

# DIVISION 27 – COMMUNICATIONS: DESIGN GUIDE

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## 27 00 00 - Communications

### *Introduction*

This document's objective is to provide Architects and other designers with a design-requirements and guidelines document that will help them plan the telecommunications facilities for the UCSC campus. The Scope of Work includes the telecommunication inside plant (ISP) and outside plant (OSP) cabling and support facilities required by new buildings or additions and/or upgrading of existing buildings and facilities. The document is a design guide and is not a project specifications document.

### *Telecommunications Spaces (TS)*

1. Telecommunications Spaces (TS): The term TS refers to space allocated within a building to provide a secure operating environment for telecommunications cabling and termination facilities and/or network equipment. TS's shall be designed and provisioned per ANSI/TIA-569 Telecommunications Pathways and Spaces and per the BICSI Telecommunications Distribution Methods Manual (TDMM), most recent edition. Depending on the building size, design, and network requirements, one or more of the functions of a TS may be combined into one space. The primary functions housed in TS's are:
  - a. Telecommunications Rooms (TR)
  - b. Entrance Facility (EF)
  - c. Equipment Room (ER)
  - d. Area Distribution Frame (ADF)
  - e. Building Distribution Frame (BDF)
  - f. Intermediate Distribution Frame (IDF)

### *Types of ISP TS/TR Facilities*

1. Types
  - a. Entrance Facility (EF): Is a room that houses the termination and grounding point of OSP network service cables that enter or exit a building. It enables the joining of intra-building and inter-building backbone cabling. The EF is generally co-located in a BDF or ADF rather than being a separate room.
  - b. Equipment Rooms (ER): Is a room that houses telecommunications equipment.
  - c. Area Distribution Frame (ADF): Is a multiple-building serving facility. The ADF is the room within a building for telecommunications equipment that meets the voice, data, video, radio, and wireless needs of its building and also serves other buildings in a designated area (zone) on the UCSC campus. It generally acts as an EF and BDF but can also act as an IDF serving the floor it occupies. ADFs are generally placed on the lowest floor of a building to allow the entry of OSP cables without transition splicing and for grounding of

cables.

An ADF provides a controlled environment to house telecommunications equipment, termination hardware, splice closures, Main Telecommunications Grounding Busbar (MTGB) grounding and bonding facilities, and protection apparatus where applicable. Equipment in the ADF includes the Campus PBX telephone systems (LIMs) or MX1 equipment; local area and core network switches; video distribution equipment; wireless network equipment; Land Mobile Radios (LMR) and Public Safety Networks (PSN) for firefighters, police and first responders including the campus 800 MHz radios and off-campus police and fire frequencies used for in-building radio equipment (also known as Distributed Antenna System or DAS as defined in CBC Article 915 and CFC Article 510); in-building cellular systems; and large uninterruptible power sources that are sized to operate the ADF cooling and electronics for up to 8 hours.

ADFs are distinct from other TRs due to the nature and/or complexity of the equipment they contain. They are distribution points for the campus fiber and copper OSP cable plant.

- d. Building Distribution Frame (BDF): Is a building-serving facility. The BDF enables connection of OSP services (telecommunications) to the building and then distributes those services throughout the building to IDFs using riser cables.
  - e. Intermediate Distribution Frames (IDF): Are considered to be floor servicing facilities as opposed to building service facilities. The IDF provides a connection point between riser cable from the BDF and the end user Work Area Outlet (WAO) horizontal cabling. All new multi-story buildings shall have at minimum one (1) IDF on each floor of the building. More than one (1) IDF per floor may be required in larger buildings where cable lengths of 295 ft. per ANSI/TIA Standards would otherwise be exceeded. In remodels of existing buildings of or less than 5000 GSF it is permissible for an IDF to service an adjacent floor. This exemption from the rule of one IDF per floor must be approved by the University Representative on a case by case basis. Access switches and UPSs are equipment commonly used in IDFs.
2. The TRs described above shall be designated for the exclusive use of the following telecommunication systems:
    - a. Voice systems
    - b. Data network systems; including uninterruptible Power Supplies (UPS) both rack-mount and stand-alone supporting these systems
    - c. Wireless network systems
    - d. Cellular telephone and in-building DAS systems
    - e. Video surveillance systems
    - f. Access control systems

## ***TR Use Restrictions***

No TR shall be used as a passageway to other equipment rooms, power transformers, custodial equipment, or any other function that would require access for reasons other than service and maintenance of the communication equipment and cabling they house.

TR's shall be designed and provisioned according to the requirements in ANSI/TIA-569.

## ***Design Requirements***

Telecommunications Spaces shall be:

1. Dedicated to the building's telecommunications function and related support facilities and shall not be shared with electrical, building services or any equipment other than those required in direct support of the telecommunications equipment and services. Nor shall they be located near potential sources of electromagnetic interference (EMI), radio frequency interference (RFI) such as induction devices, transformers, ballasts, power supplies, elevator equipment, generators, motors, X-ray generators, photo copiers, microwave ovens, and similar equipment or sources of mechanical vibration. Take care to design Distributed Antenna System uplink devices so as not to interfere with campus systems.
2. Located above water level and not in a place subject to any corrosive atmospheric or environmental conditions.
3. Located as close as practical to the center of the area served and preferably in the core area. Avoid locations that limit expansion such as structural steel, stairwells and elevator shafts, outside walls or other fixed building walls.
4. The average horizontal cable run is 150 feet or less and no individual cable run shall exceed 295 feet; minimizing the length of the backbone and horizontal distribution cables. Unlisted Building entrance cables shall not be longer than 50-feet once they exit the incoming conduit, as required by the California Electrical Code.
5. Easily accessible and accessed directly from public hallways and not through offices or other utility spaces.
6. Have easy access to distribution cable pathways.
7. Vertically aligned (Stacked) within a multistory building. Horizontal pathways shall terminate in the TR located on the same floor as the area being served.
8. Meet Seismic Design Category D requirements.
9. Equipment and piping not related directly to the support of the telecommunications function shall not be installed in, pass through, pass overhead or enter the telecommunications space. Pipes for sprinkler heads located within the room shall not be located directly above electronic equipment racks and/or cabinets.
10. A TR numbering scheme is to be applied for new and existing facilities. The first number will be the last three digits of the CAAN, all TRs located in the basement are to be labeled "0". The first TR will be 0.1 with each successive TR to be number 0.2, 0.3 and so on. All 1st floor TRs are

1.1, 1.2 etc. “0” is not to be applied to any TR room. The actual room number will be at the end. Example: The first TR on the first floor of the Communications building would appear as “175-1.1-1234”.

11. A TR must be a rectangular room with no obstructions or protrusions (beams, columns, etc.) that decrease the usable square footage available in the room.
12. TRs shall not service WAOs on more than one floor except as previously noted in this document with reference to existing buildings.

### ***TR Room Construction Guidelines***

1. Enclosing Walls
  - a. TR walls shall extend to the structural ceiling above.
  - b. Fire rating of TR walls shall meet all requirements of the A.H.J. that are typically 1 hour, verify with the University Representative.
  - c. Penetration of rated TR walls shall be fire stopped.
2. Ceiling: A suspended, false, lay-in, or hard lid ceiling shall not be installed over any TR floor space. Minimum clear ceiling height shall be 10 feet (10'). In remodels of existing structures where HVAC needs cannot be met without a false ceiling, this rule can be waved with the written approval of the University Representative. This exemption must be approved by the University on a room by room basis.
3. Floor
  - a. Do not design raised floor systems for TRs regardless of the set of functions they perform. TR floors should be floor slab, no raised or false floor.
  - b. Floor finish shall be smooth, dust-free, and not susceptible to static electricity build-up. Acceptable finishes are low static composition tile, static dissipating tile (SDT), or sealed concrete.
4. Door: Provide 3 ft. 0 in. wide X 7 ft. 0 in. high door, opening outward, with a card reader lock that supports brass key access for emergency use. ADFs require double-doors.
5. Windows: TRs shall not have windows.
6. Water Infiltration: Measures must be taken to prevent water intrusion. Water, sewer, chemical, or drain piping of any kind shall not be routed through/within a TR.
7. Sprinkler Systems: If codes require fire protection sprinkler system heads within a TR, the sprinkler heads shall be the high heat type and shall be protected with a wire cage to prevent accidental discharge. Do not install sprinklers directly above the equipment racks.
  - a. Note: For TRs that support the ADF or BDF functions consider installing a standalone dry pipe sprinkler system.

8. Wall Plywood Sheeting: Provide sufficient number of 4 ft. X 8 ft., ¾ in. thick Grade A-C, certified/ stamped as fire retardant and painted with two coats of white fire-retardant paint plywood sheets, to cover all four TR walls. Fire retardant stamps shall be visible after painting. Sheets shall be mounted securely to walls with 8-foot length vertical, 4-foot or less width horizontal. Bottom of sheet shall be at six inches (6") A.F.F.

### ***TR Room Sizing Guidelines and Two (2) Typical TR Room Layouts***

1. The size of the TR is dependent upon the size of the area that the room will serve and the variety of equipment installed within the room. The TR shall provide enough space for all planned termination and electronic equipment and cables that will be installed within the TR; including any environmental control equipment, power distribution/conditioners, door access controllers and other security systems, in-building cellular equipment and uninterruptible power supply systems. Special consideration needs to be given to space requirements for Distributed Antenna Systems and back-up batteries required.
2. TR Sizing
  - a. If the Gross Square Footage (GSF) is between 1,000 and 10,000 sq. ft., the IDF shall be 12 ft. long X 9 ft. wide.
  - b. If the GSF is between 10,000 and 17,000 sq. ft., the IDF shall be 14 ft. long X 9 ft. wide.
  - c. If the GSF exceeds 17,000 sq. ft. the IDF shall be 17 ft. long X 10 ft. wide.
  - d. If a second IDF is required to manage the horizontal cable placement run distance limit of 295 ft. (90 meters), size the second IDF per the GSF guidelines explained above.
  - e. When a TR supports the BDF and ADF functions, dimension that TR at a minimum of 22 ft. long X 10 ft. wide.
  - f. When remodeling existing buildings, it is permissible to use cabinets or smaller TR sizing with written approval of the University Representative on a case by case basis.
3. The TR sizes listed above are minimum requirements, and provide a good starting point for the programming phase of a project. Depending on the services and functions performed by the building's TRs, such as serving as an ADF, or serving a building with high density of WAOs, or installation of DAS equipment additional space and fire ratings may be required. ADFs and BDFs for larger size buildings may require additional rows of equipment racks or cabinets not accounted for in the above sizing guidelines.
4. Typical TR Layouts: It is always preferable to size TRs with enough length so that a single row of racks is sufficient to house all equipment and cabling. The following guidelines reference clearances for equipment and cross-connect fields housed in TRs.
5. Provide the following clearances for equipment and cross-connect fields in TRs.
  - a. Allow a minimum of 36 inches (36") of clear working space in front and 42 inches (42") at rear of equipment racks measured from the front and rear wire managers.

- b. Allow a minimum of 36 inches (36") of clear working space in front and at rear of equipment cabinets.
  - c. Allow for 8-inch depth off wall for wall-mounted equipment.
  - d. If multiple equipment rack rows are required, provide a minimum 36-inch aisle between each row of racks measured from the face of the equipment installed in the racks. In multiple rows, fronts of each rack shall face each other.
  - e. A minimum aisle clearance of 36-inches is required at one end of an equipment rack row. Clearance shall align with TR doorway.
  - f. In many cases, equipment and termination hardware may extend beyond racks and backboard mounting surfaces. Clearance is measured from the outermost surface of these devices, rather than from the mounting surface of the rack or backboard.
6. IDF/ADF Racks, Patch Panels, Fiber Panels, Cable Management design considerations.
- a. 19" 7'-tall (racks are 24.75" wide) seismic category D rated seismic relay racks shall be used.
  - b. A 7' tall, 6.25" wide, double sided vertical cable manager shall be placed between racks and at the ends of each rack row. Wider vertical wire managers can be utilized if required to accommodate more incoming cabling or patch cord containment and management.
  - c. 2RU, 48-port patch panels shall be used for horizontal cabling.
  - d. A 2RU horizontal cable manager shall be placed above and below each copper patch panel.
  - e. Mount 2RU, 48 port voice cross-connect patch panels below WAO station cable patch panels. The number of voice cross-connect jacks shall be equal to the number of pairs in the voice riser cable pair count.
  - f. A 2RU horizontal cable manager shall be placed above and below each voice cross-connect patch panel.
  - g. The fiber connector housings shall be placed in the center rack of the row, in the top-most position of the rack. A fiber connector housing does not require its own horizontal cable managers.
  - h. The rack with the fiber connector housing will be loaded with one less 48-port station cabling patch-panel than other racks.
  - i. 2 RU fiber panels shall be used for IDFs. 4 RU fiber panels shall be used for BDFs and ADFs.
  - j. Fiber terminations shall be fusion spliced LC pigtails.



### **TR Layout (General Notes)**

1. Lighting shall not receive power from the same electrical distribution panel breaker as the telecommunications equipment in the TR.
2. Door shall be fire rated as dictated by local code requirements. Double doors shall be 6-feet wide by 7-feet, 5-inches high without a doorsill and center post. TR doors that open to an outside environment shall be rated for exterior use and shall have a weatherproof gasket to prevent vermin, water, dirt and dust from entering the room. A positive pressure type of HVAC system shall be installed in this type of TR. Coordinate keying and door handle specifications with Division 9, and the University Representative.
3. Coordinate requirements for CCTV and Card Access with Division 28 and the University Representative.
4. Floor loading capacity in the ER (ADF/BDF):
  - a. Minimum distributed load rating of 100 lb/sq. ft. and a minimum concentrated load rating of at least 2000 lb/sq. ft.
  - b. Minimum load rating of 50 lb/sq. ft.
  - c. A raised floor system shall comply with the requirements of Article 645 Information Technology Equipment of the most current California Electrical Code version approved by the authority having jurisdiction and with NFPA 75 Standard.
  - d. In developing Emergency Power Off schemes coordinate with University Representative to assure life safety features such as 911 service, fire alarm and emergency phones (elevators and blue phones), security systems and global lockdown features are not inadvertently shut off in an event, provide signage as required.
5. Ceilings shall be open to the underside of the floor above and have a minimum clearance of 9-feet.
6. A standalone HVAC unit shall be provided for the telecommunications space. The filters in the HVAC system shall have an ASHRAE dust spot rating of 85 percent or better. Initial planning should allow for 6,000 BTU's (1/2 Ton) per equipment rack with the heat rejection. Temperature 68-72 degree Fahrenheit. Humidity between 30-55 percent.
7. The back wall of the Telecom Room, behind the equipment racks, shall be dedicated for low voltage security equipment. Contractor shall provide a submittal of the low voltage equipment conduit route that will be entering the Telecom Room. Conduits shall be installed in a clean, neat and organized fashion. The University Representative shall coordinate CR approvals on submittal, installation and field changes. See Figures 1a.

### **TR Environmental Requirements**

1. HVAC
  - a. Each TR in a building should have its own dedicated HVAC system not served or dependent upon other building HVAC systems. A TR's HVAC must be designed for 24

hours per day, 365 days per year operation. Each TR shall have its own thermostat. This need can typically be fulfilled by a dedicated high efficiency split system air conditioning unit, coordinate with Division 23.

- b. HVAC systems shall not use the same electrical panel that is used to support the outlets servicing the electronics housed within a TR.
- c. The temperature in a TR shall be maintained in the range of 68°F to 78°F.
- d. The humidity shall be non-condensing. HVAC should provide for a minimum of 1 air change per hour.
- e. For HVAC sizing at the programming state of a project assume the following:
  - i. For a TR performing the IDF function only, assume 1.5 tons of HVAC will be required (5,100 watts, 17,000 Btu/hr).
  - ii. For a TR performing the BDF/IDF function, assume 2 tons of HVAC will be required (7033 watts, 24,000 Btu/hr).
  - iii. For a TR performing the ADF function, assume 3.75 tons of HVAC will be required (13,200 watts, 45,040 Btu/hr).
  - iv. As the program evolves coordinate with Division 23, 26 and 28 to refine the HVAC loads. It has been historically found the design too loads identified above result in an oversized system when not evaluated in later stages of design.
- f. The filters in the HVAC system should have an ASHRAE dust spot rating of 85% or better.
- g. The TR HVAC shall be on standby or emergency power when the TR equipment within has been deemed critical enough to require standby or emergency power, coordinate with Division 26.
- h. Condensate from in room evaporators shall be trapped, routed away from electronic equipment and be connected to the Sanitary Sewer via an indirect waste connection. If on the perimeter of the building it may be acceptable to drain to landscape coordinate with Division 26 and 33 and the University Representative as appropriate.

### ***TR Room Electrical***

1. Sub-panels shall be provided for dedicated electrical service for all TRs. The estimated electrical load for the telecommunications space shall not exceed 80% of the panel capacity. No power outlets outside the TR shall be serviced by this panel. For initial planning, provide a 100 amp, 120/208 volt, 3 phase panel.
  - a. Individual branch circuits: All power circuits that supply outlets that support electronics shall be individual branch circuits from their breaker in the TR sub-panel to the outlet receptacle supplying the electronics.

- b. Sub-panels: Ideally sub-panels should be located on the inside of the TR near the room entrance door and should be connected to a standby or emergency power source. Sub-panels shall be lockable.
  - c. Standby or Emergency power: Standby or emergency power connection is critical in the TRs that house campus telephone systems equipment or Core Routers (ADFs) to ensure voice and emergency systems remain operational during power outages that may extend past the systems battery backup capability, coordinate requirements with Division 26.
  - d. Convenience wall outlets
    - i. Convenience wall outlets should be mounted in each room at +18 inches A.F.F. and horizontally spaced not to exceed 6 feet around the perimeter of the room.
    - ii. Convenience outlets shall be non-switched, 120VAC 20 Amp, duplex and divided equally on branch circuits, (i.e., all receptacles in the same room shall not all be on the same circuit). Minimum of two (2) circuits shall be provided per room alternating duplexes around room with no more than four (4) receptacles on the same circuit.
    - iii. Outlet labeling: Label all TR outlets with breaker and panel designation.
2. Estimating Electronics Power Circuit Count for Equipment Racks
- a. Provide One (1) quad device box containing two (2) duplex 20 Amp, 120V AC individual branch circuits terminated on NEMA L5-20R-twist-lock receptacles for each equipment rack.
  - b. Provide One (1) quad device box on standby or emergency power containing two (2) duplex 20 Amp, 120V AC individual branch circuits terminated on NEMA L5-20R-twist lock receptacles for each equipment rack.
  - c. Device boxes should be mounted to the cable tray on the backside of each equipment rack.
  - d. The placement of the device box and its conduit shall not block or interfere with the rack's equipment mounting area (rails) on either side of rack.
  - e. For estimating at the programming stage of a project, see the TR sizing guidelines for number of racks to be installed.
3. Estimating Electronics Power Circuit Count for Enclosed Equipment Cabinets
- a. Provide two (2) quad device boxes with each device box containing two (2) duplex 20 Amp, 120V AC individual branch circuits terminated on NEMA L5-20R-twist lock receptacles for each equipment cabinet.
  - b. Device boxes should be mounted to the cable tray on the backside of each equipment rack.
  - c. The placement of the device boxes and their conduit shall not block or interfere with the cabinet's equipment mounting area (rails) on either side of or front and rear of the cabinet.

4. The TR Performing the ADF Function - Special considerations
  - a. Four (4) 30 Amp, 220V L6-30R outlets for ADFs containing voice equipment. Specific number and location of outlets to be confirmed with the University Representative. Dedicated circuits shall be on standby or emergency power.
5. Lighting
  - a. Lighting in the TR shall provide a minimum light level of 50 fc at desktop level on all sides of the rack equipment.
  - b. If the building is equipped with a standby or emergency power system, TR lighting should be connected to it, or the TR should be provided with its own standby or emergency lighting in case of power failure

### ***The Telecommunications Grounding and Bonding System***

Telecommunications grounding and bonding systems shall be installed to support the telecommunications infrastructure. The requirements for this system are specified in ANSI/TIA-607: The Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

### ***Fire Safety and Protection Requirements***

1. Portable fire extinguishers shall be located within 50 feet of room. The size of the fire extinguisher shall be a minimum 2-A, 10-B, C rating.
2. Generally, TR rooms will be sprinklered with the rest of the building, drainage troughs shall be placed under the sprinkler pipes to limit leakage from joints onto the electronic equipment. Provide a drain to route the water outside of the TR.
3. Verify with the University Representative if Pre-Action or Clean Agent Systems are to be specified, in these systems provide cross-zoned operation. In cases where an under-floor fire suppression system is provided it shall be a cross-zoned. Placement of the detector may affect the way cables are routed under a raised floor. Provisions shall be made in the fire suppression system design to reduce the possibly of false alarms and activation of a fire suppression system when ionization detectors are installed.

### ***Telecommunications OSP Pathway***

The main UCSC Campus is served from offsite Central Office facilities by Sunesys, ATT and Comcast via underground structures that enter the campus. The campus has a “north core” and a “south core” that make up entrance facilities with redundant backbone cables connecting the two facilities and that extend independently up the east, and west sides of campus to provide a High Availability Backbone Infrastructure.

In designing the OSP infrastructure the concept is to provide 48 strands from the west backbone, and 48 strands from the east backbone, these cables would terminate at an Area Distribution Frame (ADF). Single cables serve Telecommunication Rooms (TR) where switches are arranged in a matrix patching to

provide redundancy of equipment locally off the single fiber cable from the ADF to the Building Distribution Frame (BDF).

Given the size and age of the campus not all areas have access to the High Availability Backbone Infrastructure and its necessary to plan major extensions early in the project to capture infrastructure requirements.

Verify points of connection to the existing outside plant cabling system (OSP) with the University Representative.

1. Campus OSP Environments: Construction involving a new or existing building structure shall have an assessment of the OSP pathway connectivity infrastructure. If sufficient duct space is not available additional duct space will need to be made available through cable consolidation, cable-mining, or installation of new ducts. This assessment is of particular importance if demolition of any structure is required as part of the overall project, and/or the new project may impact an existing OSP connectivity infrastructure.
2. ADF Function Connectivity
  - a. All buildings, unless they contain the ADF function, must physically (note: physical includes wireless technology) connect to an ADF designated to service the campus area that a particular building is located in or the building will not be able to function as an integrated component of the UCSC telecommunications infrastructure.
  - b. Define as early as possible in the project planning phases how any given project will achieve its required ADF connectivity.
3. Building OSP EF (Entrance Facility)
  - a. A minimum of four (4) 4" entrance conduits shall be installed into the EF of any building from the nearest existing telecommunications OSP plant point of connection, usually a telecommunications maintenance hole (MH). If the required OSP point of connection is non-existent or the use of the nearest OSP access point is impractical, the required OSP access point must be designed and built.
  - b. Dual OSP entrances from different OSP point of connection are very desirable where possible, and are essential for buildings that house emergency services, data core systems, disaster recovery systems, or those buildings designated as essential services building on campus. These dual duct paths should be on physically separate routes if at all possible.
4. OSP Design Reference Material
5. OSP shall be designed per BICSI, Outside Plant Design Reference Manual (OSPDRM), most recent Edition.
6. Slab on Grade
  1. Shall meet the following minimum requirements:
    - a. Supporting conduits shall run beneath the slab and shall be PVC schedule 40 or better.

- b. At no time shall the conduit run below the membrane barrier or be placed directly in the soil.
- c. Conduits shall not contain more than two 90-degree Sweep bends and exceed more than 100-feet in length between pulling points.

### **Telecommunications ISP Pathway**

1. Pathway design coordination: Clarify as early in the design planning phases as possible what pathway is required and which construction discipline will draw, specify, and construct each portion of the required pathway. Telecommunication pathways detail design and build out requires coordination between the electrical/mechanical and telecommunications drawings and specification documents so that build out supply and construction responsibilities are clearly defined before the start of the Design Development phase of a project.
2. Interior TR Pathway
  - a. Cable run management:
    - i. All cable tray shall be a minimum 12" wide.
    - ii. Cable tray shall meet Zone 4 or higher seismic bracing standards.
    - iii. Cable tray layout design shall be reviewed and approved the University Representative.
3. Riser pathway
  - a. Riser pathway interconnects the TRs in a building.
  - b. When more than one IDF will be needed in a building, four (4), four-inch (4") conduits will be installed from the BDF to the first IDF. Then each IDF will connect to the one above it with three (3), four-inch (4") sleeves. When the TRs are stacked this requirement is easily accomplished using only conduit riser sleeves floor/ceiling penetrations from one IDF to the next. If the IDFs are not in a stacked configuration, then conduits must be installed between the IDFs.
  - c. Two (2), two-inch (2") conduits shall connect the IDF on the top floor of each building to the roof for use by distributed antenna systems. Note these conduits must be installed in a 2 hours rated shaft, and the TR must then be provided with the appropriate fire rating.
4. Primary horizontal cabling pathways
  - a. Primary horizontal cabling pathways are major pathways that transport WAO cables from the TR to secondary horizontal cabling pathway access points (see below). Conduits can be used when it is necessary for the pathway to cross over a hard-lid ceiling.
  - b. At a minimum, primary horizontal pathways will always require pathway fire-wall penetration fire-stop technology ("assemblies") through the TR walls into the occupied space of the floor the TR serves. Other wall penetrations may be required depending on the wall/ceiling layout of the TR's WAO service area.

- c. These primary horizontal cabling pathways should be routed following building lines and major floor access routes such as corridors and hallways. They should never cross over end user work areas such as offices, conference rooms, or work cube areas.
  - d. Access for cabling personnel and technicians that is sufficient for easy cable placement yet causes minimal disruption to floor occupants is an important design consideration when laying out the routing of primary horizontal cabling pathway.
5. Secondary horizontal cabling pathways: to each WAO (conduits to WAO junction boxes)
- a. Conduits will be installed from within 3 feet of a cable tray to each WAO in-wall junction box.
  - b. Junction boxes are mounted in the wall and connect to the conduit. They are used to mount the WAO faceplate that houses the cable termination jacks that are the WAO's network connection points. Generally double-gang boxes with single-gang mud rings are used.
  - c. There are two special cases of secondary pathway that must be accounted for in most projects. These secondary pathways require an understanding of the layouts and use of the areas they serve before they can be sized and specified in any detail.
    - i. Modular furniture raceway access.
    - ii. Wall-mount access - stand alone or raceway
  - d. Conduits to each WAO will be sized depending on the number of cables at the WAO, but unless otherwise noted, most WAO conduits will be 1-1/4" conduits.
  - e. All cable to each WAO will be homerun through the pathway systems described. The WAO cable will travel through the secondary pathway (conduit), then the primary pathway (cable tray and possibly conduits), then to the area-serving TR.
6. Pathway Fill
- a. Conduit: See BICSI Telecommunications Distribution Methods Manual (TDMM), most recent edition, for pathway cable fill recommendations and restrictions.
  - b. Cable tray and J-hooks: See manufacturer's load tables.

### **Structured Cabling System**

1. The Telecommunications/ITS spaces and pathway requirements stated above support what the Telecommunications industry calls a Structured Cabling System which includes OSP backbone, riser cable, and WAO horizontal cabling.
2. The Contractor installing the Structured Cabling System shall be documented by the manufacturer/supplier as a certified and approved installer of the manufacture's Structured Cabling System.
3. Quantity Estimates

- a. Estimate number of required OSP backbone copper pairs based on each buildings utilization and Assignable Square Footage (ASF). This is typically 50 pair to each building.
- b. Estimate number of required OSP backbone fiber strands based on each buildings utilization and ASF. At a minimum, 96 strands should be estimated for both ADF and non-ADF buildings. All OSP fiber shall be OS2 suitable for underground duct installation.
- c. The riser copper and fiber strand count are to be determined on a case by case basis. Confirm sizing with University Representative.
- d. Reference project drawings for specific WAO cable counts.
- e. Minimum cable performance certification shall be UTP Category 6 for remodels and new construction.

### **Network Wireless**

1. Existing network wireless is 802.11n service.
2. Network wireless shall be designed per TIA/TSB 162 and BICSI Wireless Design Reference Manual (WDRM), most recent Edition.
3. Design all wireless coverage to 802.11 ac for the entire building.
4. WAP cabling and jacks are for the exclusive use of network services.
5. WAP
  - a. Each WAP location shall have 1 horizontal cable.
  - b. WAP junction boxes shall be at ceiling level and opening shall face downward. Junction box shall not be higher than 20 ft.
  - c. WAP power is Power Over Ethernet (POE).
  - d. Location of WAPs
    - i. University rep will review heat maps develop by designer
    - ii. Place in hallways on or near cable trays.
    - iii. Place in conference rooms.

### **Horizontal Cabling Density Design Requirements**

The goal of the cabling density standards is to provide guidance to the design teams for the purpose of sizing the ISP structured cabling system and in turn enable the organization of the TR's to provide a level of service that achieves:

- Data service to Work Area Outlets at standard speeds up to and including 1 Gbps.
- Voice over IP (VoIP) service capability.
- Station wiring media types and density to support all communications service for 10+ years



- Closet space to allow simultaneous support to two generations of data service and support parallel voice services from existing and new campus VoIP systems
- Cabling closets to support all communications services for 25 years.

**General Outlet Density Standards**

The schedule below describes the quantity of jacks/cables required at Work Area Outlet (WAO) faceplates for specific applications. Faceplate density for the various room types is addressed herein.

Room types not shown on this list will be on a case by case basis. Size for one WAO per 100 sf unless otherwise noted. For reference, the space type designation in the table below is based on space types as defined in the UC Facilities Data System (FDX) maintained by the Campus Office of Planning and Budget. In the programming phase of the project coordinate space types with the University Representative.

<b>WAO Definition (Cat6 Jacks/Cables per faceplate)</b>	
Standard	Jack/Cable Quantity
General UCSC WAO Standard (u.o.n.)	2
<b>Occupancy Specific WAO (Space types map to FDX standard coding)</b>	
Campus Phone, Wall Mount	1
Computer Teaching Lab	As required per narrative
Campus Phone, Wall Mount	1
Elevator Machine Room	1 per cab
Intrusion Detection/Access Control	1 per panel (Radionics/Bosch/C-Cure iStar)
IP Cameras	1 per camera
Fire alarm panel	2 (where FACP not already connected by fiber)
BMS Devices (Building Controls)	1 (Minimum of 1 per BMS device)
Omnilocks gateway	1
Research Lab Bench	1
Research Lab, Staff Workstation	2
Wireless Access Point (WAP)	2
Wireless Phone Access Point	1

Application Narratives/Tables		
Reference (Space Type)	Definition	Assignment
Classrooms, Lecture Halls (Conference Rooms, Seminar Rooms, Colloquia over 500 SF)		
CL		<p>See classroom design standards, page 30 Section IX B. in May 2012 draft.</p> <p>Lecture Halls standards:</p> <ol style="list-style-type: none"> <li>1) WAO with at least two jacks at each of at least two locations at the front of the classroom.</li> <li>2) WAO with at least two jacks at each video projector.</li> <li>3) WAO's with at least one jack at each wireless network access point. Density: 1 WAO for wireless per every 50 stations (seats).</li> <li>4) WAO with at least four jacks in the projection booth.</li> <li>5) WAO with at least four jacks at the media equipment rack</li> <li>6) WAO with at least four jacks at the lectern.</li> <li>7) WAO with at least two jacks on each wall of the room.</li> <li>8) One WAO per wall and one campus phone WAO at doorway.</li> </ol> <p>Classrooms, Seminar Rooms and Colloquia - as per the above w/o the projection booth.</p>
Circulation Space/Corridors		
		<p>Wireless Systems: 30 foot o.c. Intent is combination with the specific space WAP WAO allocations herein to develop a wired grid infrastructure to support WiFi at 30 foot on center.</p> <p>Alternate placement of WAO's on adjacent floors to limit cross-talk.</p>
Fine Arts (Elena Baskin Area)		
		<p>There are not standards established in this area, consult with the University Representative prior to start of preliminary design for projects in this facility.</p>

Instructional Computing labs larger than 120 SF		
IL	120 asf+	<p>One campus phone at door.</p> <p>1 jack per workstation</p> <p>2 jack WAO per shared printer</p> <p>2 jack WAO for supervisor</p> <p>(E) Omnilocks and IP cameras to be rewired 1:1</p> <p>Media Services std implementation at projection system where they exist.</p>
	120 asf and below	Provide Office/General WAO density with Instructional Computing Lab WAO.
Interior Interactive Spaces		
IA		Minimum of one WAO per interactive space. 1 WAO for wireless
Library/Study		
ST		<p>Basic plan - replace existing 1:1.</p> <p>Science Library is special case with the Active Learning Classroom, consult with the University Representative for this space.</p> <p>Most non-stack areas are covered in other categories herein.</p> <p>At stacks: Wiring to OPAC's, wireless per campus std for student access, 1 WAO per group study room.</p>
Lobbies and Entries		
EN		Two WAO locations, with 2 jacks each. 1 WAO for wireless in large lobbies with seating areas.
		One exterior WAP associated with each entry/ exterior gathering areas, coordinate with the University Representative to confirm current requirements as designated by ITS.
Mechanical, Electrical and Plumbing Rooms		
MEP		Replace (e), on a 1:1, + 1 jack basis. Typically, only one such room per building needs to be provisioned with a campus IP interface. The remaining MEP spaces will tie to one another using the building controls network, refer to Division 23 and 27. In renovations of existing buildings coordinate with the University Representative

		to facilitate Physical Plant point of interface to existing systems. WAO is surface mounted to wall adjacent to JACE enclosure.
Office, Research Office, Open Office, and General space (Incl Conference Rooms < 500 SF):		
OG	40 to 80 asf	1 WAO
OG	Open Plan/Cubicle	1 WAO
OG0	80 to 135 asf	2 WAO on opposite walls.
OG1	136 to 200 asf	3 WAO.
OG2	201 to 300 asf	4 WAO.
OG3	Larger than 301 asf	4+ WAO - One plate per 100 sf, with a minimum of 4 plates. The sf will include aisles and common space. For conference rooms (CF) add 1 WAO for wireless.
OS	Office Service	Kitchen or Break Rooms: Minimum 1 WAO. Rooms currently used for Storage to be fit out as if an office based on size. Copier/Print rooms= special case as needed. Fit up as Office UON.
Research Labs		
General Narrative	Consult with the University Representative on WAO density in dry labs, in the absence of information follow Office standards.  At permanently installed lab benches, place one WAO at each side of each bench. Locate at center. Maintain 3' min separation from sinks and permanently installed lab equipment.  Lab Phones. Where labs have existing wall phones, project installs new station cabling to existing locations. Otherwise, no new wall phone cabling is installed in lab spaces. Place cabling and WAO (630A mount style) for courtesy phones in lab corridors at regular intervals. Select locations for line of sight while complying with path-of-travel requirements of CBC.	
RL0	40 to 64 asf	1 WAO
RL1	Small, 65 to 120 asf	2 WAO's
RL2	Medium, 121 to 300 asf	3 WAO's and 1 WAO for wireless
RL3	301 asf and greater	1 WAO per 100 ASF rounded up to nearest whole unit + 1 WAO for wireless (assumes less than 900 SF).
RLS	minimum 2 WAO	If room is large, set up for flexibility to become research lab.
Scholarly Activity/Tutorial/College Study		

SR/CF		Basic plan for renovations is replace existing 1:1 For flexibility of changes in room use, use Office standards. Provide 1 WAO for wireless per room.
Small Server Room/ Departmental Computer Room		
DC	< 300SF	For remodel: Use office WAO std, confirm with the University Representative to anticipate if it is intended for service to feed a Firewall or datacenter/server cabinet core switch).
Teaching Labs (Class Labs, Special Class Labs):		
TL	Teaching Labs	Minimum one WAO per wall on four walls (three walls if window wall can't readily be wired) and one campus phone WAO at doorway. For wet teaching labs, provide one WAO for every four stations. For most dry teaching labs and all teaching labs with computer stations (TLC), provide one WAO to match station count in room.
TLS	Teaching Labs Service (Class Lab Service, etc.)	One WAO per wall on three walls (assumes window wall can't readily be wired) with minimum 2 WAO for lab prep.
Trailers/Relocatable Buildings		
RE		1 WAO per 60 sf density.
Housing		
	<p><b>[Specifiers note: coordinate requirements with other disciplines as appropriate]</b></p> <p>Provide a minimum of one electrical outlet at each bedroom wall. Provide a double duplex electrical outlet adjacent to the data/cable TV outlet. For single bedrooms provide one TV, one data and one telephone outlet. For double bedrooms and lounges provide one TV, one dual data and one</p>	This is applicable to dorm style rooms, consult with the University Representative for apartment and suite style rooms.

	telephone outlet (note that standard telephone wire can accommodate additional outlets).	
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**Work Area Outlets (WAO)**

1. Power receptacles shall be installed near each WAO location (i.e. within 3-feet). Install WAO at the same height as the power receptacles.
2. For office areas, provide maximum flexibility for change within the work area (i.e. on opposing walls).
3. Open office area interior design, telecommunications distribution planning and power system distribution planning shall be coordinated to eliminate placement discrepancies.
4. Building Systems WAO's, coordinate requirements with Division 23, 26, 28 and 33
  - a. A minimum of one WAO shall be installed for each elevator bay (incl. wheelchair elevator) in an accessible area outside and near the Elevator Control Room. The WAO is to be placed within an indoor rated box with a hinged cover. A conduit will need to be provided from the box to the elevator room control panel.
  - b. For the minimum number of jacks per WAO, reference the general outlet density standards. The WAO shall be installed outside within 3ft of the BMS device.
  - c. For the minimum number of jacks per WAO, reference general the outlet density standards table. The WAO shall be planned for any Building Access Systems (card readers, cameras...) within 3ft of the Security Control Panel (SCP).
5. Note to Design Professional: Provide note on the drawings that the Contractor shall coordinate Building Management WAO final locations with building systems and with the University Representative.

**Courtesy, Pay, Text, Emergency and Wheelchair Elevator Telephones**

1. Comply with the most current American Disabilities Act (ADA) Accessibility Guidelines.
  - a. Wall-mounted telephones shall not be installed above a counter top.
  - b. If a Text Telephone is required, provide a shelf, a power receptacle at 18-inches AFF under the Text Telephone and a handset cord long enough to allow an acoustic coupler connection.

**Tenant Improvement Project**

1. Abandoned cables, not identified or labeled for future use, increase the fire fuel load and shall be removed in accordance with the current approved National Electrical Code.

2. Contact the University Representative to survey the existing cable plant. There is a possibility that all or a portion of the existing installed cable may be reused.

**End Section 27 00 00**

## 27 05 00 - Common Work Results for Communications

1. Work shall be designed and installed per the following:
  - a. California Electrical Code (CEC)
  - b. National Electrical Safety Code (NEESC)
  - c. California PUC General Orders 95 and 128
  - d. ANSI/TIA-758 Customer-Owned Outside Plant Telecommunications Infrastructure Standard.
2. Consult with University Representative to coordinate with the campus ITS department to determine the best cable distribution method along a proposed cable route.

**End Section 27 05 00**

## 27 05 26 - Grounding and Bonding for Communications Systems

The following standards shall apply:

1. ANSI/TIA-607, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications,
2. ANSI/TIA-606 Administration Standards for the Telecommunications Infrastructure of Commercial Buildings.
3. BICSI guidelines
4. National Electrical Code (NEC)
5. California Electrical Code Article 250 and references therein.
6. California Electrical Code Article 800.

In the event of conflicting requirements, the most restrictive requirement shall prevail.

If the designer finds a conflict between a local safety code, BICSI guidelines and the manufacturer's requirements, the conflict shall be resolved with the University Representative before proceeding.

### ***Telecommunications Bonding Infrastructure***

In addition to the normal electrical ground system, a Telecommunications Main Ground Busbar (TMGB) and a Telecommunications Ground Busbar (TGB) system are required per ANSI/TIA-607. Refer to Section 26 06 00 – Schedules for Communications. Product/Material Category, "Bonding".



### ***Telecommunications Main Grounding Busbar (TMGB) & Telecommunications Grounding Busbar (TGB)***

1. IG systems are not recommended for voice and data equipment, regardless of intent. It defeats the purpose of an equipotential plane, verify requirements with University Representative.
2. The TMGB & TGB must be a pre-drilled copper busbar with holes for use with standard- 2-hole sized lugs, have minimum dimensions of 6.3 mm (0.25 in) thick by 101 mm (4 in) wide and be minimum 20" of an equipotential plane, verify requirements with University Representative.
3. TMGB to be located in a building's ADF.
4. The TMGB needs to be connected directly to the building's main electrical entrance facility Primary Bonding Busbar (PBB).
5. The TGBs are to be located in the buildings IDFs and sourced from the TMGB.
6. The Telecommunications Bonding Backbone (TBB) must be a continuous conductor, not daisy chained or segmented in any way.

#### **Labeling**

All ground attachments shall be properly tagged and labeled in accordance with ANSI/TIA-606.

#### **Testing**

1. Test per ANSI/TIA-607 with an Earth Ground Resistance Tester used in the Two Point Test Method.
2. The installer / technician conducting these tests must be certified level VI by UIC ACCC TED.
3. These tests shall be recorded on documents provided by the University Representative.

**End Section 27 05 26**

## **27 05 29 - Hangers and Supports for Communications Systems**

### ***Communications J-hooks***

1. J-hooks shall be spaced at a maximum of 48-inches in the main bundle, 48 to 60-inches apart in the secondary bundles and within 6-inches of an EMT conduit stub-up.
2. Main cable bundle shall be made up of 4-inch saddle bags and supported on a minimum of 3/8-inch rod.

3. Secondary cable bundles shall be made of minimum 2-inch j-hooks with a closer. Support secondary cable bundles with pencil rod. Cable supports shall not exceed 30-percent fill ratio. Refer to manufacturer's recommendations. Secondary pathway to 90 degrees off cable tray and contain no more than 25 cables. Location of J-hooks shall be indicated on the Electrical Design and/or Telecommunications drawings.
4. Cables shall not be secured to the J-hook with cable ties or vinyl tape.
5. Contractor to provide drawings indicating Primary and Secondary pathways to University Representative for approval before installing cable.

**End Section 27 05 29**

## **27 05 33 - Conduits and Backboxes for Communications Systems**

### ***Interior Conduits***

1. Be installed in the most direct and accessible route possible (parallel to building lines and located in and above accessible hallways).
2. Contain no more than two 90-degree sweep in any dimensional plane or exceed 100-feet in length between pulling points or interior pull boxes.
3. A pull box is not to be used in place of a conduit sweep.
4. Stub up to an accessible ceiling area within 6-inches of a J-hook or cable tray from a device box.
5. Be reamed at both ends and have a plastic bushing installed on each end to prevent damage during cable installation.
6. Have a pull string installed in all conduits with a minimum test rating of 200 lb.
7. Not be installed through areas in which flammable materials may be stored or over and adjacent to boilers, incinerators hot water lines or steam lines.
8. All conduits shall be bonded and grounded in accordance with the CEC (California Electrical Code) and ANSI/TIA-607, where applicable.
9. Interior conduits and/or sleeves shall be properly sized in accordance with ANSI/TIA-569.
10. Wall-mounted riser conduits and/or sleeves entering a Telecommunications Space (ER/TR) shall have a plastic spillway installed onto the end of the conduit to prevent kinking of the installed cable bundle.

### ***Structures to Support Vertically Aligned Telecommunications Spaces (TS)***

1. Vertically aligned TS's shall utilize sleeves and slots.

2. TS's that are not vertically aligned shall be connected with conduits.
3. In a multistory building, grip brackets shall be specified to support the riser cable's weight as it passes through the ER/TR.
4. Vertical cable runway shall be installed behind the sleeves and slots to allow for proper cable management.
5. Conduit shall be used to route the riser cables between the BDF/IDF located in the same ER/TR, if cable trays are not used to support the horizontal cabling. Conduit paths shall be coordinated with other work during construction or remodeling.
  - a. Each 4-inch metallic conduit shall be installed with a mule tape and contain a ground bushing on each end grounded to the TGB.
  - b. Conduits that enter the ER/TR shall be placed near the corner and as close as possible to the wall where the backboard is mounted to allow for proper cable racking and to minimize the cable route inside the ER/TR.
  - c. Conduits located in the ceiling or wall shall protrude into the ER/TR 1 to 2 inches and a minimum 8 feet above the finished floor. Conduit shall not turn down.
  - d. Provide a conduit riser diagram in the Drawings.
  - e. Note: A 2-inch conduit shall be dedicated from the ER/TR to a sealed junction box or weather head on the roof of the building for the installation of an 800 MHz antenna cable. This conduit shall be grounded using a path other than the telecommunications ground provided in the ER/TR. Coordinate in-building Distributed Antenna System (i-DAS) cabling requirements with the University Representatives.

### ***Work Area Outlet (WAO) Conduit and Backbox Size Requirements***

1. All WAO's shall have a minimum of one (1) 1-1/4 inch trade size Electrical Metallic Tubing (EMT) conduit installed from the device box to readily accessible ceiling space within 6-inches of an installed J-hook or cable tray. WAO's shall have a standard 4-inch square by 2-7/8-inch deep device box with a single gang mud ring installed flush mounted within the wall.
2. Wall-mounted courtesy telephone device boxes shall be mounted per ADA requirements.
3. Floor-mounted WAO's shall have a minimum of one (1) 1-1/4 inch trade size Electrical Metallic Tubing (EMT) conduit installed from the device box to readily accessible ceiling space of the same floor within 6-inches of an installed J-hook or cable tray. Floor boxes shall not be looped or daisy-chained together with one single conduit, regardless of the size of conduit.
4. The maximum allowable conduit fill requirements shall be adhered to when designing conduit installations for WAO device box and Wiremold®, locations.
5. Typical mounting height shall be +18-inches AFF or match the height of new and existing power receptacles, where appropriate.

6. WAO's located in hose or wash-down areas shall be installed at a height above the anticipated damp area and shall include a UL Listed NEMA rated water resistant faceplate, outlet covers and patch cords.

### ***Communication Floor Poke-through Devices***

1. All floor poke-through devices shall be
  - a. Indicated on the electrical and/or telecommunications drawings with the size of conduit to be installed. Cables shall terminate on the same floor they are installed on.
  - b. Suitable for use in air handling spaces in accordance with Sec 300-22(C) of the National Electrical Code.
2. For the purpose of estimating provide Wiremold Legrand® Evolution Series Poke-Thru Devices, confirm product features with the University Representative starting at the DD phase of the project. Unit shall be fully recessed with die-cast aluminum spring-loaded slide doors; meet or exceed UL scrub water exclusion requirements; and meet ADA Standard 4.5 for floor surface level changes.

### ***Pull Box Installation Requirements***

1. Pull boxes shall be installed in easily accessible locations.
2. Pull boxes shall be placed in an interstitial ceiling space only if it is listed for that purpose and it is placed above a suitably marked removable ceiling panel.
3. Pull boxes shall not be located in restricted and/or highly secured areas, such as X-Ray rooms, Clean rooms, etc.
4. Pull boxes are not to be used in place of sweeps and 90's to round corners.
5. Pull boxes are to be sized per the CEC (California Electrical Code).

**End Section 27 05 33**

## **27 05 36 - Cable Trays for Communications Systems**

### ***Communications Cable Runway and Trays***

Cable Runway shall be:

1. Used only in Telecommunications Rooms (TR).

2. Secured on 5-foot centers overhead using a standard trapeze type support system with 1/2-inch threaded rod in accordance with manufacturer specifications and applicable California Building and Electrical (CBC, CEC) Codes.
3. Cable tray not to be attached to the walls, secure overhead to a single plane.
4. UL Classified, gold zinc plated and minimum 12-inches wide with 9-inch rung spacing.
5. Installed with a minimum clearance of 12-inches above the cable ladder.
6. Meet the current requirements in ANSI/TIA-569 and applicable addendums
7. Grounded and bonded in accordance with ANSI/TIA-607. All splices, T-Sections and bends shall be bonded together. Cable runway and trays shall not be used as an equipment ground nor seismic support or bracing.
8. Meet Seismic Category D seismic bracing standards.

### **Cable Trays**

1. Shall be steel wire basket or mesh suitable for hallways and false ceiling areas.
2. That are used to support horizontal cabling may be used to support riser cables provided the cable tray's carrying capacity can accommodate the riser cables.
3. Shall be a minimum of 12-inches wide and 2-inches deep and contain a metal divider with 4-inches sectioned off for security low voltage. The use of carbon steel, electro zinc plated wire basket tray system is the preferred cable tray system within the corridors. Refer to manufacture fill charts for correct sizing.
4. Shall be secured on 10-foot centers and within 18-inches of a splice using a wall support or a standard trapeze support system with 1/2-inch threaded rod in accordance with manufacturer specifications and applicable California Building and Electrical codes. Single center-mounted steel supporting rod and bottom "T" connector style of support shall not be used.
5. Provide swing bracing every 30 feet --per manufacturer requirements-- on continuous lengths over 39 feet. Cable trays shall meet seismic design category D seismic bracing standards.
6. Shall be sized to accommodate future installations and building growth. Initial cable fill not to exceed 25% of tray capacity.
7. Shall be installed in accessible ceiling areas only and shall transition to a minimum of four 4-inch EMT conduits (one for security low voltage) when routed over fixed, hard and inaccessible ceiling spaces.
8. Cable tray shall transition to a fire rated assembly to penetrate walls. Where conduits drop down onto cable tray provide plastic spillways installed onto the end of the conduit to prevent kinking of the installed cable bundle.
9. Shall be grounded and bonded in accordance with ANSI/TIA-607 and manufacturers requirements (bonded to building steel approx. every 60 feet). All splices, T-Sections and bends

shall be bonded together. Cable trays shall not be used as an equipment ground nor seismic support or bracing.

10. Penetrations through firewalls shall allow cable installers to firestop around the cables after they are installed. Tray-based mechanical firestop systems shall be used when a cable tray penetrates a fire barrier. All firestopping installations shall be labeled in accordance with ANSI/TIA-606.
11. Cables installed in cable trays shall not contain, nor be fastened with Velcro, tape or plastic type cable ties (tie-wraps).
12. Shall meet the requirements in ANSI/TIA-569 and applicable addendums.

### ***Cable Tray and Runway Clearances***

1. Cable trays shall not be placed within 5-inches of any overhead light fixture nor within 12-inches of any electrical ballast.
2. A minimum clearance of 12-inches above and 12 to 18-inches to one side of the cable tray shall be maintained at all times. All bends and T-joints in the cable trays shall be fully accessible from above (within one foot).
3. Cable trays shall be mounted no higher than 12-feet above the finished floor and shall not extend more than 4-feet over a fixed ceiling area.

Note: All cable trays and ladder racking, equipment racks and cabinets shall have seismic bracing as designed by a California Licensed Structural Engineer.

**End Section 27 05 36**

## **27 05 39 - Surface Raceways for Communications System**

Raceway shall be:

1. Used only in areas where cabling cannot be placed within walls, ceilings or cable trays.
2. Secured using mechanical fasteners, double sided sticky tape is not acceptable.
3. Comply with the most restrictive requirements of Division 27 for wiring of the applicable class in the applicable location.
4. At a minimum, provide raceway with cross-sectional area equivalent to 1 inch diameter trade size for communication station cabling.

5. Install complete raceway system including track, cover plate, device boxes, radiused inside and outside elbows and manufacturer's category and fiber cabling guideway fittings, splice plates, T's, transitions and extension rings and end caps as required.

**End Section 27 05 39**

## **27 05 41 – Fire-Stopping Systems**

Fire stopping is intended to prohibit the spread of a fire and smoke from one location within a building to another. This means restoring the integrity of rated walls, floors, and ceilings when these barriers are penetrated. Penetrations include cable tray, ladder racking, cables, sleeves, and conduits. A fire resistance rating uses the time (in hours) that a firestop "Assembly" or an architectural feature show an acceptable resistance to fire. The rating of the firestop Assembly must meet (or be better than) the rating of the architectural feature that is penetrated. It is difficult to standardize on an overall firestop system because of the complex interactions of the materials, penetrating items, and construction assemblies. Since many proprietary solutions are available, only the engineering considerations are referenced. All system **MUST** be a UL listed system/assembly.

**End Section 27 05 41**

## **27 05 43 - Underground Ducts and Raceways for Communications Systems**

Coordinate with Division 26 and 33 for conduit routing.

### ***Underground Conduit Construction***

#### **General**

1. All designs must be coordinated with and approved by the University Representative.
2. Conduit shall be Polyvinyl-Chloride (PVC) Schedule 40 or 80 (dependent upon concrete encasement requirements), corrosion-resistant plastic with a 4-inch inside diameter for underground installations and Galvanized Rigid Steel (GRS) or PVC Externally Coated GRS for riser applications.
3. Spacers shall be used in the trench to support the conduits.
4. A solid core #10 AWG copper wire shall be installed externally along any conduit run for the purpose of locating and tracing the conduit route.

