inch x 24 inch x ½ inch steel fishplates on top with through bolts. Fishplate assemblies shall be chased in and grouted flush with the top of slab screed line, where no fill is to be applied.
 - b. At steel decking or sub-floor for all fastenings, provide through bolts or threaded rods.
 - c. The tops of bolts or rods shall be set at least one inch below the top fill screed line and grouted in. Suitable washers shall be used under bolt heads or nuts. In cases where the decking or sub-floor manufacturer produces specialty hangers to work with his decking or sub-floor such hangers shall be provided.
 4. Where weight applied to building attachment points exceeds 300 pounds, coordinate with and obtain the approval of the Cal Poly ITS Telecomm group representative and conform to the following as a minimum:
 - a. Provide suitable auxiliary channel or angle iron bridging between building structural steel elements to establish fastening points. Bridging members shall be suitably welded or clamped to building steel. Provide threaded rods or bolts to attach to bridging members.
 5. For items, which are shown as being ceiling mounted at locations where fastening to the building construction element above is not possible, provide suitable auxiliary channel or angle iron bridging tying to the building structural elements.
 6. Wall mounted equipment may be directly secured to wall by means of steel bolts. Groups or arrays of equipment may be mounted on adequately sized steel angles, channels, or bars.
- E. Equipment pads and Anchor Bolts
1. Provide concrete pads under all floor-mounted telecommunications equipment where specifically required by the Specifications or shown on the Drawings. Equipment pads shall conform to the shape of the piece of equipment it serves with a minimum 1-inch margin around the equipment and supports. Pads shall be a minimum of 4 inches high and made of a minimum 28 day, 2500psi concrete reinforced with 6 inch x 6 inch 6/6 gauge welded wire mesh. Trowel tops and sides of pad to smooth finishes, equal to those of the floors, with all external corners bull-nosed to a ¾ inch radius. Shop drawings stamped NO EXCEPTIONS NOTED shall be used for dimensional guidance in sizing pads.
 2. Provide galvanized anchor bolts for all equipment placed on concrete equipment pads, inertia blocks, or on concrete slabs. Provide bolts of the size and number recommended by the manufacturer of the equipment and locate by means of suitable templates. Equipment installed on vibration isolators shall be secured to the isolator. Secure the isolator to the floor, pad, or support as recommended by the vibration isolation manufacturer.
 3. Where equipment is mounted on gypsum board partitions, the mounting screws shall pass through the gypsum board and securely attach to the partition studs. As an alternative, the mounting screws may pass through the gypsum board and be securely attached to 6 inches square, 18 gauge galvanized metal back plates, which are attached to the gypsum board with an approved non-flammable adhesive. Toggle bolts installed in gypsum board partitions are not acceptable.

3.04 GROUNDING & BONDING

- A. See individual sections for specific details.
- B. Refer to Section 27-05-26 for additional details.

3.05 TESTING

- A. Comply with the project construction schedule for the date of final performance and acceptance testing, and complete work sufficiently in advance of the Contract completion date to permit the execution of the testing prior to occupancy and Contract Closeout. Complete any adjustments and/or alterations, which the final acceptance tests indicate as necessary for the proper functioning of all equipment prior to the completion date. Refer to Specification Section 27-08-13 and 27-08-23 for extent of testing required.
- B. Provide a detailed schedule of completion indicating when each system is to be completed and outlining when field-testing will be performed. Submit completion schedule for review within six months after the notice to proceed by Cal Poly ITS Telecomm group Representative has been given. Update this schedule periodically as the project progresses.

3.06 ACCEPTANCE

- A. Perform all tests required by local authorities, in addition to tests specified herein.
- B. Technicians shall be ready with all necessary tools, test equipment, and supplies necessary to troubleshoot and correct cabling system faults.
- C. Upon receipt of the Contractor's documentation of cable testing, the Cal Poly ITS Telecomm group representative will review/observe the installation and randomly request tests of the cables/wires installed. Once the 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 Cal Poly ITS Telecomm group representative will notify the Contractor or Cal Poly Project Manager in writing.
- D. Specific system acceptance requirements are listed in the appropriate specification section.
- E. Final Punch List
 - 1. Prior to the Final Punch list, certify that systems and equipment are complete, operational, and are in compliance with the Contract Documents.
 - 2. Any deficiencies noted on the Final Punch list shall be expeditiously corrected and certified in writing.
- F. Operating and Maintenance manuals
 - 1. Provide Operating and Maintenance Manuals and Training of maintenance personnel for equipment and materials furnished under each Division.
 - 2. Maintenance manuals shall include complete cleaning and servicing data compiled in a clear and easily understandable format. Show model numbers of each piece of equipment, complete lists of replacement parts, capacity ratings, and actual loads.

3.07 RECORD (AS-BUILT) DRAWINGS

- A. Record dimensions clearly and accurately to delineate the work as installed; suitably identify locations of all equipment by at least two dimensions to permanent structures. In addition, mark the Record Drawings to show the precise location of concealed work and equipment, including concealed or embedded raceways

- B. and cables and all changes and deviations in the telecommunications infrastructure work form that shown on the Contract Documents. This requirement shall not be constructed as authorization to make changes in the layout or work.
- C. In a neat and accurate manner, provide a complete record of all revisions of the original drawings, as actually installed. The cost for these documents shall be included in the Contract. Submit drawings in AutoCAD and PDF format on CD for review. After review, make necessary changes to documents and then deliver 3-CD copies of them to the Cal Poly ITS Telecomm group representative.
- D. 3 copies of the final record drawings shall be submitted in AutoCAD and PDF format on CD.
- E. Submit 3 copies of the as-built telecommunications cabling schedules on CD as comma delimited ASCII format files (or other mutually acceptable media and format).

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 |