5. Fabric multi-cell type of inner duct shall be considered for conduits planned.
6. All installed conduits shall be cleaned and verified with a flexible mandrel and a stiff brush. Mandrels shall be 12-inches in length and sized to within 1/4-inch of the inside diameter of the conduit.
7. All conduits shall be provided with mule tape with a minimum of 200 pound pulling tension.
8. All unused entrance conduits shall be capped/plugged with expandable type duct plugs, Jackmoon or equal, inside the building to prevent rodents, water or gases from entering the building.
9. Conduit stubs entering the building shall extend beyond the foundation and landscaping to prevent shearing of the conduit and allow for access. Conduit entering from a below grade point shall extend 4-inches above the finished floor in the ER/TR. Conduit entering from ceiling height shall terminate 4 inches below the finished ceiling.
10. All future conduit stubs shall be flagged for easy identification and an electronic ball marker shall be placed.
11. All metallic conduit and sleeves shall be reamed, bushed and capped when placed.
12. The minimum depth of a trench shall allow for 24-inches of cover from the top of the conduit/cable to final grade. Warning tape containing metallic tracings shall be placed a minimum of 18-inches above the underground conduit/duct structure and direct-buried cable to minimize any chance of an accidental dig-up. Both ends of the metallic warning tape shall be accessible after installation.
13. There shall not be more than the equivalent of two (2) 90-degree bends (180-degrees total) between pull points, including offsets and kicks. Back-to-back 90-degree bends shall be avoided. All bends shall be manufactured long sweeping bends with a radius not less than 6 times the internal diameter of conduits 2-inches or smaller or 10 times the internal diameter of conduits larger than 2-inches. Bends made manually shall not reduce the internal diameter of the conduit. All branch conduits exiting a MH/PB shall be designed as Subsidiary conduits only (exit from the end wall of the MH/PB, not from the side wall). Lateral conduits entering/exiting MH/PB's are not allowed. The lowest conduit knock-outs shall be used first when adding new conduit to a MH/PB.
14. The University Representative shall observe and inspect utilities trenching, excavation, backfilling and compaction as appropriate. Design shall include Contractor instructions to schedule all inspections prior to commencing trenching and backfilling operations. All installations are subject to satisfactory inspection by the University Representative.
15. Conduits shall be secured with rebar when covering conduits with concrete.
16. All conduit bends and sweeps shall be concrete encased to prevent movement and "burn-through" by the pull rope during cable installations.
17. Concrete encasement shall comply with State of California, Department of Transportation standard specifications.



18. An orange colored additive shall be raked or trowel-worked into the wet concrete or cement slurry to identify the duct structure as communications.
19. Reinforcing bars, if used within the concrete shall be sized accordingly for the load and stress at each location.
20. Contact the University Representative to inspect and approve all conduits prior to encasement.
21. Conduit shall be encased in concrete or cement slurry when the following conditions exist:
  - a. Minimum conduit depth cannot be attained.
  - b. Conduits pass under sidewalks, roadways, driveways, railroad tracks and at bend points.

Note: The American Public Works Association has adopted the color orange for the telecommunications cables.

### **Directional Boring**

1. High-density polyethylene (HDPE) conduit to be used for directional boring.
2. A swivel shall be used at all times to prevent rotation of the product pipe.

### **Sizing Underground Conduit**

The quantity and size of underground entrance conduits are based on the Size of the building: (3) 4-inch conduits are standard. (4 or more) 4-inch conduits shall be used down main pathways.

### **Conduit Separation Requirements**

The minimum recommended separation between telecommunications conduit systems and outside surfaces of foreign structures as required by the National Electrical Safety Code (NESC) for personnel safety and the protection of telecommunications equipment shall be maintained at all times.

All plastic underground piping shall be kept at a 10-foot distance from steam/condensate lines unless approved by the University Representative. When crossing is necessary within the 10-foot distance limitation, transition to galvanized rigid pipe for at least 10 feet on either side of the intersection.

Communications conduits may also require a pipe insulation treatment be installed.

If required separation cannot be obtained, an engineered solution shall be submitted to the University Representative for review and approval prior to the beginning of any installation work.

### ***Maintenance Holes (MH) and Pull Boxes (PB)***

#### **General Requirements**

1. MH/PB's are required where maximum cable reel lengths are exceeded, at the intersection of main and branch conduit runs and at other locations where access to the cable in a conduit system is required.

2. The maximum distance allowed between buildings and MH/PB's or between two MH/PBs' is 600 feet.
3. No more than (2) 90 degree bends in conduit between MH/PBs'.
4. MH's and PB's shall be constructed to withstand a minimum of ASSHTO-H20-44 full traffic loading.
5. All MH/PB covers shall be rated for heavy and constant vehicular traffic, regardless of placement location.
6. All hardware in MH/PB's shall be galvanized.
7. Pulling eyes shall be a minimum of 7/8-inches in diameter and located at opposite ends of each conduit entrance point.
8. All MH/PB covers shall be marked for easy identification (Communications) and have a permanently attached label indicating the assigned MH/PB number. (Contact the University Representative for MH/PB number).
9. MH locations where the distance between the ceiling of the manhole and the street level exceeds 24-inches shall require the installation of permanent steps in the neck of the MH. These steps shall be installed in the neck rings at the same time as the MH is being installed, per manufacturer instructions. Steps shall not be cut and cemented in place after the installation of the neck ring.
10. Provide (4) L-Cable Racks PB and (8) L-Cable Racks per MH.
11. Where placement location is a roadway, driveway, bike path, fire line, loading dock or trash pickup area, provide only a MH.

### **Additional PB Requirements**

1. All Pull Boxes (PB) shall be equipped with slip resistant covers with height adjustment brackets, torsion assist openings, guard bars and hex head type bolts.
2. PB's shall not be placed in a main conduit route between two MH's. MH/PB's shall be placed at strategic locations in a conduit system to allow installers to pull cable through the conduit with minimum difficulty and to protect the cable from excessive tension.
3. Step rungs are to be installed within a pull box installed deeper than the standard 3-feet and extension rings are required to match grade. A minimum of a 4-feet by 6-feet by 3-feet box shall be installed. Coordinate the installation with the University Representative.

### **MH/PB Conduit Entry Requirements:**

1. If the total number of conduits being placed is significantly less than the capacity of the termination MH or cable entrance, conduit shall enter at the lower level. The upper space shall be reserved for future additions.
2. Conduit servicing buildings or other MH/PB's shall be installed using the subsidiary conduit method. Lateral conduits entering/exiting MH/PB's are not allowed.

3. 22-degree and 45-degree conduit angles are preferred. Regardless of depth, all bends and sweeps shall be concrete encased to prevent movement and “burning through” by the pull rope during cable installations.
4. Conduits installed between MH/PB’s and buildings and between other MH/PB’s shall be sloped per ANSI/TIA-758 to ensure proper drainage of water.
5. All conduits entering buildings shall be plugged with expandable type duct plugs, Jackmoon or equal, inside the building to prevent rodents, water or gases from entering the building. MH/PB conduits shall be plugged with duct seal material to prevent the entrance of water and gases.

**End Section 27 05 43**

## **27 05 53 - Identification and Labeling for Communications Systems**

Identification and labeling shall meet the requirements in this document and the current ANSI/ TIA-606, “Administration Standard for the Telecommunications Infrastructure of Commercial Buildings”, where applicable.

### ***Permanent Links Terminated on a WAO***

1. Each Permanent Link consists of 1 Horizontal Cable, 1 WAO jack and 1 Patch Panel port. Each Permanent Link is assigned a unique identification number and every part of the Permanent Link must be labelled with that number.
2. Permanent Link Identification Number and WAO Jack Label Placements: Each WAO jack position shall be labeled with the corresponding Permanent Link identification number. Place label directly above or below jack. The Permanent Link Identification number shall be YZZZ where:
  - a. Y = the floor number - use zero (0) for basement.
  - b. ZZZ = the WAO jack number the cable is terminated on - 001 through 999.
3. An alternate labeling method to increase label readability would be to label the jacks with the 4-digit jack number and have a header label on the faceplate in the following format: “Building XXX.” This alternate must be approved by the project manager.
4. All labels shall be machine created labels, clearly legible, black letters on white background.

### ***Outside Plant and Riser Cable Labeling Requirements***

#### **Fiber Optic Cable Termination Cabinet/Housing Labeling**

1. Fiber optic termination housings shall be labeled using the manufacturer’s provided termination-housing labeling system. The panel shall be overlaid with one-piece, self-adhesive, full-size,

laser printer generated label sheet adhered to the slide out metal panel or inside door of the enclosure, where applicable using an 8.5-inch by 11-inch laser printable adhesive backed sheet.

2. Fiber strand numbering shall be consistent with the Consecutive Fiber Numbering (CFN) sequence as identified in ANSI/TIA-568. This fiber stand numbering sequence shall be accomplished at each terminated end of the fiber optic cable. The rolling of fiber optic strands, as identified in ANSI/TIA-568 as Reverse Pair Positioning (RPP) shall not be used on the Campus.

### **Fiber Optic Housings Connector Panels Labeling**

1. Fiber strand number 1 (Blue) shall occupy fiber port number 1 in the upper most left position of the first duplex bulkhead connector installed in the connector panel placed in the first slot on the left side as seen when facing the front of the housing.
2. Fiber strand number 2 (Orange) shall occupy fiber port number 2, immediate right of fiber port number 1, of the same duplex bulkhead connector.
3. All remaining fiber optic strands shall be number consecutively left to right, top to bottom.

### **Fiber Optic Splice Shelf Labeling**

1. Fiber optic splice shelves and drawers shall be labeled sequentially from top to bottom using an adhesive backed, self-laminated labeling machine and vinyl glossy label stock affixed to the inside door of the splice housing or shelf.
2. Identify in tabular form the splice tray, position number and the fiber strand spliced at that location. Labeling shall consist of the cable number, the fiber optic strand number and the strand type.

### **Fiber Optic Cable Sheath Labeling**

1. Label Fiber optic cable sheaths located inside buildings within 12 inches of the fiber housing, the point at which the cable enters and/or exits the room and at one mid-point location when the cable is installed in a cable tray or ladder rack, as a minimum.
2. Fiber optic cables located in maintenance holes (MH) shall have their sheaths labeled in at least one location that is visible from grade level. MH's and PBs containing splice closures shall be labeled on each side of the splice closure. Outside Plant (OSP) fiber optic cables shall contain an orange fiber optic warning tag with large black letters.
3. The fiber optic cable label shall consist of a plastic yellow and black type tag with a self-laminating cover for use with pre-printed labels and attaches with a plastic tie wrap.

### **Copper Cable Termination Housing Labeling**

1. Building entrance terminals shall be labeled with the name of the building, the building zone number, the building CAAN number, the cable pair numbers entering the terminal and the cable pair numbers exiting the terminal (if applicable).

2. Labels shall be pre-printed using an electronic label maker such as the Brother P-Touch®, or a laser printer. Electronic label maker labels shall be 18 point, “font 1” black block letters on a white background. Desktop printed labels shall be black, Helvetica, 10 Font, block letters on a white background.

### **Copper Cable Sheath Labeling**

1. Copper cables located inside buildings shall have their sheaths labeled within 12 inches of the termination housing, the point at which the cable enters and/or exits the room and at one mid-point location when the cable is installed in cable tray or ladder rack, as a minimum.
2. Wiring jacks shall be left protruding from the faceplate for inspection by the University Representative of the jacks and labels prior to the installation into the faceplate.
3. Copper cables located in maintenance holes (MH) and pull boxes (PB) shall have their sheaths labeled in at least one location that is visible from grade level. Existing MH's and PB's containing splice closures shall be labeled on each side of the splice closure and shall be visible from grade level.
4. The copper cable label shall consist of a gray plastic type tag with a write-on surface attached with a plastic tie wrap.

**End Section 27 05 53**

## **27 10 00 - Structured Cabling, Basic Materials and Methods**

The University Representative shall coordinate with ITS early during the utilities planning phase of the project since each site may have technical requirements requiring a modification of these specifications.

**End Section 27 10 00**

## **27 11 13 - Communications Entrance Protection**

### ***Building Entrance Terminals***

1. Outside Plant copper cables entering the ADF/BDF/IDF shall be terminated on wall-mounted building entrance protector terminal(s) equipped with digital solid-state protector modules, which include heat coils for sneak current protection.

2. Building entrance terminals shall not be located directly above the room entrance conduits, slots or sleeves. Terminals shall be mounted in a location on the backboard that shall allow sufficient space for future cable and cross-connect installations.
3. Copper entrance cables up to and including 300 pairs shall be terminated on protected building entrance terminals equipped with a splice chamber and factory installed large 710-type splice modules in the splice chamber (field side) and 110 type terminations on the output (equipment side) and lockable cover. Cable shall be blocked with an approved manufactured seal to prevent the gel filled compound from escaping.
4. Copper entrance cables 301 pairs and larger shall be terminated on individual 100 pair protected terminals equipped with a factory installed, 26AWG swivel cable stub in the splice chamber (field side) and on the output (equipment side): stub-in, stub-out configuration. Cable stubs shall be no shorter than 2 feet in length after installation.
5. Factory cable stubs shall be spliced with 25-pair 710-type splice modules to the outside plant copper. An indoor rated splice closure shall be securely mounted to the plywood backboard. Indoor closures shall not be encapsulated.
6. Contractor shall extend the copper backbone cable from the building entrance terminal to a separate 110-type termination block field.
7. All terminals shall be labeled in accordance with Section 27 05 53 Identification for Communications Systems and properly grounded to the Telecommunications Grounding Busbar (TGB) in accordance with ANSI/TIA-607.

**End Section 27 11 13**

## **27 11 16 - Communications Cabinets, Racks, Frames and Enclosures**

### ***Equipment Racks and Distribution Cabinets***

1. Free standing equipment racks shall be used in all ADF/BDF/IDF locations that are secured by a lockable door. CH751 cabinet key core preferred.
2. Equipment racks shall meet the following requirements:
  - a. One piece 10 gauge welded steel. Nominal height is 7 feet (45U). Fits 19 in. rack mount equipment. Rails shall be double sided and tapped on both sides with 12-24 UNC threads in EIA Universal 5/8 – 5/8 – 1/2 inch vertical mounting hole pattern that matches industry standards.
  - b. UL 1863 Tested / Listed to 2,500 lbs. static load – max safety factor of 4 – tested to 10,000 lbs. Proof of conformance shall be supplied with submittal prior to work.

- c. NEBS-Telecordia GR-63-CORE Zone 4: Tested with 500 lb of equipment installed. Dynamic shaker table tested and passed. Proof of conformance shall be supplied with submittal prior to work.
  - d. Approved and Stamped by a Certified State of California Structural Engineer to OSHPD (Office of Statewide Health Planning and Development), CBC (California Building Code). Proof of conformance shall be supplied with submittal prior to work.
  - e. Ground holes provided in multiple locations in accordance with Building Industry Consulting Services International (BICSI) guidelines. Ground symbol pressed into metal as required by NEC (National Electric Code).
3. Free standing cabinets shall be used only in locations that are not securable by a lockable door or meet environmental requirements. The University Representative shall approve these areas prior to the design or installation of these cabinets.
  4. Cabinets shall meet the same requirements as equipment racks listed above.

**Equipment Rack and Cabinet Dimensions**

*Table 13 Equipment Rack and Cabinet Dimensions*

Type of Termination	Equipment Rack Dimensions (H by W)	Distribution Cabinet Dimensions (H by W by D)
ADF	84-inches by 19-inches (3 each)	84-inches by 24-inches by 32-inches (3 each)
BDF	84-inches by 19-inches (5 each)	84-inches by 24-inches by 32-inches (5 each)
IDF	84-inches by 19-inches (4 each)	84-inches by 24-inches by 32-inches (4 each)

*Table 14: Wall Mountable Cabinet Dimensions*

Type	RU	Height	Depth	Width
R5A	5 + 4	42	10	24
R5B	5 + 4	32	10	24
R12A	24	49	34	24
R12B	35	68	28	24
R13A	40	91	32	24
R13B	46	102	29	24

Note: Overall height of all standing equipment racks and cabinets shall not exceed 84 inches.

### ***Electrical Requirements***

Refer to Section 27 00 00 Telecommunications Space Electrical Requirements.

### ***Equipment Rack and Cabinet Layouts***

1. Area Distribution Frame (ADF)
  - a. Planning for a new ADF shall be coordinated with the ITS Engineering and Construction Management, contact the University Representative.

**End Section 27 11 16**

## **27 11 19 - Communications Termination Blocks and Patch Panels**

### ***Copper Patch Panels***

1. UTP cable patch panels that provide data service to WAO's shall meet the following specifications.
  - a. Patch panels shall support specified performance requirements as listed in Table below.
  - b. Patch panels shall be manufactured by an ISO 9001 Certified Manufacturer and be fully compliant with ISO/IEC/DIS-11801 standard and meet FCC specifications where applicable. These products shall also be UL® certified, where applicable.
  - c. Patch panels shall be empty, utilize Keystone port openings, and capable of accepting the same jacks as used at the WAO with an exact fit.
  - d. Patch panels shall be labeled above the port opening using an electronic label. The electronic label shall be 3/8" in width, contain black, Helvetica, Size 1 Font, block letters on a white background as shown in the Figure below. Labels shall be inserted into the magnifying label holder depicted.
2. Provide horizontal wire managers above, below or between each patch panel as appropriate.

UC Santa Cruz has adopted a Universal Wiring Scheme. All Work Area Outlets (WAO) consist of data service. WAO UTP cabling shall be terminated on CAT6 jacks, mounted in a Quickport® patch panel mounted within the patch panel equipment rack located within the Telecom Room. Jacks at the patch panel shall correspond in color and rating to jacks at the WAO.



*250 MHz Data Patch Panel Specifications (UL certified testing laboratory)*

Data Patch Panel Termination Hardware	Specifications
Construction (48 Port Patch Panels)	16-gauge steel. Accepts Category 5e, 6 and 6A jacks to match WAO, T568B wiring, 8P8C, high density, 6 port groupings, rear cable management, front magnifier strips, 19-inches (483mm) wide by 3.5-inches (89mm) high (48 port), Low emission IDC contacts, ANSI/TIA-568 compliant and UL Listed
Electrical Data (Jacks at 250MHz)	Return Loss: 16 dB
	Insertion Loss: 0.32 dB (max)
	NEXT: 46 dB
	FEXT: 35.1 dB

**Voice Cross Connect System**

At the backbone wall field, install a voice 100 pair 110 block. At the rack side, install a dedicated patch panel. In a R15 environment, install a voice patch panel. Terminate two pair per port. Quantity to be determined by building and/or user requirements.

**Voice Backbone UTP Cable Termination Blocks**

1. Voice backbone UTP cables that provide voice service to Work Area Outlets (WAO's), cross-connects and Digital Loop Carrier systems shall be installed using the following products.
  - a. Wall-mountable 110-type cross connect termination blocks with backboard shall support the appropriate Category 5e rating. Manufactured in 100 pair size to include 110-type blocks, 110-C type connecting blocks, jumper trough, bottom tray and labels.
  - b. Wall-mountable 110-type cross connect field shall facilitate cross connection and intermediate cross connection using 110 wall mount backboard channel and cross-connect wire or patch cords. The cross-connect hardware shall be of the same manufacturer as the 110-type patch panel to insure compatibility, function, fit and appearance.
2. The top of the 110-type block shall be mounted on a plywood backboard at a maximum height of 72-inches Above Finished Floor (AFF).
3. Electrical Specification:
  - a. ANSI/TIA-568 compliant in both design and performance.
  - b. Be UL LISTED 1863, Communications Circuit Accessories, 1995.

- c. 110-type connecting blocks shall be manufactured by an ISO 9001 Certified Manufacturer, and be fully compliant with ISO/IEC/DIS-11801 standard and meet FCC specifications where applicable. These products shall also be UL® certified, where applicable.

### ***Fiber Patch Panels***

1. Fiber Patch Panels provide termination and inter connectivity of fiber systems. Patch Panels should be manufactured by an ISO 9001 certified manufacturer. All patch panels shall be of steel construction.
  - a. Patch panels shall be empty, utilize plug and play systems and capable of accepting duplex LC and SC connectors.
  - b. Patch panels shall be installed with easy access splice trays.
  - c. Patch panels shall be labeled on front access door with clear labels and cable identifiers provided by university representative.
  - d. Patch panels shall have all exposed pigtails and buffer tubes protected by approved meshing or solid tube insulation.
  - e. Patch panels shall be sealed with solid plastic grommets at cable entrance to prevent rodent intrusion.

**End Section 27 11 19**

## **27 11 23 - Communications Cable Management**

The goal of a pathway component is to accommodate all standards-compliant cabling and the potential need for change during the life cycle of the cabling system. Furthermore, the design should minimize the unit change time and cost for cabling system renovations.

### ***Inner Ducts, Conduits, Cable Trays, Raceways***

Horizontal cabling supported by continuous cable pathways shall not be bundled (to minimize the risk of alien crosstalk).

### ***Cable Hangers***

The distance between cable hangers is not to exceed 4'

## ***Racks, Cabinets, Enclosures, Patch Panels (PPs)***

### **TR Rack Elevations**

1. Top RU is typically populated with a 2 RU Fiber Patch Panel (FPP).
2. Next leave 2 RU empty for future expansion.
3. Next a group of Voice Copper Patch Panels (V-CPPs) and Wire Manager Panels (WMPs) (see below for V-CPP/ WMP arrangements) .
4. Next a group of Data Copper Patch Panels (D-CPPs) and WMPs (see below for D-CPP/ WMP arrangements).
5. Next a group of Network switches and WMPs.
6. Then lastly a power supply group, with a Power Distribution Unit (PDU) on top, the UPS in the middle and battery packs at the bottom.
7. The Network Switch and Power Supply Group is typically supplied, wired and dressed by the University Representative. All other groups are wired and dressed by the contractor.

### **Horizontal and vertical WMPs:**

WMs shall be properly sized with a maximum fill-ratio of 80% at system design. Horizontal and vertical WMPs front surfaces shall be flush.

### **FPPs and WMPs**

No fiber WMPs are required for the FPPs.

### **D-CPPs and WMPs**

1 x 2RU WMP above and 1 x 2RU WMP below each 48 port CPP.

1 x 2RU WMP above or 1 x 2RU WMP below each 24 port CPP.

### **V-CPPs and WMPs**

1 x 2RU WMP above or 1 x 2RU WMP below each 24 port CPP

### **Network Switches and WMPs**

1 x 2RU WMP followed by 1 network switch, followed by an empty 1RU space, followed by 1 network switch and lastly followed by 1 x 2RU WMP.

## ***TR Backboards***

Copper, Fiber, Voice Cross-Connects

**End Section 27 11 23**

## **27 13 00 - Communications Backbone Cabling**

Consult with the university representative for specific design specifications. Reference 27 13 13 and 27 13 23.

**End Section 27 13 00**

## **27 13 13 - Communications Copper Backbone Cabling**

### ***Building Backbone Inside Plant UTP Copper Cable***

The building backbone consists of the riser cable and the supporting infrastructure within a building or cluster of buildings that connects the Telecommunications Spaces (ADF/BDF/IDF's within the ER/TR's).

### **Copper Riser Cable Specifications**

Riser cables shall meet the following requirements:

1. UL 444 and 1666, ANSI/TIA-568, FCC Part 68, Telecordia GR-111, Category 3, listed as CMR or CMP.
2. Riser or plenum rated multi-pair copper cables shall be installed in horizontal (cable tray) installations between the BDF and IDF as required per building specifications.
3. The riser cable is labeled based on a cable number assigned by the University Representative. The cable pair count shall also be included in the label.
4. Reference Division 27 11 19, Communications Termination Blocks and Patch Panels, for riser cable termination hardware.

### **Size Copper Riser Cable**

1. The size of the riser cable is a function of the number of WAO's supported by the IDF.
2. The minimum number of copper riser cable pairs required for each voice WAO = 2 pairs, three (3) or more voice WAOs = 1.5 pairs per WAO.
3. Riser cables shall be sized to the next larger, even pair size (i.e. 100, 200, 300, etc.).

### ***Outside Plant UTP Copper Cable***

1. Filled core (waterproofing compound) cable shall be used for underground cable installations.
  - a. PE-39 refers to filled cable with solid polyolefin insulation and is suitable for conduit and direct-buried applications. Cable shall meet ANSI ICEA 7CFR-1755-039 and 390 specifications.
  - b. PE-89 refers to filled cable with formed polyolefin insulation and is suitable for conduit and direct-buried applications. Cable shall meet ANSI ICEA 7CFR-1755-089 and 890 specifications.
2. All outside plant cable shall be Plastic Insulated Conductors (PIC) and the cable jacket shall be marked with the cable length, cable code, date and manufacturer.
3. The minimum bend radius during installation is 10 times the outside diameter of the cable and 8 times the outside diameter after installation. Minimum bend radius shall be maintained during and after the installation phase.
4. OSP Copper cable shall have a 10-foot service loop prior to terminations at the ADF/BDF/IDF location. The University Representative shall approve the location of this service loop prior to cable installation and termination. OSP copper shall have a loop left in each Manhole/pull box.

**End Section 27 13 13**

## **27 13 13.13 - Communications Copper Cable Splicing and Terminations**

### ***Cable Splicing Methods and Splice Closures***

#### **Copper Cable Splice Methods**

1. Copper telephone cables shall be spliced using a 710-type, 25-pair, large size, gray in color connector for underground, direct-buried, aerial and building terminal splices. 710-type connectors shall be 3M.
2. All splices shall be accomplished using the conductor fold-back method to ease future splicing and maintenance efforts.

#### **Copper Cable Splice Closures**

1. Copper cable splices (Aerial, Underground, and Direct-buried) shall be sealed using a bolt together, washer-less, stainless-steel type of closure with field adaptable/drillable/reusable 1, 2 and 3 section end plates to match the existing cable plant.

2. The closure shall be sized to allow sufficient interior space for the fold-back method of splicing and to allow for the addition of future bridge spliced cables.
3. The closure shall be air pressure tested (flash-tested) upon installation and shall not be filled with encapsulant.
4. All splice closures shall be properly supported, racked and lashed to the MH racks. Closures shall be supported by their own individual cable steps, in addition to the steps used to support the cable itself.
5. All splice closures shall be properly grounded to the MH grounding and bonding system.
6. All splices shall be inspected by the University Representative prior to the completion and sealing of the splice.
7. All copper cables shall be labeled in accordance with Division 27 05 53 Identification for Communication Systems, outside plant and riser cable labeling requirements.

**End Section 27 13 13.13**

## **27 13 23 - Communications Optical Fiber Backbone Cabling**

### ***Fiber Optic Riser Cable***

Riser cables shall meet the following requirements:

1. Conform to CEC (California Electrical Code) Article 770 and comply with the State of California fire codes and the Campus Fire Marshal's office.
2. The type of riser cable shall be UL listed OFNR/OFNP rated as required.
3. The cable shall be of the same manufacturer as the fiber optic termination equipment to ensure fit, function, system compatibility, performance and warranty.
4. Reference Figure 15 for labeling requirements.
5. Reference Division 27 11 19 Communications Termination Blocks and Patch Panels for termination hardware.

### ***Outside Plant Fiber Optic Cable***

1. Loose Tube dry cable with water blocking technology cable by use of a water-swellable tape shall be used for underground installations. Equipment shall be installed in accordance with the manufacturer's instructions.
2. Note: Indoor/outdoor rated cable shall be installed in locations where the termination or splice location exceeds 50-feet.

3. Minimum bend radius shall be maintained during and after the installation phase. The minimum bend radius during installation is 15 times the outside diameter of the cable and 10 times the outside diameter after installation.
4. Buffer tube fan out kits shall be used per manufacturer's requirements.
5. Fiber optic cable shall have a 30-foot service loop prior to terminations at the ADF/BDF/IDF location. The University Representative shall approve the location of this service loop prior to cable installation and termination. OSP fiber shall have a 50-foot service loop left in each Manhole and pull box. This slack shall be properly stored and lashed to the MH racks and shall not interfere with existing cables and splice closures.

**End Section 27 13 23**

## **27 13 23.13 - Communications Optical Fiber Splicing and Terminations**

### ***Fiber Optic Cable Splice Methods***

1. Coordinate with the University Representative to confer with ITS Engineering and Construction Management when designing the outside plant cable layout.
2. When a field splice is required, single-mode OSP fiber cables shall be fusion spliced only. Mechanical splices shall not be allowed. Heat shrink type fusion protectors with a strength member shall be used for all fusion splices.
3. The larger 24-strand 13-inch size splice trays shall be used for single-mode splices to allow additional space for retaining fiber loops and controlling bend radius.
4. Coordinate with the University Representative for inspection of all splices prior to sealing the splice.

### ***Fiber Optic Splice Closures***

1. Fiber optic cable splices shall be sealed using a hard plastic, bolt together, re-usable/re-sealable type of fiber optic cable closure.
2. Closure shall allow manufacturer's recommended slack (typically 8 to 10 feet) within the closure to facilitate present and future fiber splicing and maintenance activities.
3. All splice closures shall be properly supported, racked and lashed to the MH racks. Closures shall be supported by their own individual cable steps, in addition to the steps used to support the cable itself.
4. All splice closures shall be properly grounded to the MH grounding system, when applicable.

5. All Fiber Optic cables shall be labeled in accordance with Division 27 05 53 Identification for Communication Systems.

### ***Fiber Optic Connectors***

Fiber optic cable for outside plant and riser/backbone installations shall be fusion spliced to factory made LC Ultra PC Polish (UPC) type pigtails at the ADF/BDF/IDF.

### ***Closet Connector and Splice Housings***

1. All fiber optic connectors, termination housings and hardware shall be of the same manufacturer as the installed cable to ensure campus wide network system compatibility, optimum performance, fit, function, appearance and warranty. The type and manufacturer of fiber optic connectors, termination housings and connector panels shall be Corning Cable Systems or equal. If substitutions are requested by the consultant, then documented and demonstrated equivalency shall be provided to the University Representative for review.
2. Fiber distribution cabinets (rack and wall-mounted closet connector housings) shall be labeled in accordance with Division 27 05 53 Identification for Communication Systems.

### **End Section 27 13 23.13**

## **27 15 00 - Communications Horizontal Cabling**

1. Two types of cables may be used for use in the horizontal segment: Unshielded Twisted Pair (UTP) and single-mode (SM) fiber optic cable.
  - a. UTP cable shall be 4-pair, 23 AWG, solid conductor UL Listed OFNP (Optical Fiber Nonconductive Riser) cabling that meets ANSI/TIA-568 Category 6 cable, to include all current Addendums and Bulletins and shall meet specified specifications and performance requirements. Use Berk-Tek LANmark-6 CMP, Blue.
2. All conductive cable, fiber optic, radio and television, community antenna and network-powered broadband communications systems and associated components shall comply with the most current edition of the following California Electric Code (CEC) articles:
  - a. Article 770 Optical Fiber Cables and Raceways
  - b. Article 800 Communications Circuits
  - c. Article 810 Radio and Television Equipment
  - d. Article 820 Community Antenna Television and Radio Distribution
  - e. Article 830 Network Powered Broadband Communications Systems



3. Horizontal cables shall not be spliced, nor shall these cables contain manufacturer splices.
4. Cable shall be manufactured, tested, certified and meet the performance requirements specified in Section 27 06 00 - Communications Product Schedule.
5. The maximum total length of horizontal cable from the IDF to WAO not to exceed 295 feet; 328 feet (100 meters) including patch cords (equipment and workstation).
6. Cable slack shall be provided at the workstation to accommodate future cabling system changes.
  - a. The minimum amount of slack shall be 6-inches for UTP cables and 36-inches for fiber optic cables at the WAO.
  - b. Service loops are not recommended in copper cable installation practices. Service loops placed during the installation of 4-pair horizontal cables were tested and determined to cause Return Loss and NEXT problems on the order of 2-3dB.
7. Note: These limits apply to all types of horizontal cables. In establishing these limits, a 33-foot allowance was made for the combined length of the manufactured patch cords used to connect equipment at the WAO and IDF locations.

**End Section 27 15 00**

## **27 15 43 - Communications Faceplates and Connectors**

The term Work Area Outlet (WAO) refers to the actual faceplate or surface mounted box installed in the work area. WAO shall be permanently labeled per spec in section 27 05 53 "faceplate labeling."

### ***Work Area Outlet (WAO) Faceplates, Surface Mount Boxes, Raceway, Adapters and Modules***

Faceplates, Surface Mount Interface Boxes and 106-Type Receptacles:

1. WAO's shall be flush-mounted, front entry, front removable, multiple port faceplates and surface mount interface boxes.
2. All voice, data and coax faceplates shall be a minimum of double gang faceplate. Blank modules of the same color and manufacturer shall cover all open ports not utilized.
3. Device frames as listed in 27 06 00 - Communications Product Schedule, shall be used when installing WAO's in metallic type surface raceways when a standard type faceplate cannot be used.

4. WAO are not to be installed within Modular furniture. WAO to terminate flush on the wall and extended to the work area with WAO extensions. Coordinate work with furniture installation. When necessary to pass cable through furniture, install extra deep surface mounted boxes on the bottom panel of modular furniture with a rubber grommet installed in the panel opening.

**End Section 27 15 43**

## **27 15 53 and 27 15 54 - Communications Fiber and Copper Cable Plant Testing**

### *Testing Requirements for Copper and Fiber Optic Horizontal Cables*

1. General
  - a. Test and document each horizontal cable segment separately.
  - b. Test each end-to-end cable link.
  - c. Design Professional shall develop testing specifications and requirements.
2. The Contactor shall perform testing on all installed cabling systems. All documented test results shall be provided to the University Representative for review and approval by CR.
3. Prior to testing, all cables shall be installed, terminated, labeled and inspected. The Contractor shall notify the University Representative 48 hours in advance and provide a testing schedule. The University Representative has the right to verify the setup and procedures of testing instruments and be present during cable certification. The Contractor shall provide calibration certificates for testing equipment to be used, prior to commencement of testing. All testers are to have been calibrated within the last year of testing. All tests conducted before approval shall not be accepted.

### *Unshielded Twisted Pair (UTP) Horizontal Voice and Data Cable Testing*

Permanent Link test all UTP horizontal station cables with a Level IIIe or later tester for full compliance with ANSI/TIA-568, Category 6 specifications. Test using Cat 6 test cords, by same manufacturer as test equipment and save all graphs when testing. Contractor to test 110 voice terminal blocks with a 110 smart adapter probe test cord provided by the manufacturer of the test equipment.

Test results shall be provided for all conductors of each cable and shall meet or exceed the guaranteed performance headroom parameters as specified in Table 11.

Table 11 Permanent Link Testing

Parameter	Category 6
Return Loss (dB)	2 dB
NEXT (dB)	2 dB
PSNEXT (dB)	2 dB
Insertion Loss (dB)	2%
ACR (dB)	2 dB
PSACR (dB)	2 dB
ACRF (dB)	2 dB
PSACRF (dB)	2 dB
Propagation Delay	67% nom.
Delay skew (ns)	45ns/100m

### **Horizontal and Riser/ Backbone Fiber Cable Testing**

Field-testing instruments for single-mode fiber optic cabling shall meet the requirements of ANSI/TIA-526 using testing Method A and B. Reference ANSI/TIA-568 for additional test requirements.

Fiber optic testing procedures include the following.

#### **Link attenuation (Power Meter)**

1. All horizontal single-mode fiber optic cables shall be tested for link attenuation (i.e. power insertion loss) as referenced in ANSI/TIA-568, Section 11.3 and/or per Table 12, which is ever more stringent. See Table 12 for proper fiber testing measures.
2. All strands shall be tested in a bi-directional method at both wavelengths with a power meter/light source capable of recording and plotting data.
3. ANSI/TIA 568 and ANSI/TIA-526 outlines the steps required to test single-mode fiber optic cable.
4. Ensure that all connectors (on both sides of the mating sleeve) are clean prior to testing. Do not use canned air to clean the connectors or mating sleeves.

#### **Optical Time Domain Reflectometer (OTDR)**

1. Horizontal cables shall be tested bi-directional and at both wavelengths for dB loss and end-to-end total installed distance with an OTDR.

2. Each strand tested must have a typical OTDR trace and a graphical representation of the trace
  - a. A typical OTDR trace shall indicate
    - i. The cable length
    - ii. 2-Point dB loss between the A and B test trace cursors.
  - b. A graphical representation trace shall indicate
    - i. Launch connection
    - ii. Connectors
    - iii. Splices
    - iv. Termination points
3. Test using a manufactured and terminated Corning MM/SM or equal, as appropriate, glass launch cable.
4. OTDR traces shall use the Medium Smooth setting and readings taken in feet.
5. Cables tested at the appropriate pulse width to accommodate short cable lengths (MM cable at maximum 5 ns/6.6 ft and SM maximum 20 ns/6.6 ft).
6. A photograph on the connector end face at each end is required.

Table 12 Maximum Loss Measurements

Maximum Loss Measurements for Installed Fiber Optic Cables	
Mated Connector Loss:	0.5 dB per mated pair
Connector Loss:	0.5 dB per connector
Fusion Single-mode	0.06 dB
Mechanical	0.3 dB
Fiber loss: Single-mode	0.4 dB/km @ 1310 nm (Outside Plant Cable) 0.3 dB/km @ 1550 nm (Outside Plant Cable) 0.7 dB/km @ 1310 nm (Inside Plant Cable) 0.7 dB/km @ 1550 nm (Inside Plant Cable)

### Test Result Documentation

1. Power meter fiber optic test results shall be submitted electronically and according to Division 1 requirements. Provide in manufacturer software format.

2. OTDR fiber optic traces shall be submitted electronically and according to Division 1 requirements. Provide in manufacturer software format.
3. Test results shall be organized by technology room in an orderly fashion.
4. CD electronic copy shall have the latest version of software burned on it for viewing test results and a copy of the transmittal letter explaining any issues regarding the test results (skipped #'s, cause of failures, etc.).
5. CD shall have a computer-generated label with:
  - a. Contractor's Name
  - b. Date
  - c. UC Santa Cruz Bldg. name, CAAN and project number
  - d. Contents (Fiber/copper Test Results, etc.)

**End Section 27 15 53 & Section 27 15 54**

## **27 20 00 - Data Communications**

All electronics shall be provided by the University.

**End Section 27 20 00**

## **27 21 33 - Data Communications Wireless Access Points**

### ***Wireless Access Coverage***

For New Construction projects, it is the responsibility of the consultant to provide wireless and heat maps for the placement of Wireless Access Point locations. It is mandatory to provide 100% wireless building coverage in 2.4 GHz and 5 GHz spectrums in all designs. Wireless WAO locations shall be cabled using a square cell topology. Provision for a Wireless Access Point location every 30-feet (900ft<sup>2</sup>). Provision for one Wireless Access Point (WAP) for every 20 people (50-60 devices) based on occupancy rate of the area.

## **Wireless Access Points**

1. Wireless access points consist of two data jacks. The wireless device is to be terminated with an 8-position, 8 conductor module and placed into a 2 port surface mount box.
2. Location of the wireless device is based on the room design:
  - a. Standard ceiling height rooms (offices, classrooms, conference rooms, etc.) with drop tile ceiling: leave the wireless device, placed within a 2-port surface mount box, concealed above the drop tile ceiling on an SMB hanger, suspended by dedicated ceiling wire or pencil rod as previously described. Utilize a varying length patch cord to optimize signal coverage. Place the surface-mount block and hanger where it may initially provide the greatest amount of useable coverage.
  - b. High ceiling rooms (lecture rooms, auditoriums, etc.): depending on the size of the room, provision for ceiling and wall mounted WAO locations on each side wall at approximately 8-foot-6-inches AFF. Install each WAO location with a 4-inch square by 2-7/8-inch deep device box with a single- or dual-gang mud ring installed flush mounted within the wall. Secure jacks if WAP is to be mounted directly to backbox.
3. Hard cap ceilings: Install the WAO with a 4-inch square by 2-7/8-inch deep device box with a single- or dual-gang mud ring installed flush mounted within the wall. Secure jacks if WAP is to be mounted directly to backbox.
4. For Major and Minor Renovation projects, consult the University Representative for determination of wireless scope.
5. Wireless network equipment shall be provided by the University.

**End Section 27 21 33**

## **27 32 23 - Elevator Telephone**

Each elevator bay, including elevator chair lifts, is required to have a dedicated phone line.

**End Section 27 32 23**

# DIVISION 27 – COMMUNICATIONS

27 00 00 - COMMUNICATIONS

27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS

27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

27 05 29 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

27 05 33 - CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

27 05 36 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

27 05 39 - SURFACE RACEWAYS FOR COMMUNICATIONS SYSTEMS

27 05 41 – FIRE-STOPPING SYSTEMS

27 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS

27 05 48 - NOISE AND VIBRATION FOR COMMUNICATIONS SYSTEMS

27 05 53 - IDENTIFICATION AND LABELING FOR COMMUNICATIONS SYSTEMS

27 06 00 – COMMUNICATIONS PRODUCT SCHEDULE

27 10 00 - STRUCTURED CABLING, BASIC MATERIALS & METHODS

27 11 13 – COMMUNICATIONS ENTRANCE PROTECTION

27 11 16 - COMMUNICATIONS CABINETS, RACKS, FRAMES AND ENCLOSURES

27 11 19 - COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

27 11 23 - COMMUNICATIONS CABLE MANAGEMENT

27 13 00 - COMMUNICATIONS BACKBONE CABLING

27 13 13 - COMMUNICATIONS COPPER BACKBONE CABLING

27 13 23 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

27 15 00 - COMMUNICATIONS HORIZONTAL CABLING

27 15 43 - COMMUNICATIONS FACEPLATES AND CONNECTORS

27 15 53 - COMMUNICATIONS FIBER CABLE PLANT TESTING

27 15 54 - COMMUNICATIONS COPPER CABLE PLANT TESTING

27 20 00 - DATA COMMUNICATIONS

27 21 33 - WIRELESS ACCESS POINT (WAP)

27 32 23 - ELEVATOR TELEPHONES

## 27 00 00 - Communications

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This project requires the Contractor furnish, label, test, document, and warranty a Structured Cabling System in conformance with this specification for the facilities of the University of California Santa Cruz (UCSC) referenced as – ***[Specifiers note – add specific project number and name]*** the Project Number, Project Name.
- B. Construction drawings and all provisions of other Contract Divisions shall apply to this Division 27 specification.
- C. The list of Division 27 section specifications that may be included as part of this Division 27 specification set includes, but is not limited to, the following:
  - 1. Section 27 06 00 - Communications Product Schedule
  - 2. Section 27 05 26 - Grounding and Bonding for Communications Systems
  - 3. Section 27 05 29 - Hangers and Supports for Communications Systems
  - 4. Section 27 05 33 - Conduits and Back boxes for Communications Systems
  - 5. Section 27 05 41 - Fire Stopping for Communications Systems
  - 6. Section 27 11 13 - Communications Entrance Protection
  - 7. Section 27 11 16 - Communications Cabinets, Racks, Frames, and Enclosures
  - 8. Section 27 11 19 - Communications Termination Blocks and Patch Panels
  - 9. Section 27 13 00 - Communications Backbone Cabling
  - 10. Section 27 15 00 - Communications Horizontal Cabling
  - 11. Section 27 15 43 - Communications Faceplates and Connectors
  - 12. Section 27 15 53 - Communications Cable Plant Testing

#### **1.2 QUALITY CONTROL**

- D. The Contractor shall have a current State of California C-7 license or C-10 license.
- E. All work shall be performed in a neat and workmanlike manner (also see Division 1).
- F. Product, materials, and equipment provided by the Contractor shall be of the quality specified.
- G. All materials furnished under this contract shall be new and of a regularly manufactured line, currently in production at the time of installation.
- H. Codes: (Most recent editions with addenda/TSB, etc.) All materials, installation, and workmanship shall comply with the applicable requirements and codes addressed within the following references:
  - 1. National Electrical Manufacturers Association (NEMA).



2. National Electrical Code (NEC) 2008.
  3. National Electrical Safety Code (NESC) 2009.
  4. FCC Rules and Regulations.
  5. Local, county, state, and federal regulations and codes in effect as of the bid submission date.
- I. Standards: (Most recent editions with addenda/TSB, etc.) All materials, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references:
1. ANSI/TIA-568
  2. ANSI/TIA-569
  3. ANSI/TIA-606
  4. ANSI/TIA-607
  5. ANSI/TIA-758
  6. BICSI - Telecommunications Distribution Methods Manual (TDMM) - 13th edition.
  7. BICSI - Outside Plant Design Reference Manual (OSPDRM) - 5th edition.
  8. BICSI – Information Technology Systems Installation Methods Manual – 6th edition.
  9. All products shall be Underwriters Laboratories (UL) listed, or other nationally recognized testing laboratory acceptable to UCSC listed for the application intended.
- J. Where conflicts exist from one code or standard to another, the code or standard which is most stringent will govern.

### **1.3 WARRANTIES**

- A. The Contractor shall provide a one (1) year material and labor warranty on all the work the Contractor has performed.
- B. The Contractor shall submit on and provide the Structured Cabling System (SCS) manufacturer's materials and link performance certification warranty for all new cable installed by the Contractor in his execution of the work of this specification. Fiber warranty shall be minimum 25 years, copper shall be Limited Lifetime.
- C. See and comply with Division 1

### **1.4 MATERIAL SUBSTITUTIONS**

All substitutions are to adhere to the requirements as stipulated in Division 1.

### **1.5 SUBMITTALS**

- A. See Division 1 requirements. The following submittals are required upon award of contract, - These submittals must be received and approved by the University Representative before commencement of work.

1. A complete jack numbered plan set in UCSC jack numbering format in printed and AutoCAD format.
  2. An Excel spreadsheet listing jack number, floor number, room number and jack type (workstation, wireless, camera, emergency phone, etc.)
  3. Mock-ups of each type of communications outlet faceplate to be furnished for this project. Each faceplate mock-up shall contain the following:
    - a. Full load ceplate labeling to include faceplate icons as required by these Division 27 Specifications and the accompanying construction drawing set.
    - b. Manufacturers' cut sheets for all products to be supplied by the Contractor in response to these Division 27 specification sections.
  4. Listed fire stop system documentation - reference Section 27 05 41 - Fire Stopping for Communication Systems.
  5. A copy of the Contractor's C-7 license or C10 licenses - both if Contractor has both.
  6. A copy of testing personnel certification(s) that show they are properly trained in the use of the testing equipment that will be employed by the contractor - reference Section 27 15 53 - Cable Plant Testing.
  7. Testing device(s) calibration documentation.
  8. Copies of Contractor's Structured Cabling System (SCS) manufacturer's authorized vendor/installer Certification document(s).
- B. Required submittals prior to final acceptance.
1. Two (2) sets of CDs or DVDs of the as-built drawings (AutoCAD or AutoCAD LT Rev 2007 or later) - reference Section 27 15 53 - Cable Plant Testing.
  2. Two (2) sets of CDs or DVDs of cable plant testing results documentation - reference Section 27 15 53 - Cable Plant Testing.
  3. Two (2) sets of CDs or DVDs of all fire stop pictures reference Section 27 05 41 - Fire Stopping for Communication Systems.
  4. Two (2) copies of required warranties.

## **PART 2 - PRODUCTS**

### **2.1 SCHEDULES FOR COMMUNICATIONS**

In this specification, product/material shall be specified by reference to the Product/Materials Schedule contained in Section 27 06 00 - Communications Product Schedule.

### **2.2 QUANTITIES**

Determining quantity of any given required item or product shall be the Contractor's responsibility.

### **2.3 DEFINITION**

In this Division 27 specification, the term "Furnish" shall mean "provide and install."

## **PART 3 - EXECUTION**

### **3.1 COORDINATION**

- A. The Contractor shall coordinate the work specified in this Division 27 specification with the work of all other trades
- B. The Contractor shall coordinate with Division 26 - Electrical concerning provision and installation of the following:
  - 1. Conduit and cable tray pathway for communications.
  - 2. Wall penetrations and floor coring for communications.
  - 3. Back boxes for communications.
  - 4. Telecommunications Space Power placement of communications.
  - 5. Grounding and bonding for communications.
- C. All questions and issues regarding coordination and construction element phasing shall be directed to the University Representative or his/her designate.
- D. The Contractor shall coordinate their work so there shall be no disruption to any occupants of the UCSC campus unless coordinated and approved by the University Representative. Any necessary disruption shall be scheduled a minimum of 2 weeks in advance of its occurrence and affected parties shall be notified in writing of date, time, and planned duration of the disruption.
- E. The Contractor shall follow all rules, regulations, and instructions in this specification, general provisions of the Contract, including General and Supplementary Conditions, and Division 1 specification sections, if issued in conjunction with these Division 27 specifications with regard to the following:
  - 1. Delivery hours.
  - 2. Delivery locations.
  - 3. Storage.
  - 4. Hazardous Material.
  - 5. Security
  - 6. Safety.
  - 7. Logistics.

### **3.2 INTENT OF DRAWINGS AND SPECIFICATIONS**

- A. Contractor shall keep on the Project site a copy of the Specifications and Drawings, and the same shall be available at all reasonable times for inspection and use by The University Representative and by any other person authorized by The University Representative. Any Drawings listed in the detail Specifications shall be regarded as a part thereof and of the Contract. Anything mentioned in these Specifications and not shown on the Drawings, or shown on the Drawings and not mentioned in these Specifications, shall be of like effect as though shown or mentioned in both.

- B. It shall be the duty of Contractor to see that the provisions of these Specifications are complied with in detail irrespective of the inspection given the work during its progress by The University Representative. Any failure on the part of Contractor to observe the Specifications will be sufficient cause for the rejection of the work at any time before its acceptance.
- C. The University Representative will furnish from time to time, such detail drawings, drawings, profiles, and information as The University Representative may consider necessary for Contractor's guidance to insure the proper and adequate execution of the Contract. Contractor shall comply with such detail drawings, drawings, profiles and information.
- D. Only favorably reviewed shop drawings and submittals shall be used in construction. Refer to Section 01300.
- E. See and comply with Division 1.
- F. DO NOT USE drawing scale to determine exact dimensions or exact location. Scaled drawings are still to be considered diagrammatic. If exact lengths or location placement dimensions are required, the drawings will specifically show those dimensions or placement coordinates.

### **3.3 INSTALLATION**

The Contractor shall furnish all required materials, equipment, and tools necessary to properly complete the work of these specifications including, but not limited to, tools for pulling and terminating the cables, mounting hardware, cable ties, bolts, anchors, clamps, hangers, kits of consumables, lubricants, technician communication devices, cable testing equipment, stands for cable reels, cable winches, etc.

### **3.4 EXAMINATION**

- A. The Contractor is responsible for examining existing conditions and comparing them with drawings and specifications and notifying the University Representative or his/her designate of any discrepancies.
- B. The Contractor is responsible for coordinating with the University Representative or his/her designate to address, adjust, and resolve any discrepancies found before commencing work.
- C. If a discrepancy between existing conditions and the Contract drawings and specifications are found after commencing work, stop any work that in the Contractor's opinion is affected by the found discrepancy. The contractor shall submit an RFI requesting information on how to resolve the discrepancy. The RFI shall also contain a possible solution, before commencing work in work areas affected by the discrepancy.

### **3.5 VERIFICATION**

- A. The Contractor shall verify that the installation and materials used have been inspected before they are enclosed within building features, or otherwise hidden from view. The Contractor shall bear costs associated with uncovering or exposing installations or features that have not been inspected and approved.
- B. After installation, the Contractor shall test, certify and provide required warranties for the Structured Cabling System (SCS) installed per the requirements of this specification.

### 3.6 ADJUSTMENTS

The Contractor is responsible for coordinating and documenting with the University Representative or his/her designate the change order process and fully comply with requirements of Division 1.

### 3.7 LIST OF REQUIRED AS-BUILT DRAWINGS

- A. As stated under "Submittals" above, as-built drawing files shall be "AutoCAD", confirm applicable version with the University Representative.
- B. The list of required as-built drawings is as follows:
  - 1. All cabling outlets with IDs for each connector on the faceplate.
  - 2. Two-inch (2") and larger conduit pathways to include conduit size label.
  - 3. Pull box locations.
  - 4. Two-inch (2") and four-inch (4") J hook runs indicated by a long broken line with an "X" between each segment.
  - 5. Telecom room layout labeled per current construction drawing field mark-ups.
  - 6. Rack elevation labeled per current construction drawing field mark-ups.
  - 7. Backbone copper and fiber schematic drawings with labeling information.
- C. After review of as-built drawings by the University Representative or his/her designate be prepared to make any required corrections for final submittal.

### 3.8 ACCEPTANCE

The project specified by this specification shall be considered completed and signed off as completed by the University Representative or his/her designate contingent upon the following:

- A. All punch lists have been completed and signed as complete by the PP&C Project Manager or his/her designate.
- B. Required cable plant testing has been executed and required test result documentation has been submitted and approved by the University Representative or his/her designate - Refer to Section 27 15 53 - Communications Cable Plant Testing.
- C. Any required adjustments to as-built drawings have been completed, submitted, and approved as complete by the University Representative or his/her designate.
- D. Required warranty documentation has been submitted and approved as complete by the University Representative or his/her designate.

**END OF SECTION 27 00 00**

## 27 05 00 - Common Work Results for Communications

### **PART 1 – GENERAL**

#### **1.1 SUMMARY**

A. Section includes, but is not necessarily limited to:

1. Common standards and procedures for the Communications Work.
2. Design, engineer and provide complete, all means of support, suspension, attachment, fastening, bracing, and restraint (hereinafter "support") of the Work of this Division. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction.

B. Provisions of this Section apply to Communications Work, including the following Sections:

1. Section 27 05 26 – Grounding and Bonding for Communications Systems
2. Section 27 05 29 – Hangers and Supports for Communications Systems
3. Section 27 05 33 – Conduits and Backboxes for Communications Systems
4. Section 27 05 36 – Cable Trays for Communications Systems
5. Section 27 05 39 – Surface Raceway for Communications Systems
6. Section 27 05 41 – Firestopping for Communications Systems
7. Section 27 05 48 – Noise and Vibration Controls for Communications Systems
8. Section 27 05 53 – Identification for Communications Systems
9. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
10. Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures
11. Section 27 11 19 – Communications Termination Blocks and Patch Panels
12. Section 27 11 23 – Communications Cable Management
13. Section 27 13 00 – Communications Backbone Cabling
14. Section 27 15 00 – Communications Horizontal Cabling
15. Section 27 21 33 – Wireless Access Points

#### **1.2 REFERENCES**

A. Usage: In accordance with Division 1.

B. American National Standards Institute (ANSI) – Current Version

1. ANSI/TIA-568
2. TIA-569
3. ANSI/TIA/-606
4. ANSI-J-STD-607

5. ANSI/TIA-758

C. BICSI

1. Telecommunications Distribution Methods Manual (TDMM) - 13th edition.
2. BICSI - Outside Plant Design Reference Manual (OSPDRM) - 4th edition.

### 1.3 DEFINITIONS

A. See also Division 1.

B. General Abbreviations used in these specifications. Refer additionally to the abbreviations list appearing on the Drawings.

1. ADA - Americans With Disabilities Act.
2. AFC - Above Finished Ceiling.
3. AFF - Above the Finished Floor.
4. BLDG - Building
5. CAT - Category
6. CL - Centerline
7. DIV - Division
8. (E) - Existing
9. FBO - Furnished By University
10. HR - Home Run
11. ID - Inside Diameter
12. LAN - Local Area Network
13. MAX - Maximum
14. NIC - Not in Contract.
15. OD - Outside Diameter
16. PSRH - Project Standard Receptacle Height.
17. PSSH - Project Standard Switch Height.
18. TYP - Typical
19. OFE - University Furnished Equipment.
20. UON - Unless Otherwise Noted.

C. Electrical and electronics terms used in the Communications Sections shall be as defined in:

1. ANSI/TIA-568
2. ANSI/TIA-569
3. ANSI/TIA-606
4. IEEE Std 100

#### D. This Section.

##### 1. Area Distribution Facility (ADF)

Is a multiple-building serving facility. The ADF is the room within a building for telecommunications equipment that meets the voice, data, video, radio, and wireless needs of its building and also serves other buildings in a designated area (zone) on the UCSC campus. It generally acts as an EF (Entrance Facility) and BDF (Building Distribution Facility) but can also act as an IDF (Intermediate Distribution Facility) serving the floor it occupies. ADFs are generally placed on the lowest floor of a building to allow the entry of OSP cables without transition splicing and for grounding of cables. An ADF provides a controlled environment to house telecommunications equipment, termination hardware, splice closures, Main Telecommunications Main Grounding Busbar (TMMTGB) grounding and bonding facilities, and protection apparatus where applicable. Campus telephone systems (LIMs) or MX1 equipment, local area network switches, video distribution equipment, wireless network equipment, 800MHz and police and fire VHF in-building radio equipment, in-building cellular systems, and large uninterruptible power sources with large battery stacks are types of telecommunication equipment found in an ADF. ADFs are distinct from other TRs due to the nature and/or complexity of the equipment they contain. They are distribution points for the campus fiber and copper OSP cable plant.

##### 2. Building Distribution Facility (BDF)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made.

##### 3. Intermediate Distribution Facility (IDF)

A distributor used to connect horizontal cable and cabling subsystems or equipment.

##### 4. Telecommunications Room (TR)

The term TR refers to space allocated within a building to provide a secure operating environment for telecommunications cabling and termination facilities and/or network equipment. TRs shall be designed and provisioned per ANSI/TIA-569.

Telecommunications Pathways and Spaces and per the BICSI Telecommunications Distribution Methods Manual (TDMM), most recent edition. Depending on the building size, design, and network requirements, one or more of the functions of a TR may be combined into one space. The primary functions housed in TR's are:

- a. Entrance Facility (EF).
- b. Building Distribution Frame (BDF).
- c. Intermediate Distribution Frame (IDF).
- d. Area Distribution Frame (ADF).

##### e. Entrance Facility (EF) (Telecommunications)

A room that houses the termination and grounding point of OSP network service cables that enter or exit a building. It enables the joining of intra-building and inter-building backbone cabling. The EF is generally co-located in a BDF or ADF rather than being a separate room



- f. Entrance Room (ER) (Telecommunications)  
A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.
- g. Open Cable  
Cabling that is not run in a raceway as defined by NFPA 70. This refers to cabling that is open to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.
- h. Open Office - A floor space division provided by furniture, moveable partitions, or other means instead of by building walls.
- i. Pathway - A physical infrastructure utilized for the placement and routing of telecommunications cable.
- j. Reference to Named Products
  - i. Selected Item: Item so noted was selected based on comparative testing of similar products. Procedure for determination of equivalence is noted in the specification for the item(s).
  - ii. System Design Basis: Item so noted interacts with other system items to produce total system function. Substitution of this item may require coordinated substitution of other system items.
  - iii. Design Basis: Item so noted was used as basis for system drawings to establish features, size, etc. Use of specified equivalents may require adjustment of physical layout or wiring, but does not affect system function. No preference is implied.

## 1.4 SUBMITTALS

### A. Comply with Division 1 and the following.

1. Submit all materials for review arranged in same order as Specifications, individually referenced to Specification Section, Paragraph and Contract Drawing number. Conform in every detail as applies to each referencing Section.
2. Submit 8 ½"x 11" items bound in volumes and drawings in edge bound sets. Submit all drawings on sheets of the same size.
3. Make each specified submittal as a coordinated package complete with all information specified herein. Incomplete or uncoordinated submittals will be returned with no review action.
4. Progress Schedule: Comply with Division 1.

### B. Contractor and Key Personnel Experience.

1. With the bid submission, provide qualification documentation of the experience of the low voltage systems, equipment and infrastructure contractor(s) and of their key personnel.
2. Qualifications shall be provided for:
  - a. the low voltage systems, equipment and infrastructure contractor(s),

- b. the low voltage systems, equipment and infrastructure installers, and the supervisor(s) (if different from the installers).
  - 3. A copy of the Contractor's C-7 license or C-10 licenses - both if Contractor has both.
  - 4. A copy of testing personnel certification(s) that demonstrate that the proposed personnel have the necessary training and certifications to conform with the proof of performance testing requirements of this Division and that they are properly trained in the use of the testing equipment that will be employed by the contractor.
  - 5. Copies of Contractor's Structured Cabling System (SCS) manufacturer's authorized vendor/installer Certification document(s).
  - 6. Refer to Quality Assurance paragraph in this section for complete requirements.
- C. Manufacturer's Product Data Sheets are to be submitted to PP&C per the instructions given by PP&C. The process is mandatory and structured to accommodate the document archive system used by PP&C. Instruction, as noted below, will be expected of the successful bidder for the submittal process.
- 1. Manufacturer's Product Data Sheets. Collate in sequence of List of Materials:
  - 2. Data sheet for each item in each Communications Section, including all accessories, clearly marked for proposed product.
  - 3. Material Safety Data Sheet, where applies.
  - 4. List of Materials Schedule. For each item, include:
    - a. Field (Installation) Drawings:
      - i. Drawings shall present the proposed installation using the makes and models of devices proposed for use this project; replace vendor neutral nomenclature used in bid set with the actual part numbers to be installed or provide a lookup table in the drawings to permit determining the actual part number.
      - ii. Where the existing systems and/or infrastructure are used and integrated into the work of the project, indicate them on drawings, including points of interface and demarcation of existing and new work.
      - iii. Provide registered communications distribution designer (RCDD) approved, drawings depicting a complete communication infrastructure in accordance with ANSI/TIA-606. The drawings should provide details required to prove that the distribution system shall properly support connectivity from the communications rooms including EF, ER, and TR to the telecommunications work area outlets.
    - b. Schedule Submittals
      - i. An Excel spreadsheet listing jack number, floor number, room number and jack type (workstation, wireless, camera, emergency phone, etc.)
      - ii. Voice cable plant: Cut sheets for use by University Telephone Systems Contractor.

- iii. Samples
- c. Mock-ups of each type of communications outlet faceplate to be furnished for this project. Each faceplate mock-up shall contain the following:
  - i. Full load of required connectors with eighteen inches (18") of connector type appropriate specified cable terminated on each connector.
  - ii. Required faceplate labeling to include faceplate icons as required by these Division 27 Specifications and the accompanying construction drawing set.
- d. Cabling and Equipment Test Plan
  - i. Submit complete documentation of the proposed test plan and equipment to be used to document that the performance of the cabling, equipment, sub-systems and complete systems installed under the work of this project conform with the performance standards outlined in each specification section.
  - ii. Submit not less than 45 days prior to the proposed test date. Include procedures for certification, validation, and testing.
  - iii. Submit manufacturer's or recognized national test laboratory's calibration certificate one (1) month before any post-installation testing begins. Date on test unit calibration certificate shall be no longer than one (1) year prior to the date that post-installation testing is scheduled to begin.
  - iv. Submit a copy of the Test Equipment manufacturer's recommended testing procedure for each of the structured cabling system elements listed above in this section.
- e. Test Reports
  - i. Manufacturer's Field Reports
  - ii. Factory reel tests
- f. Project Site Test Reports:
  - i. Submit following system completion and prior to and as condition precedent to Acceptance Review and Testing of the Work of this Section.
  - ii. Schedule: Submit test reports in timely manner relative to Project schedule such that the University Representative may conduct verification of submitted test data without delay of scheduled progress.
  - iii. Provide test reports as specified within each section of Division 27 requiring performance testing.
  - iv. Content: Include at least:
    - (A) Time and date of test.
    - (B) Personnel conducting test.

- (C) Test equipment, including serial and date of calibration.
  - (D) Test object.
  - (E) Procedure used.
  - (F) Results of test
  - (G) Numerical or graphical presentation.
- v. Submit copy of final results on paper and in electronic form, organized by circuit number, consistent with circuit numbering scheme used in preparing submittal drawings and in labeling receptacles and terminations.
- (A) Submit machine-generated documentation and raw data of all test results in electronic form on CD-R media
  - (B) Where the electronic documentation requires use of a proprietary computer program to view the data, provide the University with 1 licensed copy of the software.

## 1.5 QUALITY ASSURANCE

- A. Procedures: In accordance with Section 01 43 00 – Quality Assurance.
- B. Designated Supervisor: Provide a designated supervisor present and in responsible charge in the fabrication shop and on the Project Site during all phases of installation and testing of the Work of this Section. This supervisor shall be the same individual through the execution of the Work unless illness, loss of personnel, or other circumstances reasonably beyond the control of the Contractor intervene.
- C. Reference Documents: At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies.
- 1. A complete set of the latest stamped, actioned submittals of record.
  - 2. A complete set of manufacturer's original operation, instruction and service manuals for each equipment item.
- D. Standard Products
- 1. Telecommunications Equipment. Provide telecommunications materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 1 year prior to bid opening. The 1-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 1-year period.
    - a. Alternative Qualifications. Products having less than a 1-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 4000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.
  - 2. Material and Equipment Manufacturing Date

- a. Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

#### E. Test Equipment

##### 1. Requirements:

- a. Maintain and operate test equipment at the fabrication shop and the job site for both routine and Acceptance Testing of the Work of this Section.
- b. Maintain test equipment at the job site while work is in progress from installation of equipment racks until University's Acceptance of this Work; thereafter remove all of this test equipment from the job site.
- c. Unless otherwise indicated, test equipment shall remain property of the Contractor.
- d. Provide all required test cables, jigs and adapters.
- e. Provide equipment with traceable calibration, with calibration date not greater than one year prior to the date of the use of the equipment to perform the specified testing.

#### F. Qualifications

##### 1. Key Personnel, General

- a. Indicate the proposed key persons that are currently employed by the telecommunications contractor or who have a commitment to the low voltage systems and infrastructure contractor for the work of this project. All key persons shall be employed by the low voltage systems and infrastructure contractor at the date of issuance of this project, or if not, have a commitment to the low voltage systems and infrastructure contractor to work on this project by the date that the bid was due to the University Representative.
- b. Note that only the key personnel approved by the University Representative in the successful proposal shall perform work on this project's low voltage systems and infrastructure systems. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the low voltage systems and infrastructure contractor's key personnel requires approval from the University Representative.

#### G. Telecommunications Contractor

1. The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment.
  - a. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years.
  - b. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor.
2. Key Personnel

- a. Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this project depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.
  - b. Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.
  - c. In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of 3 years' experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this project. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this project. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity
3. Minimum Communications Infrastructure Manufacturer Qualifications
    - a. Cabling, equipment and hardware manufacturers shall have a minimum of 3 years' experience in the manufacturing, assembly, and factory testing of components which comply with ANSI/TIA-568.

## 1.6 REGULATORY REQUIREMENTS

- A. Regulations Applicable: Including but not limited to those defined in Division 1.
  1. Nothing in the Contract Documents shall be construed to permit Work not conforming to applicable laws, ordinances, rules, or regulations.
  2. Safety Agency Listing: All devices provided under the Work of this Section which are connected to the Project electrical system shall be listed by a Nationally Recognized Testing Laboratory, and shall be so labeled.

3. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the University Representative. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

## **1.7 DELIVERY, STORAGE AND HANDLING**

### **A. Procedures:**

1. In accordance with Division 1, as specified in the individual sections of Division 27 and the following.

### **B. General**

1. Protect materials and equipment from damage during delivery, storage, handling and throughout the staging and construction periods. Equipment and materials shall be protected against physical damage, dirt, theft, sun, moisture (including surface water and precipitation) and extreme temperature.
2. The top and bottom ends of all cable shall be available for testing. When not being prepared for testing, both ends of each cable shall be sealed to prevent the ingress of moisture.
3. Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.
4. Do not deliver or install equipment frames and cable trays until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, and work above ceilings is complete.
5. During installation, equipment shall be protected against entry of foreign matter on the inside and be vacuum-cleaned both inside (as appropriate) and outside before testing, operating or painting.
6. As determined by the University Representative, damaged equipment shall be fully repaired or shall be removed and replaced with new equipment to fully comply with requirements of the Contract Documents. The decision of the University Representative shall be final.
7. Painted surfaces shall be protected with removable heavy kraft paper, sheet vinyl or equal, installed at the factory and removed prior to final inspection.
8. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with same quality of paint and workmanship as used by manufacturer.

## **1.8 ENVIRONMENTAL REQUIREMENTS**

- A. Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, non-condensing.

## 1.9 SEQUENCING

- A. Work with owner or owner's representative to sequence all work across trades and develop a coordinated schedule.

## 1.10 OPERATING AND MAINTENANCE DATA

- A. Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the communications cabling and systems. Precede the manuals with a systems narrative specific to this Project, outlining the major systems functionality, the major systems components, and identifying which manuals document the performance of which subsystems.

1. Submit operations and maintenance data in accordance with Section 01 77 00 – Closeout Procedures and 01 78 00 - Closeout Submittals and as specified herein not later than 2 weeks prior to the date of beneficial occupancy or as specified in Division 1, whichever is sooner.

## 1.11 PROJECT RECORD DOCUMENTS

Comply with Section 01 77 00 – Closeout Procedures, Section 01 78 00 Closeout Submittals, and the following. Include at least as much information as required for the submittal drawings.

### A. Record Drawings

1. CAD.
  - a. Use a computer aided drafting (CAD) system in the preparation of record drawings for this Project. CAD system shall produce files in AutoCAD® .DWG format, version 2004 or later.
2. Except where prohibited by Contract, University will furnish CAD backgrounds in AutoCAD® .DWG format, for use by the Contractor in preparing Record Drawings.
3. Contractor shall be responsible for updating building and communications plans to reflect as-built conditions.
  - a. Indicate actual work on Drawings; indicate actual products used, replace vendor neutral nomenclature used in bid set with makesand models of actual installed devices.
4. Disk copy of Record Drawings: Two (2) sets of CDs or DVDs of the as-built drawings.
5. Reproducible: As required by Division 1

- B. Provide T drawings including documentation on cables and termination hardware in accordance with ANSI/TIA-606. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum. Provide the following T5 drawing documentation as a minimum:

1. Cables - A record of installed cable shall be provided in accordance with ANSI/TIA-606. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility in accordance with ANSI/TIA-606. Include manufacture date of cable with submittal.



2. Termination Hardware - A record of installed patch panels, cross-connect points, distribution frames, terminating block arrangements and type, and outlets shall be provided in accordance with ANSI/TIA-606. Documentation shall include the required data fields as a minimum in accordance with ANSI/TIA-606.
3. The list of minimum required Project Record drawings is as follows:
  - a. All cabling outlets with IDs for each connector on the faceplate;
    - i. Two inch (2") and larger conduit pathways to include conduit size label;
    - ii. Pull box locations;
    - iii. Two inch (2") & four inch (4") J hook runs indicated by a line series of "x"s;
    - iv. Telecom room layout labeled per current construction drawing field mark-ups;
    - v. Rack elevation labeled per current construction drawing field mark-ups;
    - vi. Backbone copper and fiber schematic drawings with labeling information

#### C. Record of Cable Plant Test

1. Two (2) sets of CDs or DVDs of final University accepted cable plant testing results documentation.
2. Provide at least a copy of software with at least 1 user license if required to view submitted test data.

#### D. Penetrations

1. All penetrations provided under the work of the project, including fire rated and non-fire rated.

#### E. Fire stopping

1. Two (2) sets of CDs or DVDs of all fire stop graphical UL fire resistance manual reference drawings and supporting text.

#### F. Spare Parts

1. In addition to the requirements of Section 01 77 00 – Closeout Procedures, provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

### 1.12 WARRANTY SERVICE

#### A. In addition to provisions of Division 1, provide the following.

1. Response Time: Provide a qualified technician familiar with the work at the Project Site within 24 hours after receipt of a notice of malfunction. Provide the University Representative with telephone number attended 8 hours a day, 5 days a week, to be called in the event of a malfunction.
2. The Contractor shall provide a one (1) year material and labor warranty on all the work the Contractor has performed.

3. Provide all additional Warranties as defined in each Communication Systems Section.

### **ACCEPTANCE REVIEW AND TESTING PROCEDURES**

- A. Complete all Work of this Section. Submit Test Report. Submit review copies of Operating and Maintenance Manuals, less reduced set of Record Drawings. Notify the University Representative in writing that the Work of these Sections is complete and fully complies with the Contract Documents. Request Acceptance Review and Testing. The University Representative will conduct Verification of Submitted Test Data, and otherwise direct testing and adjustment of this Work. These procedures may be performed at any hour of the day or night as required by the University Representative to comply with the Project Schedule and avoid conflict with Residents. Provide all specified personnel and equipment at any time without claim for additional cost or time.
- B. Personnel: Provide services of the designated supervisor and additional technicians familiar with work of this Section. Provide quantity of technicians as required to comply with Project Schedule.
- C. In addition, provide:
  1. All tools appropriate for performance of adjustment of and corrections to this Work. Include spare wire and connectors and specified tooling for application.
  2. Ladders, scaffolding and/or lifts as required to access high devices.
  3. All test equipment.
  4. Complete set of latest stamped, actioned submittals of record for reference.
  5. Complete set of Test Reports.
  6. Complete set of manufacturer's original operation, instruction and service manuals for each equipment item for reference.
  7. Demonstrate: Complete operation of all systems and equipment, including Portable Equipment.
  8. Adjust: As directed by the University Representative.
  9. Correct: In timely manner, failure to comply with the Contract Documents, as reasonably determined by the University Representative.
- D. Temporary Equipment: Provide and operate, without claim for additional cost or time, temporary equipment and/or systems to provide reasonably equivalent function, as determined by the University Representative, in place of the Work of this Section which is incomplete or found not in conformance with the Contract Documents as of seven (7) days prior to the scheduled completion date. Provide such temporary equipment until Acceptance of the Work of this Section. Thereafter, remove such temporary equipment.

### **1.14 CLOSEOUT**

- A. Punch List: Perform any and all remedial work, at no claim for additional cost or time. Where required, retest and submit Test Report. Notify the University Representative of completion of Punch List.

- B. Portable Equipment: Furnish all portable equipment and spares to the University Representative, along with complete documentation of the materials presented. Where applicable, furnish portable equipment in the original manufacturer's packing.
- C. Operating and Maintenance Data: Install framed operating and maintenance instructions. Submit Manuals.
- D. Project Record Documents: Submit print and digital copies. Digital files shall be in AutoCAD .dwg format.
- E. Keys: If applicable, replace construction locks with permanent locks. Provide 5 sets of keys to the University Representative.
- F. Instruction: Conduct specified instruction.
- G. Warranty: Submit Warranty dated to run from date of Acceptance of the Work of this Section.

## ***PART 2 - PRODUCTS***

### **GENERAL**

- A. Where a particular material, device, piece of equipment or system is specified directly, the current manufacturer's specification for the same shall be considered to be a part of these specifications, as if completely contained herein in every detail.
- B. Each material, device or piece of equipment shall comply with all of the manufacturer's current published specifications for that item.
- C. Products shall be made by manufacturers regularly engaged in the production of such products.
- D. Provide quantity as shown on Contract Drawings, or as otherwise indicated.
- E. Provide all auxiliary and incidental materials and equipment necessary for the operation and protection of the Work of this Section as if specified in full herein.
- F. Unless recycled content is specified, provide new materials.
- G. Provide the manufacturer's latest design/model, permanently labeled with the manufacturer's name, model number and serial number.
- H. Where products are of similar type or use, provide products of the same manufacturer, unless otherwise indicated. When more than one unit of the same type of equipment or material is required, such units shall be the products of a single manufacturer and part number.
- I. UCSC has established an installed product set for the campus IT systems. It is the intention of UCSC ITS to continue the use of the established product set to match existing. The first-named product in these specifications is the basis for the design. Substitutions which are equal in quality, utility, and appearance to those specified must be submitted and meet all requirements of Division 01 specification section 01 25 00 Substitution Procedures
- J. Components
  - 1. UL or third party certified. Cabling and interconnecting hardware and components for telecommunications systems shall be UL listed or third party independent testing

laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.

2. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance.
  - a. The label or listing by the specified organization will be acceptable evidence of compliance.
  - b. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the University Representative.
  - c. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

K. Enclosures:

1. Provide steel frames and enclosures designed and wired to eliminate all induced currents.
2. Make bolted connections with self-locking devices.
3. Ensure enclosures exposed to weather, are weather-tight, rain and leak proof, and include thermostatically controlled fans to maintain the optimum operating temperature as specified by the equipment manufacturer.

L. Finishes: Any item or component of the Work of this Section which is visible shall comply with the following.

1. Finishes noted or scheduled on the Contract Drawings take precedence.
2. Where design location requires that products, materials or equipment are visible to the public, no manufacturer's logos larger than 1/2 inch shall be visible. Unless Otherwise noted or directed, neatly remove or permanently paint out such logos.
3. Where finishes are not noted or otherwise defined in the Contract Documents, submit manufacturer's standard finish samples for selection by the University Representative.

## ***PART 3 - EXECUTION***

### **INTENT OF DRAWINGS AND SPECIFICATIONS**

- A. Contractor shall keep on the Project site a copy of the Specifications and Drawings, and the same shall be available at all reasonable times for inspection and use by The University Representative and by any other person authorized by The University Representative. Any Drawings listed in the detail Specifications shall be regarded as a part thereof and of the Contract. Anything mentioned in these Specifications and not shown on the Drawings, or shown on the Drawings and not mentioned in these Specifications, shall be of like effect as though shown or mentioned in both.
- B. It shall be the duty of Contractor to see that the provisions of these Specifications are complied with in detail irrespective of the inspection given the work during its progress by The University

Representative. Any failure on the part of Contractor to observe the Specifications will be sufficient cause for the rejection of the work at any time before its acceptance.

- C. The drawings use symbols and schematic diagrams to indicate the scope of work. These symbols and diagrams will not typically identify dimensions nor will they identify inclusion of specific accessories, appurtenances and related items necessary and appropriate for a complete and proper installation and operation. The Contractor shall install work complete and ready for proper operation, including related items not specifically identified, shown, indicated or specified. The work shall be installed in accordance with the intent diagrammatically expressed on the drawings and in conformity with the dimensions indicated on architectural drawings and on shop drawings approved by the University Representative.
- D. The drawings include some details for various items, which are specific with regard to the dimensions and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not obviate field coordination for the indicated work. Work shall not proceed until actual field conditions and requirements are verified by the Contractor.
- E. The University Representative will furnish from time to time, such detail drawings, drawings, profiles, and information as The University Representative may consider necessary for Contractor's guidance to insure the proper and adequate execution of the Contract. Contractor shall comply with such detail drawings, drawings, profiles and information.
- F. In accordance with the requirements of Division 1, only shop drawings and submittals have been received a review of "No Exceptions Taken" or "Make Corrections As Noted" shall be used in construction.
- G. Contractor shall not scale the Contract Document set to determine exact dimensions or exact location. Scaled drawings are to be considered diagrammatic. If exact lengths or location placement dimensions are required, the drawings will specifically show those dimensions or placement coordinates.

## **Installation**

- A. The Contractor shall furnish all required materials, equipment, and tools necessary to properly complete the work of these specifications including, but not limited to, tools for pulling and terminating the cables, mounting hardware, cable ties, bolts, anchors, clamps hangers, kits of consumables, lubricants, technician communication devices, cable testing equipment, stands for cable reels, cable winches, etc.

## **Examination**

- A. The Contractor is responsible for examining existing conditions and comparing them with drawings and specifications and notifying the University Representative or his/her designate of any discrepancies.
- B. The Contractor is responsible for coordinating with the University Representative or his/her designate to address, adjust, and resolve any discrepancies found before commencing work.
- C. If a discrepancy between existing conditions and the Contract drawings and specifications are found after commencing work, stop any work that in the Contractor's opinion is affected by the found discrepancy. The contractor shall submit an RFI requesting information on how to resolve

the discrepancy. The RFI shall also contain a possible solution, before commencing work in work areas affected by the discrepancy.

### **Preparation**

- A. Prepare and sequence the work to minimize disruption to each room environment and existing communications systems.
- B. The Contractor shall follow all rules, regulations, and instructions in this specification, general provisions of the Contract, including General and Supplementary Conditions, and Division 1 specification sections, if issued in conjunction with these Division 27 specifications with regard to the following:
  - 1. Delivery hours
  - 2. Delivery locations
  - 3. Storage
  - 4. Hazardous Material
  - 5. Security
  - 6. Safety
  - 7. Logistics
- C. The Contractor shall coordinate their work so there shall be no disruption to any occupants of the UCSC campus unless coordinated and approved by the University Representative. Any necessary disruption shall be scheduled a minimum of 2 weeks in advance of its occurrence and affected parties shall be notified in writing of date, time, and planned duration of the disruption.
- D. Protection:
  - 1. When work is being done in or adjacent to occupied spaces, the Contractor shall protect the occupied spaces from dust, trash and debris through the use of barriers and/or other devices
  - 2. When working in occupied spaces, cover all computers, electronic equipment, desks, chairs, furniture and other articles when working at ceiling level and/or performing dust producing tasks.
  - 3. At no time shall the Contractor use University property including but not limited to University furniture, loose equipment or supplies located in occupied spaces in the course of installing the work of this project.

### **3.5 Cleaning**

- A. When working in spaces not currently occupied by University personnel during ordinary work week:
  - 1. Work areas shall be left broom clean at the end of each work day. This includes the removal of packing material, trash and debris caused by the work.
- B. Where working in spaces occupied by the University:

1. Immediately after completing work within each space, clean up and remove all materials, scrap and dust.
2. Surfaces exposed to dust either during the installation or following removal of protection systems as specified herein above shall be cleaned to their original state daily prior to the return of the occupants to the space.
3. All dust resulting from work performed shall be vacuumed up daily prior to the return of the occupants to the space.

C. Disposal

1. All scrap material in work area shall be picked up and removed from the building at the end of each day.
2. See Division 1 for additional requirements and project procedures for waste disposal and recycling requirements that apply to this project.

### 3.6 Repair and Restoration

- A. Where working in spaces occupied by the University, return to their original positions any furniture or articles relocated to perform the work.

### 3.7 Verification

- A. The Contractor shall verify that the installation and materials used have been inspected before they are enclosed within building features, or otherwise hidden from view. The Contractor shall bear costs associated with uncovering or exposing installations or features that have not been inspected and approved.
- B. The Contractor shall verify that requirements of this specification are met. Verification shall be through a combination of analyses, inspections, demonstrations and tests, as described below.
- a. Verification by Inspection. Verification by inspection includes the examination of items and comparison of pertinent characteristics against the qualitative or quantitative standard set forth in the specifications. Inspection may require moving or partially disassembling the item to accomplish the verification, included as part of the work at no additional cost to the University.
- C. Verification by Test and Demonstration. The Contractor shall verify by formal demonstrations or tests that the requirements of this specification have been met. The Contractor shall demonstrate that the communications systems components and subsystems meet specification requirements in the "as-installed" operating environment during the System Operation Test. Even though no formal environmental testing is required, the Contractor shall measure and record temperature, humidity and other environmental parameters and the environmental conditions, which were encountered during the System Operation Test.

### 3.8 COMMISSIONING AND ACCEPTANCE

A. General:

1. Upon completion of the work, remove excess debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.

**B. Results Expected:**

1. Communications Infrastructure Systems shall be complete and ready for use.
2. Testing, start-up and cleaning work shall be complete.
3. Maintenance Materials: Special tools for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the University.

**C. Inspections**

1. There shall be three phases of commissioning inspections:
  - a. Rough-in inspection
  - b. Above-ceiling inspection (after cables are placed)
  - c. Final inspection and testing
2. The Contractor shall verify that the installation and materials used have been inspected before they are enclosed within building features, or otherwise hidden from view. The Contractor shall bear costs associated with uncovering or exposing installations or features that have not been inspected and approved.

**D. Rough-in inspection.** Once electrical rough-in and pathways have been installed, but prior to walls and ceilings being installed, the Contractor shall request the design team, in writing, for the official rough-in inspection to take place. The University Representative will then schedule a time to be on-site to conduct this inspection.

1. At a minimum, the University Representative will evaluate the following items:
  - a. Accurate location and height above finished floor for all outlet boxes.
  - b. Accurate dimensions (particularly depth) of all outlet boxes and diameter of in-wall conduit serving outlet boxes.
  - c. Cable tray size, location, and clearance.
  - d. Location and size of all other communications conduits or pathways.
  - e. Location, spacing and clearance of and around racks and wall-mounted equipment.
  - f. That communications room power receptacles, where installed under the work of this project, meet the design requirements.
2. The University Representative is then to issue a written report to the Contractor identifying all items which currently do not meet the construction document requirements. All items are to be resolved prior to walls and ceilings being closed up. This report is not necessarily all-inclusive; should issues be discovered later in the project, the Contractor is still responsible for corrections/repairs.

**E. Above-ceiling inspection**

1. Once all communication cabling has been installed and properly supported and walls have been painted, but prior to the installation of ceiling tiles/material, contractor shall request of the design team, in writing, for the official above-ceiling inspection. The



University Representative will then schedule a time to be on-site to conduct this inspection

2. At a minimum, the University Representative will evaluate the following items:
  - a. That all items from the previous inspection have been corrected.
  - b. That communications cabling is routed correctly and adequately supported.
  - c. That communications cabling is not painted or over-sprayed.
  - d. That the installed communications cabling matches what was specified/submitted.
  - e. That there are no kinks, splices, or other damage to the installed communications cabling.
  - f. That all cables and WAOs are properly labeled.
  - g. That all penetrations through fire-rated walls are properly firestopped, including fire blocking materials installed in the annular spaces; and that the firestops are properly labeled.
3. The University Representative is then to issue a written report to the Contractor identifying all items which currently do not meet the construction document requirements. This report is not necessarily all-inclusive; should issues be discovered later in the project, the appropriate communications subcontractor is still responsible for corrections/repairs.

#### F. Final inspection.

1. Once all communications work has been completed, contractor shall request of the University Representative, in writing, the official final inspection. This request shall be made 3 weeks before substantial completion. The University Representative will then schedule a time to be on-site to conduct this inspection.
2. At a minimum, the University Representative will check the following items:
  - a. That all items from the previous inspections have been corrected.
  - b. That all faceplates are installed, with the correct modules, quantity of modules, and approved labeling scheme.
  - c. That all equipment and cabling within communications rooms is installed per the contract documents, including all patch panels and wall blocks (with specified spare capacity), horizontal and backbone cabling labeling, and telecommunications grounding.
  - d. And all other items necessary to guarantee contract documents are met and complete and functioning communications systems are installed.
  - e. That all cables and WAOs are properly labeled.
  - f. That all penetrations through fire-rated walls are properly firestopped, including fire blocking materials installed in the annular spaces; and that the firestops are properly labeled.

3. The Contractor shall provide the following for the acceptance testing.
  - a. All personnel required for perform the tests. This shall include the site supervisor.
  - b. All tools appropriate for performance of adjustment of and corrections to this Work. Include spare wire and connectors and specified tooling for application.
  - c. Ladders, scaffolding and/or lifts as required to access high devices.
  - d. All test equipment.
  - e. Complete set of latest stamped, actioned submittals of record for reference.
  - f. Complete set of Test Reports.
  - g. Complete set of manufacturer's original operation, instruction and service manuals for each equipment item for reference.
4. The Contractor shall execute the test plan required in the above Submittals section and as approved and/or modified by the University Representative. The testing must demonstrate complete operation of all systems and equipment, including any portable equipment.
5. These procedures may be performed at any hour of the day or night as required by the University Representative to comply with the Project Schedule and avoid conflict with Residents. Provide all specified personnel and equipment at any time without claim for additional cost or time.
6. After installation, the Contractor shall test, certify and provide required warranties for the Structured Cabling System (SCS) installed per the requirements of this specification.

### **Adjustments**

- A. The Contractor is responsible for coordinating and documenting with the University Representative or his/her designate the change order process and fully comply with requirements of Division 1.

### **3.10 Acceptance**

- A. The project specified by this specification shall be considered completed and signed off as completed by the University Representative or his/her designate contingent upon the following:
  1. All punch lists have been completed and signed as complete by the University Representative.
  2. Abandoned cabling has been removed.
  3. Cleaning is complete.
  4. Required cable plant testing has been executed and required test result documentation has been submitted and approved by the University Representative or his/her designate - refer to Section 27 10 00 – Structured Cabling, Basic Materials & Methods
  5. Any required adjustments to as-built drawings have been completed, submitted, and approved as complete by the University Representative or his/her designate.

6. Required warranty documentation has been submitted and approved as complete by the University Representative or his/her designate.

**END OF SECTION 27 05 00**

## **27 05 26 - Grounding and Bonding for Communications Systems**

### ***PART 1 - GENERAL***

#### **1.1 SUMMARY**

- A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of communication bonding required by these specifications and related construction drawings.
- B. Division 26 (16) - Electrical specifications and accompanying drawings are particularly applicable to this section of this Division 27 specification.
- C. The specification sections of this Division 27 that are particularly applicable to this section include, but are not limited to, the following:
  - 1. Section 27 00 00 – Communications
  - 2. Section 27 06 00 - Communications Product Schedule
  - 3. Section 27 11 13 - Communications Entrance Protection
  - 4. Section 27 11 16 - Communications Cabinets, Racks, Frames, and Enclosures
  - 5. Section 27 13 00 - Communications Backbone Cabling
  - 6. Section 27 11 19 - Communications Termination Blocks and Patch Panels

#### **1.2 QUALITY CONTROL**

Comply with Section 27 00 00 - Communications.

#### **1.3 WARRANTIES**

Comply with Section 27 00 00 - Communications.

#### **1.4 MATERIAL SUBSTITUTIONS**

Comply with Section 27 00 00 - Communications.

#### **1.5 SUBMITTALS**

Comply with Section 27 00 00 - Communications.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

Comply with Section 27 00 00 - Communications.

### ***PART 2 - PRODUCTS***

#### **2.1 QUANTITY DETERMINATION**

Comply with Section 27 00 00 – Communications.

## 2.2 BUSBARS

Furnish all required telecommunications grounding system busbars - See Section 27 06 00 - Communications Product Schedule

## 2.3 BONDING CONDUCTORS

Furnish all required 6 AWG green thermoplastic insulated stranded copper wire - See Section 27 06 00 - Communications Product Schedule

## 2.4 BONDING CONDUCTOR TERMINATIONS

- A. Furnish all required two-hole compression lugs: Color coded to appropriate cable, high conductivity wrought copper, electro tin plated - See Section 27 06 00 - Communications Product Schedule
- B. All bonding compression lugs and other bonding hardware shall be Underwriters Laboratories (UL), or other nationally recognized testing laboratory acceptable to UCSC, listed for the application intended.

## PART 3 - EXECUTION

### 3.1 GENERAL

The contractor shall comply with all requirements as listed in ANSI/TIA-607 "Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications" whether shown on the drawings or not.

### 3.2 INSTALLATION

- A. Install busbars per manufacturer's instructions and at locations shown on the plans. If locations are unclear, clarify location with PP&C project manager before installing.
- B. Provide all bonding and grounding as specified by these Division 27 specifications and the conjoined construction drawings. In particular, make sure, when present in a Telecommunication Room (TR), that the following elements are bonded and grounded:

Element	Bonded	Grounded
Metallic equipment racks.		X
Cable Shields	X	X
Copper Cable Protector Modules		X
All metal raceways and cable trays.	X	X

Vertical Busbars on each rack		X
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- C. Bonding conductors shall be continuous and routed in as direct a route as possible to the point of termination while adhering to the following: No bonding conductor shall vertically traverse a wall except at wall corners.
- D. Clean ground bars prior to terminating bonding conductors.
- E. Remove paint or finish from racks or other devices directly underneath the hardware to insure conductivity.
- F. Label ground wire at Busbar with name of bonded equipment (rack, tray, etc.)
- G. Ground and bond per Manufacturer's specifications

### 3.3 EXAMINATION

Comply with Section 27.00 00 – Communications.

### 3.4 LABELING

- A. Reference construction drawings accompanying this Division 27 specification.
- B. Label all telecommunications bonding conductors as close as possible to the termination points with an ANSI/TIA-606 compliant label for bonding.

### 3.5 AS-BUILT DRAWINGS

Comply with Section 27 00 00 – Communications.

**END OF SECTION 27 05 26**

## 27 05 29 - Hangers and Supports for Communications Systems

### **PART 1 - GENERAL**

#### **1.1 SCOPE OF WORK**

A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the provision of communications supports and cable hook system as described in this specification, including but not limited to:

1. Strut supports
2. Cable Hooks (J-hooks)
3. Beam clamps
4. Concrete Fasteners
5. Touch-Up Materials
6. Conduit supports.
7. Equipment supports.
8. Fastening hardware.

B. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1. Section 27 05 00 – Common Work Results for Communications
2. Section 27 05 26 – Grounding and Bonding for Communications Systems
3. Section 27 05 33 – Conduits and Backboxes for Communications Systems
4. Section 27 05 36 – Cable Trays for Communications Systems
5. Section 27 05 39 – Surface Raceways for Communications Systems
6. Section 27 05 48 – Noise and Vibration Controls for Communications Systems
7. Section 27 05 53 – Identification for Communications Systems
8. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
9. Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures
10. Section 27 11 23 – Communications Cable Management
11. Section 27 15 00 – Communications Horizontal Cabling

#### **1.2 SYSTEM DESCRIPTION**

A. Provide devices specified in this Section and related Sections for support of communications equipment specified for this Project.

B. Provide support systems that are adequate for the weight of equipment, conduit and wiring to be supported.

### 1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM A123/A123M-02 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  - 2. ASTM A153/A153M-04 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
  - 3. ASTM B633-98e1 Specification for Electro-deposited Coatings of Zinc on Iron and Steel.
  - 4. ASTM A653/A653M-04a Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. American National Standards Institute (ANSI) – Current Version
  - 1. ANSI/TIA-568
  - 2. ANSI/ TIA 569
- C. National Fire Protection Association
  - 1. NFPA 70, National Electrical Code

### 1.4 SUBMITTALS

- A. Conform with the requirements of Section 01 33 00 – Submittal Procedures and Section 27 05 00 - Common Work Results for Communications and the following:
  - 1. As part of the project submittals, the contractor to provide engineered shop drawings indicating the proposed design for mounting all work of this Division, inclusive of mounting systems weighing more than 20 pounds and exterior mounted equipment.
    - a. Shop drawings to be accompanied by anchorage calculations indicating that it shall remain attached to the mounting surface after experiencing forces in conformance with California Code of Regulations, Title 24, 2010 California Building Code.
    - b. Structural Calculations shall be prepared and signed by a California Registered Structural Engineer. Specify proof loads for drilled-in anchors, if used.

### 1.5 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.
- B. Cable hooks shall be listed and labeled by Underwriters Laboratories (UL) as required.
- C. Cable hooks shall have the manufacturer's name and part number stamped in the part itself for identification.



## **PART 2 - PRODUCTS**

### **2.1 SUPPORTING DEVICES**

#### **A. General**

1. Supports to be sized to suit load and selected to match mounting conditions

#### **B. Manufacturers**

1. See Section 27 06 00 - Communications Product Schedule

#### **C. Concrete Fasteners**

1. Furnish post-installed concrete anchors as required. Each post-installed anchor shall have an ICC-ES evaluation report stating that the product is compliant with the current edition of the CBC and the intended conditions of use.
2. Provide expansion-shield type concrete anchors.
3. Provide powder driven concrete fasteners with washers. Obtain approval from University Representative prior to use.

#### **D. Concrete Inserts**

1. Provide pressed galvanized steel, concrete spot insert, with oval slot capable of accepting square or rectangular support nuts of ¼ inch to ½ inch diameter thread for rod support.

#### **E. Aircraft cable sway braces**

1. Steel rope sized to meet load.

#### **F. Construction Channel:**

1. Construction:
  - a. 1-5/8" square galvanized channel formed from U.S.S.G No. 12 or 0.109 inch cold formed steel with 17/32-inch diameter bolt holes, and 1-1/2 inch on center in the base of the channel.
  - b. 10 foot sections.
2. All supporting materials by same manufacturer.

#### **G. Beam Clamps**

1. Malleable iron electro-galvanized steel beam clamps selected to match building structural steel members.

#### **H. Conduit Straps**

1. One hole strap, steel or malleable iron, with malleable iron clamp-back spacer for surface mounted wall and ceiling applications.
  - a. Use malleable strap with spacers for exterior and wet locations.
  - b. Use steel strap without spacers for interior locations.
2. Steel channel conduit strap for support from construction channel.

3. Steel conduit hanger for pendant support with threaded rod
  4. Steel wire conduit support strap for support from independent #12 gauge hanger wires.
- I. Threaded rods, couplings, screws and nuts:
1. Electrolytically coated with zinc, 2 oz. zinc per square foot of surface, ASTM A123 or A153.
- J. Miscellaneous Parts
1. Hot dipped galvanized after fabrication; after cutting, de-burring and hole drilling. Coated with zinc, 2 oz. zinc per square foot of surface, ASTM A123 or A153.
- K. Paint/Tape for Touch-up:
1. Zinc: CRC "Zinc-It", Glyptal, Enterprise Galvanizing "Galambra", or equal.

## 2.2 CABLE HANGERS

### A. Ceiling Hung J-Hooks

1. Features/Functions/Construction
  - a. Specifically intended to carry the load of up to 50 communications cables without applying excess forces to cables at bottom of bundle.
  - b. Integral broad bottom edge to spread cable load with flat bottom and provide a minimum of 1-5/8 inch cable bearing surface.
  - c. Integral hanger rod attachment hardware at top.
  - d. Load rated for application.
  - e. Incorporates smooth 90-degree radiused edges to prevent snagging cable jackets on installation.
  - f. Designed so the mounting hardware is recessed to prevent cable damage.
  - g. Integral mechanical cable latch retainer to provide containment of cables within the hook. The retainer shall be removable and reusable.
  - h. Suitable for direct attachment to walls, hanger rods, beam flanges, purlins, strut, floor posts, etc. to meet job conditions.
  - i. Multi-tiered cable hooks to be used where required to provide separate cabling compartments, or where additional capacity is needed.
  - j. Finishes:
    - i. Cable hooks for non-corrosive areas shall be pre-galvanized steel, ASTM A653. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish, ASTM B633, SC3.
    - ii. Cable hooks for corrosive areas shall be stainless steel, AISI Type 304.
2. Manufacturer
  - a. See Section 27 06 00 - Communications Product Schedule

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

The University Representative reserves the right to request additional supports where in their sole opinion said supports are required. Any additional supports shall be installed at no additional cost to the University.

### **3.2 EXAMINATION**

Thoroughly examine site conditions for acceptance of supporting device installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

### **3.3 PREPARATION**

- A. Coordinate size, shape and location of concrete pads required for equipment installation with Division 3, Cast-in-place Concrete Specification.
- B. Layout support devices to maintain headroom, neat mechanical appearance and to support the equipment loads.
- C. Where shown on the Drawings or Specifications, install freestanding communications equipment on concrete pads.

### **3.4 INSTALLATION**

- A. Furnish and install supporting devices as noted throughout Division 27.
- B. Communications device and conduit supports shall be independent of all other system supports that are not structural elements of the building, unless otherwise noted.
- C. Fasten hanger rods, conduit clamps, outlet and junction boxes to building structure using precast inserts, expansion anchors, preset inserts or beam clamps.
- D. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster or gypsum board partitions and walls.
- E. Use expansion anchors or preset inserts in solid masonry walls.
- F. Use self-drilling anchors, expansion anchor, or preset inserts on concrete surfaces.
- G. Use sheet metal screws in sheet metal studs and wood screws in wood construction.
- H. Do not fasten supports to piping, ductwork, mechanical equipment, conduit, or acoustical ceiling suspension wires.
- I. Do not drill structural steel members unless first approved in writing by the University Representative.
- J. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- K. Install surface-mounted cabinets with minimum of four anchors. Provide additional support backing in stud walls prior to sheet rocking as required to adequately support cabinets and panels.

- L. Bridge studs top and bottom with channels to support flush mounted cabinets and panelboards in stud walls.

### **3.5 ANCHORAGE**

- A. Identify each item requiring seismic restraint installation in accordance with CBC Chapter 16A.
- B. All floor mounted, free standing electrical equipment such as racks and cabinets, etc. shall be securely fastened to the floor structure.

### **3.6 DISTRIBUTION PATHWAY VIA CEILING HUNG CABLE HOOKS (J-HOOKS):**

- A. Void, Plenum or Suspended Ceiling Exposed Cable Installation. Where drawings specifically show or permit use of exposed cable installation in voids, conform to the most restrictive requirements of Code, TIA-569-C and this Section.
- B. Provide support for all cabling. Do not place or attach directly to T-bar grid, concealed spline grid, flexible or rigid ductwork, HVAC registers, sprinkler piping or fixtures, light fixtures or building structure. Conform to the National Electric Code.
- C. Placement: The distance between supporting rings shall not exceed 48 inches or as required by the current edition of TIA-569-C.
- D. Refer to the separation requirements listed in Section 27 15 00 – Communications Horizontal Cabling for minimum distances from electrical power and other electromagnetic sources.
- E. Follow manufacturer's recommendations for allowable fill capacity for each size of cable hook.
  - 1. Cable hooks shall be capable of supporting a minimum of 30 pounds with a safety factor of 3.
  - 2. Spring steel cable hooks shall be capable of supporting a minimum of 100 pounds with a safety factor of 3 where extra strength is required.
  - 3. Where aggregate cable bundle supported by ceiling hung cable hooks exceeds either the rated cable or weight load limit of the ceiling hung cable hook system, provide ceiling basket tray – Type CTW – as specified in Section 27 05 36.

**END OF SECTION 27 05 29**

## 27 05 33 - Conduits and Backboxes for Communications Systems

### **PART 1 - GENERAL**

#### **1.1 SCOPE OF WORK**

- A. Provide telecommunications pathways in accordance with ANSI/TIA-569, as specified in this Section and as shown on the plans. Provide system furniture pathways in accordance with UL 1286.
1. Provision of all low voltage Communications Systems Pathway and Electronic Security and Safety System Pathway, including:
    - a. Rigid steel conduit and fittings.
    - b. PVC insulated rigid steel conduit and fittings.
    - c. Intermediate metal conduit and fittings.
    - d. Electrical metallic tubing and fittings.
    - e. Flexible metallic conduit and fittings.
    - f. Liquidtight flexible metallic conduit and fittings.
    - g. Miscellaneous conduit fittings and products.
  2. Terminal cabinets and pull boxes
- B. Provide fire penetration sealant systems at rated wall and floor/ceiling penetrations and where indicated.
- C. At Hazardous Occupancies, installation conforms to the requirements of National Electric Code for Class and Division rating of spaces.

#### **1.2 RELATED WORK IN OTHER SECTIONS:**

- A. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.
1. Division 1: Cutting and patching.
  2. Section 27 05 00 – Common Work Results for Communications.
  3. Section 27 05 26 – Grounding and Bonding for Communications Systems
  4. Section 27 05 29 – Hangers and Supports for Communications Systems
  5. Section 27 05 36 – Cable Trays for Communications Systems
  6. Section 27 05 39 – Surface Raceways for Communications Systems
  7. Section 27 05 48 – Noise and Vibration for Communications Systems
  8. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
  9. Section 27 13 00 – Communications Backbone Cabling

## 10. Section 27 15 00 – Communications Horizontal Cabling

**1.3 REFERENCES**

## A. Usage: In accordance with Division 1.

1. American National Standards Institute (ANSI) - Current Version
  - a. ANSI C80.1 - Rigid Steel Conduit - Zinc Coated
  - b. ANSI C80.3 - Electrical Metallic Tubing - Zinc Coated
2. American Society For Testing and Materials (ASTM)
  - a. ASTM E 84 Surface Burning Characteristics of Building Materials
  - b. ASTM E 119 Fire Tests of Building Construction and Materials
  - c. ASTM E 814 Fire Tests of Penetration Firestop Systems
3. BICSI
  - a. Telecommunications Distribution Methods Manual (TDMM)
  - b. Information Transport Systems Installation Methods Manual (ITSIMM)
4. National Electrical Manufacturers Association (NEMA)
  - a. NEMA 250-2003 Enclosures for Electrical Equipment (1000 Volts Maximum)
  - b. NEMA FB 1 (ANSI/NEMA FB 1-2003) Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
  - c. FB 2.10 2000 Selection and Installation Guidelines For Fittings For Use With Non-Flexible Metallic Conduit Or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, And Electrical Metallic Tubing).
  - d. FB 2.20 2000 Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable
  - e. NEMA ICS 6 1988 (Rev. 1) Enclosures for Industrial Control and Systems
  - f. NEMA OS 3-2002 Selection and Installation Guidelines for Electrical Outlet Boxes.
  - g. NEMA RN 1-1998 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
  - h. NEMA TC 7 2000 Smooth Wall Coilable Polyethylene Electrical Plastic Duct
  - i. NEMA TC 13 2000 Electrical Nonmetallic Tubing (ENT).
  - j. NEMA TC 14 1984(R 1986) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
5. National Fire Protection Association
  - a. NFPA 10 Life Safety Code
6. Underwriters Laboratories, Inc. (UL)

- a. UL 1 2000 Flexible Metal Conduit
- b. UL 6 2004 Electrical Rigid Metal Conduit – Steel
- c. UL 50 (1995; R 1999, Bul. 2001) Enclosures for Electrical Equipment
- d. UL 263 Fire Tests of Building Construction and Materials
- e. UL 360 1986 (Bul. 1991) (R 1993) Liquid-Tight Flexible Steel Conduit
- f. UL 514A 1991 (R 2004) Metallic Outlet Boxes
- g. UL 514B 1989 (R 2004) Conduit, Tubing and Cable Fittings
- h. UL 514C 1996 (R 2000) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
- i. UL 651 1989 (R 1989) (Bul. 1993) Schedule 40 and 80 Rigid PVC Conduit.
- j. UL 723 Surface Burning Characteristics of Building Materials
- k. UL 797 1993 (R 2004) Electrical Metallic Tubing – Steel
- l. UL 1242 1983 (R1993) (Bul. 1993) Intermediate Metal Conduit.
- m. UL 1286 (1999; R 2001, Bul. 2002) Office Furnishings
- n. UL 1479 Fire Tests of Through Penetration Firestops
- o. UL Fire Resistance Directories

#### 1.4 SUBMITTALS

A. Conform with the requirements of Division 1 and Section 27 05 00 - Common Work Results for Communications and the following:

- 1. Contractor shall complete and submit for review to University Representative
  - a. Coring/Sawcutting Summary Description and obtain written authorization for University prior to the commencement of any cutting or coring activities. Contractor shall include all pertinent information with the Coring/Sawcutting Summary Description and submit with detailed work plan fourteen (14) days prior to desired coring/cutting activity.
  - b. Coring/Sawcutting Summary Description to identify means of protection of the:
    - i. Structural integrity of any element of Project.
    - ii. Integrity of weather-exposed or moisture-resistant element.
    - iii. Efficiency, maintenance, or safety of any operational element.
    - iv. Visual qualities of sight-exposed elements.
    - v. Work of University.
    - vi. Utility supply, drains, fire alarm, communication.
  - c. Include in request:

- i. Identification of Project, including University Project Name and A/C number.
- ii. Location and description of affected Work.
- iii. Necessity for cutting and patching.
- iv. Description of proposed work, and products to be used, methods to be employed to locate existing structural members.
- v. Alternatives to cutting and patching.
- vi. Effect on work of University.
- vii. Date and time work will be executed.
- viii. Location on form for University Representative to provide direction.

## 1.5 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.
- B. Only products and applications listed in this Section may be used on the project unless otherwise submitted and approved by the University Representative.
- C. Comply with Section 27 00 00 Communications General Requirements.
- D. Comply with Section 27 05 41 Fire-Stopping Systems
- E. Mortar may be used to fill the annular space around a sleeve only if such material and application meets the requirements of the California Building Code Section 713, paragraph 713.3.1.

## **PART 2 - PRODUCTS**

### 2.1 GENERAL

Provide the following types of conduit systems listed by their commonly used generic name.

### 2.2 RACEWAY

- A. Manufacturers:
  1. See Section 27 06 00 - Communications Product Schedule
- B. Rigid Steel Conduit.
  1. Drawing and Spec Reference: RSC.
  2. Construction:
    - a. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and UL 6.



- b. Standard threaded couplings, locknuts, bushings, and elbows: Only materials of steel or malleable iron are acceptable. Locknuts shall be bonding type with sharp edges for digging into the metal wall of an enclosure.
- c. Three piece couplings: Electroplated, cast malleable iron.
- d. Insulating bushings: Threaded polypropylene or thermosetting phenolic rated 150 degree C minimum.
- e. Insulated grounding bushings: Threaded cast malleable iron body with insulated throat and steel "lay-in" ground lug with compression screw.
- f. Insulated metallic bushings: Threaded cast malleable iron body with plastic insulated throat rated 150 degrees C.
- g. All fittings and connectors shall be threaded.

#### C. Coated Rigid Steel Conduit:

- 1. Drawing and Spec Reference: CRSC.
- 2. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and NEMA RN-1 with nominal 40 mil thermoplastic vinyl coating, heat fused and bonded to the exterior of the conduit.
  - a. Fittings:
    - i. Conduit couplings and connectors shall be as specified for galvanized rigid steel conduit and shall be factory PVC coated with an insulating jacket equivalent to that of the coated material.
    - ii. Fittings over-sleeve to extend 1 conduit diameter or 1-1/2" beyond fitting, whichever is less.
  - b. Performance:
    - i. Tensile Strength: 3500 psi.
  - c. Approvals:
    - i. NEMA RN1 (Type 40 - 40 mils thick)
    - ii. CalTrans Type 2
  - d. Manufacturers:
    - i. See Section 27 06 00 – Communications Product Schedule

#### D. Intermediate Metal Conduit

- 1. Drawing Reference: IMC
- 2. Conduit: Hot dip galvanized steel meeting the requirements of NEC Article 345 and conforming to ANSI C80.6 and UL 1242.
- 3. Fittings: Conduit couplings, connector and bushing shall be as specified for galvanized rigid steel conduit. Integral retractable type IMC couplings are also acceptable.

#### E. Electrical Metallic Tubing.

1. Drawing and Spec Reference: EMT.
2. Conduit: Shall be formed of cold rolled strip steel, electrical resistance welded continuously along the longitudinal seam and hot dip galvanized after fabrication. Conduit shall conform to ANSI C80.3 specifications and shall meet UL classifications.
3. Set screw-type couplings: Electroplated, steel or cast malleable iron, UL listed concrete tight. Use set screw-type couplings with four set screws each for conduit sizes over 2 inches. Set screws shall be of case hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
4. Set screw-type connectors: Electroplated steel or cast malleable iron UL listed concrete tight with male hub and insulated plastic throat, 150 degree C temperature rated. Set screw shall be same as for couplings.
5. Rain-tight couplings: Electroplate steel or cast malleable iron; UL listed rain-tight and concrete tight, using gland and ring compression type construction.
6. Rain-tight connectors: Electroplated steel or cast malleable iron, UL listed Rain-tight and concrete tight, with insulated throat, using gland and ring compression type construction.

#### F. Flexible Conduit:

1. Drawing Reference: FLEX
2. Construction:
  - a. Flexible steel, zinc coated on both inside and outside by hot-dipping process.
  - b. Interlocking spirally wound continuous steel strip.
  - c. 3/4" minimum size.
3. Fittings: Connectors shall be of the single screw clamp variety with steel or cast malleable iron bodies and threaded male hubs with insulated throats. Exception: Pressure cast screw-in connectors shall be acceptable for fixture connection in suspended ceilings and cut-in outlet boxes within existing furred walls.
4. Approvals:
  - a. UL 1

#### G. Liquidtight Flexible Metallic Conduit

1. Drawing Reference: Liquidtight
2. Conduit: Shall be fabricated in continuous lengths from galvanized steel strips, interlocking spirally wound, covered with extruded liquidtight jacket of polyvinyl chloride (PVC) and conforming to UL 360. Provide conduit with a continuous copper-bonding conductor wound spirally between the convolutions.
3. Fittings: Connector body and gland nut shall be of cadmium plated steel or cast malleable iron, with tapered, male, threaded hub; insulated throat and neoprene "O" ring gasket recessed into the face of the stop nut. The clamping gland shall be of molded nylon with an integral brass push-in ferrule.

## 2.3 MISCELLANEOUS CONDUIT FITTINGS AND PRODUCTS

### A. General

1. UL 514B.
2. Listed in UL Electrical Construction Materials List.

### B. Conduit Fittings, Insulated Throat Grounding Bushings

1. Description
  - a. Threaded for Rigid Steel Conduit and Intermediate Metal Conduit.
  - b. UL Listed for use with copper conductors.
  - c. Thermoplastic insulated liner for 105 degrees Celsius.
  - d. Body of malleable iron, zinc plated; or die cast zinc.
2. Manufacturer
  - a. See Section 27 06

### C. Epoxy

1. J-B Weld (U.S. Navy preferred product)

### D. One Way/Breakaway Nut for sealing NEMA type PDS pullboxes

1. Subject to approval of University Representative.

E. Watertight conduit entrance seals: Steel or cast malleable iron bodies and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel pressure rings. Fittings shall be supplied with neoprene sealing rings between the body and PVC sleeve.

F. Watertight cable sealing bushings: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel sealing screws and zinc plated cast malleable iron locking collar.

G. Expansion fittings: Multi-piece unit comprised of a hot dip galvanized malleable iron or steel body and outside pressure bussing designed to allow a maximum of 4" conduit movement (2" in either direction). Furnish with external braid tinned copper bonding jumper. Unit shall be UL listed for wet or dry locations.

H. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve with internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling shall accommodate .75-inch deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections. Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber jacket and stainless steel jacket clamps. Unit shall comply with UL467 and UL514.

1. Manufacturer
  - a. See Section 27 06 00 - Communications Product Schedule

### I. Fire rated penetration seals:

1. UL classified.

2. Conduit penetrations in fire rated separation shall be sealed with a UL classified assembly consisting of fill, void or cavity materials.
3. The fire rated sealant material shall be the product best suited for each type of penetration, and may be a caulk, putty, composite sheet or wrap/strip.
4. Penetrations of rated floors shall be sealed with an assembly having both F and T ratings at least equal to rating of the floor.
5. Penetrations of rated walls shall be sealed with an assembly having an F rating at least equal to the rating of the wall.

J. Standard products not herein specified:

1. Submit for review a listing of standard electrical conduit hardware and fittings not herein specified prior to use or installation, i.e. locknuts, bushings, etc.
2. Listing shall include manufacturer's name, part numbers, and a written description of the item indicating type of material and construction.
3. Miscellaneous components shall be equal in quality, material, and construction to similar items herein specified.

K. Hazardous area fittings: UL listed for the application.

## 2.4 BOXES AND ENCLOSURES

A. Junction and Device Boxes

1. Drawing References: As shown on Symbol Schedule
2. Construction:
  - a. Concealed/Flush Mounted:
    - b. One or two piece welded knockout boxes.
    - c. UL 514A, cadmium or zinc-coated 1.25 oz/sq. ft., if ferrous metal.
    - d. Pressed sheet steel, for indoor locations.
    - e. UL 514C approved if non-metallic.
    - f. At hollow masonry, tile walls and plaster walls, provide with device rings as required.
  - g. Surface mounted:
    - i. Exterior - Conform to the Junction and/or PullBox construction scheduled on the Plans. Where construction not otherwise scheduled or noted on the plans, conform to the following:
      - (A) Cast iron or aluminum with threaded hubs and mounting lugs.
      - (B) Gasketed cover with spring lid.
    - ii. Concrete floor embedded:
      - (A) Cast iron concrete pour boxes with screwed brass cover, unless otherwise noted.

- (B) Cadmium plated screw cover attachment at least 6" on center.
  - h. If size not otherwise noted, at least 4S (4" square) by 2-1/8" deep, or Code minimum size, whichever is larger.
  - i. Provide complete with approved type of connectors and required accessories, including attachment lugs or hangers. Provide raised device covers as required to accept scheduled device.
3. Approvals.
- a. UL 514A
4. Manufacturers:
- a. See Section 27 06 00 - Communications Product Schedule

## **2.5 TERMINAL BOXES, PULL CANS AND ENCLOSURES**

### **A. Terminal Cabinets:**

1. Drawing Reference: As Scheduled.
2. Construction:
  - a. Zinc Coated Sheet Steel, code gauge with standard concentric knockouts for conduit terminations.
  - b. Interior dimensions not less than those scheduled.
  - c. Finish: Manufacturer's standard gray baked enamel finish.
  - d. Covers: Trim fitted, continuous hinged steel door, flush catch – lockable and keyed to match. Screw fastened doors not acceptable.
    - i. Door face to be not less than 95% of panel interior dimensions.
3. Mounting:
  - a. Flush cabinets shall be furnished with concealed trim clamps and shall be not less than 4 inches deep.
  - b. Surface cabinets shall be furnished with screw cover trim, flush hinged door and shall not be less than 6 inches deep.
  - c. Interior Applications:
    - i. NEMA 250 Type 1, unless otherwise noted. Refer to plans and schedules.
  - d. Exterior Applications:
    - i. NEMA 250 Type - As scheduled, not less than NEMA 3R.
  - e. Manufacturers:
    - i. See Section 27 06 00 - Communications Product Schedule

## 2.6 WIRELESS ACCESS POINT ENCLOSURES

### A. Wireless Access Point (WAP) Enclosure, Exterior Application

1. Drawing Reference: Work Area Outlet Symbol with X subscript.
2. Features/Functions/Construction:
  - a. Compact, low profile wireless access point enclosure suitable for use in continuous outdoor usage under weather conditions typical of the project site.
  - b. Designed to NEMA 3R, 4, 4X, 12, and 13, and IEC529-IP65 specifications for indoor/ outdoor wet, dirty, or corrosive environments.
  - c. UV stabilized for exposure to direct sunlight
  - d. Effectively transparent to wireless signals in the frequency bands used by IEEE 802.11a, b, g, n and ac signaling
  - e. Included universal mounting plate allows easy installation of most manufacturers access points
  - f. Cover is hinged. Cover can be latched and locked with University furnished padlock.
  - g. UL508 listed. Back box and cover are light gray UL94-5VA Polycarbonate/PBT blend. Field paintable to match surrounding surfaces.
3. Manufacturer
  - a. See Section 27 06 00 - Communications Product Schedule

## 2.7 SAW-CUTTING AND CORE-DRILLING EQUIPMENT AND MATERIALS

### A. Cutting Equipment, Tools, and Materials

1. Contractor shall furnish appropriate and proper equipment, tools, and materials for the saw-cutting and core-drilling of concrete as required.
2. Lubricant material for the cutting of concrete shall be of type and manufacture for the purpose.

B. Concrete Bonding Agent: Adhesive for the bonding of new mortar and grout to existing concrete shall be "Concresive LPL" as manufactured by Master Builders, Burke's "BurkEpoxy MV", Sika's "Sikadur 32, Hi-Mod", or equal.

### C. Patching Mortar

1. Mortar: Mortar shall be an epoxy mortar or similar high bonding mortar, such as "SikaTop 122" as manufactured by Sika Corporation, Burke, "Masterpatch 20" as manufactured by Master Builders, or equal.

### D. Sand

1. Sand shall be a washed, kiln-dried fine sand, all passing a U.S. Standard No. 16 sieve.

### E. Curing Compound:

1. Water-based curing compound such as Master Builders "Masterkure", Burke's "Spartan-Cote", or approved equal.

## 2.8 EXTERIOR JOINT SEALANTS

A. Exterior Polyurethane Weatherproofing and Control Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT, M, G, A, and O; single component, chemical curing, non-staining, non-bleeding, non-sagging type; color as selected; use in exterior vertical surfaces such as, but not limited to:

1. Sealing around exterior wall penetrations required for conduit pathways.
2. Manufacturers:
  - a. See Section 27 06 00 - Communications Product Schedule

### B. Joint Sealant Backing

1. General: Provide sealant backings and accessory materials, including primers, of material and type that are non-staining; are compatible with joint substrates, sealants, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
2. Foam Joint Fillers: Non-gassing, preformed, compressible, resilient, nonstaining, non-waxing, non-extruding strips of flexible plastic foam of one of materials indicated below, as recommended by manufacturer for compatibility with their sealant; of size, shape, and density to control sealant depth, prevent three-sided adhesion, provide a surface against which to tool, and otherwise contribute to producing optimum sealant performance:
  - a. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) or Type B (bicellular material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance and as recommended by sealant manufacturer.
  - b. Elastomeric Tubing Sealant Backings: Flexible cellular rubber tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
  - c. Filler Type at EIFS Conditions: Non-gassing, closed-cell polyethylene foam as recommended by EIFS manufacturer.

### C. Miscellaneous Sealant Materials

1. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant-substrate tests and field tests. Certify that primer will not permanently stain adjacent joint surfaces.
2. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable

of staining or harming in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.

3. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints, to mask off adjacent joint surfaces where sealant is not permanently intended to be applied.
4. Bondbreaker Tape: Polyethylene pressure sensitive adhesive tape, to be used in areas where backer rod cannot fit and where three-sided adhesion is to be avoided.

## **PART 3 - EXECUTION**

### **3.1 CONDUIT APPLICATION**

A. General: Install the following types of conduits and fittings in the locations listed, unless otherwise noted in the drawings:

1. Exterior, Exposed:
  - a. RSC for applications up to 8 feet AFF or to first pull box, whichever is first, applications subject to physical abuse or for applications greater than 4" diameter.
  - b. EMT acceptable in all other applications not noted above up to 4", where used in conjunction with specified Raintight (compression) couplers.
2. Interior, Exposed, Wet and Damp Locations:
  - a. RSC
  - b. At interior locations over 8 feet above finished floor, EMT acceptable.
3. Interior, Hazardous Locations
  - a. RSC
  - b. IMC, where permitted by the NEC.
4. Interior, exposed or concealed, dry locations:
  - a. RSC, if subject to physical abuse.
  - b. EMT, if not subject to physical abuse.
5. Interior, concealed, damp locations, including in masonry walls.
  - a. RSC
6. Embedded in Concrete
  - a. RSC or rigid non-metallic conduit.
  - b. PVC Type DB-120.
7. Transition from walls to open plan furniture systems:
  - a. Liquidtight



### 3.2 GENERAL REQUIREMENTS

- A. Refer to the manufacturer's instructions and conform thereto.
- B. Distribution Pathway via EMT Raceway:
  - 1. The EMT conduit is to be installed meeting the NEC handbook Article 348 Installation Specifications.
  - 2. Provide escutcheon plates for all through wall conduit stubs.
  - 3. All ends of conduits shall be cut square, reamed and fitted with insulated bushing.
  - 4. All conduit which passes through fire walls shall be sealed with fire stop putty after all station wire has been installed. Reference 27 05 41 Fire-stopping Systems.

### 3.3 MOUNTING AND INSTALLATION - BOXES AND ENCLOSURES

- A. Conform to the more restrictive of NEMA OS 3-2002 and the following.
- B. Provide backboxes at all communications systems devices. Installation of device plates directly to wall surface without use of a backbox, unless specifically directed on plans, is unacceptable.
- C. The distance between pull boxes shall not exceed 150 feet or more than two 90 degree bends.
- D. Align boxes plumb with floor and surrounding construction. At door frames, locate 4" from frame. Verify placement with University Representative details to ensure that box clears all trim, etc.
- E. Support and fasten boxes securely. At stud walls use rigid bar hangers, attached to hanger with stud and nut.
- F. At existing locations, provide cutting, patching and finishing as required to maintain or restore finishes so that resulting installation is integrated into the Architectural decor of the particular location.
- G. Mounting Height: the mounting height of a wall-mounted outlet box is defined as the height from the finished floor to the horizontal center line of the cover plate.
- H. Mount outlet boxes with the long axis vertical. Three or more gang boxes shall be mounted with the long axis horizontal.
- I. Install wiring jacks and outlet devices only in boxes which are clean; free from excess building materials, dirt, and debris.
- J. Install wiring jacks and outlet devices after wiring work is complete.

### 3.4 SUPPORT

- A. Provide supports for raceways as specified in Section 27 05 29 – Hangers and Supports for Communications Systems.
- B. All raceways installed in exposed dry locations shall be grouped in a like arrangement and supported by means of conduit straps, wall brackets or trapeze hangers in accordance with Code and the requirements of the this Section. Fasten all hangers from the building structural system.
- C. Provide supports and mounting attachments per the most restrictive of Code and the following.
  - 1. Raceway Size (inches)

2. No of cables in run
  3. Location Support Spacing (feet)
- D. Install no more than one coupling or device between supports.
- E. Conduit support
1. As specified in Section 27 05 29 – Hangers and Supports for Communications Systems

### **3.5 CUTTING AND PENETRATIONS**

- A. Execute all cutting, associated structural reinforcing, and patching/restoring work in a manner to prevent damage to other work and to provide proper surfaces for the installation of materials, equipment, and repairs.
- B. Perform demolition in accordance with ANSI A10.6 “Safety Requirements for Demolition Operations” and NFPA 241 “Standard for Safeguarding Construction, Alteration, and Demolition Operations”, applicable regulatory requirements of public authorities having jurisdiction, the requirements of Division 1 and this specification section.
- C. Do not cut or alter structural members when not indicated without prior approval of the University Representative.
- D. Execute cutting and patching of weather-exposed, moisture-resistant and sight-exposed surfaces by methods to preserve weather, moisture and visual integrity. Employ skilled workers for cutting and patching. Wherever practicable, employ original installer or fabricator providing Work under this Contract to perform cutting and patching for new work.
- E. Provide temporary support of construction to be cut to ensure structural integrity.
- F. Perform cutting and patching using methods and materials so as not to void existing warranties.
- G. Cutting:
1. Cut existing construction to provide for installation of Work. Make new openings neat, as close as possible to profiles indicated and only to extent necessary for new Work.
  2. Do not cut or alter structural members without prior consultation with the University Representative. Do not damage reinforcing or structural steel that is to remain. Do not damage electrical conduits, plumbing lines, and other utilities that are to remain. Restore any damaged work at Contractor’s expense.
  3. At concrete, masonry, paving, and other materials where edges of cuts and holes will remain exposed in the completed work, make cuts using power-sawing and - coring equipment; do not overcut at corners of cut openings. Saw overruns shall not be permitted. Refer to additional concrete coring specific procedures below.
- H. Adjust and fit products to provide a neat installation.
- I. Concrete Coring:
1. Cutting work shall include saw-cutting of concrete and any other miscellaneous work, as required, core-drilling of concrete slabs and walls for structural work, or other items, and removal from the premises and site of all broken concrete and debris.

2. Contractor shall use extreme caution not to cut, nick, or break any rebar or post tension systems during execution of work.
  3. Contractor shall select and employ a Testing Agency to furnish a pachometer, where required, and take readings for the location of reinforcing steel in existing concrete.
    - a. The selected Testing Agency shall meet with the approval of the University Representative.
    - b. Pachometer readings shall be taken by the Contractor's employed Testing Agency to locate reinforcing steel, including but not limited to rebar and post-tension strand support members, in concrete to be cored and cut.
    - c. The contractor or his testing agency shall mark the locations of the reinforcing steel with bright paint. Mark all reinforcing steel within 3 ft of all cuts and cores, except at slabs on grade and stem walls.
    - d. Submit proposed methods for review by the University Representative prior to proceeding as required elsewhere in this Section.
    - e. Cutting work shall be accurately located and shall be closely coordinated with the individual trades requiring such cutting work.
    - f. Cutting work shall be neatly and accurately performed with proper tools and equipment. Cuts shall be of minimum size required for the work.
    - g. Work to remain shall be properly protected to prevent damage from core-drilling and saw-cutting operations. Lubricant to be used with the equipment shall be channeled to prevent damage to work to remain.
    - h. At the completion of work all visible marks shall be removed to the satisfaction of the Construction Manager.
- J. Gypsum Wall Board Penetrations: Provide circular penetrations maximum 1/8" inch larger than outer diameter of conduit being used. On both sides of the wall fill space between conduit and wall with joint compound, depth to match gypsum board thickness.
- K. All communications systems conduit openings in walls and floors are the responsibility of the Contractor. Install sleeves shown on the drawings when the concrete is poured. Any openings required after the concrete has set maybe core drilled per the procedures outlined above.
- L. Patching and Restoring Work
1. General
    - a. Patching shall achieve security, strength, and weather protection, as applicable, and shall preserve continuity of existing fire ratings.
    - b. Upon completion of cutting and coring, clean remaining surfaces of loose particles and dust.
    - c. Patch existing construction by filling repairing, refinishing, closing up and similar operations. Patching includes the insertion or projection of other products in or from a surface.

- d. Patch weather-exposed components in a manner that restores them to a weathertight condition.
- e. Finish or refinish, as required, cut and patched surfaces to provide an even surface of uniform finish, color, texture, and appearance, matching existing adjacent. Finish complete surface plane, unless otherwise indicated. Over patched wall or ceiling surfaces, finish to nearest cutoff line for entire surface, such as intersection with adjacent wall or ceiling, beam, pilasters or to nearest opening frame, unless otherwise indicated. Finished surfaces shall not present a spotty, touched-up appearance
- f. Finish or refinish, as required; cut and patch surfaces to match adjacent finishes. Patching shall successfully duplicate undisturbed adjacent finishes, colors, textures, and profiles. Where there is dispute as to whether duplication is successful or has been achieved to a reasonable degree, the University Representative's judgment shall be final.

## 2. Concrete

- a. Preparation of Existing Surfaces: Use wire brush and air pressure to clean concrete of laitance, dirt, dust, and loose particles. Surface to received mortar shall be rough and reasonably even.
- b. Mixing of Materials: Concrete bonding adhesive and patching mortar shall be prepared and mixed in accordance with the manufacturer's specifications and recommendations. Two (2) to five (5) parts sand shall be added to mortar as required to achieve the desired consistency for the type of work involved.
- c. Patching of Concrete:
  - i. Where removal of partitions, equipment, and other items has exposed holes in existing concrete floor slabs, fill in holes with new concrete and reinforce as necessary. Prepare slabs as required to provide clean, sound surfaces
  - ii. Patching of concrete work shall be expertly performed with adhesive and mortar materials specified. At completion, patched surfaces shall match adjacent surfaces as closely as possible.
  - iii. Concrete bonding agent and patching mortar shall be applied or installed where indicated on the drawings, or where otherwise required, in accordance with the manufacturer's specifications and recommendations.
  - iv. Where necessary to built-out cut, spalled, or chipped concrete surfaces, mix concrete bonding agent, mortar, and sand into a special mortar, and apply in layers as required to fill out or build up surfaces. Float, trowel, or texture new surfaces to match adjacent surfaces.
  - v. Repair gravel pockets by cutting out (1 in. min.) to solid surface, form key and apply epoxy concrete adhesive before placing patching mortar; compact into place and neatly finish to exactly match surface texture. Honeycombed areas or gravel pockets which, in the Engineer's opinion,

are too large and unsatisfactory for mortar patching as described above are to be cut to solid surfaces, keyed, and coated with epoxy concrete to produce firm bond and solid surface.

- d. Curing: Immediately after finishing patch approved curing compound according to manufacturer's instructions.

### 3.6 RACEWAY INSTALLATION, GENERAL

A. Raceway runs are shown schematically. Install concealed unless specifically shown otherwise. Supports, pull boxes, junction boxes and similar generally not indicated. Provide where designated.

1. Install exposed conduit and raceway parallel and perpendicular to nearby surfaces or exposed structural members, and follow the surface contours. Level and square conduit and raceway runs.
2. Raceway runs shall be mechanically and electrically continuous.
3. Each conduit shall enter and be securely connected to a cabinet, junction box, pull box, or outlet by means of a locknut on the outside and a bushing on the inside or by means of a liquid-tight, threaded, self-locking, cold-weld type wedge adapter.
4. Bends
  - a. All bends or elbows shall have a minimum radius as follows:

<i>Conduit Size</i>	<i>Minimum Bend Radius (Inches)</i>
3/4"	8
1"	12
1-1/4"	18
2"	24
2-1/2"	24
3"	30
3-1/2"	30
4"	30
5"	36
6"	42

- b. Use factory elbows or machine bends for conduit bends 1-1/4" and larger.
5. Make bends and offsets so the inside diameter is not effectively reduced. Make ends in parallel or banked runs from the same center line so that the bends are parallel.
6. Install at least one (1) 3/8", 200-pound strength nylon pull cord in all empty raceways. Raceways crossing building expansion joints or in straight runs exceeding 100 feet shall be provided with UL listed expansion fittings.
7. Install conduit seals and drains to prevent accumulated moisture in conduits from entering Communications System enclosures.

- B. Do not install conduit in concrete slabs unless specifically directed by University Representative. Embedded conduits in concrete slab walls, and columns shall be installed in center third between upper and lower layers of reinforcing steel as directed by the University Representative. Space conduits 8" on center except at cabinet locations where slab thickness shall be increased as directed by the University Representative.
- C. All conduits to be kept 12" away from steam or hot water lines. Install horizontal conduit and raceway runs below water and steam piping.
- D. Conduit dropping down to equipment shall be as straight as possible without any offsets, parallel or perpendicular to walls, ceilings and other building features.
- E. Conduit installed on any equipment shall be run symmetrical with the equipment and in such a manner as to:
  - 1. Not to be exposed to damage
  - 2. Not interfere with access to components of the equipment that will interfere with maintenance operation
  - 3. Not to be in a manner that the University deems detrimental to its operation.
  - 4. Whenever an installation listed above occurs, the Contractor shall make all necessary changes at no cost to the University.
- F. All cut ends of conduit, scratches, tool marks, etc. on any metallic raceway installed in the ground or on the exterior of the building shall be treated with two coats of specified touch up paint/tape.
- G. Exposed conduit and metallic surface raceway installed in finished spaces shall be painted to match surrounding surfaces using paint and methods directed by the University Representative.
- H. All raceways stubbing up into equipment or racks shall be sealed. Raceways with conductors shall be plugged with duct-seal. Spare raceways shall be capped. To prevent foreign matter from entering conduit and raceway, use temporary closure protection. Replace conduits containing concrete, varnish or other foreign material.
- I. Complete installation of conduit and raceway runs before starting installation of cables/wires within conduit and raceway.
- J. Use specified conduit and raceway fittings that are compatible with the associated conduit and raceway and suitable for the use and location. Join and terminate conduit and raceway with fittings designed and approved for the purpose of the conduit and raceway system.
- K. Where chase nipples are used, align the raceway and coupling square to the box and tighten the chase nipple so no threads are exposed.
- L. Horizontal conduit or EMT runs, where required and permitted, shall be installed as close to ceiling or ceiling beams as practical.
- M. Conduit and EMT connected to wall outlets shall be run in such a manner that they will not cross water, steam or waste pipes or radiator branches.
- N. Conduit and EMT shall not be run through beams, purlins or columns except where permission is granted by University Representative in writing.
- O. Bond installed metallic raceway in accordance with the requirements of the NEC.

### 3.7 HAZARDOUS LOCATIONS

- A. Use rigid steel conduit only.
- B. Install UL listed sealing fittings that prevent passage of explosive vapors in accordance with the manufacturers written instructions. Locate fittings at suitable, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover-plate having a finish similar to that of adjacent plates or surfaces.
- C. Install seal-tight raceway fittings at the following points and elsewhere as indicated:
  - 1. Where conduits enter or leave hazardous locations.

### 3.8 REUSE OF EXISTING CONDUIT

- A. Existing conduit is to be used as a pathway only where so shown on the drawings.
- B. Prior to beginning work involving the use of an existing conduit, the Contractor shall consult with the University Representative in order to establish whether or not the conduit contains active service.
- C. If no active service exists within the conduit, all cable is to be removed, and work is to proceed.
- D. If active service does exist within the conduit and it has been determined that service needs to be disrupted, then work on that conduit shall not proceed until a schedule of service outage has been established by University Representative. Once given permission to proceed, the Contractor shall within the time period of one (1) working day; remove the old cable, install, terminate and test the new cables, and notify the University Representative the work using the specific conduit has been completed. The University Representative shall be responsible for disconnecting and reconnecting of the active service cross-connects within the terminal closet(s).
- E. Conduit preparation procedure:
  - 1. Remove existing wires and cables (if any).
  - 2. Run a mandrel ½" smaller than the inside diameter of the conduit through the conduit receiving new wires and cables.
  - 3. If the specified size mandrel will not pass through the existing conduit, start with a smaller size mandrel and increase mandrel size until the specified sized mandrel will pass.
  - 4. Run a wire brush and clean rag with an outside diameter 1/8" larger than the inside of the conduit through the conduit until clean.

### 3.9 STATION CABLE PATHWAY INSTALLATION

- A. Cut In Boxes and Station Outlet Boxes:
  - 1. Review the proposed installation height of the WAO's with the University Representative at each building.
  - 2. Standard Work Area Outlets (WAO)
    - a. Unless otherwise noted on the plans, all cut in boxes and surface station outlet boxes installed for conventional application WAO's in walls with existing electrical

receptacles that are installed within 18" of the floor are to be installed at +18" AFF (Above Finished Floor) to center.

- b. Unless otherwise noted on the plans, in walls without electrical receptacles, standard WAO's are to be installed at a height of 38" AFF to center.
- c. Wall Telephone WAO's
  - i. For WAO's indicated for use for telephone wall jacks, cut-in boxes are to be installed at a height of 47" AFF to top of box.
  - ii. All station outlets shall be installed so that their edges are parallel to the vertical and horizontal edges of the surface on which they are mounted.

### **3.10 WIRELESS ACCESS POINT ENCLOSURES**

#### **A. Mock Up**

1. Prior to installation mockup each wireless access point enclosure for aesthetic review by the University Representative. Obtain the University Representative's review prior to proceeding.

#### **B. Installation**

1. Conform with the Manufacturers Installation instructions and the following, whichever is more restrictive.
  - a. Comply with the penetration details in the Drawings where penetrating existing exterior conditions.
  - b. Select fasteners appropriate to mounting conditions, weight and wind load of enclosure and existing surfaces in accordance with Section 27 05 29 – Hangers and Supports for Communications Systems. Make attachment to building structural elements, not surface finish materials.
2. Install enclosure plumb, parallel and aligned to surrounding surfaces. Center on surrounding architectural features as directed by the University Representative.
3. Seal holes at base of enclosure to provide NEMA 4 functionality as indicated in the manufacturer's instructions.
4. Paint enclosure and mounting hardware to exactly match surrounding surfaces. Protect the perimeter of the enclosure during the painting to ensure that operation of the door will not be impaired after painting.

#### **C. Touch Up and Cleaning**

1. Touch up painting and remove ceiling debris as required following review by University Representative of installed condition.

### **3.11 EXTERIOR JOINT SEALANT APPLICATION**

#### **A. Examination**



1. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance.
2. Verify that joint sizes and surfaces are free of defects and acceptable for installation of joint sealants.
3. Verify joint dimensions and shapes to ensure they are within the sealant manufacturer's guidelines. Resolve any variances prior to installation. Do not proceed with sealant installation until the unsatisfactory conditions have been corrected.

#### B. Preparation

1. Thoroughly clean the areas that the new sealant will contact using a de-greasing solvent not harmful to the environment using the two-rag wipe technique. IPA (isopropyl alcohol) is not a degreasing solvent. The new sealant should have a minimum contact area of 1/4".
2. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - a. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - b. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - i. Concrete
    - ii. Masonry
  - c. Remove laitance and form-release agents from concrete.
  - d. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - i. Metal
    - ii. Glass
    - iii. Porcelain enamel
    - iv. Glazed ceramic tile
3. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such

contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

#### C. Joint Priming

1. Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on pre-construction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations.
2. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
3. Allow primer to dry. Do not prime areas that cannot be sealed the same day.

#### D. Installation Of Sealant Backings

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - a. Do not leave gaps between ends of joint fillers.
  - b. Do not stretch, twist, puncture, or tear joint fillers.
  - c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.

#### E. Installation of Joint Sealants

1. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
2. Sealant Installation Standard: Comply with recommendations of ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
3. Perform acoustical sealant application work in accordance with ASTM C919.
4. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.
5. Install joint backing to maintain the following joint ratios, but in no case less than 1/4 inch (6 mm):
  - a. Joints up to 1/2-inch-wide: 1:1 width to depth ratio.
  - b. Joints Greater than 1/2-inch-wide: 2:1 width to depth ratio; maximum 1/2 inch joint depth.
  - c. Sub-caulk joints that are deep, or joints without suitable backstop, to proper depth.
  - d. Protect side walls of joint (to depth of caulking) with bond breaker tape.
  - e. Install with adhesive on 2 faces in contact with sides of joints.

6. Tooling of Non-Sag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint.
  - a. Remove excess sealant from surfaces adjacent to joints.
  - b. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - c. Provide concave joint configuration per Figure 5A in ASTM C1193, unless otherwise indicated.
  - d. Provide flush joint configuration where indicated per Figure 5B in ASTM C1193.
7. Cleaning
  - a. Clean off excess sealants and sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
  - b. Leave finished work in a neat, clean condition with no evidence of spillovers onto adjacent surfaces.
8. Protection
  - a. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion.
  - b. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that installations with repaired areas are indistinguishable from original work.

**END OF SECTION 27 05 33**

## **27 05 36 - Cable Trays for Communications Systems**

### ***PART 1 - GENERAL***

#### **1.1 SCOPE OF WORK**

- A. Cable Trays for Communications Cabling
  - 1. Cable Trays
  - 2. Cable Runways
  - 3. Basket Tray
- B. Cable Tray Support

#### **1.2 RELATED WORK UNDER OTHER SECTIONS**

- A. Section 27 05 00 – Common Work Results for Communications
- B. Section 27 05 26 – Grounding and Bonding for Communications Systems
- C. Section 27 05 29 – Hangers and Supports for Communications Systems
- D. Section 27 05 33 – Conduits and Backboxes for Communications Systems
- E. Section 27 05 39 – Surface Raceways for Communications Systems
- F. Section 27 05 48 – Noise and Vibration Controls for Communications Systems
- G. Section 27 05 53 – Identification for Communications Systems
- H. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
- I. Section 27 13 00 – Communications Backbone Cabling
- J. Section 27 15 00 – Communications Horizontal Cabling

#### **1.3 REFERENCES**

- A. Usage: In accordance with Division 1.
  - 1. National Electrical Manufacturers Association (NEMA)
    - a. NEMA VE 1 1-1998 Metal Cable Tray Systems
    - b. NEMA VE 2 2001 Metal Cable Tray Installation Guidelines

#### **1.4 SUBMITTALS**

- A. Conform to the requirements of Division 1 and Section 27 05 00 - Common Work Results for Communications.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

Procedures: In accordance with Division 1.

## 1.6 SEQUENCING

Not Used.

## **PART 2 - PRODUCTS**

### **2.1 CABLE TRAY, CABLE RUNWAY AND BASKET TRAY**

#### A. Cable Tray

1. Drawing and spec reference: CTxx-yy, where "xx" denotes nominal width of cable runway in inches and "yy" denotes nominal depth.
2. Construction:
  - a. Steel or aluminum.
  - b. Rungs 9" on center, unless otherwise noted.
  - c. UL Classified splice kits.
  - d. Accessories. Provide with a complete system of accessories, including radiused corners at vertical and horizontal bends, section splice plates, expansion plates, blind-end plates, etc. Provide waterfall drop-outs at each end of cabling racks and cabinets indicated on the plans scheduled or indicated to terminate open wiring systems.
3. Approvals:
  - a. ASTM A513
  - b. National Electrical Code, Article 318
  - c. NEMA VE1 Class 12C minimum, or to suit indicated cable and raceway loads, whichever is greater.
4. Manufacturers:
  - a. See Section 27 06 00 - Communications Product Schedule

#### B. Cable Runway

1. Drawing and spec reference: CR\*, where "\*" denotes nominal width of cable runway in inches.
2. Construction:
  - a. Solid Steel Side Bar per ASTM A-36 or Tubular Steel Side Bar per ASTM A-513.
  - b. 1.5" x 0.375 minimum tubular side stringers.
  - c. UL Classified splice kits.
  - d. Designed to support at least 100 pounds per foot load with a Safe Working Load deflection of ½" or less.
3. Finish: Telco gray powder coat or gold on zinc plating.
4. Approvals:

- a. ASTM A513
  - b. UL Classified as an equipment grounding conductor.
  - c. National Electrical Code, Article 318
5. Manufacturers:
- a. See Section 27 06 00 - Communications Product Schedule

#### C. Cable Tray, Open Wire Frame

1. Drawing and spec reference(s): CTWxx-y, where xx denotes the tray width and y the depth of the tray, in inches.
2. Construction
  - a. Welded wire mesh with continuous safety edge wire lip.
  - b. Mesh forms grid at nominally 2" by 4"
  - c. Carbon Steel
  - d. Electroplated zinc galvanized
  - e. All bends, seams and joints field fabricated from basic straight section pieces and splice components as supplied by the manufacturer.
  - f. Where supported from ceiling, supported at both sides in trapeze arrangement – centerline support not acceptable.
  - g. Provide a complete system of accessories, including bonding and grounding connections, conduit connectors, to terminate conduits extended to basket edge, radius shields to protect cabling at inside corners, and waterfall drop-outs at each end of cabling racks and cabinets indicated on the plans scheduled or indicated to terminate open wiring systems.
  - h. Provides pathway complying with ANSI/TIA-569 and NEMA Publications VE1 & VE2
  - i. Meets requirements of National Electrical Code, Article 318
3. Approvals:
  - a. NEMA Publications VE1 & VE2
4. Manufacturers:
  - a. See Section 27 06 00 - Communications Product Schedule

## **PART 3 - EXECUTION**

### **3.1 CABLE TRAY APPLICATION**

- A. Unless otherwise noted, communications cable tray installations shall conform to the following:
1. Type CT - Within Communications Rooms (including ADF, BDF and IDF spaces)

2. Type CTW - Horizontal station cabling outside of the communications rooms where shown on plans or where more than 100 cables are supported, whichever is greater.
3. Type CR – Wherever vertical transitions from ceiling or floor sleeves are required within the Communications Rooms.

### 3.2 INSTALLATION

- A. Provide all required supports, fittings and accessories for a complete system as described in NEMA VE-2, by Code, manufacturer recommendation or as shown on the plans, whichever is most restrictive.
  1. Cable Tray. Provide with a complete system of accessories, including UL Classified splice kits, radiused corners at vertical and horizontal bends, section splice plates, expansion plates, blind-end plates, etc. Provide waterfall drop-outs at each end of cabling racks and cabinets indicated on the plans scheduled or indicated to terminate open wiring systems.
  2. For wire basket tray, provide a complete system of accessories, including bonding and grounding connections, conduit connectors, to terminate conduits extended to basket edge, radius shields to protect cabling at inside corners, and waterfall drop-outs at each end of cabling racks and cabinets indicated on the plans scheduled or indicated to terminate open wiring systems.
- B. Bond sections to one another and to building ground.
- C. Access Clearance. Maintain access for use by University personnel to tray as described below. Coordinate installation with work of structural, mechanical, plumbing/fire protection and electrical trades to maintain required access.
  1. Unless shown otherwise on the plans, provide a clear access of at least 24" wide along one side of each tray for use by University personnel.
  2. Unless shown otherwise on the plans, installation to maintain at least 12" vertical clearance over the top of each tray for use by University personnel.

### 3.3 SUPPORT

- A. Support in accordance with the most restrictive of the following:
  1. California Building Code.
  2. Contractor's engineered means of engineered support submitted in accordance with the requirements of 27 05 00 – Common Work Results for Communications and Section 27 05 29 Hangers and Supports for Communications Systems.
  3. Metallic Cable Tray: NEMA VE 2-2001, or latest edition
- B. Provide lateral sway bracing as required by Code.

**END OF SECTION 27 05 36**

## **27 05 39 - Surface Raceways for Communications Systems**

### ***PART 1 – GENERAL***

#### **1.1 SCOPE OF WORK**

- A. Metallic Surface Raceways
- B. Non-Metallic Surface Raceways
- C. Surface Raceway Fittings

#### **1.2 RELATED WORK UNDER OTHER SECTIONS**

- A. Section 27 05 00 – Common Work Results for Communications
- B. Section 27 05 26 – Grounding and Bonding for Communications Systems
- C. Section 27 05 29 – Hangers and Supports for Communications Systems
- D. Section 27 05 33 – Conduits and Backboxes for Communications Systems
- E. Section 27 05 36 – Cable Trays for Communications Systems
- F. Section 27 05 48 – Noise, Vibration and Seismic Controls for Communications Systems
- G. Section 27 05 53 – Identification for Communications Systems
- H. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
- I. Section 27 13 00 – Communications Backbone Cabling
- J. Section 27 15 00 – Communications Horizontal Cabling

#### **1.3 REFERENCES**

- A. Usage: In accordance with Division 1.
  - 1. American National Standards Institute (ANSI) – Current Versions
    - a. ANSI/TIA-569
    - b. ANSI/TIA-568
  - 2. Underwriters Laboratories, Inc. (UL)
    - a. UL 94 -1996 (R 2001), Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
    - b. UL 514C 1988 (R 1989) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.

#### **1.4 SUBMITTALS**

- A. Conform with the requirements of Division 1 and Section 27 05 00 - Common Work Results for Communications.



## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Products provided under the work of this Section shall provide the following minimum characteristics:
1. Approvals
    - a. U.L Listed
    - b. Multi-chamber surface raceway shall conform to NEC 352B for simultaneous power and telecommunications use.
  2. Meet or exceed the requirements of ANSI/TIA-569 for a surface raceway system
  3. Fittings shall incorporate radiussed corners such that wiring cannot be placed therein with bend radius less than the minimum bend radius specified in ANSI/TIA-568
  4. Raceway base shall be designed to be securely fastened to mounting surface per manufacturer's recommendations using mechanical fasteners. Systems requiring use of adhesive fasteners will not be accepted.
  5. Raceway system shall include fittings for connection and change of raceway direction and/or plane of installation.
  6. Available in-line raceway connector fittings shall include at least:
    - a. External Elbow
    - b. Flat Elbow
    - c. Internal Elbow
    - d. End Cap
    - e. Splice Cover
    - f. Tee
    - g. Cable clips to retain contents in overhead installation. Alternatively, provide separate cable ties and independent restraint for same.
  7. System shall accommodate connection to trade standard boxes and fittings through accessory boxes and transition pieces
  8. Trade connections, device boxes and mounting systems shall not reduce fill capacity, except where specifically scheduled.
  9. System shall include device plates of types to meet requirements shown on Communication Systems drawings.
  10. Available device mounting boxes shall include at least:
    - a. Raised Device Box
    - b. 2-gang Raised Device Box
    - c. In-Line Device Box

11. System shall include device plates of types to meet requirements shown on Communication Systems drawings.
12. Available device plates shall include at least:
  - a. Single Receptacle Plate
  - b. Duplex Receptacle Plate (NEMA 106)
  - c. Duplex - Duplex (Quadplex) Plate
  - d. Ring to secure 3rd party communications plates and jack subframes as specified in Section 27 15 00.

## 2.2 SURFACE RACEWAY

### A. Metallic Surface Raceway

1. Drawing and Specification Reference: #MSR\*, where "#" denotes number of chambers, "\*" denotes cross sectional area of each chamber in square inches.
2. Construction
  - a. Capacity:
    - i. One chamber, 1.4 inches:
      - (A) Drawing and reference designation: 1MSR-1.4.
      - (B) Minimum cross-sectional area of 1.4 square inches.
    - ii. One chamber, 6.75 inches:
      - (A) Drawing and reference designation: 1MSR-6.75.
      - (B) Minimum cross-sectional area of 6.75 square inches.
    - iii. One chamber, 16.5 inches:
      - (A) Drawing and reference designation: 1MSR-16.5
      - (B) Minimum cross-sectional area of 16.5 square inches.
    - iv. Two chamber, 3.3 inches:
      - (A) Drawing and reference designation: 2MSR-3.3
      - (B) Minimum cross-sectional area of each chamber equal to 3.3 square inches.
    - v. Two chamber, 8 inches:
      - (A) Drawing and reference designation: 2MSR-8
      - (B) Minimum cross-sectional area of each chamber equal to 8 square inches.
    - vi. Three chamber, 5.5 inches:
      - (A) Drawing and reference designation: 3MSR-5.5

- (B) Minimum cross-sectional area of each chamber equal to 5.5 square inches.
  - b. Material: Galvanized steel or anodized aluminum.
  - c. Provide Ivory color finish, unless otherwise noted.
  - d. Two chamber surface raceway shall have two adjacent chambers or equal area as specified separated by a removable horizontal dividers
  - e. Three chamber surface raceway shall have three adjacent chambers separated by removable horizontal dividers. Removal of one of the two dividers to result in a two chamber raceway systems with useable cross-sectional areas of 2/3'rds and 1/3 of the overall raceway capacity.
  - f. System and installation shall not compromise separation of Class 1 and low voltage services.
  - g. Keyed cover plate shall require tool for removal.
3. Manufacturers:
- a. See Section 27 06 00 - Communications Product Schedule

#### B. Non-Metallic Surface Raceway

1. Construction
- a. Two piece construction.
    - i. Three chamber, 2.5 inch:
    - ii. Drawing and reference designation: 3SR-2.5
    - iii. System components to provide at least a one (1) inch bend radius at corners.
    - iv. Color: White or Ivory, to best match surrounding surfaces. Submit color options to University Representative for selection.
    - v. Three chamber surface raceway shall have three adjacent chambers separated by removable horizontal dividers. System and installation shall not compromise separation of services.
    - vi. Keyed cover plate shall require tool for removal.
2. Approvals:
- a. Plastic meeting UL 94 V-0 flammability rating.
3. Manufacturers, subject to the above
- a. See Section 27 06 00 - Communications Product Schedule

### **PART 3 - EXECUTION**

#### **3.1 APPLICATION**

Surface raceway installed in fire rated exitways shall be metal surface raceway.

### 3.2 GENERAL INSTALLATION

- A. Install complete raceway system as shown on drawings, including track, cover plate, device boxes, radiused inside and outside elbows and manufacturer's category and fiber cabling guideway fittings, splice plates, T's, transitions and extension rings and end caps as required.
- B. Any existing surface raceway and/or exposed cabling along the indicated pathway of the raceway to be installed shall be removed prior to the installation of the new raceway. If the existing cabling contains active service, then Contractor shall consult with the University Representative as to how best maintain the existing service before proceeding with the work.
- C. Provide and install the proper factory fabricated corners, support clips, end connectors, etc. as required. Support and restrain cabling as required to suit installation conditions. Removal of the raceway cover shall not result in cabling dropping out of the raceway.
- D. Corners and joints are to be cut neatly and finished using connector components of specified system. Where components are not available using specified system, to meet requirements of drawings, provide cleanly mitered joints, EMT and/or surface backboxes specified elsewhere herein.
- E. All installed surface raceway shall be inspected for marks, scratches, gaps between sections or improper fitting of connector parts. All such damage shall be repaired to the University Representative's satisfaction, or the raceway shall be removed and replaced.
- F. Remove sharp corners and edges prior to installation of cable.
- G. Attachment of raceway to walls, floors, and partitions:
  - 1. Attach raceway to the supporting surface with mechanical fasteners applied to building structure per the most restrictive of manufacturer's directions, Code, or these provisions.
  - 2. All surface raceway shall be installed so that its edges are parallel to the vertical or horizontal edge of the surface on which they are mounted. All surface raceway, found not to be installed in this manner, shall be removed and reinstalled correctly.
  - 3. Surface raceway shall be secured at 2'-0" intervals (2 spaced screws for 2" and wider raceways) with wood screws into wooden framing or self drilling wall anchors (ITWBildex "Heavy Duty E-Z Toggle", no known equal) into sheetrock or plastic inserts with pre-assembled drive screw for concrete (ITT-HOLUB "HIDRIVE" nail anchors, no known equal) Powder (explosive charge) driven anchors are not acceptable. The use of adhesives as the sole means for fastening to any surface is not allowed.
  - 4. Screws used in fastening surface raceway shall be no less than 3/4" in length.
  - 5. The proper support clips, as called for by the manufacturer, for securing surface raceway to walls or floors are to be used per the manufacturer's instructions.
  - 6. Placement of surface raceway:
    - a. As indicated on the plans, all vertical runs from surface station outlets shall drop directly from a horizontal run to the station outlet unless noted otherwise.
      - i. Raceway base and cover sections shall be minimum 24" long unless the run is shorter.
      - ii. Off-set cover joints from base joints by at least 12".

- iii. Miter joints shall have gaps of less than 1/16". Caulk gaps after completion of wiring installation.

**END OF SECTION 27 05 39**

## 27 05 41 – Fire-Stopping Systems

### Part 1 - GENERAL

#### 1.1 Summary

- A. This section includes labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to:
1. Fire-stopping of Through Penetrations in Fire Rated Assemblies.
  2. Smoke and Acoustical Sealing in Non-Rated Assemblies.

#### 1.2 RELATED SECTIONS

- A. Related Work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

#### 1.3 REFERENCES

- A. ASTM E 814, "Fire Tests of Through Penetration Firestops".
- B. ANSI/UL1479, "Fire Tests of Through Penetration Firestops".
- C. ASTM E90, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".
- D. Underwriters Laboratories Inc. (UL) – Fire Resistance Directory
- E. National Fire Protection Association (NFPA) – NFPA 101: Life Safety Code.
- F. National Fire Protection Association (NFPA) – NFPA 70: National Electrical Code.
- G. ANSI/TIA-1179-2010 "Healthcare Facility Telecommunications Infrastructure Standard".
- H. ANSI/TIA-EIA-569 "Commercial Building Standard for Pathway's and Spaces"

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Fire rated cable pathway devices shall be used in fire-rated construction for ALL low-voltage, video, data and voice cabling, optical fiber raceways and certain high-voltage cabling where frequent cable moves, adds and changes may occur. Pathways required for high voltage cabling will be detailed on the prints. Such devices shall:
1. Meet the hourly fire-rating of fire rated wall and or floor penetrated.
  2. Be tested for the surrounding construction and cable types involved.
  3. Have UL Systems permitting cable loads from; "Zero to 100% Visual Fill." This requirement eliminates need for fill-ratio calculations to be made by cable technicians to ensure cable load is within maximum allowed by UL System.
  4. Not have inner fabric liner that tightens around and compresses cables tightly together encouraging potential cable damage or interference.

5. Be "Zero-Maintenance." Zero-maintenance is defined as: no action required by cabling technician to open and/or close pathway for cable moves, adds or changes, such as, but not limited to:
    - a. Opening or closing of doors.
    - b. Spinning rings to open or close fabric liner.
    - c. Removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.
    - d. Furnish letter from manufacturer certifying compliance with this definition of "Zero-Maintenance".
  6. Pathways shall be engineered such that two or more devices may be ganged together for larger cable capacities.
  7. Pathways shall be engineered to be re-enterable so they can be retrofitted and removed from around existing cables without cutting and re-splicing them.
  8. Cable Pathway Devices passing vertically through floors shall have equal F & T Rating. (See UL System # F-A-3037)
  9. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction and others the manufacturer of the device and the corresponding UL System number installed.
- B. Non-rated cable pathway devices shall be used in non-fire-rated construction for ALL low-voltage, video, data and voice cabling, optical fiber raceways and certain high-voltage cabling where frequent cable moves, adds and changes may occur. Pathways required for high voltage cabling will be detailed on the prints. Such devices shall:
1. Limit the movement of smoke and sound of wall and or floor penetrated.
  2. Restore the STC (Sound Transmission Class) Rating of the penetrated wall.
  3. Provide L Ratings of <1 CFM when empty and <2.5 CFM at all other loading up to 100 percent.
  4. Accommodate cable loads from; "Zero to 100% Visual Fill."
  5. Not have inner fabric liner that tightens around and compresses cables tightly together encouraging potential cable damage or interference.
  6. Be "Zero-Maintenance." Zero-maintenance is defined as: no action required by cabling technician to open and/or close pathway for cable moves, adds or changes, such as, but not limited to:
    - a. Opening or closing of doors.
    - b. Spinning rings to open or close fabric liner.
    - c. Removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.

- d. Furnish letter from manufacturer certifying compliance with this definition of "Zero-Maintenance".
  7. Pathways shall be engineered such that two or more devices may be ganged together for larger cable capacities.
  8. Pathways shall be engineered to be re-enterable so they can be retrofitted and removed from around existing cables without cutting and re-splicing them.
  9. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction and others the manufacturer of the device and the corresponding UL System number installed.
- C. As an alternate to using a fire-rated or non-rated cable pathway device for single low voltage cables (up to 0.27 in. (7 mm) O.D) penetrating one or two-hour, gypsum board/stud wall assemblies or non-rated assemblies, either as a through-penetration or as a membrane-penetration, a fire-rated cable grommet may be substituted. The product shall consist of a molded, two-piece, plenum-rated grommet having a foam fire and smoke sealing membrane that conforms to the outside diameter of the individual cable. The grommet product shall be capable of locking into place to secure the cable penetration within the wall assembly. The grommet shall be UL Classified and tested to the requirements of ASTM E814 (UL1479) and CAN/ULC S115.
- D. Where non-mechanical pathways must be utilized, such as sealing (caulking) around single or grouped conduits, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction. Provide letter from manufacturer certifying compliance with this section.
- E. Cable pathway shall replace conduit sleeves in walls and floors, and;
1. When installed individually in floors, devices shall pass through core-drilled opening utilizing tested floor plates.
  2. When multiple units are ganged in floors, devices shall be anchored by means of a tested grid.
  3. When installed individually in walls, devices shall pass through core drilled opening utilizing tested wall plates or integrated flanges.
  4. When multiple units are ganged in walls, devices shall be anchored by means of a tested grid.
- F. Cable tray shall terminate at each barrier and resume on the other side such that cables pass independently through devices. Cable tray shall be properly supported on each side of the barrier.

## 1.5 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Provide manufacturer's standard catalog data for specified products demonstrating compliance with referenced standards and listing numbers of systems in which each product is to be used.



- C. Schedule of UL System Drawings for Fire Rated Construction: Submit schedule of all expected opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.
- D. UL System Drawings for Fire Rated Construction: Furnish copies of all UL Systems identified in schedule above. Include any engineering recommendations.
- E. Certificates: Product Certificate of Compliance from the manufacturer certifying material compliance with applicable code and specified performance characteristics.
- F. Installation Instructions: Submit manufacturer's printed installation instructions.

## 1.6 QUALITY ASSURANCE

A. Products/Systems: Provide firestopping systems that comply with the following requirements:

- 1. Fire-stopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop system acceptable to authorities having jurisdiction.
- 2. Fire-stopping products bear the classification marking of qualified testing and inspection agency.

B. Installer Qualifications:

- 1. Experience in performing work of this section who is qualified by the fire-stopping manufacturer as having been provided the necessary training to install firestop products in accordance with specified requirements.
- 2. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer qualification on the Installer. The Installer shall have been trained by a direct representative of the manufacturer (not a distributor or sales agent) in the proper selection and installation procedures.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

- 1. Manufacturer's original, unopened, undamaged containers, identification labels intact identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instruction for multi-component products.
- 2. Handle and store products according to manufacturer's recommendations published in technical materials. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.

B. Storage and Protection:

- 1. Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

## 1.8 PROJECT CONDITIONS

- A. Do not install products when ambient or substrate temperatures are outside limitations recommended by manufacturer.
- B. Do not install products when substrates are wet due to rain, frost, condensation, or other causes.
- C. Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.
- D. Do not use materials that contain flammable solvents.
- E. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- F. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- G. Schedule installation of fire-stopping after completion of penetrating item installation but prior to covering or concealing of openings

## *Part 2 - PRODUCTS*

### 2.1 MANUFACTURERS

- A. Reference 27 06 00 Communications Product Schedule
- B. Substitutions: Not permitted. No known equal.
- C. Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer.

### 2.2 MATERIALS

- A. General: Use only products that have been tested for specific fire resistance rated construction conditions or acoustical and smoke related requirements conforming to construction assembly type, penetrating item type, annular space requirements, and rating involved for each separate instance.
- B. Firestop Sealants: single component latex formulations that upon cure do not re-emulsify during exposure to moisture, the following products are acceptable:
- C. Firestop Putty: intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds, the following products are acceptable:
- D. Firestop Pillows: re-enterable, non-curing, mineral fiber core encapsulated on six sides with intumescent coating contained in a flame retardant poly bag, the following products are acceptable:
- E. Fire-Rated Cable Grommet: firestop grommet is a molded, two-piece grommet with an integral fire and smoke sealing foam membrane for sealing individual cable penetrations through framed wall assemblies. Grommet snaps together around cable and locks tightly into the wall.

- F. Fire-Rated Cable Pathways: Fire-Rated Pathway device modules comprised of steel pathway with self-adjusting intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:
- G. Smoke and Acoustical Pathways: Smoke & Acoustical Pathway device module comprised of a nonmetallic pathway with integral self-adjusting smoke and sound sealing system for cable penetrations through non-fire-resistance rated wall or floor assemblies, the following products are acceptable:

## **Part 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of fire-stopping in accordance with manufacturer's installation instructions and technical information.
- B. Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.
- C. Provide masking and temporary covering to protect adjacent surfaces.
- D. Do not proceed until unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. General: Install systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of products.

### **3.3 FIELD QUALITY CONTROL**

- A. Keep areas of work accessible until inspection by authorities having jurisdiction.
- B. Where deficiencies are found, repair fire-stopping products so they comply with requirements.

### **3.4 ADJUSTING AND CLEANING**

- A. Remove equipment, materials, and debris, leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed openings to be free of excess fire-stopping materials and soiling as work progresses.

### **3.5 SCHEDULES:**

Reference current UL listing for rated systems in concrete floors, concrete walls and gypsum board walls.

### **3.6 Documentation**

- A. Per manufacture guidelines and recommendations.

**END OF SECTION 27 05 41**

## **27 05 43 - Underground Ducts and Raceways for Communications Systems**

### ***PART 1 - GENERAL***

#### **1.1 SUMMARY**

- A. Provide all labor, materials, transportation and equipment to complete the furnishing, installation, assembly, and set up of the Communications System Raceway, Conduit and Backbone work indicated on the drawings and specified herein. Notwithstanding any detailed information in this Section, provide complete, contiguous working raceway systems.
- B. Communications Outside Plant Ductwork - refer to the drawings for demarcation of the work of this Project.
  - 1. Communications Outside Plant Ductwork.
  - 2. Communications Manholes
  - 3. Communications Pullboxes and Vaults
  - 4. Connection of underground ductbanks to ductbank placed by Others
  - 5. Connection of underground ductbanks to buildings and new and existing manholes

#### **1.2 RELATED WORK IN OTHER SECTIONS**

Section 31 23 33 - Trenching And Backfilling

#### **1.3 REGULATORY REQUIREMENTS**

California Electric Code

#### **1.4 REFERENCES**

- A. Usage: In accordance with Division 1
- B. American Association of State Highway and Transportation Officials (AASHTO)
  - 1. AASHTO M-306 Standard Specification For Drainage, Sewer, Utility, And Related Castings
- C. American National Standards Institute (ANSI) – Current Version
  - 1. ANSI C80.1 Rigid Steel Conduit - Zinc Coated
  - 2. ANSI /SCTE 77 Specification for Underground Enclosure Integrity
- D. BICSI
  - 1. Customer Owned Outside Plant Design Manual
- E. National Electrical Manufacturers Association (NEMA)
  - 1. NEMA 250-2003 Enclosures for Electrical Equipment (1000 Volts Maximum)

2. ANSI/NEMA FB 1-2003 Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
3. FB 2.10 2000 Selection and Installation Guidelines for Fittings For Use With Non-Flexible Metallic Conduit Or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, And Electrical Metallic Tubing).
4. FB 2.20 2000 Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable
5. NEMA ICS 6 2001 Industrial Controls and Systems Enclosures
6. NEMA RN 1 1998 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
7. NEMA TC 2 2003 Electrical Polyvinyl Chloride (PVC) Conduit
8. NEMA TC 3 1999 PVC Fittings for Use with Rigid PVC Conduit and Tubing
9. NEMA TC 6&8 2003 PVC Plastic Utilities Duct for Underground Installations
10. NEMA TC 7 2000 Smooth Wall Coilable Polyethylene Electrical Plastic Duct
11. NEMA TC 9 1999 Fittings for ABS and PVC Plastic Utilities Duct for Underground Application
12. NEMA TC 14 1984(R 1997) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
13. NEMA TC 19 2001 Nonmetallic Riser U-Type Guards
14. NEMA VE 1 1-1998 Metallic Cable Tray Systems.
15. NEMA VE 2 2001 Cable Tray Installation Guidelines

F. Underwriters Laboratories, Inc. (UL)

1. UL 6 2004 Electrical Rigid Metal Conduit - Steel
2. UL 360 1986 (R 2003) Liquid-Tight Flexible Steel Conduit
3. UL 514A 1991 (R 2004) Metallic Outlet Boxes
4. UL 514B 1989 (R 2004) Conduit, Tubing, and Cable Fittings
5. UL 514C 1988 (R 1996) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
6. UL 651 1989 (R 1995) Schedule 40 and 80 Rigid PVC Conduit.

## 1.5 SUBMITALS AND SHOP DRAWINGS

Procedures: In accordance with Division 1.

## 1.6 DELIVERY, STORAGE AND HANDLING

A. Procedures: In accordance with Division 1.

B. Duct

1. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances.
2. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

## ***PART 2 - PRODUCTS***

### **2.1 DUCTBANK CONSTRUCTION**

#### **A. PVC Conduit**

1. Drawing and Spec Reference: PVC.
2. Construction:
  - a. 4" trade diameter, unless otherwise noted.
  - b. Poly-vinyl chloride.
  - c. Schedule by Application
    - i. Straight segments, Schedule 40.
    - ii. Flat elbows, Schedule 40.
    - iii. Vertical elbows sweep up to grade, Schedule 80.
    - iv. Above grade, Schedule 80.
  - d. Elbows
    - i. Where innerduct liner is scheduled – CRSC.
    - ii. Elsewhere, Schedule 80. 3) 90° C rated.
    - iii. Solvent welded joints, joints by pipe manufacturer.
  - e. Application
    - i. Soil Backfill/Direct Burial
      - (A) RUS Type II, Type C or Type DB
      - (B) Schedule 40
    - ii. Concrete Encasement:
      - (A) PVC Type DB-120,
      - (B) RUS Type I, Type B or Type EB
      - (C) Any meeting Soil Backfill/Direct Burial
    - iii. Boring
      - (A) HDPE
      - (B) RUS Type Flexible Plastic.
  - f. Performance

- i. Tensile Strength: 7,000 psi at 73.4° F.
  - ii. Flexural Strength: 11,000 psi.
  - iii. Compressive Strength: 8,600 psi.
- g. Approvals:
  - i. RUS Listed for Telephone Cable Installation 5-99 Edition, or latest release thereof.
  - ii. NEMA TC-2, PVC Type EPC-40 and EPC-80.
  - iii. NEMA TC-3.
  - iv. NEMA TC14 Fiberglass Conduit.
  - v. UL 514 fittings.
  - vi. UL 651.
  - vii. ANSI C33.91.
- h. Manufacturers:
  - i. See Section 27 06 00 - Communications Product Schedule

#### B. Fiberglass Conduit

- 1. Drawing Reference: Fiberglass
- 2. Construction
  - a. Trade Standard Sizes
  - b. Meets NEMA TC 14
  - c. Complete system of joints and threaded steel conduit couplers
- 3. Manufacturer
  - a. See Section 27 06 00 - Communications Product Schedule

## 2.2 FITTINGS

- A. Couplings, adapters, transition fittings, etc., shall be molded PVC, slip on, solvent weld type conforming to NEMA TC3 for Schedule 40 or 80 and NEMA TC 9 for type EB or DB.
- B. Fitting Types Expansion Fittings, 12", Metallic Function: At road or bridge expansion joints requiring up to 12" of expansion compensation.
  - 1. Construction
    - a. Steel, hot dip galvanized.
    - b. Nylon wear bushings
    - c. O-ring seal
    - d. Bonding jumpe
  - 2. Manufacturers:



- a. See Section 27 06 00 - Communications Product Schedule

#### C. Expansion Fittings, 6", Non-metallic

1. Function: At road or bridge expansion joints requiring up to 6" of expansion compensation
2. Construction
  - a. Fiberglass
  - b. Provide bonding jumper.
3. Manufacturers:
  - a. See Section 27 06 00 - Communications Product Schedule

#### D. Caps, Underground Conduit Stubs

1. Provide at each location indicated for future expansion.
2. Watertight
3. Manufacturers See Section 27 06 00 - Communications Product Schedule

### 2.3 UNDERGROUND STRUCTURES

#### A. Vaults, PullBoxes and Manholes, Precast, General

1. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes, boxes and handholes.
2. Construction
  - a. General
    - i. Castings shall be free from warp and blow holes that may impair strength or appearance.
    - ii. Structures shall be precast to the design and details indicated, precast monolithically and placed as a unit, or structures may be assembled in sections, designed and produced by the manufacturer in accordance with the requirements specified.
    - iii. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.
    - iv. Structure top and wall shall be of a uniform thickness of not less than 4 inches except at knockouts.
    - v. The minimum concrete cover for reinforcing steel shall be 2 inches.
    - vi. All steel, except reinforcing steel, shall be hot dip galvanized after fabrication.
  - b. Knockouts & Windows
    - i. Thin-walled knock-out panels designed for future duct bank entrances are permitted.

- ii. Sides of precast windows shall be a minimum of 4 inches from the inside surface of adjacent walls, floors, or ceilings.
  - iii. Form of the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope.
  - iv. Provide welded wire-fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes.
  - v. Provide additional reinforcing steel comprised of at least 2 No. 4 bars around window openings.
- c. Extension Rings
- i. Provide extension rings as-required to extend from finished grade to communications utilities.
- d. Bottom and Drain Sumps
- i. Provide solid concrete bottom surface.
  - ii. Provide drain sumps for precast structures a minimum of 12 inches in diameter and 4 inches deep.
- e. Joints
- i. Provide tongue-and-groove or shiplap joints on mating edges of precast components.
  - ii. Design joints to firmly interlock adjoining components and to provide waterproof junctions, and adequate shear transfer.
  - iii. Seal joints watertight using preformed plastic strip conforming to AASHTO M198, Type B.
- f. Frames and Covers
- i. Covers to match across all utilities.
  - ii. Provide fiber composite lids at pedestrian rated covers, H-20 steel slip resistant covers otherwise.
  - iii. Labeling
    - (A) Provide labeling as follows:
      - (1) "Communications"
      - (2) University Manhole or Vault No, as shown on drawings or provided to Contractor prior to vault order placement.
    - (B) Labeling shall be:
      - (1) Cast in concrete lids
      - (2) Written in weld on steel lids
      - (3) Alternatively, for pedestrian grade vault lids and for the vault number only, provide ½" tall, 1/8" min. thickness

lamacoid label, rivet attached to box top in recess area below surface of lid.

- g. Pulling-In-Irons
  - i. Steel bars bent in the form indicated and cast in the walls and floors.
  - ii. Install a pulling-in iron in the wall opposite each duct line entrance at walls, not less than 6 inches above or below, and opposite the conduits entering the manhole.
  - iii. Pulling-in irons shall project into the manhole approximately 4 inches, or be cast in a pocket. Iron shall be hot-dipped galvanized after fabrication.
- h. Cable Racks and Arms
  - i. Provide nonmetallic cable racks
  - ii. Vaults and pullboxes. Minimum two (2), at each vault face 24 inches or longer, at least one (1) each face otherwise.
  - iii. Manholes. Provide AT&T standard arrangement of cable racks at each manhole, except using nonmetallic cable rack hardware.
  - iv. Provide non-metallic cable rack arms. Provide two nonmetallic cable racks arms - minimum 12" arms – for each cable rack provided at each manhole or vault as required above.

#### B. Underground Pull Boxes and Vaults, Concrete with Diamond Plate Steel or Concrete Lids

- 1. Drawing and Specification References:
  - a. PB1P
  - b. PB1T
  - c. PB2P
  - d. PB2T
  - e. PB3T
- 2. Minimum Size
  - a. As scheduled on the drawings. Provide scheduled or larger size.
  - b. Provide extension rings as required to meet required depth.
- 3. Minimum Load Performance:
  - a. PB\*P – where \* is the vault size: Manufacturer's Parkway/Pedestrian Box/Lid or using Polymer Concrete Box lid meeting ANSI/SCTE 77- 2007 Tier 8.
  - b. PB\*T – where \* is the vault size: Per AASHTO H-22. See options described in plans and Part 3 for Contractors Option to use Polymer Concrete Vaults at specific dirt road/path conditions where indicated on the plans. Refer below for specification of Polymer Concrete Vaults.
- 4. Lid Construction:

- a. As scheduled on the plans and in the schedule of applications in Part 3.
  - b. Labeling "Communications" in addition to the vault number identified by the University.
5. Solid Bottom, with sump as indicated on the plans.
  6. Sidewall Duct Entries with bell end fittings.
  7. Cover Components
    - a. PB1 and PB2 Size: One piece construction
    - b. PB3 Size: Two piece hinged lids with torsion spring lifters.
  8. Manufacturers:
    - a. See Section 27 06 00 - Communications Product Schedule

#### C. Manhole/Maintenance Hole

1. Drawing and Specification Reference:
  - a. MH: Maintenance Hole, 12 feet by 6 feet minimum inside dimensions, 7' clear interior height.
  - b. Minimum Load Performance: AASHTO H-22.
  - c. Construction:
  - d. AT&T Reference Specification 38Y-4046 for overall size and shape.
    - i. Arrange duct bank entry per 2004 BICSI Customer Owner Outside Plant Manual, Basic A Splayed Duct Entries, not AT&T standard Basic A center window.
    - ii. Provide non-metallic racking and cable support arms, not AT&T standard metallic arms.
    - iii. Increase wall thickness where indicated installation depth exceeds rating of 38Y-4046 assembly.
    - iv. Provide extension rings as required to meet required depth.
  - e. Ladder
    - i. Provide 1 ladder per maintenance hole
      - (A) Steel
      - (B) Hooks to rungs at top of maintenance hold neck
      - (C) Long enough to reach bottom of maintenance hole
  - f. Labeling
    - i. Labeling "Communications" in addition to the manhole number identified by the University.
  - g. Manufacturers
    - i. See Section 27 06 00 - Communications Product Schedule

#### D. Underground Pull Boxes and Vaults, Polymer Concrete

1. Drawing and Specification References – where the option to use of composite vault assemblies is indicated on the plans and per Part 3 of these specifications
  - a. PB1P
  - b. PB1T
  - c. PB2P
  - d. PB2T
  - e. PB3T
2. Minimum Size
  - a. As scheduled on the drawings. Provide scheduled or larger size.
3. Cover Components
  - a. PB1 and PB2 Size: One piece construction
  - b. PB3 Size: Two piece hinged lids with torsion spring lifters.
4. Construction:
  - a. Polymer concrete cover and body.
5. Labeling
  - a. Labeling "Communications" in addition to the vault number identified by the University.
6. Sidewall Duct Entries with bell end fittings.
7. Solid bottom with sump as indicated on the plans.
8. Minimum Load Performance:
  - a. PB\*P – where \* is the vault size: ANSI/SCTE 77-2007 Tier 8.
  - b. PB\*T – where \* is the vault size: At indicated dirt roads, per ANSI/SCTE 77-2007 Tier 22.
9. Manufacturers
  - a. See Section 27 06 00 - Communications Product Schedule

## 2.4 MISCELLANEOUS UNDERGROUND PRODUCTS

### A. Cable Warning Tape

1. Provide
  - a. 6 inches wide minimum
  - b. 5 mil plastic.
  - c. Metallic backing at least 10 feet o.c.
  - d. 1 mil metallic foil core

- e. Orange in color
    - f. Suitable for buried applications.
    - g. Continuously imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" or similar at not more than 48 inch intervals.
  2. Manufacturers
    - a. See Section 27 06 00 - Communications Product Schedule
- B. Pull Rope
  1. At least 3/8 inch diameter polyethylene or 3/8" min width woven aramid fiber pulltape.
  2. 200 pound minimum strength.
  3. Manufacturers
    - a. See Section 27 06 00 - Communications Product Schedule
- C. Length Marked Tape
  1. Provide 1/2 inch flat tape with sequential markings in whole feet.
  2. Manufacturers
    - a. See Section 27 06 00 - Communications Product Schedule
- D. Conduit Plugs
  1. Provide universal blank duct plug type, with eye for tying rope and tape.
  2. Manufacturers
    - a. See Section 27 06 00 - Communications Product Schedule
- E. Line Marker Post
  1. Orange polyethylene, post height 4 feet above surface.
  2. Soil anchor
  3. Manufacturers
    - a. See Section 27 06 00 - Communications Product Schedule
- F. Conduit Spacer, Trench
  1. Construction
    - a. Non-metallic.
    - b. Sized to snap around conduits as shown on Drawings.
    - c. Interlocking
  2. Manufacturers
    - a. See Section 27 06 00 - Communications Product Schedule
- G. Pulling In Irons
  1. 7/8" Diameter

- a. 6" exposed length minimum after embedment
- b. RUS/REA approved
2. Manufacturer
  - a. See Section 27 06 00 - Communications Product Schedule

#### H. Cable Racks & Supports

1. Construction:
  - a. Non-metallic
  - b. 12" minimum rack arms
  - c. Snap into vertical strut sections provided with new manhole, pullboxes and vaults, or into the University's existing vaults, where indicated.
  - d. Approvals
    - i. RUS/REA
    - ii. NEMA
2. Manufacturers
  - a. See Section 27 06 00 - Communications Product Schedule

### **PART 3 - EXECUTION**

#### **3.1 GENERAL REQUIREMENTS**

Refer to the most restrictive of the Code, the manufacturer's instructions, these specifications and the relevant CalTrans, NEMA or RUS/REA guidelines and conform.

#### **3.2 CONDUIT APPLICATION**

- A. General: Install the following types of conduits and fittings in the locations listed, unless otherwise noted in the drawings.
  1. Underground Ductbanks, Concrete Encased
    - a. PVC
- B. Exterior, Exposed
  1. RSC to be used for applications up to 8 feet AFF or to first pull box, whichever is first, applications subject to physical abuse or for applications greater than 4" diameter.
  2. EMT acceptable in all other applications not noted above up to 4", where used in conjunction with specified Rain-tight (compression) couplers.
- C. Embedded in Concrete
  1. RSC or rigid non-metallic conduit.
  2. PVC
- D. In Utility Tunnels

1. RSC
2. CRSC
3. IMC

### **3.3 UNDERGROUND VAULT APPLICATION**

#### **A. Condition**

Acceptable vault construction standard AASHTO H-20 ANSI /SCTE 77 2007 Tier 22 Pedestrian/Parkway and ANSI/SCTE 77 2007 Tier 8 Pedestrian pathways shall apply as applicable.

1. At unpaved roads subject to infrequent vehicle traffic.
2. At paved roads and at paved surfaces ordinarily exposed to motor vehicle traffic.

### **3.4 UNDERGROUND CONSTRUCTION:**

#### **A. Duct and Conduit Placement**

1. Duct lines shall have a continuous slope downward toward underground structures and away from buildings with a minimum pitch of 3 inches in 100 feet.
2. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes.
3. Excavate trenches along straight lines from structure to structure before ducts are laid or structure constructed so the elevation can be adjusted, if necessary, to avoid unseen obstruction.
4. Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet. Sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.
5. Short-radius manufactured 90-degree duct bends may be used only for building, pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 450 mm 18 inches for ducts of less than 80 mm 3 inch diameter, and 900 mm 36 inches for ducts 80 mm 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.6 m 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used.

#### **B. Duct Bank**

1. Duct Entrance Arrangement - Conform to Table 3.33 and applicable arrangement diagrams 3.67-3.74 of 2004 BISC I Customer Owned Outside Plant Design Manual.
2. Terminate conduits in end-bells where duct lines enter underground structures.
3. Stagger conduit joints by rows and layers to strengthen the duct bank.



4. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers and top spacers to provide a completely enclosed and locked-in duct bank. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of duct bank. Before pouring concrete or backfilling, as applies, anchor duct bank assemblies to prevent the assemblies from floating. Anchoring shall be done by driving reinforcing rods adjacent to every other duct spacer assembly and attaching the rod to the spacer assembly.
5. Partially Completed Duct Banks. Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, sand and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 1 foot apart. Restrain reinforcing assembly from moving during concrete pouring.
6. As each section of a duct line is completed from structure to structure, for conduit sizes 3 inches and larger draw a flexible testing mandrel approximately 12 inches long with a diameter less than the diameter of the conduit through a conduit. After which, draw a stiff bristle brush having the same diameter of the conduit through the conduit, until conduit is clear of particles of earth, sand, and gravel; then immediately install end plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through the conduit, until conduit is clear of particles of earth, sand, and gravel; then immediately install end plugs.
7. Field cuts requiring tapers shall be made with proper tools and match factory tapers.
8. Joints shall be staggered at least 6 inches vertically. Plastic Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.
9. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape.
10. Unless otherwise noted, exterior communications conduit runs shall be buried a minimum of 24" below finished grade or as required to conform to local utility requirements.
11. Refer to the details in the plans for additional depth required for PDS communications duct construction.
12. Where new trenching is required, backfill and compaction requirements shall be as defined Division 33.
13. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.
14. Provide concrete encasement of all communications duct runs. Construct underground duct lines of individual conduits encased in concrete. Do not mix different kinds of conduit in any one duct bank. Ducts shall not be smaller than shown on plans. The concrete

encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts, 8" minimum at PDS conduits. Separate communications conduits by a minimum concrete thickness of 2 inches. Separate light and power conduits from communications conduits by a minimum concrete thickness of 4 inches. The top of the concrete encasement shall not be less than 18 inches below grade except under roads and pavement, where concrete shall be a minimum of 24 inches below grade.

- a. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. Submit proposed bonding method for approval in accordance with the detail drawing portion of the submittals.
- b. Where conduit runs under existing roads, cut and patch the pavement as indicated on the Civil Plans.

C. Conduit Plugs and Pull Rope. New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weep hole or screen to allow water drainage. Provide a 3/8-inch nylon pull rope having 3 feet of slack at each end of unused or empty conduits.

D. Manhole Placement and Connections

1. In unpaved areas, the top of new manhole covers shall be approximately 1/2 inch above the finished grade.
2. Where existing grades higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate the manhole cover to existing grade level.
3. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole.
4. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell.
5. A cast metal grille-type sump frame and cover shall be installed over the manhole sump.
6. Connections to Existing Manholes. For duct line connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and bend out to tie into the reinforcing of the duct line encasement. Chip out the structure wall to form a key for the duct line encasement. Grout new bell end entries watertight to the formed opening.
7. Provide pre-cast reinforced concrete pullboxes set flush in ground for future underground raceways. Pullboxes shall be labeled with a stamped brass disk identification plate tied to conduit end with "Ty-Wrap", "Quick-Wrap" or equal.
8. In existing facilities underground construction, the Contractor shall promptly repair any indicated utility lines or systems damaged by Contractor operations. Damage to lines or

systems not indicated, which are caused by Contractor operations, shall be brought to the immediate attention of the University Representative. If the Contractor is advised in writing of the location of a non-indicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In any event, the Contractor shall immediately notify the University Representative of any such damage.

9. At twelve inches below grade, place specified warning tape continuously.

**END OF SECTION 27 05 43**

## 27 05 48 - Noise and Vibration for Communications Systems

### *PART 1 - GENERAL*

#### 1.1 SCOPE OF WORK

A. Provisions of:

1. Flexible communications raceway connections to vibrating machinery
2. Sealing of communications device boxes and related installed in sound rated walls. Refer to the architectural plans and wall schedules - any walls identified with an STC rating are sound rated.
3. Coordination of airtight installation requirements where Communications Systems Pathway penetrates Meeting Rooms, Mechanical, Electrical Room and other high noise areas of the project.

#### 1.2 REFERENCES

A. American National Standards Institute (ANSI)

1. ANSI/UL 1479-2003 Fire Tests of Through Penetration Firestops
2. American Society for Testing and Materials (ASTM)
  - a. ASTM E814-02 Standard Test Method for Fire Tests of Through Penetration Fire Stops.
3. Underwriters Laboratories, Inc. (UL)
  - a. UL Fire Resistance Directories

#### 1.3 SUBMITTALS

Comply with the requirements of Section 01 33 23 – Shop Drawings, Product Data and Samples and Section 27 05 00 – Common Work Results for Communications.

### *PART 2 - PRODUCTS*

#### 2.1 FLEXIBLE COMMUNICATIONS CONNECTIONS:

A. Make communications connections to vibrating equipment flexible as follows:

1. For conduit over 1" O.D. make communications connections to vibrating equipment via a flexible expansion/deflection conduit coupling sized as required. Coupling shall have flexible and watertight outer jacket, internal grounding strap, plastic inner sleeve to maintain smooth wireway, and end hubs with threads to fit standard threaded metal conduit.
2. Manufacturers:

- a. See Section 27 06 00 - Communications Product Schedule
3. For conduit under 1" O.D. utilize FLEX or LIQUIDTIGHT conduit as specified in Section 27 05 33 – Conduits and Backboxes for Communications Systems with slack at least 3' or 15 diameters long, whichever is the longer or provide a flexible coupling as defined above.

## 2.2 J-BOX MASTIC

- A. At all electrical boxes, flush and semi-flush pull cans, media panel backboxes, device boxes and similar penetrating sound isolating partitions, utilize sheet form adhesive mastic to increase the mass of the enclosure through application to the entire concealed surface within the wall cavity.
- B. Manufacturers
  1. See Section 27 06 00 - Communications Product Schedule

## 2.3 RESILIENT PENETRATIONS

- A. For conduit:
  1. Sleeves: Sleeves of appropriate gage galvanized sheet metal shall be formed to at least the thickness of the penetrated construction and 3/4" to 1" larger in each cross-sectional dimension than the penetrating element.
    - a. Manufacturers:
      - i. See Section 27 06 00 - Communications Product Schedule
  2. Batt: Glass fiber of batt or mineral wool, 1 to 3 lb./cu. ft. density.
    - a. Manufacturers
      - i. See Section 27 06 00 - Communications Product Schedule
  3. Acoustical Sealant
    - a. Manufacturers
      - i. See Section 27 06 00 - Communications Product Schedule
  4. Firestop Sealant:
    - a. Where required, resilient firestop caulking may be used in lieu of Acoustical Sealant when installed in strict conformance with the manufacturer's directions. Fully hardened firestop caulk shall develop a Shore A hardness of no greater than 35. Refer to the requirements of Section 27 05 33 – Conduits and Backboxes for Communications Systems.

## ***PART 3 - EXECUTION***

### **3.1 GENERAL INSTALLATION REQUIREMENTS, CONNECTION TO VIBRATING EQUIPMENT**

- A. The Contractor shall not install any vibrating equipment or conduit attached thereto which makes rigid contact with the "building" unless it is approved in this specification or by the Owner's

Representative. "Building" includes, but is not limited to slabs, beams, columns, walls, partitions, ceilings, studs, ceiling framing and suspension systems.

- B. Prior to installation, the Contractor shall bring to the Owner' Representative's attention any conflicts between trades which will result in unavoidable rigid contact at equipment, conduit, piping, ducts, etc., as described herein, due to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
- C. The Contractor shall obtain inspection and approval from the Owner's Representative of any installation to be covered or enclosed, prior to such closure.

### **3.2 INSPECTION OF CONDITIONS:**

- A. Examine related Work and surfaces before starting Work of this Section. Report to the Owner's Representative, in writing, conditions which will prevent proper provision of this work. Beginning the Work of this Section without reporting unsuitable conditions to the Owner's Representative constitutes acceptance of such conditions by Contractor. Perform any required removal, repair, or replacement of this Work caused by unsuitable conditions at no additional cost to the Owner.
- B. Coordination
  - 1. Coordinate with the work of the Base Building Construction Contract. Coordinate Work of this Section with all other impacted trades.

### **3.3 INSTALLATION REQUIREMENTS, FLEXIBLE ELECTRICAL CONNECTIONS**

- A. The installation of flexible electrical connections to vibration isolated equipment shall in no way impair or restrain the function of the vibration isolation installed by the work by Others.
  - 1. Using gross slack. Install flexible conduit in a grossly slack loop form or shallow "U" form. Install stranded conductors with sufficient slack to accommodate maximum possible movement.
  - 2. Using flexible coupling. The flexible coupling shall be free and not in contact with any nearby building construction and shall be installed slack, and free of strain in any direction. Install stranded conductors as above.

### **3.4 INSTALLATION REQUIREMENTS, J-BOX MASTIC**

- A. Application: All Communications Systems work in sound isolating assemblies, including but not limited to residential rooms, offices, mechanical rooms, electrical rooms and related to utilize backboxes for all services, including but not limited to low voltage communication. Installation of backboxes to conform with following:
  - 1. Space outlet boxes on opposite faces of the wall by more than 24" o.c. Where daisy chained conduits indicated on the plans, connect such boxes by slack flexible conduit (2 times longer than distance between outlets).
  - 2. Cutouts for electrical boxes and penetrating piping/conduit shall be no more than 1/4" oversize.

3. Caulk gap between drywall and electrical boxes and/or piping/conduit airtight with Acoustical Sealant. Apply J-Box mastic to back of all penetrating electrical boxes and press firmly at joint to wallboard to provide an airtight seal.

### **3.5 INSTALLATION REQUIREMENTS, RESILIENT PENETRATIONS**

- A. Penetrations included in this Section of the Specifications include all communications conduit connected to vibrating equipment within 30 feet of such equipment
- B. Method for round or rectangular penetrations.
  1. Cut a clean opening in the penetrated construction very nearly the size of the sleeve for each penetrating element. Provide lintels above, relief structure below and vertical framing between and to the sides, as required. Provide the above, escutcheon plates and such related construction as is necessary to make the penetrated structure as solid and massive near the penetrations as the surrounding construction.
  2. Set the metal sleeve into the penetrated construction in an airtight manner around its outer periphery, using grout, dry packing, plaster or drywall compound full depth and all around - but only to a maximum width of ½" - or the requirements of the above paragraph shall not have been satisfied.
  3. Pack annular opening with glass fiber between metal sleeve and penetrating element full depth, all around to a firm degree of compaction. Leave a ½" deep annular opening free at each end of the metal sleeve; fill this fully with sealant.

### **3.6 MECHANICAL AND ELECTRICAL ROOMS REQUIREMENTS**

- A. All mechanical and electrical rooms, plenums, duct shafts and drywall duct enclosures and other enclosures of high noise sources shall be constructed airtight. This means that every precaution shall be taken to maintain construction completely airtight around a room so designated. Construction joints, duct penetrations, electrical boxes, frames, supports, cabinets, doors, access panels, fixtures, etc., all shall be built or installed in such a manner as to prevent sound transmission through any construction enclosing a room horizontally or vertically. Appropriate lintels, frames, blocking, escutcheons, grouting, gaskets, packing, caulking, taping, filling, etc., all shall be employed to prevent sound transmission. Refer to requirements of this Section for Resilient Penetrations.
- B. All work under this section is to comply with the above. Contractor to report to Owner's Representative any construction conditions which arise which might compromise compliance with this requirement.

**END OF SECTION 27 05 48**

## 27 05 53 - Identification and Labeling for Communications Systems

### **PART 1 - GENERAL**

#### **1.1 SUMMARY:**

- A. Provide all labor, materials, tools, and equipment required for permanent intelligible labeling on, or adjacent to, all cabling, connectors, innerduct, faceplates, jacks, receptacles, controls, fuses, circuit breakers, patching jacks, and racks.
- B. This section includes minimum requirements for the following:
  - 1. Labeling Communications Cabling
  - 2. Labeling Closet Hardware
  - 3. Labeling Work Stations
  - 4. Labeling Pathways, Spaces, Grounding and Bonding.
- C. Refer to detailed plans for additional requirements
- D. Clearly and distinctly indicate the function of the item
- E. Coordinate with Record Drawings

#### **1.2 REFERENCES**

- A. Usage: In accordance with Division 1
- B. American Society for Testing and Materials (ASTM)
  - 1. ASTM D 709 (2004) Laminated Thermosetting Materials
- C. C. ANSI/TIA-606 (Current) Administration Standard Telecommunications Infrastructure
- D. Underwriters Laboratories (UL)
  - 1. UL 969 (1995; R 2001) Marking and Labeling Systems

#### **1.3 QUALITY ASSURANCE**

- A. Identification and administration work specified herein shall comply with the applicable requirements of:
  - 1. ANSI/TIA- 606 (Current)
  - 2. ANSI/TIA-569 (Current)
  - 3. ANSI/TIA- 568(Current)
  - 4. BICSI Telecommunications Distribution Methods Manual
  - 5. UL 969.



## 1.4 SUBMITTALS

Conform with the requirements of Section 01 33 23 - Shop Drawings, Product Data and Samples and Section 27 05 00 - Common Work Results for Communications.

## 1.5 DELIVERY, STORAGE AND HANDLING

A. Procedures: In accordance with Division 1

## 1.6 SEQUENCING

Not Used.

## **PART 2 - PRODUCTS**

### 2.1 COMMUNICATION CABLING LABELS, INTERIOR

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.
- C. Provide vinyl substrate with a white printing area and black print. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow – so that the labels are easily distinguishable.
- D. Shall be flexible vinyl or other substrates to apply easy and flex as cables are bent.
- E. Shall use aggressive adhesives that stay attached even to the most difficult to adhere to jacketing.
- F. Manufacturers
  - 1. See Section 27 06 00 - Communications Product Schedule

### 2.2 COMMUNICATIONS CABLE LABELS, OUTSIDE PLANT

- G. Cable Tags in Manholes, Handholes, and Vaults
  - 1. Provide tags for communications cable or wire located in manholes, handholes, and vaults.
    - a. The tags shall be polyethylene.
    - b. Machine printed - Do not provide handwritten letters.
  - 2. Polyethylene Cable Tags
    - a. Provide tags of polyethylene that have an average tensile strength of 22.4 MPa (3250 pounds per square inch) 3250 pounds per square inch; and that are two millimeter (0.08 inch) 0.08 inch thick (minimum), non-corrosive, non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 77 degrees C 170 degrees F.
    - b. Provide 1.3 mm (0.05 inch) 0.05 inch (minimum) thick black polyethylene tag holder.

- c. Provide a one-piece nylon, self-locking tie at each end of the cable tag.
  - d. Ties shall have a minimum loop tensile strength of 778.75 N (175 pounds) 175 pounds. The cable tags shall have black block letters, numbers, and symbols 25 mm (one inch) one inch high on a yellow background.
  - e. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.
3. Manufacturers
    - a. See Section 27 06 00 - Communications Product Schedule

### **2.3 CLOSET HARDWARE LABELS**

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.
- C. Where insert type labels are used provide clear plastic cover over label.
- D. Manufacturer:
  1. See Section 27 06 00 - Communications Product Schedule

### **2.4 GROUNDING AND BONDING, PATHWAY, AND SPACE LABELS**

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.
- C. Manufacturers
  1. See Section 27 06 00 - Communications Product Schedule

### **2.5 WORKSTATION LABELS**

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.
- C. Where insert type labels are used provide clear plastic cover over label.
- D. Manufacturers
  1. See Section 27 06 00 - Communications Product Schedule

### **2.6 NAMEPLATES**

- A. Field Fabricated Nameplates
  1. Features/Function/Construction
    - a. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings.
    - b. Comply with ASTM D 709
    - c. Each nameplate inscription shall identify the function and, when applicable, the position.

- d. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core.
- e. Surface shall be matte finish
- f. Corners shall be square
- g. Accurately align lettering and engrave into the core.
- h. Minimum size of nameplates shall be one by 2.5 inches.
- i. Lettering shall be a minimum of 0.25 inch high normal block style

## ***PART 3 - EXECUTION***

### **3.1 GENERAL**

- A. Apply labeling to clean surfaces free of oil, dust, solvents or loose material.
- B. Apply after Project painting in area of application is complete.
- C. Apply to locations where labeling will not be damaged, covered over or in the way of the ordinary maintenance and operation of the installed communications infrastructure or system.
- D. Apply labeling right side up, parallel to major edges of surfaces to which it is applied. When no line is evident, apply parallel to floor line. Correct conditions of labeling applied out of true.
- E. Protect installed labeling from damage.
- F. Replace labeling that is defaced, illegible or peeling off of the surface to which it is applied.

### **3.2 WORKSTATION JACK, CABLE AND PATCH PANEL ASSIGNED CIRCUIT NUMBERS**

- A. Label General: WAO jack assignment number and TS patch panel port number shall be the same number. Example: A horizontal cable terminated on WAO jack 1001 shall be terminated on patch panel port 1001. A horizontal cable terminated on WAO jack 2099 shall be terminated on patch panel port 2099. This number is also the cable number.
  - 1. Jack Labels and Placements:
    - a. The cover plate area directly above and beneath the jacks are the labeling areas. In the top area, using the specified means, label the faceplate number assigned on the contract documents
    - b. Each faceplate shall be labeled at the top with the following
      - i. Last three digits of the CAAN
      - ii. The TR floor number and
      - iii. The TR number the room in which the jack is terminated
      - iv. Example: w-x.y-z or 175-1.1-1234
    - c. Each faceplate jack position shall be labeled with its sequential number.
    - d. Place label directly above or below jack

### 3.3 Voice Cross Connect Identification and Labeling System

- A. Cable labels are required on the WAO cables only. Voice cross-connect cables do not require cable labels. Label placement: Attach a label to both end of each cable six inches (6") from the cables termination at WAO and TR patch panel port.
- B. Label content and format, both ends of cable shall be XXX - YZZZ where:
1. XXX = the 3-digit building number which is the last 3 digits of the facility asset designator - a 4-digit number called a CAAN number.
  2. Y = the floor number - use zero (0) for basement.
  3. ZZZ = the WAO jack number the cable is terminated on - 001 through 999.
  4. Example: 195-2001 = Building 195, (2) second floor, (001) first jack on the second floor. All labels shall be machine created labels. Hand labeling is not acceptable.

### 3.3 IDENTIFICATION & LABELING

#### A. Pathways

1. Pathways shall be marked at each endpoint and at all intermediate pull or junction boxes. In the case of partitioned pathways (i.e. innerduct) each partition shall have a unique identifier.
2. Label pathways using the appropriate abbreviation and a number.
3. Use adhesive type labels.

#### B. Labels shall be affixed at the entry to all telecommunications rooms and spaces (Includes entrance facilities, OSP pull-boxes, communication equipment rooms, communication equipment spaces and work areas)

1. Use adhesive type labels for all communications space labeling,
2. Affix labels to entrance doors – coordinate location with University Representative.

#### C. Cables

1. Horizontal and Indoor Backbone Cables shall be marked within 12" of each endpoint or to innerduct in which the cable is installed.
2. Except where installed in innerduct or conduit, all backbone fiber optic cable shall have affixed to the outer jacket, labels of a bright color that contain at least the legend "FIBER OPTIC CABLE." These labels must be affixed at separations no greater than 50 ft.
3. Within every manhole/vault/pullbox and within 4 ft of the entrance into a building every backbone cable's assigned identifier shall be affixed to either the cable's outer jacket or to innerduct in which the cable is installed.
4. Any cable installed in conduit shall be labeled at all intermediate pull or junction boxes.
5. Label cables using the appropriate circuit ID.
6. Use adhesive type labels for all communications cable labels.
7. Affix labels to cables – marking cable is not permitted.

8. Where cable is fully encased in innerduct label the outside of the innerduct with the cable label and, where the contents are fiber optic cabling, the "FIBER OPTIC CABLE" label.

#### D. 110 blocks

1. Each cable termination position on 110 blocks shall be labeled with number designators.
  - a. All backbone copper cable termination blocks shall be labeled with both the pair count of every 5th pair and the cable's assigned identifier.
2. Where insert type labels are used install clear plastic cover over reprinted or Laser printed type label. Install five (5) pair and four (4) pair 110 I.D. strips for backbone cabling.
3. 110 block cable ID label shall be as follows:
  - a. Label shall be UCSC generated cable number - from Telecommunications Room (TR) number - cable pair count per 25 pairs (1-25, 26-50, etc.).
  - b. 'From' UCSC building Telecommunications Room (TR) number for ISP riser or 'From' UCSC building number for OSP cable.
  - c. Cable pair count per 25 pairs (1-25, 26-50, etc.).
  - d. University Representative to provide UCSC generated cable number.
4. Pair call-out labeling: Pair call-out labeling shall designate every fifth (5th) pair consecutively through total pair count of the cable terminated on the block but not including the first (1st) and twenty-fifth (25th) pairs of each twenty-five (25) pair field bundle: Example for fifty (50) pair cable -- 5, 10, 15, 20, 30, 35, 40, 45.
5. All labels shall be machine/printer created labels.

#### E. Horizontal Copper Patch Panel Labeling

1. Label placement.
  - a. WAO jack assignment number and TR patch panel port number shall be the same number. Example: A horizontal cable terminated on WAO jack 001 shall be terminated on patch panel port 001. A horizontal cable terminated on WAO jack 099 shall be terminated on patch panel port 099.
  - b. Start patch panel port labeling at the first port in the patch panel that is at the top of the equipment rack closest to the wall. Work left to right and down that equipment rack to the last patch panel port within that equipment rack. Continue to the next equipment rack, starting in its upper left-hand corner and moving down the rack, if more than one (1) equipment rack supporting WAO horizontal cabling is installed in the TR.
2. Patch Panel Port Label content and format shall be YZZZ where:
  - a. ZZZ = the WAO jack number the cable is terminated on - 001 through 999.
  - b. Y = the floor number the TR and WAOs are on - use zero (0) for basement.

- c. Example: 2055 = (2) second floor, (055) fifty-fifth WAO/Patch Panel port. As an observation, the above number is also a key component of the horizontal cable number.

3. All labels shall be machine/printer created labels.

#### F. Backbone Fiber Patch Panel Labeling

1. Each backbone fiber patch panel shall have a header label.
  - a. Header Label format and content shall be as follows:
    - i. UCSC generated cable number.
    - ii. 'From' UCSC building Telecommunication Room (TR) number for ISP riser or 'From' UCSC building number for OSP cable.
    - iii. Fiber strand type designation and strand count. SM (single mode) XX; MM (multi-mode) XX where XX = strand count. If cable is a hybrid make sure both strand type counts are accounted for in header label.
  - b. University Representative to provide UCSC generated cable number.
  - c. Fiber Patch Panel Port Labeling: Label each fiber patch panel port with the strand count terminated on the port. Example for a duplex port termination: 5-6 = strand 5 and strand 6 of cable are terminated on this fiber patch panel port. Simplex port termination 6 = strand 6 is of cable is terminated on this fiber patch panel port.
  - d. All labels shall be printed labels. Hand labeling is not acceptable unless approved in writing as acceptable by the PP&C project manager or his/her designate.

#### G. Voice Cross-Connect System Labeling

1. The 110-Blocks shall be labeled "Voice Cross-Connect to Rack #\_ Panel #\_\_". Each cable shall be numbered from 1-48 on the 110-block Designation Strips.
2. The patch panels on the racks shall be labeled "Voice Cross-Connect Rack #\_ Panel #\_\_". Each jack shall be numbered from 1-48 on each panel.

#### H. Work Area Outlet

1. All faceplate labels shall indicate the faceplate number and the circuit ID for each cable that it houses.
2. For faceplates without insert type labels use adhesive type labels affix labels to faceplate – marking faceplates is not permitted.
3. Patch cords installed under the work of this Project shall be labeled at each endpoint using the appropriate circuit ID.
4. Use adhesive type labels for all communications cable labels.
5. Affix labels to cables – marking cable is not permitted.

#### I. Grounding and Bonding

1. The TMGB(s) (telecommunications main ground bar) shall be labeled as such with an adhesive type label(s) affix label(s) to TMGB.
2. The conductor connecting the TMGB (telecommunications main ground bar) to the building ground shall be labeled at each end with an affixed label in a visible location as close as practicable to the bonding point at each end of the conductor.

J. Firestopping

1. Each firestopping location shall be labeled at each location where firestopping is installed, on each side of the penetrated fire barrier, within 300 mm (12 in.) of the firestopping material.

K. Spaces (BDF, ER, EF, TR)

1. All spaces including TR, ER, EF etc, shall be labeled first by floor then by sequence on that floor. Basement spaces shall be designated as "0". All ensuing floors shall be numbered by their floor designation 1, 2, 3 etc. Each TR contained on a particular floor will be designated a .1, .2 etc. A first floor primary TR will receive the designation of TR1.1. An entrance facility in the basement shall be designated as TR0.1. A subsequent TR on the basement level shall be designated TR0.2 and so on.

**END OF SECTION 27 05 53**

## 27 06 00 – Communications Product Schedule

### **SUBMITTALS REQUIRED**

- A. See specifications, Section 27 00 00
- B. Any submittal of an "or equal" comply with Division 1 substitution procedures.
- C. Items not showing manufacturer and part # shall be of institutional grade quality

Section	Category	Mfgr	P/N	Description
27 00 00	Communications	Cablofil		Wiremesh Cable Tray
27 00 00	Communications	Hoffman	AHE8X6X4	For WAO: 8-inches by 6-inches by 4-inches indoor rated box with a hinged cover, or equal
27 05 26	Grounding & Bonding	Cooper B-Line	SB47902	Two-hole compression lugs
27 05 26	Grounding & Bonding			6 AWG, green insulation, bonding wire
27 05 26	Grounding & Bonding	Panduit	LTYK	ANSI/TIA-607 Compliant Bonding Tag
27 05 26	Grounding & Bonding	Cooper B-Line	SB6693/4X101/2	Grounding Strap
27 05 29	Hangers & Supports	Cooper B-Line	FT4X12X10	4"X12"X10' Flextray
27 05 29	Hangers & Supports	Cooper B-Line	FT4X16X10	4"X16"X10' Flextray
27 05 29	Hangers & Supports	Cooper B-Line	WASHER SPL KIT	WASHER SPL KIT Flextray Washer splice kit
27 05 29	Hangers & Supports	Cooper B-Line	90 DEGREE KIT	90 DEGREE KIT Flextray 90 degree kit
27 05 29	Hangers & Supports	Cooper B-Line	FTA6HD	Hold Down Plate
27 05 29	Hangers & Supports	Cooper B-Line	FTB12CS	Triangle Brackets
27 05 29	Hangers & Supports	Cooper B-Line	FTA9WTK	Wall Termination Kit
27 05 29	Hangers & Supports	Phillips	"Red-Head"	Concrete fasteners
		Ramset		
		Hilti		



Section	Category	Mfgr	P/N	Description
27 05 29	Hangers & Supports	Unistrut Corp.		Concrete inserts and construction channel:
		GS Metals "Globe Strut."		
		Thomas & Betts "Kindorf" Corp.		
27 05 29	Hangers & Supports	O-Z/Gedney.		Conduit straps
		Erico "Caddy" Fastening Products.		
		Thomas & Betts "Kindorf" Corp.		
27 05 29	Hangers & Supports	Cooper B-Line		Beam Clamps
		SuperStrut		
		Unistrut		
27 05 29	Hangers & Supports	Mason Industries		Aircraft Cable Sway Braces
		M.W. Sausse/Vibrex		
		Loos & Company, Inc.		
27 05 29	Hangers & Supports	Cooper B-Line	series BCH21, BCH32, BCH64	Cable Hangers: Ceiling Hung J-Hooks
		Erico	Caddy CableCat	
27 05 33	Conduits and Backboxes	Allied Tube and Conduit Co.		Raceways
		Triangle PWC, Inc.		
		Western Tube and Conduit Corp.		
		Spring City Electrical Manufacturing Co.		
		Occidental Coating Co. (OCAL)		
		Alflex Corp.		
		American Flexible Metal Conduit Co.		
Anaconda				
27 05 33	Conduits and Backboxes	Appleton Electric Co.		Fittings
		OZ/Gedney		
		Thomas & Betts Corp.		

Section	Category	Mfgr	P/N	Description
		Spring City Electrical Manufacturing Co.		
		Occidental Coating Co. (OCAL)		
		Carlton		
27 05 33	Conduits and Backboxes	NONE LISTED IN SPEC		Rigid Steel Conduit
27 05 33	Conduits and Backboxes	RobRoy Industries	Plastibond	Coated Rigid Steel Conduit
		Occidental Coating Co.	Occal-40	
		Plastic Applicators	KorKap	
		Ocal-Blue		
27 05 33	Conduits and Backboxes	NONE LISTED IN SPEC		Intermediate Metal Conduit
27 05 33	Conduits and Backboxes	NONE LISTED IN SPEC		Electrical Metallic Tubing
27 05 33	Conduits and Backboxes	NONE LISTED IN SPEC		Flexible Conduit
27 05 33	Conduits and Backboxes			Liquidtight Flexible Metallic Conduit
27 05 33	Conduits and Backboxes	Thomas & Betts (Steel City) O-Z/Gedney	BG-801 Series	Conduit Fittings, Insulated Throat Grounding Bushings
27 05 33	Conduits and Backboxes	J-B Weld (U.S. Navy preferred product)		Epoxy
27 05 33	Conduits and Backboxes	OZ/Gedney Steel City	Type DX Type EDF	Expansion/deflection couplings
27 05 33	Conduits and Backboxes	Steel City		Junction and device boxes: Interior
27 05 33	Conduits and Backboxes	Appleton		Junction and device boxes: Exterior, exposed with cover of same construction
		Pyle-National		
27 05 33	Conduits and Backboxes	B-Line Electrical Enclosures		Terminal Cabinets
		Circle AW Products		
		Hammond		
		Henessey		
		Hoffman		

Section	Category	Mfgr	P/N	Description
		Myers Electric Products		
		Rittal		
27 05 33	Conduits and Backboxes	Specified Technologies Inc.	EZ-Path Fire Rated Pathway	Through Penetration Sealant Assembly, Re-Enterable (Zero Maintenance)
		Wiremold	FlameStopper	
		Hilti CP 653	Speedsleeve	
27 05 33	Conduits and Backboxes	Specified Technologies, Inc.		Firestopping for Conduits and Other Closed Pathways
		3M		
27 05 33	Conduits and Backboxes	Master Builders		Concrete Bonding Agent
		Burke's	BurkEpoxy MV	
		Sika's	Sikadur 32, Hi-Mod	
27 05 33	Conduits and Backboxes	Sika Corporation	SikaTop 122	Patching Mortar
		Burke		
		Master Builder	Masterpatch 20	
27 05 33	Conduits and Backboxes	Master Builders	Masterkure	Curing Compound
		Burke's	Spartan-Cote	
27 05 33	Conduits and Backboxes	Pecora Corporation	Dynatrol I	Exterior Polyurethane Weatherproofing and Control Joint Sealant
		Sika Corporation, Inc.	Sikaflex 1a	
		BASF (Sonneborne)	NP 1	
		Tremco	Dymonic F	
27 05 33	Conduits and Backboxes	Leviton	Duraport	
27 05 36	Cable Trays	B-Line	Cable Tray Systems - Ladder Type Cable Tray (with a complete system of accessories, including Ladder Drop-outs)	Cable Tray
		PW Industries		
27 05 36	Cable Trays	B-Line Telecom	Saunders SB-17	Cable Runway
		Chatsworth Products Inc.	11275 series.	
		PW Industries		
27 05 36	Cable Trays	B-Line Wire Basket Runway		Cable Tray, Open Wire Frame

Section	Category	Mfgr	P/N	Description
		Cablofil		
		G.S. Metals Corp		
		PW Industries		
27 05 36	Cable Trays	Enduro Composite Systems.		Cable Tray, Fiberglass
		Robroy		
		P-W Industries		
27 05 39	Surface Raceways	Wiremold	2400 System (Design Basis)	Metallic Surface Raceway - One Chamber, 1.4 inches
27 05 39	Surface Raceways	Wiremold	V4000 System (Design Basis)	Metallic Surface Raceway - One Chamber, 6.75 inches
27 05 39	Surface Raceways	Wiremold	V6000 System (Design Basis)	Metallic Surface Raceway - One Chamber, 16.5 inches
27 05 39	Surface Raceways	Wiremold	V4000 System with G4000D divider and G4001D	Metallic Surface Raceway - Two Chamber, 3.3 inches
27 05 39	Surface Raceways	Wiremold	V6000 System with G6000D divider and G6001D	Metallic Surface Raceway - Two Chamber, 8 inches
27 05 39	Surface Raceways	Wiremold	V6000 System with two G6000D dividers and divider clips as required (Design Basis).	Metallic Surface Raceway - Three Chamber, 5.5 inches
27 05 39	Surface Raceways	Wiremold	PN10	Non-Metallic Surface Raceway - One Chamber, 1 inch (ISR-1)
27 05 39		Panduit	LDP-10	
27 05 39	Surface Raceways	Wiremold	5400B Series (Design Basis)	Non-Metallic Surface Raceway - Two Chamber, 2 inch (2SR-2)
27 05 39		Hubbell		
27 05 39	Surface Raceways	Wiremold	5400 Series with 5400 BD Base (Design Basis)	Non-Metallic Surface Raceway - Three Chamber, 3/4 inch (3SR-.75)
27 05 39		Hubbell	Mediatrak System	
27 05 39	Surface Raceways	Wiremold	5500 Series with 5500BD Base (Design Basis)	Non-Metallic Surface Raceway - Three Chamber, 2.5 inch (3SR-2.5)
27 05 39		Hubbell	Mediatrak 10	
27 05 41	Fire Stop	STI	SSP	Fire Stop Putty

Section	Category	Mfgr	P/N	Description
27 05 41	Fire Stop	STI	FP200	2" Intumescent Firestop Plug
27 05 41	Fire Stop	STI	FP400	4" Intumescent Firestop Plug
27 05 41	Fire Stop	STI	EZ-PATH	Re-Enterable firestop assembly
27 05 41	Firestop Systems	Specified Technologies 200 Evans Way, Somerville, NJ 08876 Tel: (800) 992-1180, Fax: (908) 526-9623, Email: techserv@stifirestop.com Website: www.stifirestop.com.		Firestop system
27 05 41	Firestop Systems	Specified Technologies Inc.	SpecSeal® Series SSS Sealant SpecSeal® Series LCI Sealant	Firestop Sealants
27 05 41	Firestop Systems	Specified Technologies Inc.	SpecSeal® Series SSP Putt	Firestop Putty
27 05 41	Firestop Systems	Specified Technologies Inc.	SpecSeal® Series SSB Pillows	Firestop Pillows
27 05 41	Firestop Systems	Specified Technologies Inc.	SpecSeal® Brand Ready® Firestop Grommets; RFG1	Fire-Rated Cable Grommet
27 05 41	Firestop Systems	Specified Technologies Inc.	EZ-PATH® Fire Rated Pathway	Fire-rRated Cable Pathways
27 05 41	Firestop Systems	Specified Technologies Inc.	EZ-PATH® Smoke & Acoustical Pathway; Model No. NEZ33	Smoke and Acoustical Pathways
27 05 43	Underground Ducts & Raceways			PVC Conduit
27 05 43	Underground Ducts & Raceways			Fiberglass Conduit
27 05 43	Underground Ducts & Raceways	O-Z Gedney	Type AX, Type AX-8, and Type EX w/ Type BJ Bonding Jumper	Expansion Fittings, 12", Metallic
		TVC/Vikimatic	VB0285X series	
27 05 43	Underground Ducts & Raceways	TVC Communications	HW or Extra Heavy Wall Expansion Joint	Expansion Fittings, 6", Non-metallic:
		Vikimatic		

Section	Category	Mfgr	P/N	Description
		FRE Composites, Inc		
27 05 43	Underground Ducts & Raceways	Carlou Vikimatic	E985N	Caps, Underground Conduit Stubs
27 05 43	Underground Ducts & Raceways	Oldcastle Precast Brooks Products Jensen PreCast Utility Vault Company, Inc./Oldcastle Precas Associated Concrete Products Forni Corporation.	 * 1P & 1T: 5 Series & extension rings as req * 2P & 2T: 67 Series & extension rings as req * 3T: 400 Series; 11C Type Lid.  (with base and extension rings as required) * PB1P: P9 with FL9D lid, P9BA * PB1T P9 with P9-61 lid, P9BA * PB2P: P36 with FL36D cover, P36BA * PB2T: P36 with P36-61D lid, P36BA * PB3T: 35T  PB3T: PTS-3660, with H-20-44 loading cover, with 3660-06 and 3660-12 extensions as required.	Underground Pull Boxes and Vaults, Concrete with Diamond Plate Steel or Concrete Lids
27 05 43	Underground Ducts & Raceways	OldCastle/Utility Vault Company, Inc. Teichert Precast Products	AT&T 61284MH manhole, with ladder, with cover with nameplate "Communications", and with extension rings as required. ASY-6000-84-HT-AT with ladder, with cover with nameplate " Communications",	Manhole/Maintenance Hole

Section	Category	Mfgr	P/N	Description
			and with extension rings as required.	
		Jensen PreCast		
		Associated Concrete Products		
		Forni Corporation.		
27 05 43	Underground Ducts & Raceways	Armorcast Polymer Concrete Vaults		Underground Pull Boxes and Vaults, Polymer Concrete
		Oldcastle Enclosure Solutions	H-Series	
		New Basis		
		Quazite		
		Hubbell Power Systems		
27 05 43	Underground Ducts & Raceways	Carlton Telecom Systems		Cable Warning Tape
		Monarch Duct & Conduit		
		Vikimatic		
27 05 43	Underground Ducts & Raceways	Arnco	Dandy-Line	Pull Rope
		Carlton Telecom Systems		
		Fibertek Pull-line		
		Monarch Duct & Conduit		
		Vikimatic		
		Any length marked tape listed elsewhere herein below constructed as a pulltape		
27 05 43	Underground Ducts & Raceways	Carlton Telecom Systems		Length Marked Tape
		Greenlee		
		Fibertek Pulltape or Tracertape		
		Vikimatic		
27 05 43	Underground Ducts & Raceways	Carlton Telecom Systems	Universal Blank Duct Plugs, Simplex, Triplex and Quadplex Duct Plugs	Conduit Plugs

Section	Category	Mfgr	P/N	Description
		Condux International, Inc.		
		Monarch	Duct & Conduit Duct Plugs and Multistep Cap Ends	
		GS Industries of Bassett, LLC	Expandable Watertight Plugs	
27 05 43	Underground Ducts & Raceways	Carlton Telecom Systems		Line Marker Post
		Vikimatic		
27 05 43	Underground Ducts & Raceways	Underground Devices	Wunpeece	Conduit Spacer, Trench
		GS Industries of Bassett, LLC	Underground Products Spacer System.	
		Armorcast Products Company		
		Carlton	Snap-Loc Spacers	
27 05 43	Underground Ducts & Raceways	Cooper Power Systems Or equal by listed vault or maintenance hole manufacturer		Pulling In Irons
27 05 43	Underground Ducts & Raceways	Underground Devices (no known equal)		Cable Racks & Supports
27 05 48	Noise and Vibration	Cooper Crouse-Hinds of Syracuse, N.Y.	XD Xpansion Deflection Coupling	Flexible Communications Connections
		O-Z Gedney	Type DX Expansion Deflection Fitting	
27 05 48	Noise and Vibration	Dottie Corp	Insul-Pad	J-Box Mastic
		Gardner Bender, Inc	Duct-Seal	
		Manville	Duxseal	
		Lowry	Outlet Pad	
		3M	Fire Barrier Moldable Putty Pads	
27 05 48	Noise and Vibration	Thunderline Corporation	Century-Line Sleeves	Resilient Penetrations for Conduit: Sleeves
		Custom by Contractor		
27 05 48	Noise and Vibration	Certain-Teed		Resilient Penetrations for Conduit: Batt
		Johns-Manville		



Section	Category	Mfgr	P/N	Description
		Owens-Corning		
27 05 48	Noise and Vibration	DAP		Resilient Penetrations for Conduit: Acoustical Sealant
		Pecora		
		Tremco		
		U.S. Gypsum		
		3M		
27 05 53	Identification	Brady	TLS2200 labels – PTL-31-427, PTL-32-427	Communication Cabling Labels, Interior
		Brady	Laser tab labels – LAT-18-361, LAT-53-361	
		Leviton		
		Panduit		
27 05 53	Identification	Panduit		Communication Cabling Labels, Outside Plant
		Brady		
27 05 53	Identification	Brady	Laser tab labels – 2.8" x 0.375" (71.12mm x 9.52mm), LAT-43-707	Closet Hardware Labels
		Leviton		
		Panduit		
27 05 53	Identification	Brady		Patch Panel Name Label
		Leviton		
		Panduit		
27 05 53	Identification	Brady		Non-keystone based fiber patch panels
		Leviton		
		Panduit		
		as provided with Patch Panel by the manufacturer		
27 05 53	Identification	Brady	Laser tab labels – 7.9" x 0.475" (200.6mm x 12.07mm), LAT-177-124	110 Blocks

Section	Category	Mfgr	P/N	Description
		Leviton		
		Panduit		
27 05 53	Identification	Brady Corporation		Grounding and Bonding, Pathway, and Space Labels
		Panduit		
27 05 53	Identification	Brady Corporation		Workstation Labels
		Hubbell		
		Leviton		
		Panduit		
27 05 53	Identification			Nameplates
27 05 53	Identification	Avery	5165	Fiber Optic Cable Termination Cabinet/Housing Labeling - panel overlay: 8.5-inch by 11-inch laser printable adhesive backed shee
27 05 53	Identification	Panduit	PCV-FOR	Fiber Optic Cable Sheath Labeling - Outside Plant (OSP) fiber optic cables shall contain an orange fiber optic warning tag
27 05 53	Identification	Panduit	PST-FO	Fiber Optic Cable Sheath Labeling - plastic tie wrap.
27 05 53	Identification	Panduit		Copper Cable Termination Housing Labeling
27 05 53	Identification	Panduit	CM4S-L8	Copper Cable Sheath Labeling
27 10 00	Structured Cabling	Corning OFS	28e	Fiber Optic Cable - Fiber Strands, Singlemode
27 11 13	Entrance Protection	Circa Telecomm	4B1FS-240	Wall-mounted building entrance protector terminal
27 11 13	Entrance Protection	Circa Telecomm	1880ECS1-100	Protected building entrance terminals for copper entrance cables up to and including 300 pairs
27 11 13	Entrance Protection	Circa Telecomm	2000-100	Protected building entrance terminals for copper entrance cables over 300 pairs
27 11 16	Cabinets, Racks, Frames, Enclosures	Oberon	1024-00 # 522596	Wireless Access Point (WAP) Enclosure, Exterior Application

Section	Category	Mfgr	P/N	Description
27 11 16	Cabinets, Racks, Frames, Enclosures	Cooper B-Line	SB85219084FB	19" Zone 4 seismic rack, Black
27 11 16	Cabinets, Racks, Frames, Enclosures	Cooper B-Line	SB17U12BFB	12" Cable Runway
27 11 16	Cabinets, Racks, Frames, Enclosures	Cooper B-Line	SB168CBZ	Heavy Duty Butt Splice
27 11 16	Cabinets, Racks, Frames, Enclosures	Cooper B-Line	SB21312KFB	Triangular Runway Wall Support Kit
27 11 16	Cabinets, Racks, Frames, Enclosures	Cooper B-Line	SB165BZ	Runway 90 degree junction Splice Clamp and Kit
27 11 16	Cabinets, Racks, Frames, Enclosures	Cooper B-Line	SB211312FB	Runway Wall Angle Support Kit
27 11 16	Cabinets, Racks, Frames, Enclosures	Cooper B-Line	SB227E3FB	Runway Stand-Off Kit
27 11 16	Cabinets, Racks, Frames, Enclosures	Cooper B-Line	SB212712AFB	Runway Center Support hanger Kit
27 11 16	Cabinets, Racks, Frames, Enclosures	Chatsworth	15275-701	Waterfall upper tray
27 11 16	Cabinets, Racks, Frames, Enclosures	Chatsworth	13930-701	2U Horizontal Cable manager
27 11 16	Cabinets, Racks, Frames, Enclosures	Chatsworth	13912-703	7' 6" Vertical Cable Manager
27 11 16	Cabinets, Racks, Frames, Enclosures	Hoffman	ESDR19FM45U	Seismic 2-Post Open Frame Rack
27 11 16	Cabinets, Racks, Frames, Enclosures	Hoffman	ECM6DR10	D-Ring 6inch plastic black , 3.00x5.33, Plastic
27 11 16	Cabinets, Racks, Frames, Enclosures	Hoffman	ENC2178	Network Cabinet 19" 46u, 7ft

Section	Category	Mfgr	P/N	Description
27 11 16	Cabinets, Racks, Frames, Enclosures	Leviton	41MB2-3F5	300 Pair Mounting Frame Kit W/3 100-pr Bases, Mounting Frame, Cable Tray, 3 Horizontal Cord Managers, 60 C5 Clips, Labels Strip Holders And White Label Strips
27 11 16	Cabinets, Racks, Frames, Enclosures	NEBS-Telecordia	GR-63-CORE	Seismic Zone 4 Enclosure Cabinet Rack
27 11 16	Cabinets, Racks, Frames, Enclosures	Hubbell	ReBox System R5A: RE4X with REKH padlock hasp kit, REKG perimeter gasket kit, and two fans kits REFEK with Fan Filter Kit REKFF and 20A duplex surge protected receptacle REKP.	Wall Mounted IDF and Telephone Splice Enclosure
	Cabinets, Racks, Frames, Enclosures	Hubbell	Rebox System R5B: Hubbell IDF42 with REKSJ40 joining kit, REKBBJ40 Backboard and REKL	
	Cabinets, Racks, Frames, Enclosures	Middle Atlantic	HDR Series, subject to the capacity requirements and feature requirements in 27 11 16	
	Cabinets, Racks, Frames, Enclosures	Holocom Networks	Classroom Active Gateway series, subject to the capacity and feature requirements requirements in 27 11 16	
27 11 16	Cabinets, Racks, Frames, Enclosures	B-Line	Advantage Seismic Relay Rack SB-852- 19-084 FB with SB- 571-66D-084 FB double sided deep section wiring manager.	Relay Rack, Integrated Vertical Wire Chase, Zone 4 rated
		Chatsworth Products Company	Seismic Frame Two- Post Rack with Seismic Frame Two-	

Section	Category	Mfgr	P/N	Description
			Post Vertical Cabling Sections.	
27 11 16	Cabinets, Racks, Frames, Enclosures	Middle Atlantic	R26: DRK19-44-31 with DVFD-44 front door, DCLVRD-44 rear doors, MRK-Z4 Base angles, 2 pair DRK-44DUCT (front and rear, 4 total vertical ducts), MW-4QFT-FC top with fans. Keylocked side panels SPN-44-36 at ends of rows.	Equipment Rack, Zone 4, Front, Rear and Side Access, with Vertical Wire Management.
		Middle Atlantic	R26-37: Custom assembly by manufacturer with custom parts to create a 37RU version of the R26 assembly specified herein above. Reference Middle Atlantic Quote # 560524.	
		APC Infrastructure.		
		Hoffmann.		
27 11 16	Cabinets, Racks, Frames, Enclosures	ADD 4 lines from spec here		Equipment Enclosure, NEMA 3R
27 11 16	Cabinets, Racks, Frames, Enclosures	Belden	Based on XSS/XSN cabinet series. Solid doors with perimeter seals from XNM assembly. 30" width. 32" minimum useable depth. Dual vertical wire managers at front and rear. Include separate Belden Air Conditioner	Equipment Rack, Seismically Qualified, NEMA 12, Front, Rear and Side Access, with Vertical Wire Management and Cabinet AC/Cooler
		Middle Atlantic		
		APC Infrastructure		

Section	Category	Mfgr	P/N	Description
27 11 16	Cabinets, Racks, Frames, Enclosures	Middle Atlantic Products	SB Series.	Blank Panels
		Atlas Sound	S19 Series	
		Flanged Steel Blank Panels	BGW Systems Inc.	
		Dukane		
		Elkay		
		Lowell	Series L3	
		Zero	ZP112000 Series	
		Hubbell		
27 11 16	Cabinets, Racks, Frames, Enclosures	Atlas Sound	SVP Series	Vent Panels
		BGW Systems Inc.	Perforated Vent Panels	
		House of Metal Enclosures (HOME)	Series PRP.	
		Lowell	Series L5	
		Middle Atlantic Products	VT Series	
		Zero		
27 11 16	Cabinets, Racks, Frames, Enclosures	Middle Atlantic	LACE-44LP	Vertical Lacer Strips
		APW		
27 11 16	Cabinets, Racks, Frames, Enclosures	Middle Atlantic	LBP-1R4, LBP-1.5 and LBP-1S	Horizontal Lacer Bars
		APW		
27 11 16	Cabinets, Racks, Frames, Enclosures	BGW Systems		Seismic Hold-down Equipment Straps
		Everest Electronic Equipment Lock Down Kit		
		Ergotron		
		Chatsworth Products		
		Middle Atlantic Products		
		Q-Safety, Inc.		
27 11 19	Termination Blocks and Patch Panels	Leviton	49255-L48	48 port patch panel, empty

Section	Category	Mfgr	P/N	Description
27 11 19	Termination Blocks and Patch Panels	Leviton	41AB2-1F5	100-pair 110 Block kit
27 11 19	Termination Blocks and Patch Panels	Leviton	41MB2-3F5	300 Pair Mounting Frame Kit W/3 100-pr Bases, Mounting Frame, Cable Tray, 3 Horizontal Cord Managers, 60 C5 Clips, Labels Strip Holders And White Label Strips.
27 11 19	Termination Blocks and Patch Panels	Inquire with representative		Copper Termination Blocks
27 11 19	Termination Blocks and Patch Panels	Inquire with representative		Copper Patch Panels
27 11 19	Termination Blocks and Patch Panels	Inquire with representative		Fiber Patch Panels
27 11 19	Fiber	Corning	PCH-04U	4U Fiber Termination Housing
27 11 19	Fiber	Corning	PCH-02U	2U Fiber Termination Housing
27 11 19	Fiber	Corning	CSH-03U	Fiber Splice Housing
27 11 19	Fiber	Corning	CCH-CS	CCH Splice Cassette
27 11 19	Fiber	Corning	CCH-CS24-A9-P00	LC panel w pigtails 24-f LC duplex OS2 for CCH
27 11 19	Fiber	Corning	M67-048	Splice Tray
27 11 19	Fiber	Corning	2806031-01	Heat shrink sleeves
27 11 19	Fiber	Corning	VCN GNDCBL-20	Ground Strap
27 11 19	Fiber	Corning	VCN GND520	Ground Clamp
27 11 23	Cable Management - Innerduct	Carlton Optic-Gard/PE.		Innerduct Single Chamber ID in underground ductbanks:
		Arnco.		
		Vikimatic.		
27 11 23	Cable Management - Innerduct	Carlton Optic-Gard/PVC.		Innerduct Single Chamber ID in interior, non-plenum applications:
		Arnco.		
		Vikimatic		
27 11 23	Cable Management - Innerduct	Carlton Plenum-Gard.		Innerduct Single Chamber IDP
		Arnco		
		Vikimatic		

Section	Category	Mfgr	P/N	Description
27 11 23	Cable Management - Innerduct	Telecom Ducting Systems	Tamaqua Plus II Series	Innerduct, UV Rated
		Allwire	Black All Duct	
27 11 23	Cable Management - Innerduct	Maxcell	Maxcell/TVC 3" 3-cell in three unique colors per duct. (No known equal with identical 3 sleeves woven into a single assembly nor equal industry usage)	Woven Mesh Innerduct
27 11 23	Cable Management - Patch Panel	Cooper B-Line		Patch Panel Wire Management, Rack Mounted, Snap Cover. 1RU and 2RU
		Chatsworth		
27 11 23	Cable Management - Backboard	Leviton	48900-OFR	Fiber Management Ring, Preformed Loop
		Panduit		
27 11 23	Cable Management - Backboard	B-Line	Fasteners BR Series	Wire Mangement Rings, Wall/Ceiling Mounted WMRB: Bridle Ring Types, Threaded Lag Screw
		Senior Industries		
		T&B		
27 11 23	Cable Management - Backboard	Chatworth Products	12127 and 10812 - 2" and 3" - Wall Mount Closed D Ring	Wire Mangement Rings, Wall/Ceiling Mounted WMRC: Closed Ring, U shaped assembly with two screw holes at ends
		Senior Industries		
27 11 23	Cable Management - Backboard	Chatworth Products	Wall Mount 12035 Open Ring.	Wire Management Rings, Wall/Ceiling Mounted WMRO: Open, Re-enterable Split Ring permitting cables to be inserted midspan, two screw holes at ends
		AllenTel		
		Commscope/Systimax, Inc.		
		Siemon		
27 11 23	Cable Management - Backboard	Siemon	S188-*** to match adjacent terminal blocks with S188-WD	Wire Management Rings, Wall/Ceiling Mounted WMP** - Steel back board with 4 inch deep min, 8 inch wide vertical wire management rings, front enterable Provide trough at bottom of each column of WMP
		Ortronics	OR-806003194 or OR-806003196 to match terminal blocks.	
		Any manufacturer listed for 110TB under Section 27 11 19		



Section	Category	Mfgr	P/N	Description
27 11 23	Cable Management - Backboard	Siemon	S110M-WM-*** to match adjacent terminal blocks	Wire Management Rings, Wall/Ceiling Mounted WMP**T - Narrow, steel back board with 4 inch deep min, 3 inch wide vertical wire management rings, front enterable
		Any manufacturer listed for 110TB under Section 27 11 19		
27 11 23	Optical Fiber Backbone Cabling	Corning Cable Systems®	Infinicor™ MIC® type cable	Fiber Optic Riser Cable
27 11 23	Optical Fiber Backbone Cabling	Corning Freedom®	Loose tube fiber optic cable	Outside Plant Fiber Optic Cable
27 11 23	Optical Fiber Backbone Cabling	Corning Cable Systems	LC Ultra PC Polish, 3 meter Single-mode pigtail	Fiber Optic Connectors
27 11 23	Optical Fiber Backbone Cabling	Corning	Carlton Optic-Gard/PVC.	Optical Fiber
		Corning	Arnco.	Loose tube fiber optic cable
27 13 00	Indoor Backbone Cabling - Copper	Superior/Essex		Inside Distribution Wire, Horizontal
		General Cable		
		Mohawk		
		NORDX/CDT		
27 13 00	Indoor Backbone Cabling - Copper	Superior/Essex		Inside Distribution Wire, Riser
		General Cable		
		Mohawk		
		NORDX/CDT		
27 13 00	Indoor Backbone Cabling - Copper	Superior/Essex		Inside Distribution Wire, Plenum
		General Cable		
		Mohawk		
		NORDX/CDT		
27 13 00	Indoor Backbone Cabling - Fiber Optic Communications Cabling And Related	Corning Cable Systems	Fan-Out	Fiber Optic Cable, Inside Distribution, Breakout Cable
		Belden	225XXX Series	
		Berk-Tek		
		Optical Cable Corp B Series		

Section	Category	Mfgr	P/N	Description
27 13 00	Indoor Backbone Cabling - Fiber Optic Communications Cabling And Related	Any meeting requirements of Fiber Optic Cable, Outside/Inside Plant, Riser, Constrained Diameter, specified elsewhere herein.		Fiber Optic Cable, Riser:
		Optical Cable Corp	Ultrafox construction with LaserFox SLX Series glass for singlemode strands.	
		Corning Cable Systems	MIC	
		BerkTek		
		Belden		
27 13 00	Indoor Backbone Cabling Fiber Optic Communications Cabling And Related	Any meeting requirements of Fiber Optic Cable, Outside/Inside Plant, Riser, Constrained Diameter, specified elsewhere herein.		Fiber Optic Cable, Plenum
27 13 00	Indoor Backbone Cabling Fiber Optic Communications Cabling And Related	Corning Cable Systems	FREEDM LST	Fiber Optic Cable, Outside Plant, Riser and Inside, Constrained Diameter
		Berk-Tek	UNI-Lite RD	
		Belden		
		AMP		
27 13 00	Copper Cable Splicing and Terminations	3M	710SC1-25	25 Pair Module
27 13 00	Copper Cable Splicing and Terminations	3M	710SD1-25	25 Pair Module
27 13 00	Copper Cable Splicing and Terminations	3M	710BC1-25	25 Pair Module
27 13 00	Copper Cable Splicing and Terminations	3M	710TC1-25	25 Pair Module
27 13 00	Copper Cable Splicing and Terminations	Preformed Line Products® (PLP)		Copper Splice Closure

Section	Category	Mfgr	P/N	Description
27 13 00	Optical Fiber Splicing and Termination			Fiber Optice Splice Closure
		Corning Cable Systems		
27 13 00	Optical Fiber Splicing and Termination	Corning Cable Systems® Pretium®	PCH-02U	Pretium Connector Housings (PCH), Rack-mountable (up to 48 SC, 72 LC fibers)
27 13 00	Optical Fiber Splicing and Termination	Corning Cable Systems® Pretium®	PCH-04U	Pretium Connector Housings (PCH), Rack-mountable (up to 144 SC, 288 LC fibers)
27 13 00	Optical Fiber Splicing and Termination	Corning Cable Systems® Pretium®	PWH-04P	Wall-Mountable Housing (PWH) (48 fibers SC, 96 fibers LC)
27 13 00	Optical Fiber Splicing and Termination	Corning Cable Systems® Pretium®	PWH-06P	Wall-Mountable Housing (PWH) (72 fibers SC, 144 fibers LC)
27 13 00	Optical Fiber Splicing and Termination	Corning Cable Systems® Pretium®	SPH-01P	Single Panel Housing to be used in Rebox cabinet
27 13 00	Optical Fiber Splicing and Termination	Corning Cable Systems®	CCH-CP12-A9	Duplex LC type connector panels at the ADF/BDF/IDF (6 LC Duplex)
27 13 00	Optical Fiber Splicing and Termination	Corning Cable Systems®	CCH-CP24-A9	Duplex LC type connector panels at the ADF/BDF/IDF (12 LC Duplex)
27 13 00	Optical Fiber Splicing and Termination	Corning Cable Systems®	CCH-CP12-A9-P03RH	Duplex LC type connector panels at the ADF/BDF/IDF (Preloaded 12 Strand Closet Connector Housing Pigtail Modules with 6 LC duplex Single-mode adapters, Ceramic Insert, Blue), or equal.
27 13 00	Outside Plant Backbone Cabling - Fiber Optic	Corning Cable Systems		Fiber Optic Cable - Loose Tube, Outside Plant
		Berk-Tek		
		Superior Essex		
27 13 00	Outside Plant Backbone Cabling - Fiber Optic	Corning Cable Systems		Optical Fiber Splice Closure
		ADC		
		Commscope/Systimax Inc.		
		3M		
		Emerson Network Power		
		UraSeal		

Section	Category	Mfgr	P/N	Description
		Preformed Line Products Coyote Dome Serie		
27 13 00	Outside Plant Backbone Cabling - Fiber Optic	Superior/Essex		
		General Cable		
27 13 00	Copper OSP Cabling Telephone, Outside Plant, Underground in Ductbank	3M K&B Series		In Building Telephone Closure
		UraSeal	2000FR Type.	
		Tyco Electronics		
27 13 00	Copper OSP Cabling Telephone, Outside Plant, Underground in Ductbank	3M		Outside Plant Telephone Closure, Vault
		Preformed Line Products	Armadillo Stainless	
		UraSeal		
		Emerson Network Power		
27 13 00	Copper OSP Cabling Telephone, Outside Plant, Underground in Ductbank	3M 710 (Industry standard item).		Multipair Splicing Connectors
		b. or equal as required to match the standard used at the facility		
27 13 00	Miscellaneous Underground Products	Carlton Telecom Systems	Universal Blank Duct Plugs, Simplex, Triplex and Quadplex Duct Plugs	Conduit Plug
		Condux International, Inc		
		Monarch Duct & Conduit	Duct Plugs and Multistep Cap Ends	
27 13 00	Miscellaneous Underground Products	Underground Devices or equal (no known equal)		Cable Racks & Supports
27 13 00	Miscellaneous Underground Products	Inwesco 12A55		Bonding Ribbon:
		Tyco Electronics		
		Thomas and Betts		
		Preformed Line Products		
27 13 00	Miscellaneous Underground Products	Inwesco	12A56	Bonding Ribbon Clamp
		Tyco Electronics		
		Thomas and Betts		

Section	Category	Mfgr	P/N	Description
		Preformed Line Products		
27 15 00	Backbone Cable	Mohawk	M56126	CAT 3 50 pair Plenum Cable
27 15 00	Backbone Cable	Mohawk	M56128	CAT 3 100 pair Plenum Cable
27 15 00	Backbone Cable	Mohawk	M57211	CAT 3 300 pair Plenum Cable
27 15 00	Backbone Cable	Eastern	PDPU1250FxxxxR	1.25" Innerduct (Plenum rated)
27 15 00	Copper Cable	Berk-Tek	10136226	LANmark-6 CAT 6 Blue Plenum Cable
27 15 43	Faceplates	Leviton	4108W-1SP	Stainless Wall Phone recessed Faceplate
27 15 43	Faceplates	Leviton	41084-BT	Blank 1-unit insert for faceplate housing
27 15 43	Faceplates	Leviton	41080-2TP	2 Port Single Gang Faceplate (Light Almond)
27 15 43	Faceplates	Leviton	41080-4TP	4 Port Single Gang Faceplate (Light Almond)
27 15 43	Faceplates	Leviton	42080-2TP	2 Port Double Gang Faceplate (Light Almond)
27 15 43	Faceplates	Leviton	42080-4TP	4 Port Double Gang Faceplate (Light Almond)
27 15 43	Faceplates	Leviton	D670K-1S2	Duraport industrial faceplate and cover kit
27 15 43	Faceplates	Leviton	D6721-10E	Duraport industrial patch cord, industrial-to-RJ45, 10'
27 15 43	Surface Mount Box	Leviton	41089-2TP	2 Port Surface Mount Box (Biscuit) (Light Almond)
27 15 43	Jack	Leviton	61110-RL6	CAT 6 Jack
27 15 43	Jack	Leviton	6110G-RT6	CAT6A Jack

**End of Section 27 06 00**

## 27 10 00 - Structured Cabling, Basic Materials & Methods

### **PART 1 - GENERAL**

#### **1.1 SCOPE OF WORK**

This Section defines common means and methods for the work of the following Sections:

- A. Section 27 11 13 – Communications Entrance Protection
- B. Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures
- C. Section 27 11 19 – Communications Termination Blocks and Patch Panels
- D. Section 27 11 23 – Communications Cable Management
- E. Section 27 13 00 – Communications Backbone Cabling
- F. Section 27 15 00 – Communications Horizontal Cabling

#### **1.2 RELATED DOCUMENTS**

Section 27 05 00 – Common Work Results for Communications applies to the work of this Section.

#### **1.3 REFERENCES**

- A. Usage: In accordance with Division 1.
- B. In Addition to the requirements of Section 27 05 00 – Common Work Results for Communications, conform to the applicable portions of the following standards agencies:
  - 1. American Society for Testing and Materials (ASTM)
    - a. ASTM A228/A228M-02 Steel Wire, Music Spring Quality
  - 2. Institute of Electrical and Electronic Engineers
    - a. IEEE 383-2003 Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations
    - b. IEEE 100-00 The Authoritative Dictionary of IEEE Standards Terms
  - 3. National Electrical Manufacturers Association (NEMA)
    - a. NEMA WC 63.1(2000) Twisted Pair Premise Voice and Data Communications Cables
  - 4. National Fire Protection Association (NFPA)
    - a. NFPA 70 National Electrical Code
  - 5. Telecommunications Industry Association (ANSI/TIA) – Current version
    - a. ANSI/TIA-568
    - b. ANSI/TIA 569
    - c. ANSI/TIA-606

- d. ANSI- J-STD-607
- 6. Underwriters Laboratories, Inc. (UL)
  - a. UL 444(2002; Bul. 2002, 2003) Communications Cables
  - b. UL 910(1998) Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
  - c. UL 1286(1999; R 2004) Office Furnishings
  - d. UL 1581 Reference Standard for Electrical Wires, Cables, and Flexible Cords. Oct. 2001
  - e. UL 1666(2000; R 2002) Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
  - f. UL 1863(2000; R 2004) Communications Circuit Accessories

## 1.4 DEFINITIONS

A. Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in current versions of the following:

- 1. ANSI/TIA-568
- 2. ANSI/TIA-606
- 3. IEEE Std 100
- 4. Section 27 05 00

## 1.5 SUBMITTALS

Conform with the requirements of Division 1 and Section 27 05 00 - Common Work Results for Communications.

## 1.6 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Division 1, Section 27 05 00 – Common Work Results for Communications and the following:

B. Shipping Conditions:

- 1. All cable shall be shipped on reels or manufacturer supplied “handy boxes”.
- 2. The diameter of the drum shall be at least 13 times the diameter of the cable.
- 3. The reels shall be substantial and so constructed as to prevent damage during shipment and handling.
- 4. Secure the outer end of the cable to the reel head so as to prevent the cable from becoming loose in transit.
- 5. Project the inner end of the cable into a slot in the side of the reel, or into a housing on the inner slot of the drum, in such a manner and with sufficient length to make it available for testing.

6. The inner end shall be fastened so as to prevent the cable from becoming loose during installation. End seals shall be applied to each of the cables to prevent moisture from entering the cable.

#### C. Storage:

1. Do not roll or store cable reels without an appropriate underlay.
2. Retain factory cable protection until installation. Supplement with heavy gauge plastic sheeting if factory protective membrane is pierced prior to installation. Tape ends and seams water and dust tight.
3. The reels with cable shall be suitable for outside storage conditions when the temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent. Protect cable reels from physical damage from site construction vehicles or from settling into the soil.
4. Equipment, other than outside plant rated cable protected with fully watertight cable caps, to be delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

#### D. Handling

1. Cabling other than outside plant cabling exposed to standing water or other liquids at any time during storage, delivery or placement shall be replaced at no expense to the University.
2. Cut ends of outside plant rated cabling or portions of outside plant rated cable with a damaged jacket shall not be exposed to standing water or other liquids at any time during storage, delivery or placement. Where such conditions occur, the University Representative may require that the cable be replaced at no cost to the University.

## 1.7 SEQUENCING

Not Used.

## 1.8 PERFORMANCE STANDARDS

#### A. Telephone (Voice) Copper Cabling Plant:

1. Suitable for direct connection to the Public Switched Network in accordance with rules set forth by FCC Part 68, California Public Utilities Commission, and other Authorities Having Jurisdiction.
2. Category 3 as defined in ANSI/TIA-568

#### B. Horizontal (Station) Category 6 Copper Cabling – Permanent Link

1. Testing shall commence while University equipment in the area of service is operational and creating worst case emissions associated with its operation while in good working order.
2. In accordance with the field test specifications defined in ANSI/TIA-568 "*Commercial Balanced Twisted-Pair Telecommunications Cabling and Components Standard*", every horizontal station cabling link in the project shall be tested for:



- a. Wire Map
  - b. Length
  - c. Insertion Loss
  - d. NEXT Loss
  - e. PS NEXT Loss
  - f. ACR-F Loss
  - g. PS ACR-F Loss
  - h. Return Loss
  - i. Propagation Delay
  - j. Delay Skew
3. Report whether tested link passes or fails
  4. Note exceptions to required Category standards. Remedy and retest

C. Fiber Optic Cabling - as specified herein below.

## 1.9 TESTING

### A. General

1. In addition to the tests detailed in this specification section, the contractor shall notify the University Representative of any additional tests that are deemed necessary to guarantee a fully functional system. The contractor shall carry out and record any additional measurement results at no additional charge
2. Test and report on each intermediate cabling segment separately, including station cabling, horizontal distribution (each segment, if multiple) and telecommunications room wiring.
3. Test each end to end cable link.
4. Submit machine-generated documentation and raw data of all test results on Contractor-provided, and University Representative approved, forms; and in electronic format approved by the University Representative.
5. Provide machine-generated data on an appropriate disk media (CD-ROM CD-R format) to be transferred to University computers.
  - a. Where the machine-generated documentation requires use of a proprietary computer program to view the data, provide the University with 1 licensed copy of the software.
6. Provide registered testing software used for the actual tests to the University for review of test data.

### B. Test Equipment:

1. Provide in conformance with the applicable requirements of 27 05 00 – Common Work Results for Communications.

2. Test systems using at least one (1) each of the following test measurement devices or their functional equivalents:
  - a. Level III field testers as defined in ANSI/TIA-1152
    - i. Fluke
    - ii. Agilent or equal.

#### C. Station Wiring, General

1. Test station wire only after all pairs of station wire in a work area have been terminated at both ends, and no work of this Section or other Sections may cause physical disturbance to the wiring.
2. Correct any and all transpositions found. Retest.
3. If any conductor in a station wire tests either open or short, then the entire station wire is to be removed, replaced, and re-tested.

#### D. Inside Category 6 Cabling

1. Using the listed Category 6 cable test set, test and submit report on the parameters specified for Category 6 cabling in this Section. Report whether tested link passes or fails the Category 6 standards. Cables must pass TIA Permanent Link Certification for the cable type being installed. A "Marginal" test result will not be accepted.
2. Note exceptions to required Category standards. Remedy and retest.

#### E. Telephone: Outside Plant, Inside Riser Wire:

1. General:
  - a. A new cable shall be tested only after all wires within the cable have been terminated at both ends.
  - b. For unshielded cable, "measurements to ground" means an electrical connection to the Telecommunications Ground Bus, building steel, electrical metallic conduit or a water pipe.
  - c. The Contractor shall correct all defects possible.
  - d. If the maximum number of unrepairable defective pairs exceeds 4% of the cable's pair count, the cable shall be deemed unacceptable and shall be replaced. Replace, re-terminate and retest new cable at no additional cost to the University.
2. Test procedures:
  - a. TEST #1 – Continuity:
  - b. TEST #2 - Balance, Polarity and Conductor Transpositions:
3. Test Report:
  - a. Submit Test Report. Documentation shall include loop resistance regarding any opens, shorts, transpositions found, as well as corrective action taken to correct any found opens, shorts, or transpositions.

## F. Fiber Optic Cabling

1. Perform fiber optic cable testing on all installed fiber optic cabling. Submit test results.
2. Trained technicians who have successfully attended an appropriate training program, which includes testing with an OLTS and an OTDR and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
  - a. Manufacturer of the fiber optic cable and/or the fiber optic connectors
  - b. Manufacturer of the test equipment used for the field certification
  - c. Training organizations (e.g., BICSI, A Telecommunications Association headquartered in Tampa, Florida; ACP [Association of Cabling Professionals™] Cabling Business Institute located in Dallas, Texas)
3. Submit calibration certification for testing equipment to be used and certification of training of persons proposed to perform specified testing prior to scheduling testing.
4. The University Representative shall be provided with the opportunity to witness and/or review field-testing.
5. The University Representative shall be notified of the start date of the testing phase five (5) business days before testing commences.
6. The University Representative will select a random sample of 5% of the installed links. The University Representative shall test these randomly selected links and the results are to be stored in the manner described in this section. The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor shall repeat 100% testing at no cost to the University.
7. Submit test report no later than five days after the cables are tested.

### 1.10 ACCEPTANCE OF FIBER OPTIC TEST RESULTS

A. Each cabling link shall be in compliance with the following test limits:

1. Optical loss testing
  - a. Single mode links Single mode (Inside plant)
    - i. 1310 - 1.0 dB
    - ii. 1550 - 1.0 dB
  - b. Single mode (Outside plant)
    - i. 1310 - 0.5 dB
    - ii. 1550 - 0.5 dB
2. OTDR Testing
  - a. Reflective events (connections) shall not exceed 0.4 dB.
  - b. Non-reflective events (splices) shall not exceed 0.05 dB.

- B. All installed cabling links shall be field-tested and pass the test requirements and analysis as described in Part 3. Any link that fails these requirements shall be diagnosed and corrected. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected link meets performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with Part 3.
- C. Acceptance of the test results shall be given in writing after the project is fully completed and tested in accordance with Contract Documents and to the satisfaction of the University.

## **PART 2 - PRODUCTS**

### **2.1 COMMUNICATIONS CABLES AND RELATED**

#### **A. GENERAL:**

- 1. Cabling shall be UL listed for the application and shall comply with TIA-568 and NFPA 70.
- 2. Ship cable on reels and/or in boxes bearing manufacture date for UTP in accordance with ICEA S-90-661 and optical fiber cables in accordance with ICEA S-83-596 for all cable used on this project.
- 3. Cabling manufactured more than 12 months prior to date of installation shall not be used.
- 4. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.
  - a. At plenums, provide type CMP or OFNP cabling.
  - b. At risers, provide type CMR or OFNR cabling
  - c. At horizontal wiring conditions, provide type CM or OFN cabling.
- 5. Refer to Section 27 13 00 - Communications Backbone Cabling and 27 13 23 – Communications Optical Fiber Backbone Cabling for underground cabling installation.

### **2.2 FIBER OPTIC CABLING, GENERAL REQUIREMENTS**

#### **A. General**

- 1. Fiber count per cable to comply with minimum counts indicated on the plans. Plans indicate specific cable counts providing quantities of single mode fiber strands.
- 2. Quantities are minimum quantities. At Contractor's option, provide a greater number. Where a greater number are provided, terminate, test, label and document all strands on fiber patch panels and/or terminal boxes as indicated as if quantity provided were called out for on the plans.
- 3. Comply with applicable Code for insulation, jacket, marking and listing for applicable use in accordance with NFPA 70.
- 4. Fiber media shall, at minimum, meet the following performance standards:
  - a. ANSI/TIA 568
- 5. Fiber media shall, at minimum, meet one of the following construction standards:

- a. ANSI/ICEA S-87-640-2011 Fiber Optic Outside Plant Communications Cable
  - b. ANSI/ICEA S-83-596-2011 Indoor Optical Fiber Cables
6. Construction
- a. Indoor: All dielectric, unless otherwise noted
  - b. Outdoor: All dielectric, unless otherwise noted
7. The cable cordage jacket, fiber, unit, and group color shall be in accordance with EIA TIA/EIA-598
- a. Colors shall be across specified storage/installation temperature range.
  - b. Means of providing conforming colors shall not degrade performance of cable.
8. Jacket:
- a. Free of splits, holes or blisters
  - b. Marked and listed in conformance with California Electric Code 770
  - c. Conform with
    - i. NFPA 70
  - d. Heavy duty construction, Fiberglass Epoxy Rod/Kevlar strength
    - i. UL 1666 and member(s)
  - e. Each fiber to be 100% attenuation tested by the Manufacturer prior to shipping. Manufacturer's test to be affixed to shipping reel.
  - f. Cable shall be imprinted with fiber count, fiber type and aggregate length at regular intervals not to exceed 40 inches. Hybrid fiber optic cable marking shall comply with TIA/EIA-598.
9. Performance:
- a. All fibers in the cable must be usable and meet required specifications.
  - b. Each optical fiber shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification.
  - c. Temperature Sensitivity:
    - i. Storage: -40C degrees to +70C degrees.
    - ii. Installation: -30C degrees to +70C degrees.
  - d. Variance:
    - i. Single Mode:
      - (A) Average change, not more than 0.05 dB/km at 1550 -40C degrees to +70C degrees.
      - (B) Maximum change not more than 0.15 dB/km at 1550 nm.

**B. Fiber Strands, Singlemode – General**

1. Meeting
  - a. ISO/IEC 24702 OS2
  - b. TIA 568 and EIA TIA/EIA-492, single-mode, 8/125-um diameter, 0.10 numerical aperture.
2. Construction:
  - a. Each optical fiber shall consist of a germania-doped silica core surrounded by a concentric glass cladding. The fiber shall be a matched clad design.
  - b. Each optical fiber shall be proof tested by the fiber manufacturer at a minimum of 100 kpsi (0.7 GN/m<sup>2</sup>).
  - c. The fiber shall be coated with a dual layer acrylate protective coating. The coating shall be in physical contact with the cladding surface.
  - d. The attenuation specification shall be a maximum value for each cabled fiber at 23 ± 5 °C on the original shipping reel.
  - e. Single-mode (Dispersion Un-shifted): The single-mode fiber shall meet EIA/TIA-492 Specification for Optical Waveguide and ITU recommendation G.652 (Categories A, B, C & D), "Characteristics of a single-mode optical fiber cable."
  - f. Meets or exceeds ISO/IEC 11801 OS2
3. Manufacturer:
  - a. See Section 27 06 00 - Communications Product Schedule

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. All system cabling and terminations be installed in accordance with the manufacturer's instructions and as shown.
- B. All necessary interconnections, services, and adjustments required for a complete and operable system shall be provided. All installation work must be done in accordance with the safety requirements set forth in the general requirements of ANSI C2 and NFPA 70.
- C. Coordinate insulation displacement (quick connect) terminal devices with wire size and type. Comply with manufacturer's recommendations. Make connections with automatic impact type tooling set to recommended force.
- D. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections. No wire or cable shall be supported by a connection point. Provide service loops where harnesses of different classes cross, or where hinged panels are to be interconnected.
- E. The Contractor shall be responsible for all damage to the cable during placement.
  1. Cabling shall be maintained free of splits, holes or blisters.
  2. Cabling shall not be painted or exposed to construction solvents or other caustic chemicals unless rated and warranted for such exposure by its manufacturer.

F. Correct unacceptable wiring conditions including but not limited to:

1. Deformed, brittle or cracked insulation.
2. Torn or worn cable jacket.
3. Excessively scored cable jackets.
4. Insulation shrunken or stripped further than 1/8" away from the actual point of connection within a connector, or on a punch block.
5. Un-grommited, un-bushed, or uninsulated wire or cable entries.
6. Deformation or improper radius of wire or cable.

### 3.2 SPLICING

A. All interior wire and outside plant/exterior cable shall be continuous and splice-free for the entire length of run between designated connections or terminations.

1. At designated splices, maintain conductor color code across all splices.
  - a. All shielded cables shall be insulated. Do not permit shields to contact conduit, raceway, boxes, panels or equipment enclosures.
  - b. Within buildings, make splices only in designated terminal cabinets and/or on designated equipment backboards.

B. Backbone Copper Cabling

1. At interior: Provide splice free cabling
2. At outside plant: Do not splice at exterior, unless different splicing is indicated on Plans or is unavoidable due to either cable length exceeding the maximum commercially available in the indicated pair count, or due to on-site pulling conditions. In either condition, provide documentation of the condition to the University Representative for review prior to proceeding. If the University Representative concurs that the conditions warrant the splice:
  - a. Provide specified multipair splices assembly.
  - b. Protect the splice in an encapsulated splice case fastened to a pair of cable rack arms.
  - c. Document the installed splice case on the record drawings.
  - d. Encapsulated Closures
    - i. Adhere to all manufacturer installation guidelines.
    - ii. Support closure at both ends via racks and steps, so that no unnecessary stress or weight is applied to the splice case or associated conductors.
    - iii. End Caps and Closure Extension Sleeves
      - (A) Adhere to all manufacturer installation guidelines.
    - iv. Encapsulants

(A) Adhere to all manufacturer installation guidelines.

v. Splicing Tapes

(A) Adhere to all manufacturer usage guidelines.

vi. Gel Stripper

(A) Adhere to all manufacturer usage guidelines.

C. Fiber Optic Cabling

1. At interior: Provide splice free
2. At outside plant: Do not splice at exterior unless splicing is indicated on Plans or is unavoidable due to either cable length exceeding the maximum commercially available in the indicated strand count, or due to on-site pulling conditions. In either condition, provide documentation of the condition to the University Representative for review prior to proceeding. If the University Representative concurs that the conditions warrant the splice:
  - a. Splice only within manholes.
    - i. Provide fusion splices.
    - ii. Protect the splice in a fiber optic splice case fastened to a pair of cable rack arms.
    - iii. Document the installed splice case on the record drawings.
  - b. Splicing, where required due to field pulling conditions and/or cable length limits, shall be provided at no additional cost to the University.
  - c. Ensure that all splice closures are properly sealed for protection of the cable and splices.

### 3.3 PULLING IN

- A. Verify that all raceway has been de-burred and properly joined, coupled, and terminated prior to installation of cables. Verify that all raceway is clear of foreign matter and substances prior to installation of wire or cable.
- B. Inspect all conduit bends to verify proper radius. Comply with Code for minimum permissible radius and maximum permissible deformation.
- C. Apply a chemically inert lubricant to all wire and cable prior to pulling in conduit. Do not subject wire and cable to tension greater than that recommended by the manufacturer. Use multi-spool rollers where cable is pulled in place around bends. Do not pull reverse bends.
- D. Provide a box loop for all wire and cable routed through junction boxes or distribution panels. Cable loops and bends shall not be bent at a radius greater than that recommended by the manufacturer.
- E. Pull Rope/Tape
  1. For OSP installations, pull new pulling 'mule' tape through all conduits while placing new backbone cable. Leave a pulling 'mule' tape in the utilized conduits for future use.



2. For ISP installations, pull new pull rope through all conduits while placing new backbone cable. Leave a pull rope in the utilized conduits for future use.
- F. Do not leave cable slack on cable runway
- G. Firestop all sleeves, station cable conduit and ISP backbone conduit openings through rated partitions after the cable installation is complete.

### **3.4 SUPPORT**

- A. A. Secure all wire and cable run vertically for continuous distances greater than thirty (30) feet. Secure robust non-coaxial cables with screw-flange nylon cable ties or similar devices appropriate to weight of cable. For all other cables, provide symmetrical conforming non-metallic bushings or woven cable grips appropriate to weight of cable.
- B. Separation. Conform to the NEC (National Electric Code) with respect to separation from power and radio frequency (RF) sources. Provide at least twice the listed separation at fluorescent light fixtures, ballasts and similar high intensity Electromagnetic Field sources, including but not limited to motors, transformers and copiers. Separation of Telecommunications Cabling and Pathways from 480 V or Lower Power Lines
- C. Support: Provide support for all cabling. Conform to the restrictions of the California Electric Code and Section 27 05 29.

### **3.5 FIBER OPTIC CABLE TESTING**

#### **A. ADMINISTRATION**

1. Administration of the documentation shall include test results of each fiber link.
2. The test result information for each link shall be recorded in the memory of the field-test instrument upon completion of the test. The test result records saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records.

#### **B. GENERAL**

1. All tests performed on optical fiber cabling that use a laser or LED in a test set shall be carried out with safety precautions in accordance with ANSI Z136.2.
2. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to field-testing. Any testing performed on incomplete systems shall be redone on completion of the work.

### **3.6 CATEGORY RATED STATION PROOF OF PERFORMANCE DEMONSTRATION**

- A. Comply with the requirements of Part 1 of this Section and the following:
1. After submittal of test result documentation and the associated as-built drawings, the University Representative shall randomly pick five percent (5%) of the submitted cable plant installation for re-test.
  2. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the representative shall repeat 100% testing at no cost to the University.

### **3.7 LABELING**

- A. Reference Section 27 05 53 - Identification For Communications Systems, the plans and the specifications.
- B. Comply with labeling instructions to include, but not be limited to, the following:
  - 1. Label technology to be utilized
  - 2. Label content
  - 3. Label placement

### **3.8 REMOVAL OF ABANDONED CABLING**

- A. The California Electrical Code (CEC) requires all unused telecommunications cable intended for future use to be terminated in a patch panel or cross-connect and labeled for such use. Any other unused cable is considered abandoned including cable abandoned due to installation of new cabling under the work of this Project.
- B. Abandoned cable must be removed and disposed of, per CEC 770.53(A) & 770.53(B) (fiber) and 800.52(B), 800.53(A) & 800.53(B) (copper). Similar requirements are elsewhere in the CEC for other types of cable.
- C. Refer to Division1 regarding means and methods to be employed in the disposal of construction waste materials including material subject to recycling such as abandoned copper cabling.

**END OF SECTION 27 10 00**

## **27 11 13 – Communications Entrance Protection**

### ***PART 1 - GENERAL***

#### **1.1 SUMMARY**

- A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of building entrance protection (BEP) equipment as called for in this section of the Division 27 specifications and conjoined construction drawings.
- B. The specification sections of this Division 27 that are particularly applicable to this section include, but are not limited to the following:
  - 1. Section 27 00 00 - Communications
  - 2. Section 27 06 00 - Communications Product Schedule
  - 3. Section 27 11 13 - Communications Entrance Protection
  - 4. Section 27 13 00 - Communications Backbone Cabling
  - 5. Section 27 15 00 - Communications Horizontal Cabling
  - 6. Section 27 15 53 - Cable Plant Testing

#### **1.2 QUALITY CONTROL**

Comply with Section 27 00 00 - Communications.

#### **1.3 WARRANTIES**

Comply with Section 27 00 00 - Communications.

#### **1.4 MATERIAL SUBSTITUTIONS**

Comply with Section 27 00 00 - Communications.

#### **1.5 SUBMITTALS**

Comply with Section 27 00 00 - Communications.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

Comply with Section 27 00 00 - Communications.

### ***PART 2 - PRODUCTS***

#### **2.1 QUANTITY DETERMINATION**

Comply with Section 27 00 00 - Communications.

## 2.2 COPPER TERMINATION BLOCKS

- A. Furnish all Building Entrance terminals required to terminate the copper backbone - Section 27 13 00 - Communications Backbone Cabling.
- B. Furnish all required 5-pin surge protection modules to protect all pairs in the cable.
- C. Furnish all required splice closures.
- D. Furnish all required splicing materials.
- E. See Section 27 06 00 - Communications Product Schedule

## **PART 3 - EXECUTION**

### 3.1 INSTALLATION

- A. Copper backbone termination
  - 1. Mount Building Entry Protection (BEP) terminals per manufacturer's specifications, instructions, and recommendations. Use accompanying construction drawing set to determine mounting locations and configurations.
  - 2. Mount splice closure so that it does not block incoming ducts or rest on cable tray. Splice closure shall be wall mounted.
  - 3. All incoming OSP copper cables must be transition spliced to the BEP pigtails and the splice enclosed in a splice closure.
  - 4. Terminate all backbone cables per manufacturer's specifications, instructions, and recommendations.
  - 5. At the termination end of backbone copper cables, the Contractor shall provide 15 feet (15') of managed service slack.

### 3.2 EXAMINATION

Comply with Section 27.00 00 – Communications.

### 3.3 OSP BACKBONE COPPER 110 TERMINATION BLOCK LABELING

- A. BEP 110 block cable ID label shall be as follows:
  - 1. Label shall be UCSC generated cable number - from Telecommunications Room (TR) number - cable pair count per 25 pairs (1-25, 26-50, etc.).
  - 2. 'From' UCSC building number for cable.
  - 3. Cable pair count per 25 pairs (1-25, 26-50, etc.)
- B. See PP&C Project Manager or his/her designate to obtain UCSC generated cable number.
- C. Pair call-out labeling: Pair call-out labeling shall designate every fifth (5th) pair consecutively through total pair count of the cable terminated on the block but not including the first (1st) and twenty-fifth (25th) pairs of each twenty-five (25) pair field bundle: Example for fifty (50) pair cable -- 5, 10, 15, 20, 30, 35, 40, 45.

D. All labels shall be machine/printer created labels.

### **3.4 TESTING**

Comply with Section 27 15 53 - Communications Cable Plant Testing.

### **3.5 AS-BUILT DRAWINGS**

Comply with Section 27 15 53 - Communications Cable Plant Testing.

### **3.6 ADJUSTMENTS**

Comply with Section 27.00 00 – Communications.

### **3.7 ACCEPTANCE**

Comply with Section 27.00 00 – Communications.

**END OF SECTION 27 11 13**

## 27 11 16 - Communications Cabinets, Racks, Frames and Enclosures

### **PART 1 - GENERAL**

#### **1.1 SCOPE OF WORK**

Communications racks and cabinets.

#### **1.2 RELATED WORK BY OTHERS**

##### A. By the University

1. Data switching equipment
2. Rack mounted power strips/ PDU's

#### **1.3 RELATED WORK IN OTHER SECTIONS**

##### A. Division 26

1. Power at equipment racks, mounted to cable tray above racks unless otherwise noted.

##### B. Section 27 05 26 – Grounding and Bonding for Communications Systems

1. Bonds racks and cabinets.

##### C. Section 27 05 33 – Conduits and Backboxes for Communications Systems

1. Signal systems raceways at communications rooms

##### D. Section 27 05 36 – Cable Trays for Communications Systems

1. Signal systems cable tray at communications rooms

##### E. Section 27 13 00 – Communications Backbone Cabling

1. Inside Backbone Terminations at communications rooms.
2. Outside plant backbone cabling, including Entrance Protection and Termination at communications rooms.

##### F. Section 27 15 00 Communications Horizontal Cabling

1. Rack mounted horizontal patch panels.

#### **1.4 REFERENCES**

##### A. American National Standards Institute (ANSI)

1. EIA-310-D (1992) Cabinets, Racks, Panels, and Associated Equipment (ANSI/EIA/310-D)
2. ANSI-J-STD-607-B (2011) Generic Telecommunications Bonding and Ground (Earthing) for Customer Premises

## 1.5 SUBMITTALS

Conform with the requirements of Division 1 and Section 27 05 00 - Common Work Results for Communications.

## 1.6 DELIVERY, STORAGE AND HANDLING

Procedures: In accordance with Division 1 and Section 27 10 00 – Structured Cabling, Basic Materials and Methods.

## 1.7 SEQUENCING

Not Used.

## ***PART 2 - PRODUCTS***

### 2.1 GENERAL

#### A. KEYS

1. Key all boxes, cabinets, enclosures, panels, controls, doors and related provided for similar usage within a system identically.

### 2.2 EQUIPMENT ENCLOSURE SYSTEMS

#### A. General

1. Provide enclosure systems including, but not limited to enclosures, cabinets, cases and related panels and accessories as specified herein. Provide size and quantity as shown on drawings or scheduled.
2. Provide color as shown on drawings. If no color is shown on drawings, submit manufacturer's standard color chips for selection.
3. Provide enclosure systems conforming to the IBC, latest edition, for bracing design.
4. Equipment Enclosures: Each rack provided with frame angles tapped 10-32, ANSI/EIA 310-D Universal Spaced.

#### B. Wall Mounted IDF and Telephone Splice Enclosure

1. Drawing References: R5A, R5B
2. Construction
  - a. General
    - i. Includes grounding bar and tie off points for cable management
    - ii. Powder coat finish – off white
    - iii. Two padlock hasps secure each compartment.
    - iv. Tamper resistant per Bellcore GR487
    - v. Meets NEMA 2

- vi. Knockouts for standard conduit sizes and Wiremold and Hubbell surface raceway.
  - b. R5A
    - i. Vertically mounts up to 6 RU of 19" Wide by 22" Deep EIA Equip opposite up to 4 RU of patch panels and wire managers in arrangement shown on plans.
    - ii. 4 receptacle quad electrical receptacle
    - iii. Fan kit with replaceable filter
    - iv. Perimeter Gasket Kit
    - v. Not greater than 42" H x 24.2 W x 10" D
  - c. R5B
    - i. Form factor matches that of R5A
    - ii. Not greater than 42" H x 24.2 W x 10" D
  - d. Joining Kit
    - i. Manufacturer's joining kit provide dress panel to give installed racks a neat finished appearance, while permit cabling to pass between the cabinets behind joining panel.
3. Manufacturers
- a. See Section 27 06 00 - Communications Product Schedule

C. Rack, Wall Mount, Three Section, Horizontal Pivoting

1. Drawing Reference: R12X, where X is indicated panel opening size.
2. Construction:
  - a. Wall mounted, three part sectional, with:
    - i. Steel, fixed mount wall terminal section
    - ii. Steel, center swing out section
    - iii. Vented steel locking front door.
  - b. Fully depth-adjustable mounting rails.
  - c. Combined depth of swing-away center section and fixed rear section to be not less than as scheduled below.
  - d. Center section swing is reversible, and can be both keylocked and padlocked
3. Approvals:
  - a. UL Standards Tested: UL2416
  - b. ASCE: 7-10
4. UL Load Capacity: 300 pounds minimum.



5. Seismic Certified: 140 pounds minimum
6. Meets 2010 CBC; 2012 IBC; ASCE 7-05 (2005 Edition) & ASCE 7-10 (2010 Edition) and the 2006 & 2009 editions of NFPA 5000 for use in areas of high seismicity, Seismic Use Group III, Zone 4 or Seismic Design Category (SDC) "D" with lateral force requirements for protecting 140 lbs. of essential equipment in locations with the highest level of seismicity and top floor or rooftop installations with an Importance factor (Ip) of 1.5
7. Front door 64% Open Minimum, Center Section vented to permit air intake from front and discharge to sides.
8. Manufacturers:
  - a. Reference Section 27 06 00 – Communications Product Schedule

D. Relay Rack, Integrated Vertical Wire Chase, Zone 4 rated

1. Drawing Reference: R15
2. Construction
  - a. Zone 4 listed assembly meets Zone 4 requirements with a least a 500 pound uniformly distributed load.
  - b. Two wide vertical side channels tapped with EIA mounting holes on both sides, 6" deep section construction minimum.
  - c. Full 19" wide EIA Frame fits standard equipment forms – assemblies with non-standard opening widths not permitted.
  - d. Maximum width of relay rack frame (not including vertical wire managers): 25.5 inches.
  - e. Floor mount plates
  - f. Top angle or plate.
  - g. Front and back vertical wire management troughs on both sides of rack, unless otherwise indicated on plans - 6" wide and x 6" minimum depth vertical cross-section, each trough (12" overall depth). Removable horizontal strips or braces at 12" o.c. vertical restrain cabling within trough.
  - h. 44 EIA Rack Units minimum
3. Manufacturers, Zone 4 rated rack assembly - subject to minimum panel opening criteria scheduled above:
  - a. See Section 27 06 00 - Communications Product Schedule

E. Relay Rack, Integrated Vertical Wire Chase, Seismically rated, Narrow.

1. Drawing Reference(s): R15N
2. Construction, Rack
  - a. Seismically qualified assembly meets California legacy Zone 4, CBC, ASCE 7-10 (2010 Edition) and 2009 editions of NFPA 5000 for use in areas of high

- seismicity – Zone 4 or Seismic Design Category (SDC) "D" seismic requirements with a least a 500 pound uniformly distributed load.
- b. Full 19" wide EIA Frame fits standard equipment forms – assemblies with non-standard opening widths not permitted.
  - c. Overall width of frame and vertical wire management not to exceed 27" to fit space within constrained dimension Telecommunications Rooms.
  - d. Floor mount plates
  - e. Top angle or plate.
  - f. 44 EIA Rack Units minimum
3. Construction, Surface applied single sided wire managers.
- a. Large finger openings accommodate up to 24 Category 6 cables
  - b. Integral cable retainers on the end of each finger to help contain cables within each rack unit
  - c. Bend radius fingers align with rack spaces to support cables as they transition to the vertical pathway.
  - d. Dual hinged covers can be opened 110° to the left or right to provide complete access to the cables inside the vertical pathway
  - e. Snap-on cable retainers can be placed on to fingers to help retain cables in channel during installation and maintenance
  - f. Vertical managers include hinged covers, cable retainers, mounting brackets and #12-24 screws.
  - g. Provide two each vertical wire managers at each frame, unless otherwise noted on the plans. Provide one across face of two adjacent R15N frames, unless otherwise indicated on plans.
  - h. Nominal dimensions not to exceed 83.0"H x 4.9"W x 6.5"D to minimum protrusion into mounting rail space of frame or into room. At single racks and at end or rows, mount offset to vertical centerline of frame to avoid blocking rails. Coordinate depth with rack and horizontal wire managers to maintain unrestricted full cross-sectional area cable passage from horizontal wire managers to vertical wire managers.
4. Manufacturers
- a. See Section 27 06 00 - Communications Product Schedule

F. Equipment Rack, Zone 4, Front, Rear and Side Access, with Vertical Wire Management.

- 1. Drawing Reference(s): R26, R26-37, R28
- 2. Minimum Features, Function & Construction:
  - a. Manufacturer tested Zone 4 assembly, rated for at least 900 pounds of uniformly distributed load, upper floor load, of essential equipment per California Building Code/Uniform Building Code.

- b. Fully welded construction provides:
  - i. Static load capacity: 10,000 lbs.
  - ii. UL Listed load capacity: 2,500lbs.
  - iii. Seismic Certified load capacity: 755 lbs.
- c. Seismic certified to the following codes and standards: 2007 & 2010 CBC; 2006, 2009 & 2012 IBC; ASCE 7-05 (2005 Edition) & ASCE 7-10 (2010 Edition) and the 2006 & 2009 editions of NFPA 5000 for use in areas of high seismicity – one 4 or Seismic Design Category (SDC) "D". Intended for use in Mission Critical and/or High-Importance Installations in locations with the highest level of seismicity and top floor or rooftop installations including those within UBC and CBC Essential facilities or IBC, ASCE 7, and NFPA 5000 Seismic Use Group III facilities. For all codes, the Importance factor (Ip) is 1.5.
- d. Vertical Height (Min):
  - i. R26: 44 RU
  - ii. R26-37: 37 RU
- e. Outside depth: 40" minimum - 44 inches maximum.
- f. Width: Not to exceed 30 inches
- g. Perforated mesh full height front and rear doors:
  - i. Locking front and rear doors.
  - ii. Front door with wire mesh insert covers rack contents – swing shall be field adjustable to swing from either right or left.
  - iii. Wire mesh split rear doors.
- h. Front and rear 19" mounting rail pairs 10-32 threaded on EIA spacing standard are fully adjustable in depth of setback from front to rear.
- i. Vertical cable management rings, continuous, full height cable management system shall be installed:
  - i. Fully inside of the rack enclosure, with 2" minimum clearance behind front and rear rack frame.
  - ii. Fully outside (to left of left rail and to right of right rail, and out of conflict with EIA Rails. Cable management system mounting shall not occupy rail screw openings.
  - iii. Front managers shall be accessible from front in fully loaded equipment rack.
  - iv. Rear managers shall be accessible from rear in fully loaded equipment rack.
- j. One (1) Exhaust Fan Panel, at top or at rear doors, at least 200 CFM, thermostatically controlled. Thermostat have adjustable setpoint.

- k. Rack top accommodates vertical transition of cabling from tray above into rack interior.
  - l. Gangable. Racks have been designed such that they are suitable for installation either as a single, standalone unit, or in a row of identical racks (gangable).
    - i. Single rack installation. Provide side panels at both sides.
    - ii. Multirack installation in a row. Bolt racks together using means provided by manufacturer. Omit side panels except at ends of row of racks – provide at ends of rows of racks.
3. Manufacturers. Provide manufacturer's accessories or 3rd party accessories as specified elsewhere in this Section for other specified elements. Coordinate selected shelves, fans and similar with rack submitted for finish and mounting means:
- a. See Section 27 06 00 - Communications Product Schedule

#### G. Equipment Enclosure, NEMA 3R

1. Drawing References: R40
2. Minimum Features, Function & Construction
  - a. General:
    - i. Cabinet to be designed by the manufacturer to serve as a rack mount enclosure intended to house electronic controls, terminals and instruments, and to provide protection from rain, sleet, snow, dripping water and corrosion.
    - ii. The cabinet and door(s) shall be constructed from 5052-H32 sheet aluminum alloy which has a thickness of 0.125 inch. External welds shall be made by using the Heliarc welding method; internal welds will be made by the wire welding method. All welds shall be neatly formed and free of cracks, blow holes and other irregularities.
    - iii. All inside and outside edges of the cabinet shall be free of burrs.
    - iv. The cabinet shall be designed with a crowned top or equivalent method to prevent the accumulation of water on its top surface.
    - v. The door opening(s) shall be double flanged on all four (4) sides which increases strength around openings and keeps dirt and liquids from entering the enclosure when door is opened.
    - vi. Door restraint(s) shall be provided to prevent door movement in windy conditions.
    - vii. Enclosure shall incorporate a forced air fan system that is thermostatically controlled, with air exhausted through a screened vent system in the enclosure top.
  - b. Nominal Size:
    - i. 67" High x 24" wide x 38" deep

c. Door/Hardware

- i. The cabinet front and rear doors will be a minimum of 80% of the front and rear surface area and shall be hinged on the same side when facing the cabinet.
  - (A) The doors shall be furnished with a gasket that satisfies the physical properties as found in UL508 table 21.1 and shall form a weathertight seal between the cabinet and door.
  - (B) The closed doors will be flush with the side(s) of the enclosure.
- ii. The hinges shall be bolted to the cabinet and door utilizing 1/4- 20 stainless steel carriage bolts and nylock nuts.
  - (A) The hinges will be made of 0.075 inch stainless steel with a 0.250 inch diameter stainless steel hinge pin.
  - (B) The hinge pin shall be capped top and bottom by weld to render it tamperproof. All bolt holes shall be gasketed.
- iii. The latching mechanism shall be a three-point draw roller type.
  - (A) Pushrods will be turned edgewise at the outward supports and shall be 0.250 inch by 0.750 inch aluminum, minimum.
  - (B) Rollers shall have a minimum diameter of 0.875 inch and will be made of nylon. The center catch shall be fabricated from 0.187 aluminum, minimum.
- iv. An operating handle shall be furnished.
  - (A) The handle will be stainless steel with a 3/4 inch diameter shank.
  - (B) The latching handles shall have a provision for to accept a University furnished padlocking in the closed position.
  - (C) A light/alarm switch bracket shall be provided.

d. Equipment Mounting

- i. The enclosures shall be equipped with mounting brackets that accommodate the mounting of a 19" rack frame assembly.

e. Cabinet Finish

- i. Unless otherwise specified, the outside surface of the cabinet shall have a smooth, uniform, natural aluminum finish.
  - (A) If painted, the following steps shall be taken as a minimum requirement:

- (1) The cabinet door and any other parts to be painted will be treated with an iron phosphate coating conversion technique.
      - (2) After phosphatizing, the parts shall be baked to eliminate any moisture in seams.
      - (3) The finishing coat of a polyester powder will be baked at 400-450 degrees F for ten (10) minutes.
      - (4) The finish shall be commercially smooth, substantially free of flow lines, paint washout, streaks, blisters and other defects that would impair serviceability or detract from general appearance.
    - f. Internal Rack Frame
      - i. 30 EIA 310-D Rack Units (RU) minimum.
      - ii. 29" rack frame depth between front and rear EIA mounting rails minimum
    - g. Cabinet Mounting
      - i. Enclosures intended for pedestal mounting shall be provided with a reinforced base plate with gasketed mounting holes.
    - h. Insulation
      - i. Provide insulation sufficient to reflect out of the cabinet 95% of the incoming radiant solar heat.
    - i. Sushade
      - i. Provide with manufacturer's custom aluminum sunshade kit selected and configured to reduce solar exposure during peak months.
  3. Approvals
    - a. Nationally recognized testing laboratory: UL, ETL or equal.
    - b. NEMA 3R Construction
  4. Manufacturers
    - a. See Section 27 06 00 - Communications Product Schedule
- H. Equipment Rack, Seismically Qualified, NEMA 12, Front, Rear and Side Access, with Vertical Wire Management.
1. Drawing References: R42
  2. Minimum Features, Function & Construction:
    - a. Manufacturer tested seismically qualified assembly, rated for at least 600 pounds of uniformly distributed load, upper floor load, of essential equipment per California Building Code.
    - b. Fully welded construction provides:

- i. Seismic Certified load capacity: 600 lbs. dynamic load per NEBS GR-63-CORE or equivalent shaker test.
      - c. Vertical Height (Min): 44 RU
      - d. Outside depth: 34" minimum - 48 inches maximum.
      - e. Width: Not to exceed 30 inches
      - f. Lockable, solid, gasketed full height front and rear doors with gasket kit providing NEMA 12 protection.
      - g. Front and rear 19" mounting rail pairs DIN square holes on EIA spacing standard are fully adjustable in depth of setback from front to rear.
      - h. Vertical cable management rings, continuous, full height cable management system shall be installed:
        - i. Fully inside of the rack enclosure, with 2" minimum clearance behind front and rear rack frame.
        - ii. Fully outside (to left of left rail and to right of right rail, and out of conflict with EIA Rails. Cable management system mounting shall not occupy rail screw openings.
        - iii. Front managers shall be accessible from front in fully loaded equipment rack.
        - iv. Rear managers shall be accessible from rear in fully loaded equipment rack
      - i. Solid top panel with dense brush slots cable management.
      - j. Cutouts and removable covers in cabinet top accommodates vertical transition of cabling from tray above into rack interior.
      - k. Integral cabinet cooler dissipates 1 kW of internal rack heat load in a room with an ambient of up to 90 degrees F, without allowing cabinet interior temperatures to rise above 77 degrees F. Submit calculation demonstrating selection meets criteria. Cooler is cut into side of cabinet through gasketed, sealed penetration to prevent dust ingress.
3. Manufacturers:
  - a. See Section 27 06 00 - Communications Product Schedule
  - b. Provide manufacturer's accessories or 3rd party accessories as specified elsewhere in this Section for other specified elements. Coordinate selected shelves, coolers and similar with rack submitted for finish and mounting means.

## 2.3 RACK PANELS AND ACCESSORIES

### A. Rack Mounting Screws

1. Screws 10-32; length as required for at least 1/4" excess when fully seated; oval head with black plastic non marring cup washer or equivalent ornamental head; nickel, cadmium or black plated; Phillips, Allen Hex, Square-Tip or Torx drive.

2. Slotted screws are not acceptable.

#### B. Blank Panels

1. Construction
  - a. 16 gauge minimum cold rolled steel
  - b. Powder coat finish to match rack color, unless otherwise noted
2. Manufacturers
  - a. See Section 27 06 00 - Communications Product Schedule

#### C. Vent Panels

1. Construction
  - a. 20 gauge minimum cold rolled steel
  - b. 1/8" minimum holes, at least 70% open total panel cross-section.
  - c. Powder coat finish to match rack color, unless otherwise noted
2. Manufacturers
  - a. See Section 27 06 00 - Communications Product Schedule

#### D. Vertical Lacer Strips

1. 44RU high vertical steel strips with points for attachment of velcro cable ties at at least 6" o.c.
2. Manufacturers
  - a. See Section 27 06 00 - Communications Product Schedule

#### E. Horizontal Lacer Bars

1. EIA 19" Width steel strips or bars suitable to provide support to large cable dressed horizontally through racks
2. Size to suit load and mounting width.
3. Manufacturers
  - a. See Section 27 06 00 - Communications Product Schedule

#### F. Seismic Hold-down Equipment Straps

1. Drawing Reference: None - Provide as required to secure equipment that cannot be screw fastened to mounting shelves.
2. Manufacturers
  - a. See Section 27 06 00 - Communications Product Schedule



## **PART 3 - EXECUTION**

### **3.1 MOUNTING**

- A. Unless otherwise noted, all floor supported equipment racks shall be bolted to the structure in accordance with the requirements of the CBC and the contractor's approved structural engineering submittal demonstrating the method to be used to conform to these requirements.
- B. Rows of identical racks shall be bolted together, in addition to being bolted to the floor, and bonded to form a single electrical ground plane.
- C. Wall mounted equipment racks and cabinets shall similarly be bolted to structural members in accordance with the requirements of the CBC and the contractor's approved structural engineering submittal demonstrating the method to be used to conform to these requirements.

### **3.2 EQUIPMENT ENCLOSURE (RACK) AND EQUIPMENT BACKBOARD FABRICATION**

- A. Combustible material, other than incidental trim of indicated equipment, is prohibited within equipment racks.
- B. Provide permanent labels for all equipment and devices.
- C. Floor racks to be bolted floor unless otherwise indicated.
- D. Access shall not require demounting or de-energizing of equipment. Install access covers, hinged panels, or pull-out drawers to insure complete access to terminals and interior components.
- E. Provide a permanent label on the front of each equipment rack including the rack designation, and the circuit breaker number and associated electrical distribution panel designation servicing same.
- F. Where wiring of mixed types are called for on the plans, maintain separation of wiring classifications as specified in the individual sections of Division 27.
- G. Provide vertical wire management of cabling within the rack independent of the adjustable EIA mounting rails. Vertical wiring management provided by the contractor within the rack shall not prevent such rails from being moved as required by the University.
- H. Dress and support cabling at a minimum of 24 inch on center.
- I. Access shall not require demounting or de-energizing of equipment or cabling. Install access covers, hinged panels, or pull-out drawers to insure complete access to terminals and interior components.
- J. Fasten removable covers containing any wired component with a continuous hinge along one side, with associated wiring secured and dressed to provide an adequate service loop. Provide an appropriate stop locks to hold all hinged panels and drawers in a serviceable position.
- K. Provide permanent labels for all equipment and devices. Where possible, fasten such labels to the rack frame or to blank or vent panels which will remain in place when active equipment is removed for possible service.
- L. Coordinate the design and execution of wire harnessing of multi-bay audio and video rack ensembles with conditions of delivery to installation locations at Project Site, and with the requirement herein for test of the completely wired system in the shop prior to delivery to the

Project Site. Organize the wiring harnesses such that they will fold within one shippable unit without risk of damage, or provide polarized multipin connectors and related interconnect systems as specified elsewhere herein.

### **3.3 SIGNAL GROUNDING & BONDING PROCEDURES**

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- A. Comply with National Electrical Code. Bond equipment racks to ground in accordance with the National Electric Code and ANSI/ TIA 607 and Section 27 05 26
- B. Unless otherwise noted maintain a unipoint ground scheme.
- C. Equipment enclosures shall not be permitted to touch each other unless bolted together and electrically bonded.

**END OF SECTION 27 11 16**

## 27 11 19 - Communications Termination Blocks and Patch Panels

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of communication blocks and patch panels as called for in this section of the Division 27 specifications and conjoined construction drawings.
- B. The specification sections of this Division 27 that are particularly applicable to this section include, but are not limited to the following:
  - 1. Section 27 00 00 – Communications
  - 2. Section 27 05 53 - Identification for Communication Systems
  - 3. Section 27 06 00 – Communications Product Schedule
  - 4. Section 27 11 13 - Communications Entrance Protection
  - 5. Section 27 13 00 - Communications Backbone Cabling
  - 6. Section 27 15 00 - Communications Horizontal Cabling
  - 7. Section 27 15 53 - Cable Plant Testing
  - 8. Division 28 - Electronic Safety and Security also has sections that maybe applicable to this section of the Division 27 - Communications specification set.

#### **1.2 QUALITY CONTROL**

Comply with Section 27 00 00 - Communications.

#### **1.3 WARRANTIES**

Comply with Section 27 00 00 - Communications.

#### **1.4 MATERIAL SUBSTITUTIONS**

Comply with Section 27 00 00 - Communications.

#### **1.5 SUBMITTALS**

Comply with Section 27 00 00 - Communications.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

Comply with Section 27 00 00 - Communications.

## ***PART 2 - PRODUCTS***

### **2.1 QUANTITY DETERMINATION**

Comply with Section 27 00 00 - Communications.

### **2.2 COPPER TERMINATION BLOCKS**

- A. Furnish all 110 termination block fields required to terminate the copper backbone (riser) cabling and the voice cross-connect system cabling - Reference Section 27 15 00 - Communications Horizontal Cabling; Section 27 13 00 - Communications Backbone Cabling.
- B. Furnish all required 110 system C4 and C5 termination blocks.
- C. Furnish all required pair grouping 110 termination block label strips.
- D. See Section 27 06 00 - Communications Product Schedule

### **2.3 COPPER PATCH PANELS**

- A. Furnish all patch panels required to support the TR terminations of the WAO horizontal cabling.
- B. Furnish all patch panels required to support the voice cross-connect system - Reference Section 27 15 00 - Communications Horizontal Cabling.
- C. See Section 27 06 00 - Communications Product Schedule

### **2.4 FIBER PATCH PANELS**

- A. Furnish all required wall mount fiber patch panels - See Section 27 06 00 - Communications Product Schedule
- B. Furnish all required rack mount fiber patch panels - See Section 27 06 00 - Communications Product Schedule
- C. Furnish all fiber patch panel parts required for the termination of SMF optical fiber cables and complete build-out of associated fiber patch panels including blank fill plates - See Section 27 06 00 - Communications Product Schedule
- D. SMF fiber connectors: Furnish all required SMF connector "Pigtails" - See Section 27 06 00 - Communications Product Schedule

## ***PART 3 – EXECUTION***

### **3.1 INSTALLATION**

- A. Copper backbone termination.
  - 1. Mount 110 termination fields per manufacturer's specifications, instructions, and recommendations. Use accompanying construction drawing set to determine mounting locations and configurations.
  - 2. Backbone cables are to be routed neatly on overhead cable runway to block termination locations. For cable management from cable runway to block termination and the

dressing of cable at the blocks, follow manufacturer's specifications, instructions, and recommendations and standard industry practices.

3. Terminate all riser backbone cables per manufacturer's specifications, instructions, and recommendations.
4. At the termination end of multi-pair riser cables, the Contractor shall provide 15 feet (15') of managed service slack.
5. If removal of the cable jacket is required to facilitate routing of backbone cable into the blocks, the exposed cable pairs shall be fully covered with black or gray plastic tape, neatly lapped to prevent gaps.
6. Install five (5) pair and four (4) pair 110 I.D. strips for backbone cabling as required per the construction drawing set accompanying this Division 27 specification.
7. Backbone riser cables shall be identified and labelled on both ends according to 27 05 53

B. WAO horizontal cable termination.

1. Install one (1) 48-port patch panel for every 48 WAO cables.
2. Mount patch panels per the construction drawing set accompanying this Division 27 specification. Note: See Section 27 11 16 - Communications Cabinets, Racks, Frames and Enclosures. Each patch panel shall have a 2RU horizontal manager placed both above and below the panel.
3. Horizontal cables are to be routed neatly on overhead cable runway to equipment racks; exit cable runway into equipment rack vertical cable management and proceed to the patch panels.
4. Cable termination.
  - a. Cables on the left side of the patch panel shall enter from the left side vertical cable manager. Cables on the right side of the patch panel shall enter from the right side vertical cable manager. Cables shall not cross the center line of the patch panel.
  - b. Terminate cables using the 8-pin jack, T568B four (4) pair termination standard and comply with manufacturer's termination practices, specifications, instructions, and recommendations.

C. Voice cross-connect system termination. 110 cable end termination.

1. Mount 110 termination fields per manufacturer's specifications, instructions, and recommendations. Use accompanying construction drawing set to determine mounting locations and configurations.
  - a. 110 C5 blocks shall be used for all.
2. Patch panel end terminations.
  - a. Install one (1) 24-port patch panel for every 25-pair cable terminated at the voice cross-connect system's 110 blocks.
  - b. Mount patch panels per the construction drawing set accompanying this Division 27 specification. Note: See Section 27 11 16 - Communications Cabinets,

Racks, Frames and Enclosures. Each patch panel shall have a 2RU horizontal manager placed both above and below the panel.

- c. Terminate cables using the 8-pin jack, T568B four (4) pair termination standard and comply with manufacturer's termination practices, specifications, instructions, and recommendations.
3. Voice cables between the termination blocks and copper patch panel shall be identified and labelled on both ends according to 27 05 53

D. Fiber cable termination.

1. Install the wall mount and rack mount optical fiber patch panels at the locations indicated on the construction drawing set and per manufacturer's specifications.
2. Fiber cables are to be routed neatly on overhead cable runway to patch panel termination locations. For cable management from cable runway to patch panel termination and the dressing of cable at the patch panel termination, follow manufacturer's specifications, instructions, recommendations, and standard industry practices.
3. Before terminating fiber cable neatly install twenty-five feet (25') of service loop slack on Telecommunication Room wall near location where backbone cable is to be terminated. Diameter of service loops shall be twelve inches (12") for inside plant, twenty-four inches (24") for OSP cable. Use Leviton 48900-ISP and 48900-OSP fiber slack rings, respectively.
4. Terminate fiber cable by fusion splicing the appropriate connector "Pigtail" to the backbone cable. Comply with manufacturer's specifications, instructions, and recommendations.
5. Fiber connector "Pigtail" splicing: Use only core-alignment fusion splicing to splice fiber connector pigtails to fiber backbone cable. No other splicing methodology shall be allowed.

### 3.2 EXAMINATION

Comply with Section 27.00 00 – Communications.

### 3.3 ISP/OSP BACKBONE COPPER 110 TERMINATION BLOCK LABELING

- A. 110 block cable ID label text shall be as follows:
  1. Label shall be UCSC generated cable number - from Telecommunications Room (TR) number - cable pair count per 25 pairs (1-25, 26-50, etc.).
  2. 'From' UCSC building (TR) number (i.e. 7189-TR100T) for ISP riser or 'From' UCSC building number for OSP cable (i.e. 7189-TR100T).
  3. Cable pair count per 25 pairs (1-25, 26-50, etc.)
- B. See University Representative or his/her designate to obtain UCSC generated cable number.
- C. Pair call-out labeling: Pair call-out labeling shall designate every fifth (5th) pair consecutively through total pair count of the cable terminated on the block but not including the first (1st) and

twenty-fifth (25th) pairs of each twenty-five (25) pair field bundle: Example for fifty (50) pair cable -- 5, 10, 15, 20, 30, 35, 40, 45.

D. All labels shall be machine/printer created labels.

### 3.4 HORIZONTAL COPPER PATCH PANEL LABELING

A. Label placement.

1. WAO jack assignment number, cable number, and TR patch panel port number shall be the same number. Example: A horizontal cable terminated on WAO jack 001 shall be terminated on patch panel port 001. A horizontal cable terminated on WAO jack 099 shall be terminated on patch panel port 099.
2. Start patch panel port labeling at the first port in the patch panel that is at the top of the equipment rack closest to the wall, looking from the front of the rack. Work left to right and down that equipment rack to the last patch panel port within that equipment rack. Continue to the next equipment rack, starting in its upper left hand corner and moving down the rack, if more than one (1) equipment rack supporting WAO horizontal cabling is installed in the TR.

B. Patch Panel Port Label content and format shall be YZZZ where:

1. ZZZ = the WAO jack number the cable is terminated on - 001 through 999.
2. Y = the floor number the TR and WAOs are on - use zero (0) for basement.
3. Example: 2055 = (2) second floor, (055) fifty-fifth WAO/Patch Panel port. As an observation, the above number is also a key component of the horizontal cable number.

C. All labels shall be machine/printer created labels. Hand labeling is not acceptable unless approved in writing as acceptable by the University Representative.

D. Machine label technology: Use Brady technology or approved equivalent.

### 3.5 FIBER PATCH PANEL LABELING

A. Each fiber patch panel shall have a header label.

B. Header Label format and content shall be as follows:

1. UCSC generated cable number.
2. 'From' UCSC building Telecommunication Room (TR) number (i.e. 7189-TR100T) for ISP riser or 'From' UCSC building number for OSP cable (i.e. 7189-TR100T).
3. Fiber strand type designation and strand count. SM (single mode) XX where XX = strand count.

C. See University Representative to obtain UCSC generated cable number.

D. Fiber Patch Panel Port Labeling: Label each fiber patch panel port with the strand count terminated on the port. Example for a duplex port termination: 5-6 = strand 5 and strand 6 of cable are terminated on this fiber patch panel port. Simplex port termination 6 = strand 6 is of cable is terminated on this fiber patch panel port.

E. All labels shall be printed labels.

### **3.6 VOICE CROSS-CONNECT SYSTEM LABELING**

- A. The 110-Blocks shall be labeled "Voice Cross-Connect to Rack #\_ Panel #\_\_". Each cable shall be numbered from 1-48 on the 110-block Designation Strips.
- B. The patch panels on the racks shall be labeled "Voice Cross-Connect Rack #\_ Panel #\_\_". Each jack shall be numbered from 1-48 on each panel.

### **3.7 TESTING**

Comply with Section 27 15 53 - Communications Cable Plant Testing.

### **3.8 AS-BUILT DRAWINGS**

Comply with Section 27 15 53 - Communications Cable Plant Testing.

### **3.9 ADJUSTMENTS**

Comply with Section 27.00 00 – Communications.

### **3.10 ACCEPTANCE**

Comply with Section 27.00 00 – Communications.

**END OF SECTION 27 11 19**



## **27 11 23 - Communications Cable Management**

### ***PART 1 - GENERAL***

#### **1.1 SCOPE OF WORK**

- A. Innerduct
  - 1. Outside plant.
  - 2. Inside buildings
- B. Cable Management at Communication Room Backboards.
- C. Cable Management at rack mounted Patch Panels, including provision of cable management for cabling installed under the work of this Project as well as for University furnished patch cords at equipment racks

#### **1.2 RELATED WORK IN OTHER SECTIONS**

- A. Section 27 05 33 – Conduits and Backboxes for Communications Systems
- B. Section 27 05 36 – Cable Trays for Communications Systems
- C. Section 27 05 39 – Surface Raceways for Communications Systems
- D. Section 27 05 53 – Identification for Communications Systems
- E. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
- F. Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures
- G. Section 27 11 19 – Communications Termination Blocks and Patch Panels
- H. Section 27 13 00 – Communications Backbone Cabling
- I. Section 27 15 00 – Communications Horizontal Cabling

#### **1.3 REFERENCES**

- A. American Society for Testing and Materials (ASTM): ASTM D2239-03 Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
- B. Underwriters Laboratories (UL):
- C. UL 910 Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables used in Spaces Transporting Environmental Air (Nov. 1998)

#### **1.4 SUBMITTALS**

Conform with the requirements of Division 1 and Section 27 05 00 - Common Work Results for Communications

#### **1.5 DELIVERY, STORAGE AND HANDLING**

Procedures: In accordance with Division 1 and Section 27 10 00 – Structured Cabling, Basic Materials and Methods.

## 1.6 SEQUENCING

Not Used.

## **PART 2 - PRODUCTS**

### 2.1 INNERDUCT

#### A. Innerduct, Single Chamber

1. Drawing and spec reference(s):
  - a. ID\*, Innerduct ("\*" denotes cross sectional area of innerduct referenced to standard conduit trade size).
  - b. IDP\*, Innerduct, Plenum ("\*" denotes cross sectional area of innerduct referenced to standard conduit trade size).
2. Construction:
  - a. Selected product suitable for:
    - i. Underground installation in ductbank
    - ii. Plenum (IDP)
    - iii. Exposed, in interior utility rooms where indicated
  - b. High density polyethylene
  - c. Ribbed or similar exterior construction to resist crushing surface to promote fiber cable installation.
  - d. Provides an interior chamber with a capacity equal to a trade size conduit referenced above.
3. Approvals:
  - a. ASTM D2239(1985) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
  - b. IDP - UL Standard Test Method 2024 of UL 910.
4. Manufacturers
  - a. See Section 27 06 00 - Communications Product Schedule

#### B. Innerduct, UV Rated

1. Drawing Reference: ID, UV Rated\*, where "\*" denotes cross sectional area of each chamber referenced to standard conduit trade size).
2. Approvals:
  - a. ASTM D2239(1985) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
3. Construction
  - a. Listed for UV exposure

4. Manufacturers:
  - a. See Section 27 06 00 - Communications Product Schedule

#### C. Woven Mesh Innerduct

1. Drawing Reference: MID, WMID
2. Features/Functions
  - a. Three-inch-wide woven mesh assembly contains at least three continuous pullable sleeves, each can accommodate a cable of at least 1" diameter.
  - b. Systems providing fewer than 3 integrally woven sleeves per WMID assembly not acceptable.
  - c. Includes color coded pull tape in each sleeve.
  - d. Pre-Lubricated for cable pulling
  - e. Non-Hydroscopic
  - f. 2500 Pound Tensile Strength
  - g. 480 degree melting point
  - h. At least 5 years prior field use including at least 25 million feet of product in use.
  - i. Provide plenum rated assembly at plenum locations as defined by the National Electric Code.
3. Manufacturers:
  - a. See Section 27 06 00 - Communications Product Schedule

## 2.2 PATCH PANEL CABLE MANAGEMENT

#### A. Patch Panel Wire Management, Rack Mounted, Snap Cover.

1. Drawing References:
  - a. 1 RU Version: RMWM1C
  - b. 2 RU Version: RMWM2C
2. Construction
  - a. EIA 19 or 23" Rack Mount, as required
  - b. Continuous flexible system of T shaped fingers and slots along top and panel, deburred to avoid snagging patch cord jacket.
  - c. Contoured front door with snap-hinges swings up or down and stays in the open position while cabling.
  - d. Three edge-protected, oval-shaped pass-through ports allow patch cords to pass front-to-rear.
3. Capacity
  - a. 1 RU - accommodates at least 35 patch cords.

- b. 2 RU - accommodates at least 70 patch cords.
- 4. Manufacturers
  - a. See Section 27 06 00 - Communications Product Schedule

## **2.3 BACKBOARD CABLE MANAGEMENT**

### **A. Fiber Management Ring, Preformed Loop**

- 1. Drawing Reference: FMR
- 2. Construction:
  - a. 24-inch diameter steel ring stores fiber slack using Velco fasteners at regular intervals around ring.
  - b. Screw fastens to backboard at BDF or IDF.
- 3. Manufacturer
  - a. See Section 27 06 00 - Communications Product Schedule

### **B. Wire Management Rings, Wall/Ceiling Mounted:**

- 1. Drawing References/Functions Features:
  - a. WMRB - Bridle Ring Type, Threaded Lag Screw
  - b. WMRC - Closed Ring, U shaped assembly with two screw holes at ends
  - c. WMRO - Open, Re-enterable Split Ring permitting cables to be inserted midspan, two screw holes at ends
  - d. WMP\*\* - Steel back board with 4-inch-deep min, 8-inch-wide vertical wire management rings, front enterable. Provide trough at bottom of each column of WMP.
  - e. WMP\*\*T - Narrow, steel back board with 4-inch-deep min, 3 inch wide vertical wire management rings, front enterable.
- 2. Provide as required to support indicated cable bundle and location.
- 3. Provide type WMRB at wood frame construction for cable hung from underside of ceiling, unless otherwise noted.
- 4. Manufacturers:
  - a. See Section 27 06 00 - Communications Product Schedule

## ***PART 3 - EXECUTION***

### **3.1 INNERDUCT INSTALLATION**

#### **A. Schedule of Application**

- 1. Underground

- a. Provide WMID at new and existing ducts used by the work of this project in accordance with the schedules on the plans.
  - b. Place fiber cabling and 50 pair and smaller copper telephone cabling meeting the maximum diameter requirements of the WMID manufacturer inside WMID.
  - c. Omit WMID at conduits smaller than 4"
2. At tray conditions in utility tunnel and at backboard, cable runway and tray conditions at communications closets, protect fiber cabling with ID Innerduct.
  3. At plenum tray conditions, provide IDP.
  4. At 4" and larger interior conduits, provide WMID per the schedule on the plans. Provide plenum rated WMID at plenum ceiling conditions.

### **3.2 GENERAL**

Refer to Section 27 13 00 Communications Backbone Cabling for requirements for cable routing within Communications Rooms.

**END OF SECTION 27 11 23**

## 27 13 00 - Communications Backbone Cabling

### *PART 1 – GENERAL*

#### 1.1 SCOPE OF WORK

##### A. Inside

1. Indoor Copper Backbone Cabling between Communications Rooms and communications terminal nodes other than station cabling.
2. Indoor Optical Fiber Backbone Cabling between Communications Rooms and communications terminal nodes other than station cabling.
3. Terminate fiber on patch panels as specified in Section 27 11 19.
4. Terminate copper cabling on terminal blocks as specified in Section 27 11 19.

##### B. Outside Plant

1. Outdoor (Outside Plant) Communications Cabling placed underground in new and existing communications ducts
  - a. Between buildings and existing cable ducts
  - b. Outside plant cabling terminated in indicate splice cases for use in future projects
  - c. High pair count copper cabling
  - d. Fiber Optic Cabling
2. Terminate fiber on patch panels as specified in Section 27 11 19.
3. Terminate copper cabling on lightning protectors as specified in Section 27 11 13.

##### C. For all Cabling

1. UCSC has established an installed product set for the campus IT systems. It is the intention of UCSC ITS to continue the use of the established product set to match existing.
2. The first-named product in these specifications is the basis for the design. Substitutions which are equal in quality, utility, and appearance to those specified must be submitted and meet all requirements of Division 01 specification section 01 25 00 Substitution Procedures
3. Test cabling to demonstrate performance to specified standards or better using test equipment and methods as specified in Section 27 10 00.
4. Label cables, jacks, plates and patch panels as specified in Section 27 05 53.
5. Document as described in Section 27 05 00 1.11.

##### D. Related work in other Sections

1. Section 27 05 26 – Grounding and Bonding for Communications Systems
2. Section 27 05 29 – Hangers and Supports for Communications Systems

3. Section 27 05 33 – Conduits and Backboxes for Communications Systems
4. Section 27 05 36 – Cable Trays for Communications Systems
5. Section 27 05 39 – Surface Raceways for Communications Systems
6. Section 27 05 48 – Noise and Vibration Controls for Communications Systems
7. Section 27 05 53 – Identification for Communications Systems
8. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
9. Section 27 11 13 – Communications Entrance Protection
10. Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures
11. Section 27 11 19 – Communications Termination Blocks and Patch Panels
12. Section 27 11 23 – Communications Cable Management
13. Section 27 15 00 – Communications Horizontal Cabling

## 1.2 REFERENCES

- A. In accordance with Division 1.
- B. Refer to Section 27 10 00 – Structured Cabling, Basic Materials and Methods
- C. Section 27 05 00 - Common Work Results for Communications
- D. In addition to the requirements of Section 27 05 00 - Common Work Results for Communications and 27 10 00 - Structured Cabling, conform to the applicable portions of the following current standards:
  1. BICSI
  2. Insulated Cable Engineers Association (ICEA)
  3. Telecommunications Industry Association
    - a. TIA J-STD-607-B Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
  4. Telecommunications Industry Association/Electronic Industries Association (ANSI/TIA)
  5. Underwriters Laboratories, Inc. (UL)
    - a. UL 497 Protectors for Paired Conductor Communication Circuits
    - b. UL 510 Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
    - c. UL 83 Standard for Thermoplastic-Insulated Wires and Cables
  6. U.S. Department of Agriculture, Rural Utilities Service (RUS), formerly Rural Electrification Administration (REA)

## 1.3 SUBMITTALS

Conform with the requirements of Division 1 and Section 27 05 00 - Common Work Results for Communications.

## 1.4 DELIVERY, STORAGE AND HANDLING

Procedures: In accordance with Division 1 and Section 27 10 00 – Structured Cabling, Basic Materials and Methods.

## 1.5 SEQUENCING

Reference project drawings.

## **PART 2 - PRODUCTS**

### 2.1 COPPER BACKBONE CABLING

#### A. Indoor

##### 1. General

- a. Each conductor shall be a minimum of 22 or 24 AWG.
- b. Complies with
  - i. ANSI/TIA-568
  - ii. NEMA WC 63.1
  - iii. UL 444
- c. Solid conductor 100-ohm multi-pair UTP (Unshielded Twisted Pair), formed into 25 pair binder groups covered with a gray thermoplastic jacket.
- d. Imprinted with
  - i. Manufacturers name or identifier
  - ii. Flammability rating
  - iii. Gauge of conductor
  - iv. Transmission performance rating (category designation)
  - v. At regular intervals not to exceed 2 feet.
- e. Provide communications general purpose (CM or CMG), communications plenum (CMP) or communications riser (CMR) rated cabling in accordance with NFPA 70.
  - i. Type CMP and CMR may be substituted for type CM or CMG and type CMP may be substituted for type CMR in accordance with NFPA 70.
- f. Color coding shall comply with industry standards for 25 pair cables.

##### 2. Inside Distribution Wire, Horizontal

- a. Drawing Reference \*\* pr. T-IDW, where \*\* refers to required pair count.
- b. Construction:
  - i. 2 to 300 pair count voice pair cabling in overall jacket.
  - ii. Meets EIA/TIA Category 3



- iii. USOC color code
    - iv. NEC Type CM or CMG
  - c. Manufacturer
    - i. See Section 27 06 00 - Communications Product Schedule
- 3. Inside Distribution Wire, Riser
  - a. Drawing Reference \*\* pr. T-IDW-R, where \*\* refers to required pair count.
  - b. Construction:
    - i. 25 to 300 pair count voice pair cabling in overall jacket.
    - ii. PVC jacket
    - iii. USOC color code
    - iv. NEC Type CMR
    - v. Meets EIA/TIA Category 3
  - c. Manufacturer
    - i. See Section 27 06 00 - Communications Product Schedule
- 4. Inside Distribution Wire, Plenum
  - a. Drawing Reference \*\* pr. T-IDW-P, where \*\* refers to required pair count.
  - b. Construction:
    - i. 25 to 300 pair count voice pair cabling in overall jacket.
    - ii. Plenum rated jacket
    - iii. USOC color code
    - iv. NEC Type CMP
    - v. Meets EIA/TIA Category 3
  - c. Manufacturer
    - i. See Section 27 06 00 - Communications Product Schedule

## B. Outside Plant

- 1. Telephone, Outside Plant, Underground in Ductbank
  - a. Drawing Reference: T-OPD, with pair counts as indicated.
  - b. Features/Functions:
    - i. Solid round copper wire, individually bound per RUS/REA PE-39 color coded.
    - ii. Meets RUS/REA
    - iii. Solid aluminum tape overall shield
    - iv. Gel filled

- v. Polyethylene Overall Jacket
  - vi. Listed as approved for RUS/REA borrowers for his application
  - vii. Suitable for direct burial.
  - viii. 6 to 3000 Pair counts available.
- c. Manufacturer
    - i. See Section 27 06 00 - Communications Product Schedule
2. Shield Connectors:
- a. Shield connectors shall make a stable, low-impedance electrical connection between the shield of the communications cable and a conductor such as a strap, bar, or wire.
  - b. The connector shall be made of tin-plated tempered brass.
  - c. Shield bond connectors shall comply with RUS/REA PE-33.
3. Grounding Braid:
- a. Provide grounding braid that provides low electrical impedance connections for dependable shield bonding in accordance with RUS/REA 1755.200. Braid shall be made from flat tin-plated copper.

## 2.2 OUTSIDE PLANT TELEPHONE CABLING CLOSURES

### A. In Building Telephone Closure:

- 1. Drawing Reference: IBTC
- 2. Features and Functions:
  - a. Provides transition point from unlisted, gel-filled Outside Plant Cabling to Interior (T-IDW) cabling
  - b. Can house a straight, butt, and branch splice in a protective housing.
  - c. Not pressurized or encapsulated.
  - d. Fire-retardant Plastic construction, meeting PUB55006 for interior (inbuilding) installation.
  - e. Provide a suitable means for mounting to backboard.
  - f. End Caps
    - i. Multiple End caps shall be sized precisely to fit the diameter of the tip cables entering the closure.
    - ii. Number of openings in the multiple end caps shall be determined by dividing the number pairs in the feed cable by 100 and doubling that number. (ie. 1200 pair cable would have 24 openings for tip cables.
    - iii. Collared Cap opening can be up to 6.35mm (1/4") larger than the feed cable diameter.

- iv. Actual end cap to be provided shall be based on the diameter of the feed cable to be spliced.
    - g. Plugs
      - i. Use tapered or collared plugs as required to fill extra opening in end caps.
      - ii. Seal if inside diameter of hole is less than 6.35mm (.25").
    - h. Bushings
      - i. Use rubber or variable bushings as required to reduce standard opening in end caps to accommodate custom diameters.
      - ii. Seal if inside diameter of hole is less than 6.35mm (.25").
    - i. Lubricants
      - i. Lubricant shall evaporate and shall not damage closure elements in any way.
- 3. Approvals
  - a. RUS - Rural Utilities Service, USDA
- 4. Manufacturer:
  - a. See Section 27 06 00 - Communications Product Schedule

#### B. Outside Plant Telephone Closure, Vault

- 1. Drawing Reference: OTC, TOSC
- 2. Features/Functions
  - a. Stainless Steel outer jacket housing
  - b. Can house a straight, butt, and branch splice in a protective housing
  - c. Rigid outer protective body
  - d. Suitable for periodic water immersion - air and watertight
  - e. Renter able
  - f. Gel Filled, Injected encapsulant using precision means
  - g. Minimum inside diameter shall be 5" (127mm)
  - h. Minimum inside length shall be 26" (660mm)
- 3. Approvals
  - a. RUS - Rural Utilities Service, USDA
- 4. Manufacturer
  - a. See Section 27 06 00 - Communications Product Schedule

#### C. Multipair Splicing Connectors

1. Drawing Reference: None. Provide at all IBTC, TOSC, OTC and similar locations where shown on the plans or required in the field.
2. Function:
  - a. Can gas tight terminate large pair counts of copper cabling to connectorized ends and reliable mate ends in compact area.
  - b. Industry standard termination means
  - c. Provide in quantity equal to largest number of pairs found on either of the two cables being spliced.
3. Manufacturer
  - a. See Section 27 06 00 - Communications Product Schedule

## **2.3 FIBER OPTIC COMMUNICATIONS CABLING AND RELATED**

### **A. Indoor**

1. Fiber Optic Cable, Inside Distribution, Breakout Cable:
  - a. Drawing References:
    - i. XX FOS-IDW SingleMode, where XX indicates fiber count.
  - b. Refer to Section 27 10 00 – Structured Cabling, Basic Materials and Methods
  - c. Application: In-building Distribution. Breakout Cable Applications
  - d. Approvals: Where used outside conduit, OFN, OFNP, OFNR per NEC 770-51, as applies.
  - e. Construction:
    - i. Refer additionally to Fiber Cable Construction, General, elsewhere herein.
    - ii. Suitable and approved for indoor use.
    - iii. Tight buffer
    - iv. At least one ripcord to facilitate sheath removal.
    - v. Breakout style construction, with individual jacket per fiber with overall outside jacket.g.
    - vi. Performance:
      - (A) Maximum attenuation per EIA/TIA-455-61
      - (B) Singlemode
        - (1) 1300 nm: 1.0 dB/km
        - (2) 1500 nm: 1.0 dB/km
    - vii. Maximum required bend radius:
      - (A) At installation: 15x's diameter

- (B) Long term application: 10x's diameter
  - (C) Crush resistance: 250 lb/inch
  - (D) Impact Resistance: 3.6 ft-lbs, 10 impacts
  - (E) Flex, Twist/Bend 1000 cycles, 22 lbs, 10 x O.D. radius
- viii. Manufacturer, subject to above:
- (A) See Section 27 06 00 - Communications Product Schedule
2. Fiber Optic Cable, Riser:
- a. Drawing References:
    - i. XX FOS-R Singlemode, where XX indicates fiber count.
  - b. Refer to Section 27 10 00 – Structured Cabling, Basic Materials and Methods,
  - c. Application: Intra-building distribution in building risers and below building crawl space.
  - d. Listing: Meeting NEC OFNR, Listing by nationally recognized testing agency.
    - i. Construction:
      - (A) Refer additionally to Fiber Cable Construction, General, elsewhere herein.
      - (B) Jacket: Subject to listing and rating for vertical riser cable.
      - (C) Tight Buffer construction only, “Core Lock” not required.
      - (D) Otherwise as for FO\*-OP, except for construction affecting listing.
    - ii. Performance:
      - (A) Maximum attenuation per EIA/TIA-455-61
      - (B) Singlemode
        - (1) 1300 nm: 1.0 dB/km
        - (2) 1550 nm: 1.0 dB/km
    - iii. Manufacturer
      - (A) See Section 27 06 00 - Communications Product Schedule
3. Fiber Optic Cable, Plenum
- a. Drawing References:
    - i. XX FOS-P Singlemode, where XX indicates fiber count
  - b. Refer to Section 27 10 00 – Structured Cabling, Basic Materials and Methods
  - c. Application: Intra-building distribution in building plenum and duct space
  - d. Listing: Meeting NEC OFNP, Listing by nationally recognized testing agency.
  - e. Construction:

- i. Refer additionally to Fiber Cable Construction, General, elsewhere herein.
      - ii. Jacket: Subject to listing and rating for plenum cable.
      - iii. Tight Buffer construction only, “Core Lock” not required.
      - iv. Otherwise as for FO\*-OP, except for construction affecting listing.
    - f. Performance:
      - i. Maximum attenuation per EIA/TIA-455-61
      - ii. Singlemode
        - (A) 1300 nm: 1.0 dB/km
        - (B) 1550 nm: 1.0 dB/km
    - g. Manufacturer
      - i. Any meeting requirements of Fiber Optic Cable, Outside/Inside Plant, Riser, Constrained Diameter, specified elsewhere herein.
- 4. Fiber Optic Cable, Riser and Inside, Constrained Diameter
  - a. Drawing References:
    - i. XX FOS-OPR Singlemode, where XX indicates fiber count.
  - b. Fiber and Application:
    - i. Intra-building distribution in building risers, below building crawl space, and site conduit.
  - c. Refer to Section 27 10 00 – Structured Cabling, Basic Materials and Methods
  - d. Listing: UL OFNR. Meeting NEC OFNR
  - e. Performance:
    - i. Maximum attenuation per EIA/TIA-455-61
    - ii. Singlemode
      - (A) 1300 nm: 1.0 dB/km
      - (B) 1550 nm: 1.0 dB/km
  - f. Manufacturer
    - i. See Section 27 06 00 - Communications Product Schedule

## B. Outside Plant

- 1. Fiber Optic Cable
  - a. Drawing References:
    - i. XX FOS-OP Singlemode, where XX indicates fiber count.
  - b. Refer to Section 27 10 00 – Structured Cabling, Basic Materials and Methods

- c. Application: Inter-building site distribution in manholes and site conduit. Conform to NEC limits on placement within building envelope.
- d. Listing: NEC OFN, Listing by nationally recognized testing agency.
- e. Construction:
  - i. Suitable and approved for wet location/direct burial
- f. Provide Loose Tube Gel Filled Construction
  - i. Tubes: Up to 12 fibers per tube
  - ii. Kink resistant construction within bend radius specified
  - iii. Overall Construction
    - (A) Inorganic, non-hygroscopic binder fill provided to supplement and support uniform cable construction as required.
    - (B) Buffer tubes stranded around central support member using “SZ” process, left hand lay.
    - (C) Binders to be applied with sufficient tension to secure buffer tubes to the central member without crushing buffer tubes.
    - (D) High tensile strength dielectric yarns helically woven around cable core to provide tensile strength.
  - iv. Optical fibers surrounded by 250 µm primary polymer buffer and 900 µm strippable PVC secondary buffer.
  - v. Jacket:
    - (A) Polyethylene, polyurethane or PVC
    - (B) 0.040" minimum thickness
- g. Performance:
  - i. Singlemode
    - (A) 1300 nm: 0.4 dB/km
    - (B) 1383 nm: 0.4 dB/km
    - (C) 1550 nm: 0.3 dB/km
  - ii. Maximum required bend radius:
    - (A) At installation: 20x's diameter
    - (B) Long term application: 10x's diameter
  - iii. Zero water entry per FOTP-82, 24 hours immersion
  - iv. Maximum Tensile Loads
    - (A) Short-Term: 2700 N (600 lbf)
    - (B) Long-Term: 890 N (200 lbf)

- v. Temperatures
    - (A) Storage: -40° to +70°C (-40° to +158°F)
    - (B) Installation: -30° to +70°C (-22° to +158°F)
    - (C) Operation: -40° to +70°C (-40° to +158°F)
  - vi. Suitable for Outdoor lashed aerial and duct and direct-buried; indoor when installed according to California Electrical Code Article 770
  - h. Manufacturer
    - i. See Section 27 06 00 - Communications Product Schedule
2. Optical Fiber Splice Closure
- a. Drawing Reference: FOSC
    - i. Functions/Features:
      - (A) Stainless steel outer case construction
      - (B) Provide re-enterable underground or inside plant splice closure as shown on the Drawings.
      - (C) Plastic construction – no corrodible materials
      - (D) Waterproof, suitable for direct burial
      - (E) Fusion splice protection chamber
      - (F) Grommet cable entrance and exits.
    - ii. Manufacturers
      - (A) See Section 27 06 00 - Communications Product Schedule

## 2.4 MISCELLANEOUS UNDERGROUND PRODUCTS

### A. Pull Rope

1. At least 3/8 inch diameter polyethylene or 3/8" min width woven aramid fiber pulltape
2. 200-pound minimum strength

### B. Length Marked Tape

1. Provide 1/2 inch flat tape with sequential markings in whole feet constructed to be suitable for use as a pullrope.

### C. Conduit Plugs

1. Provide universal blank duct plug type, with eye for tying rope and tape.
2. Manufacturers
  - a. See Section 27 06 00 - Communications Product Schedule

### D. Cable Racks & Supports

1. Construction:



- a. Non-metallic
  - b. 12" minimum rack arms
  - c. Snap into vertical strut sections provided with new manhole, pullboxes and vaults, or into University's existing vaults, where indicated.
2. Approvals
    - a. RUS/REA
    - b. NEMA
  3. Manufacturers
    - a. See Section 27 06 00 - Communications Product Schedule

#### E. Bonding Ribbon:

1. Annealed solid copper 3/8-inch-wide x 1/16-inch-thick, tin plated
2. Manufacturer
  - a. See Section 27 06 00 - Communications Product Schedule

#### F. Bonding Ribbon Clamp:

1. Soft lead
2. 1/16 inch thick
3. Bolt hole for attachment
4. Manufacturer:
  - a. See Section 27 06 00 - Communications Product Schedule

#### G. Encapsulant

1. Encapsulates shall be transparent.
2. Encapsulant shall be on low viscosity to allow it to penetrate around connectors and wires.
3. Splice case and Encapsulant must be re-enterable; the Encapsulant must easily come off hands.
4. Must possess sufficient tack to adhere well to the splice components during expansion and contraction caused by temperature changes.
5. When new gel is poured it must bond thoroughly to existing gel in the closure.
6. Shall be compatible with the cable insulation.
7. Shall not be corrosive to copper and must not support fungi or mold growth.
8. Shall cure quickly. (20- 30 minutes)

#### H. De-Gel Stripper

1. Shall be non-toxic
2. Shall be compatible with the cable insulation

3. Shall not be corrosive to copper

## ***PART 3 - EXECUTION***

### **3.1 General**

#### **A. Inside**

1. Perform all backbone cable installation in conformance with manufacturer's installation specifications, instructions, and recommendations.
2. Verify that field measurements and cable routing and termination conditions are as shown on construction drawings conjoined with this specification. Provide notification, in writing, of conditions deviating from drawings.
3. Ensure that maximum pulling tensions of specified cables are not exceeded and cable bends maintain the proper radius during and after placement.
4. Install all backbone cables without splices unless specifically called for by the plans and specifications.
5. For ISP installations, pull new pull rope through all conduits while placing new backbone cable. Leave a pull rope in the utilized conduits for future use.
6. The Contractor shall be responsible for all damage to the cable during placement.
7. Do not roll or store cable reels without an appropriate underlay.
8. Terminate cables so as not to pull tight on terminating equipment.
9. Ensure that all splice closures are properly sealed for protection of the cable and splices.
10. Firestop all sleeves and ISP backbone conduit openings after the cable installation is complete.
11. Do not leave cable slack on cable runway.

#### **B. Outside Plant**

1. Provide safety barriers and flag persons for all open manholes and pullboxes that are located in areas accessible to the public.
2. Provide traffic control in accordance with the requirements of Division 1.
3. Conform to OSHA and UCSC EH&S (Environmental Health & Safety) guidelines when accessing manholes and handholes, inclusive of the requirement for air sampling. Provide continuous measurements. Provide the University Representative with contractor-maintained logs of air samples taken at most two hours apart.
  - a. Provision shall be made for adequate continuous supply of air. Note: the term "adequate" includes evaluation of both the quantity and quality of the air.
4. Provide sufficient personnel to permit one individual to remain above the surface at all times, in visual contact with persons in manholes and similar. Provide the observer with an appropriate means of obtaining assistance.

5. Provide ladders for access to manholes. Do not permit workers to use cables or splice cases as ladders.
6. Smoking in campus manholes is prohibited
7. Install a length marked tape (mule tape) with all new underground cables

#### C. Cables in Manholes, Pull Boxes, and Handholes

1. Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths.
2. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators.
3. In existing manholes and handholes where new ducts are to be terminated or where new cables are to be installed, locate the existing installation of cables, cable supports and grounding as required for a uniform installation with cables carefully arranged and supported.
4. Install cables at middle and bottom of cable racks, leaving top space opening or future cables, except as otherwise indicated for existing installations.
5. Support cable splices in underground structures by racks on each side of the splice. Backbone cables and splice cases installed in manholes or pull boxes shall be strapped to the cable racks using stainless steel ties.
6. Locate splices to prevent cyclic bending in the spliced sheath.
7. Copper Splicing Modules.
  - a. All multipair splicing modules shall be tap modules and have an integrated encapsulate for outside work and air tight for inside environments. (ISP and OSP).
  - b. The module shall create a gas tight connection.
8. All conduit that enters a building shall be plugged in the last vault or box prior to entering the building with watertight conduit caulking compound after cable installation is complete to ensure foreign matter does not enter the buildings.

#### D. Service Loop and Transition Splice at Building Entry

1. For outside plant, flooded cables of 100 pair or greater entering a Building Distribution Facility or Entrance Facility, provide a transition in a splice case, Type IBTC, to non-flooded cable prior to termination on the protector blocks. Unless otherwise indicated on the plans, position the splice case high on the backboard, parallel to the floor at location suitable for service and where gel will not be drawn from the serving outside plant cabling into the IBTC. Clamp all new backbone cables at the entrance facilities for strain relief.
2. At Telecommunications Rooms (including TR's and BDF/EF's), at both ends of cables, provide at least 20 feet of cable in excess of that required to reach the protectors or terminal block by a dressed route. Form into a storage loop, typically around the perimeter of the backboard and fix in place as directed by the University Representative.

3. At each Telecommunications Room, provide at least 15 feet of fiber in excess of that required to reach the patch panel by a dressed route. Form into a storage loop with an FMR and fix in place as directed by the University Representative.
4. Bonding Harnesses shall be used to ground the shields of the spliced cables to the TGB or building service ground. Bonding harness shall be 14 AWG and sized according to closure.
5. Refer to Section 27 13 00 - Communications Backbone Cabling for additional requirements for termination within Telecommunications Rooms.

### **3.2 COPPER BACKBONE TIE CABLE INSTALLATION AND TERMINATION**

#### **A. Indoor**

1. General:
  - a. Backbone cable(s) shall be installed in conduit system unless otherwise noted.
2. Sequencing:
  - a. If the installation of a tie cable requires the disconnection and removal of any existing cable(s) carrying active service prior to installation
    - i. Notify the University Representative no less than 14 working days in advance of when this work is to be performed.
  - b. When this work is performed, the newly installed cables must be installed, tested and passed in one 24 hour period beginning when the active service on the existing cable is interrupted.
3. Routing
  - a. Backbone cables are to be routed neatly on overhead cable runway to termination block locations. For cable management from cable runway to termination block and the dressing of cable at the blocks, follow manufacturer's specifications, instructions, and recommendations and standard industry practices.
  - b. At the termination end of multi-pair riser cables, the Contractor shall provide 15 feet (15') of managed service slack.
4. Termination
  - a. If removal of the cable jacket is required to facilitate routing of backbone cable into the blocks, the exposed cable pairs shall be fully covered with black or gray plastic tape, neatly lapped to prevent gaps.
    - i. Mount 110 termination fields per manufacturer's specifications, instructions, and recommendations. Use accompanying construction drawing set to determine mounting locations and configurations.
    - ii. 110 C5 blocks shall be used on each twenty-five (25) pair row of a 110 one-hundred (100) pair.
5. Installation of Tie Cable:

- a. All tie cable between terminal blocks at IDF rooms shall be continuous, unspliced runs.
- b. Termination of Voice or Shared Use Tie Cable:
  - i. Cable shall be terminated on the 110 Type punch blocks system using 4 connecting blocks in the following order.
    - (A) Terminate pairs and groups in order top to bottom and then left to right according to insulation or binder color as listed below.
- c. Cables containing pair counts of 50 or greater shall be terminated as follows:
  - i. Columns of punch blocks stacked 2 high shall be mounted on the backboard.
  - ii. Beginning at the top right of the 1st column, first the blue binder will be punched down, followed by the orange binder directly beneath it.
  - iii. Binder punch will continue top to bottom, and then left to right until the entire cable has been terminated.
  - iv. Thus a 50-pair cable requires two punch blocks.
  - v. Upon completing the termination of all cables within an IDF, install a clear plastic cover at each punch block.

#### B. Outside Plant

- 1. Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables.
- 2. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation.
- 3. Use flexible cable feeds to convey cables through manhole opening and into duct runs.
- 4. Accumulate cable slack at each manhole or junction box where space permits by training cable around the interior to form one complete loop.
- 5. Maintain minimum allowable bending radii in forming such loops.
- 6. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into outdoor pedestals or other enclosures.
- 7. Cable with tape shield shall have a bending radius not less than 12 times the overall diameter of the completed cable.
- 8. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.
- 9. OSP Copper Cabling Special Procedures
  - a. All open ends of the cable shall have sealing/pulling caps installed at the factory prior to shipping so that infiltration of moisture between shipment and installation is prevented.

- b. Contractor shall provide notice 2 days in advance notice prior to pulling any cable greater than 400 pairs in size or when a winch is planned for use.
- c. University Representative shall have the option to be present to observe all pulling activities of cable greater than 400 pair or when a winch is planned for use.
- d. Cable bend radius shall be at least 10 times the diameter of the cable.
- e. Contractor shall be responsible for verifying that ducts are ready for occupancy prior to cable placement.
- f. Contractor shall assume responsibility for any difficulties or damage to the cable during placement.
- g. Cable feeder guides shall be used between the cable reel and the face of the duct.
- h. Cable shall be watched and inspected for sheath defects, as it is payed off the reel. Pulling operation shall be stopped and University Representative shall be notified if a defect or any other irregularity is found.
- i. Cable shall be payed out from the top of the reel.
- j. Adhere to all manufacturers requirements regarding pulling tension allowable lubricants and bending radius.
- k. Use Line Tension meter and 600 lb pulling swivel during cable pulls to provide accurate measurement of the force exerted on a cable as it is installed. The meter shall have a visual indication of an overload condition.
- l. Secure all cables and splice cases as required with heavy duty tie-wraps to T-slot cable racking and steps.
- m. Cable shield shall be continuous from end to end.
- n. All un-terminated cable pair ends must be cleared (not shorted or crossed) and binder tagged.
- o. All open-ended cables must be watertight sealed using temporary end caps or encapsulation.

### 3.3 Fiber Optic Cabling Practice

#### A. Indoor

- 1. Splicing:
  - a. Interior: Provide splice-free cabling.
  - b. Exterior: Do not splice at exterior unless splicing is indicated on Plans. In such circumstances, provide fusion splices.
- 2. Termination Methods
  - a. Review proposed breakout procedure with the University Representative before beginning this work.

- b. Use full cable breakout method. Display both connectorized and non-connectorized fibers entering a patch panel.
- c. Remove sheath so that no more than 4 inches of unstripped cable enters the panel.
- d. Strip back a sufficient amount of cable so that fiber strands wrap at least one full wrap, circle or figure eight, inside the panel with the connectorized ends attached to the most distant bulkhead connectors.
- e. Group together the fibers from each binder group with 0.125 inch nylon spiral wrap. See Section 27 06 00 - Communications Product Schedule

#### B. Outside Plant

1. Obtain allowable pulling tension for underground fiber cable from the manufacturer. Use pulling equipment with tension gauges to verify that cable pulls do not exceed allowable pulling tension.
2. Loose Tube, Gel Filled Cabling - No flow of filling when tested in accordance with FOTP-81.
3. Loose Tube Breakout
  - a. Install breakout tubing over the full exposed length of the fiber strands.
  - b. Install buffer tubing on all strands, including those not being connectorized as part of this Contract.
  - c. Reinforce and protect the junction of the cable sheath and buffer tubing using a method approved by the University Representative before beginning this work.

### 3.4 ENTRANCE FACILITY LAYOUT

#### A. General:

1. Final backboard and cable runway design layout within the Communications Rooms shall be approved by the University Representative prior to work beginning.
2. Reference the design basis layout in the plans and bring to the University Representative's attention any field conditions that would prevent installation as shown on the plans. Submit for resolution in a timely manner.

#### B. Layout of cable around backboard:

1. All cables shall be formed around the backboard before either rising or dropping vertically to the punch blocks on which they are to be terminated.
2. All cables shall be organized in Wire Management Rings, Split D, Type WMRO. No tywraps or similar bindings are permitted.

#### C. For outside plant, flooded cables entering the Communications Room:

1. Transition in a splice case to non-flooded cable prior to termination on protector blocks for voice pairs, or on an unprotected 110 block for systems pairs, where such are indicated. Where systems pairs are not indicated, assume all pairs are for voice use.

2. Position the splice case on the backboard where accessible for future service. Orient parallel to floor to prevent continuous gel flow from OSP cabling. Place on cable tray only where such placement is indicated on the plans.

### **3.5 Labeling and Identification**

See 27 05 53

**END OF SECTION 27 13 00**



## 27 13 13 - Communications Copper Backbone Cabling

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation and termination of new UTP copper cabling as specified in this Section of the specifications and conjoined construction drawings.
- B. This section includes minimum requirements and installation methods for the following:
  - 1. Copper backbone cabling
  - 2. Copper splices
- C. All specifications and conjoined construction drawings issued for this project are applicable to this Division 27 and this Section. Those specification Sections that are particularly applicable to this Section include, but are not limited to the following:
  - 1. Section 27 00 00 - Communications
  - 2. Section 27 06 00 - Communications Product Schedule
  - 3. Section 27 05 26 - Grounding and Bonding for Communications Systems
  - 4. Section 27 05 29 - Hangers and Supports for Communications Systems
  - 5. Section 27 05 41 - Fire Stopping for Communications Systems
  - 6. Section 27 11 13 - Communications Entrance Protection
  - 7. Section 27 11 16 - Communications Cabinets, Racks, Frames, and Enclosures
  - 8. Section 27 11 19 - Communications Termination Blocks and Patch Panels
  - 9. Section 27 15 53 - Communications Cable Plant Testing

#### **1.2 QUALITY CONTROL**

Comply with Section 27 00 00 - Communications.

#### **1.3 WARRANTIES**

Comply with Section 27 00 00 - Communications.

#### **1.4 MATERIAL SUBSTITUTIONS**

Comply with Section 27 00 00 - Communications.

#### **1.5 SUBMITTALS**

Comply with Section 27 00 00 - Communications.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

Comply with Section 27 00 00 - Communications.

## ***PART 2 - PRODUCTS***

### **2.1 QUANTITY DETERMINATION**

Comply with Section 27 00 00 - Communications.

### **2.2 OUTSIDE PLANT (OSP) UTP COPPER BACKBONE CABLE**

Furnish all required CAT3, OSP rated, UTP cable - See Section 27 06 00 - Communications Product Schedule

### **2.3 INSIDE PLANT (ISP) UTP COPPER BACKBONE CABLE**

Furnish all required CAT3, ISP, plenum rated, UTP cable - See Section 27 06 00 - Communications Product Schedule

### **2.6 SPLICE CASES/ENCLOSURES**

- A. UTP Copper backbone: For both OSP and ISP facility environments, furnish all required hardware and kits for field splicing in splice closures and for sealing and mounting the closures.
- B. See Section 27 06 00 - Communications Product Schedule
- C. See construction drawings conjoined with this Division 27 specification for specific requirements.
- D. Splices are only allowed where specifically indicated by UCSC.

### **2.7 BACKBONE CABLE INSTALLATION MATERIALS, EQUIPMENT, AND TOOLS**

- A. Provide all required materials, equipment, and tools necessary to properly complete the backbone cabling system installation including, but not limited to, tools for pulling, splicing, and terminating the cables, mounting hardware, cable ties, bolts, anchors, clamps, hangers, kits of consumables, lubricants, communication devices, stands for cable reels, cable winches, etc.
- B. Furnish all required pulling 'mule' tape for OSP cable installation.
- C. Furnish all required polypropylene monofilament pull rope line. Polypropylene monofilament pull rope line supplied shall have a minimum pull tensile strength of two hundred (200) pounds.

## ***PART 3 - EXECUTION***

### **3.1 GENERAL**

- A. Comply with Section 27 00 00 - Communications.
- B. Perform all backbone cable installation in conformance with manufacturer's installation specifications, instructions, and recommendations.
- C. Verify that field measurements and cable routing and termination conditions are as shown on construction drawings conjoined with this specification. Provide notification, in writing, of conditions deviating from drawings.

### 3.2 INSTALLATION

- A. Ensure that maximum pulling tensions of specified cables are not exceeded and cable bends maintain the proper radius during and after placement.
- B. Install all backbone cables without splices unless specifically called for by the plans and specifications.
- C. For OSP installations, pull new pulling 'mule' tape through all conduits while placing new backbone cable. Leave a pulling 'mule' tape in the utilized conduits for future use.
- D. For ISP installations, pull new pull rope through all conduits while placing new backbone cable. Leave a pull rope in the utilized conduits for future use.
- E. The Contractor shall be responsible for all damage to the cable during placement.
- F. Do not roll or store cable reels without an appropriate underlay.
- G. Clamp all new backbone cables at the entrance facilities for strain relief.
- H. Backbone cables and splice cases installed in manholes or pull boxes shall be strapped to the cable racks using stainless steel ties.
- I. Terminate cables so as not to pull tight on terminating equipment.
- J. Ensure that all splice closures are properly sealed for protection of the cable and splices.
- K. Plug ends of conduit entering buildings with Q-Pak System after cable installation is complete to ensure foreign matter does not enter the buildings.
- L. Firestop all sleeves and ISP backbone conduit openings after the cable installation is complete.
- M. Do not leave cable slack on cable runway.

### 3.3 OSP SAFETY

- A. Guard maintenance hole and pull box openings with appropriate work area protection and personnel.
- B. Test for gas in maintenance holes and vaults.
- C. Provision shall be made for adequate continuous supply of air. Note: The term "adequate" includes evaluation of both the quantity and quality of the air.
- D. Employees shall not smoke in or around maintenance holes or vaults.
- E. Obtain and follow all UCSC EH&S (Environmental Health & Safety) and Confined Space regulations.

### 3.4 TERMINATION

Comply with Section 27 11 19 - Termination Blocks & Patch Panels.

### 3.5 EXAMINATION

Comply with Section 27.00 00 – Communications.

**3.6 LABELING**

- A. Reference plans and specifications.
- B. Refer to Section 27 05 53

**3.7 TESTING**

Comply with Section 27 15 53 - Cable Plant Testing

**3.8 AS BUILT DRAWINGS**

Comply with Section 27 15 53 - Cable Plant Testing

**3.9 VERIFICATION**

Comply with Section 27.00 00 – Communications

**3.10 ADJUSTMENTS**

Comply with Section 27.00 00 – Communications

**3.11 ACCEPTANCE**

Comply with Section 27.00 00 – Communications

**END OF SECTION 27 13 13**

## 27 13 23 - Communications Optical Fiber Backbone Cabling

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation and termination of new fiber backbone cabling as specified in this Section of the specifications and conjoined construction drawings.
- B. This section includes minimum requirements and installation methods for the following:
  - 1. Optical fiber backbone cabling
  - 2. Optical fiber splices.
- C. All specifications and conjoined construction drawings issued for this project are applicable to this Division 27 and this Section. Those specification Sections that are particularly applicable to this Section include, but are not limited the following:
  - 1. Section 27 00 00 - Communications
  - 2. Section 27 06 00 - Communications Product Schedule
  - 3. Section 27 05 26 - Grounding and Bonding for Communications Systems
  - 4. Section 27 05 29 - Hangers and Supports for Communications Systems
  - 5. Section 27 05 41 - Fire Stopping for Communications Systems
  - 6. Section 27 11 13 - Communications Entrance Protection
  - 7. Section 27 11 16 - Communications Cabinets, Racks, Frames, and Enclosures
  - 8. Section 27 11 19 - Communications Termination Blocks and Patch Panels
  - 9. Section 27 15 53 - Communications Cable Plant Testing

#### **1.2 QUALITY CONTROL**

Comply with Section 27 00 00 - Communications.

#### **1.3 WARRANTIES**

Comply with Section 27 00 00 - Communications.

#### **1.4 MATERIAL SUBSTITUTIONS**

Comply with Division 01.

#### **1.5 SUBMITTALS**

Comply with Section 27 00 00 - Communications.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

Comply with Section 27 00 00 - Communications.

## ***PART 2 - PRODUCTS***

### **2.1 QUANTITY DETERMINATION**

Comply with Section 27 00 00 - Communications.

### **2.2 OUTSIDE PLANT (OSP) FIBER BACKBONE CABLE**

- A. Furnish all required single mode fiber (SMF) OS1, Steel Armored, OSP rated cable
  - 1. See Section 27 06 00 - Communications Product Schedule
- B. Furnish all required inner duct as noted on the drawings.

### **2.3 INSIDE PLANT (ISP) FIBER BACKBONE CABLE**

- A. Furnish all required single-mode OS1, plenum rated fiber cable.
- B. Furnish all required inner duct as noted on the drawings.
- C. See Section 27 06 00 - Communications Product Schedule

### **2.4 SPLICE CASES/ENCLOSURES**

- A. Fiber backbone: For both OSP and ISP facility environments, furnish all required hardware and kits for field fusion splicing in splice closures and for sealing and mounting the closures.
- B. See Section 27 06 00 - Communications Product Schedule
- C. See construction drawings conjoined with this Division 27 specification for specific requirements.
- D. Splices are only allowed where specifically indicated by UCSC.

### **2.5 BACKBONE CABLE INSTALLATION MATERIALS, EQUIPMENT, AND TOOLS**

- A. Provide all required materials, equipment, and tools necessary to properly complete the backbone cabling system installation including, but not limited to, tools for pulling, splicing, and terminating the cables, mounting hardware, cable ties, bolts, anchors, clamps, hangers, kits of consumables, lubricants, communication devices, stands for cable reels, cable wenchers, etc.
- B. Furnish all required pulling 'mule' tape for OSP cable installation.
- C. Furnish all required polypropylene monofilament pull rope line. Polypropylene monofilament pull rope line supplied shall have a minimum pull tensile strength of two hundred (200) pounds.

## ***PART 3 - EXECUTION***

### **3.1 GENERAL**

- A. Comply with Section 27 00 00 – Communications.
- B. Perform all backbone cable installation in conformance with manufacturer's installation specifications, instructions, and recommendations.

- C. Verify that field measurements and cable routing and termination conditions are as shown on construction drawings conjoined with this specification. Provide notification, in writing, of conditions deviating from drawings.

### **3.2 INSTALLATION**

- A. Ensure that maximum pulling tensions of specified cables are not exceeded and cable bends maintain the proper radius during and after placement.
- B. Install all backbone cables without splices unless specifically called for by the plans and specifications.
- C. For OSP installations, pull new pulling 'mule' tape through all conduits while placing new backbone cable. Leave a pulling 'mule' tape in the utilized conduits for future use.
- D. For ISP installations, pull new pull rope through all conduits while placing new backbone cable. Leave a pull rope in the utilized conduits for future use.
- E. The Contractor shall be responsible for all damage to the cable during placement.
- F. Do not roll or store cable reels without an appropriate underlay.
- G. Clamp all new backbone cables at the entrance facilities for strain relief.
- H. Backbone cables and splice cases installed in manholes or pull boxes shall be strapped to the cable racks using stainless steel ties.
- I. Terminate cables so as not to pull tight on terminating equipment.
- J. Ensure that all splice closures are properly sealed for protection of the cable and splices.
- K. Plug ends of conduit entering buildings with watertight conduit caulking compound after cable installation is complete to ensure foreign matter does not enter the buildings.
- L. Firestop all sleeves and ISP backbone conduit openings after the cable installation is complete.
- M. Fiber splicing: Use only core-alignment fusion splicing to splice fiber backbone cable. No other splicing methodology shall be allowed.
- N. Place "Caution Fiber" tags at all coils and every 50 feet along any exposed cable route.
- O. Do not leave cable slack on cable runway.

### **3.3 OSP SAFETY**

- A. Guard maintenance hole and pull box openings.
- B. Test for gas in maintenance holes and unventilated vaults.
- C. Provision shall be made for adequate continuous supply of air. Note: the term "adequate" includes evaluation of both the quantity and quality of the air.
- D. Employees shall not smoke in maintenance holes or vaults.
- E. Obtain and follow all UCSC EH&S (Environmental Health & Safety) and Confined Space regulations.

### **3.4 TERMINATION**

Comply with Section 27 11 19 - Termination Blocks & Patch Panels.

### **3.5 EXAMINATION**

Comply with Section 27 00 00 – Communications.

### **3.6 LABELING**

A. Reference plans and specifications.

1. Refer to 27 05 53 – Identification and Labeling for Communication Systems

### **3.7 TESTING**

Comply with Section 27 15 53 - Cable Plant Testing.

### **3.8 AS BUILT DRAWINGS**

Comply with Section 27 15 53 - Cable Plant Testing.

### **3.9 VERIFICATION**

Comply with Section 27 00 00 – Communications.

### **3.10 ADJUSTMENTS**

Comply with Section 27 00 00 – Communications.

### **3.11 ACCEPTANCE**

Comply with Section 27 00 00 – Communications.

**END OF SECTION 27 13 23**



## 27 15 00 - Communications Horizontal Cabling

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. The horizontal link portion of the cabling system specified in this section extends from the jack termination of the cable at the Work Area Outlet (WAO) faceplate to its patch panel jack termination in its assigned IDF (TR). It also applies to the voice cross-connect system described below.
- B. Section includes, but is not necessarily limited to provision of:
1. Horizontal Station Cabling Horizontal copper station cabling, meeting EIA/TIA Category 6 standards, homerun from receptacles to indicated IDF/TR or BDF. Terminated on rack mounted patch panels, as indicated.
  2. For all cabling:
    - a. Terminate on patch panels as specified in Section 27 11 19.
    - b. Test cabling to demonstrate performance to specified standards or better using test equipment and methods as specified in Section 27 10 00.
    - c. Label cables, jacks, plates and patch panels as specified in Section 27 05 53.
    - d. Document on Record Documents as described in Section 27 05 00.
- C. Related Documents:
1. Specification Section 27 05 00 – Common Work Results for Communications applies to this Section.
- D. Related Work in Other Sections:
1. Section 27 05 29 – Hangers and Supports for Communications Systems J-hooks and hangers for the work of this Section
  2. Section 27 05 33 – Conduits and Backboxes for Communications Systems
  3. Section 27 05 36 – Cable Trays for Communications Systems
  4. Section 27 05 39 – Surface Raceways for Communications
  5. Section 27 05 53 – Identification for Communications Systems Labeling systems and execution for the work of this Section.
  6. Section 27 11 19 – Communications Termination Blocks and Patch Panels Specification for patch panels and blocks used by work of this Section
  7. Section 27 11 23 – Communications Cable Management Specification for innerduct, backboard and patch cord management used by the work of this Section.

#### **1.2 REFERENCES**

As listed in Section 27 10 00.

### 1.3 SUBMITTALS

Conform with the requirements of Division 1 and Section 27 05 00 - Common Work Results for Communications.

### 1.4 DELIVERY, STORAGE AND HANDLING

Procedures: In accordance with Division 1 and Section 27 10 00 – Structured Cabling, Basic Materials and Methods.

### 1.5 SEQUENCING

- A. Coordinate the installation of the horizontal cabling with the other work of this Project, or Projects simultaneously in progress in each building of the project. The Contractor shall ensure that construction and preparation of the rooms and spaces in which the work of this Section are to be installed are sufficiently complete before beginning work.
- B. Removal, replacement and re-installation of communications materials and equipment required to permit the completion or correction of other building trade work that is the work of this Project shall be done at no cost to the University or impact to the project schedule.

## **PART 2 - PRODUCTS**

### 2.1 COPPER STRUCTURED CABLING SYSTEMS

#### A. General

1. Provide horizontal cable in compliance with NFPA 70 and performance characteristics in accordance with TIA/EIA-568
2. UCSC has established an installed product set for the campus IT systems. It is the intention of UCSC ITS to continue the use of the established product set to match existing. The first-named product in these specifications is the basis for the design. Substitutions which are equal in quality, utility, and appearance to those specified must be submitted and meet all requirements of Division 01 specification section 01 25 00 Substitution Procedures.

#### B. Definitions

1. Keystone Opening: A communications industry standard rectangular opening in a wall plate or patch panel having nominal dimensions of 0.58" wide and .76" high and designed to securely mount industry standard keystone jacks.
2. Keystone Jacks: A keystone module is a standardized snap-in package for mounting a variety of low-voltage electrical jacks or optical connectors into a keystone wall plate.

#### C. Inter-vendor compatibility

1. Keystone Jack Compatibility test
  - a. Any jack or panel system proposed as meeting the keystone compatibility requirements of this specification shall be able to interchangeably mount or mount in (as applies) Leviton Quickport series components.

- b. Systems exhibiting excess play, inability to insert, inability to remove, damage to the plate or jack or occupying excessive area behind the plate opening will not be accepted.

## 2.2 COPPER CABLING, CATEGORY RATED DATA/VOICE

### A. General

1. Provide horizontal cable in compliance with NFPA 70 and performance characteristics in accordance with ANSI/TIA-568

## 2.3 COPPER CABLING, CATEGORY RATED DATA/VOICE

### A. High Speed, EIA/TIA Category Cabling

1. Drawing Reference:
  - a. \*\* UTP6-4, where \*\* denotes cable count
2. Construction:
  - a. Provide horizontal copper cable in accordance with:
    - i. ANSI/TIA-568
    - ii. UL 444
    - iii. NEMA WC 66 (Performance Standard for Category 6 and Category 7 100 Ohm Shielded and Unshielded Twisted Pair)
    - iv. ICEA S-90-661
  - b. UTP (unshielded twisted pair)
  - c. 100 ohm impedance
  - d. No shield in the sheath
  - e. Jacket
    - i. Color: Blue unless otherwise indicated
  - f. Provide communications general purpose (CM or CMG), communications plenum (CMP) or communications riser (CMR) rated cabling in accordance with NFPA 70.
  - g. Type CMP and CMR may be substituted for type CM or CMG and type CMP may be substituted for type CMR in accordance with NFPA 70. 3.
3. Certification
  - a. Warranted by the manufacturer to provide Category 6 performance when installed in accordance with applicable EIA/TIA standards and when terminated with the jacks supplied by the Contractor for this Project
4. Performance
  - a. Assembly electrically meets or exceeds ANSI/TIA 568 Category 6 performance standards

5. Manufacturers

- a. See Section 27 06 00 - Communications Product Schedule

B. High Speed, Category 6 Cabling

1. Drawing Reference:

- a. \*\* UTP6-4P, where \*\* denotes cable count

2. Construction:

- a. As for non-plenum, with fire retardant overall jacket construction.
- b. National Safety Agency – UL or ETL listed, NEC compliant for plenum installation.

3. Manufacturers

- a. As for non-plenum Cat. 6, plenum construction

## 2.4 WORK AREA OUTLETS

A. Data Jacks Performance Requirements, General

1. Jack

a. Construction:

- i. Industry standard keystone construction

b. Performance - The jack shall meet or exceed the following standards.

- i. TIA/EIA 568C.1

- ii. UL listed

- iii. Physical - The modular jacks shall meet the following physical requirements.

(A) Connector-insulation displacement connectors accepting 23 and 24 gauge AWG solid conductor wire

(B) Wired to meet EIA 568C.1 and T568B Color Code

- iv. Color

(A) Jacks: Blue

(B) Blank jack cover: To match plate

(C) "C6" or equivalent molded on face of jack

- v. Mechanical - The modular jacks shall meet the following mechanical requirements

(A) Plug insertion - minimum 750 plug insertions

(B) Blank connector modules

(1) Snaps into faceplate to fill blank openings

- (2) Matches plate color
    - (3) Mounts flush with plate
  - c. Manufacturers – Jacks, subject to keystone interchangeability requirement
    - i. See Section 27 06 00 - Communications Product Schedule
  - d. Manufacturers - Blank Module
    - i. See Section 27 06 00 - Communications Product Schedule
- B. Telecommunications Outlets, Copper Jacks, Wall Mount, Flush
  - 1. Drawing Reference(s):
    - a. MMP4
    - b. MMP6
  - 2. Assembly. Provide complete telecommunications outlet assembly, including but not limited to:
    - a. Faceplate with industry standard keystone openings
    - b. Blank connector modules at faceplate openings not filled with connector modules.
  - 3. Faceplate
    - a. Features:
      - i. Single gang
      - ii. Front Loading
      - iii. Openings to match cable count specified for the location
    - b. Color: To match electrical receptacles and switch plates mounted on same wall
  - 4. Manufacturers
    - a. See Section 27 06 00 - Communications Product Schedule
- C. Voice Telephone, Station Plates & Jack/Receptacles
  - 1. Drawing References:
    - a. Wall Mounted Telephone, Flush: Type 630A
  - 2. Station jacks shall be modular four or 8 wire type and conform to FCC Part 68.
  - 3. Construction, where not otherwise specified, scheduled or indicated:
    - a. Stainless Steel or High Strength 94VO plastic
    - b. Mounts to Single Gang Ring, Single Gang Box or Surface Mounted to Wall or to opening in Surface Raceway - Refer to Schedule on Plans.
    - c. Single Gang Wall Plate with two integral wall telephone mounting studs
    - d. Insulation displacement (punchdown) termination
  - 4. Manufacturers, Flush Wall Mounted Wall Telephone

- a. See Section 27 06 00 - Communications Product Schedule

#### D. Modular Furniture Receptacle Plates

1. Drawing Reference: OMP
2. Construction:
  - a. Use manufacturer recommended faceplate for furniture system
3. Manufacturers
  - a. See Section 27 06 00 - Communications Product Schedule

#### E. Surface Mount Box

1. Drawing Reference(s):
  - a. \* MMSB, where \* represents the number of Category connectors of the type specified elsewhere herein.
  - b. Biscuit Box
2. Features Functions
  - a. Surface mount enclosure holds terminated station cabling with Category connectors parallel to face of mounting surface
  - b. Mechanically fastened to enclosure surface
  - c. 2-part assembly includes fixed mounting base plate and removable cover over terminations
3. Manufacturers
  - a. See Section 27 06 00 - Communications Product Schedule

## ***PART 3 - EXECUTION***

### **3.1 SIGNAL POLARITY AND COLOR CODE CONVENTION**

Category 6 Station Wire, RJ45 - Per EIA/TIA-568, designation T568B

### **3.2 STATION CABLE INSTALLATION AND TERMINATION PROCEDURES**

#### A. General:

1. All cable runs shall be installed per manufacturer's installation instructions.
2. Cable installation is "home-run" between the jack termination of the cable at the faceplate to the patch panel jack termination in its assigned IDF (TR).
  - a. Each cable shall be installed without any splices.
    - i. Each cable shall be installed without intermediate termination points unless approved by the University Representative.

#### B. Run Lengths:

1. Station, Horizontal and IDF Links, Copper:

- a. The total length of any horizontal station cable from jack termination of the cable at the WAO faceplate to the patch panel jack termination in its assigned IDF (TR) shall not exceed ninety meters (90m) - two hundred ninety-five feet (295') - unless approved by the University Representative.

### 3.3 CEILING TILE

- A. Ceiling tile shall be removed as necessary for the cable installation and put back in place without damaging or soiling any of the tiles or supporting framework.
- B. Ceiling tile shall be handled so no fingerprints or marks are left on the tiles, and the tiles are not damaged in any way.
- C. The Contractor is responsible for the cost of repair or replacement of any tile or ceiling tile support/framework hardware that is damaged or soiled by the Contractor.

### 3.4 WAO HORIZONTAL CABLE PLACEMENT

- A. No cable shall run unsupported by conduit, cable tray, hangers, or other specified support for distances greater than five feet (5').
- B. No cable shall be attached to the suspended ceiling structure or laid directly on the ceiling tiles or hard lid as a means of support, and the bottom of a cable or cable bundle shall be minimum of six inches (6") above the ceiling tile grid.
- C. No cable or cable bundle shall be supported by or attached by any means to fire sprinkler heads, delivery system hardware, environmental sensor system hardware, or the exterior of any conduit, ladder rack, or cable tray. Cable shall be supported by systems specifically installed for cable support.
- D. Where cable being installed is not enclosed in conduit or cable tray, cross all electrical power circuit transport at right angles.
- E. Where discontinuity of cable trays or conduit pathway occurs that causes cable or cable bundle to sag vertically three inches (3") or more, support the cable or cable bundle over the discontinuity using hangers, brackets, hooks, rings, and other applicable supporting devices specified in Section 27 05 29 - Hangers and Supports for Communications Systems.
- F. During placement of cable runs, do not exceed manufacturer's maximum pulling tension or minimum bend radius limits.
- G. Do not bundle cables in cable trays.
- H. Do bundle two (2) or more cables with plenum-rated Velcro ties that are snug but which do not deform the cable geometry as follows:
  1. Whenever cables in cable trays leave the cable tray and enter/exit distribution conduit.
  2. Wherever cables enter a TR. Maintain bundling within the TR.
- I. Manage slack to avoid excess cable or kinking.
- J. Pull new pulling string through all conduits while placing new horizontal cable. Leave a pulling string in the utilized conduits for future use.
- K. Do not roll or store cable reels without an appropriate underlay.

- L. Cables with jackets that are chaffed, burned, have exposed internal conductor insulation, or have any bare copper (shiners) shall be replaced.
- M. After cable installation is complete, tested, and, if necessary, repairs made, install all required fire stopping. The University Representative or his/her designate will not accept the installation as completed until all required fire stopping has been installed and accepted as complete. See Section 27 05 33 – Conduits and Backboxes For Communications Systems.
- N. Any horizontal cable installed, then removed for any reason, shall not be reused.

### 3.5 VOICE CROSS-CONNECT CABLE PLACEMENT

This cabling system connects 48-port patch panel(s) in each rack to 110 blocks installed adjacent to the voice backbone or riser cable 110 terminations in each TR.

### 3.6 TERMINATION

- A. Comply with Section 27 11 19 - Communications Termination Blocks & Patch Panels and the following:
  - 1. Termination of wiring at the station outlet:
    - a. All data and voice station cable shall be terminated at the individual receptacle modules in accordance with the latest EIA/TIA-568 standard.
    - b. Termination shall not untwist more than 1/2 inch of cable maximum from the manufactured condition.
  - 2. Service loop at WAO - Provide slack, which is to be no less 5.0", in the station cable at the station outlet end. This is to allow the Work Area Outlet to be removed from the outlet box and visually inspected without leaving so much wire in the box that it might become accidentally damaged during installation.
  - 3. Termination of wiring at existing station outlets:
    - a. Install jack insert in place of existing blank insert in existing faceplate.
    - b. Install new labels
  - 4. Termination of copper station wiring at the Telecommunications Room
    - a. For the installation/layout of station cable within the Communications Rooms, see detail on drawings.
    - b. Install one (1) 48-port patch panel for every 48 WAO cables.
    - c. Mount patch panels per the construction drawing set accompanying this Division 27 specification.
    - d. Each patch panel shall have a 2RU horizontal manager (WMP) placed both above and below the panel.
  - 5. Horizontal cables are to be routed neatly on overhead cable runway to equipment racks; exit cable runway into equipment rack vertical cable management and proceed to the patch panels.
  - 6. Cable termination.



- a. Cables on the left side of the patch panel shall enter from the left side vertical cable manager. Cables on the right side of the patch panel shall enter from the right side vertical cable manager. Cables shall not cross the centerline of the patch panel.
  - b. Terminate cables using the 8-pin jack, T568-B four (4) pair termination standard and comply with manufacturer's termination practices, specifications, instructions, and recommendations.
- B. Voice cross-connect system termination
1. 110 cable end termination.
    - a. Mount 110 termination fields per manufacturer's specifications, instructions, and recommendations. Use accompanying construction drawing set to determine mounting locations and configurations.
    - b. 110 C5 blocks shall be used.
  2. Patch panel end terminations.
    - a. Mount patch panels per the construction drawings Each patch panel shall have a 2RU horizontal manager placed both above and below the panel.
  3. Terminate cables using the 8-pin jack, T568B four (4) pair termination standard and comply with manufacturer's termination practices, specifications, instructions, and recommendations.

### **3.7 LABELING**

See section 27 05 53 Identification and Labeling for Communications Systems

### **3.8 TESTING, VERIFICATION, ADJUSTMENTS AND ACCEPTANCE**

Comply with Section 27 10 00 - Structured Cabling, Basic Materials & Methods

### **3.9 AS-BUILT DRAWINGS**

Comply with Section 27 05 00 – Common Work Results for Communications

**END OF SECTION 27 15 00**

## **27 15 43 - Communications Faceplates and Connectors**

### ***PART 1 - GENERAL***

#### **1.1 SUMMARY**

- A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of new faceplates and proper termination of new connectors specified in this section of the Division 27 specifications and accompanying construction drawings.
- B. The specification sections of this Division 27 that are particularly applicable to this section include, but are not limited to, the following:
  - 1. Section 27 00 00 – Communications
  - 2. Section 27 06 00 - Communications Product Schedule
  - 3. Section 27 05 33 - Conduits and Backboxes for Communications Systems
  - 4. Section 27 11 19 - Communications Termination Blocks and Patch Panels
  - 5. Section 27 15 00 - Communications Horizontal Cabling
  - 6. Section 27 15 53 - Cable Plant Testing

#### **1.2 QUALITY CONTROL**

Comply with Section 27 00 00 - Communications.

#### **1.3 WARRANTIES**

Comply with Section 27 00 00 - Communications.

#### **1.4 MATERIAL SUBSTITUTIONS**

Comply with Section 27 00 00 - Communications.

#### **1.5 SUBMITTALS**

Comply with Section 27 00 00 - Communications.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

Comply with Section 27 00 00 – Communications.

### ***PART 2 - PRODUCTS***

#### **2.1 QUANTITY DETERMINATION**

Comply with Section 27 00 00 - Communications.

#### **2.2 FACEPLATES**

Furnish all required faceplates - See Section 27 06 00 - Communications Product Schedule

## **2.3 CONNECTORS**

Furnish all required UTP CAT 6 modular jacks - See Section 27 06 00 - Communications Product Schedule

## ***PART 3 - EXECUTION***

### **3.1 GENERAL**

For all cable types, connector installation execution shall comply with connector manufacturer's installation specifications, instructions, and recommendations.

### **3.2 EXAMINATION**

Comply with Section 27.00 00 – Communications.

### **3.3 FACEPLATE LABELING**

See Section 27 05 53 Identification for Communication Systems

### **3.4 TESTING**

Comply with Section 27 15 53 - Communications Cable Plant Testing.

### **3.5 AS-BUILT DRAWINGS**

Comply with Section 27 15 53 - Communications Cable Plant Testing.

### **3.6 VERIFICATION**

Comply with Section 27.00 00 – Communications.

### **3.7 ADJUSTMENTS**

Comply with Section 27.00 00 – Communications.

**END OF SECTION 27 15 43**

## 27 15 53 - Communications Fiber Cable Plant Testing

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Provide all labor, materials, tools, field-test instruments and equipment required for the complete testing, identification and administration of the work called for in the Contract Documents.
- B. In order to conform to the overall project event schedule, the cabling contractor shall survey the work areas and coordinate cabling testing with other applicable trades.
- C. In addition to the tests detailed in this document, the contractor shall notify the PP&C Project Manager or his/her designate of any additional tests that are deemed necessary to guarantee a fully functional system. The contractor shall carry out and record any additional measurement results at no additional charge.
- D. All specifications and conjoined construction drawings issued as part of the construction documentation for this project are applicable to this Division 27 and this section. Those specifications that are particularly applicable to this section include, but are not limited to, the following:
  - 1. Division 26 – Electrical
  - 2. Section 27 00 00 – Communications
  - 3. Section 27 06 00 - Communications Product Schedule
  - 4. Section 27 05 29 - Hangers and Supports for Communications Systems
  - 5. Section 27 05 41 - Fire Stopping for Communications Systems
  - 6. Section 27 05 53 - Identification and Labeling for Communications Systems
  - 7. Section 27 11 19 - Communications Termination Blocks and Patch Panels
  - 8. Section 27 15 43 - Communications Faceplates and Connectors

#### **1.2 Scope**

- A. This Section includes the minimum requirements for the test certification, identification and administration of backbone and horizontal optical fiber cabling.
- B. This Section includes minimum requirements for:
  - 1. Fiber optic test instruments
  - 2. Fiber optic testing
  - 3. Identification
  - 4. Labels and labeling
  - 5. Administration
  - 6. Test results documentation
  - 7. As-built drawings

- C. Testing shall be carried out in accordance with this document. This includes testing the attenuation and polarity of the installed cable plant with a certifying optical loss test set (OLTS) and the testing of fiber splices, except for pigtail splicing, with an optical time domain reflectometer (OTDR).
- D. Testing shall be performed on each cabling link (connector to connector).
- E. All tests shall be documented including OLTS dual wavelength attenuation measurements for singlemode links and OTDR traces and event tables for singlemode links.
  - 1. Documentation shall include optical length measurements.

### 1.3 Quality Control

- A. All testing procedures and field-test instruments shall comply with applicable requirements of:
  - 1. ANSI Z136.2, ANS For Safe Use of Optical Fiber Communication Systems Utilizing Laser Diode And LED Sources
  - 2. ANSI/TIA-455
  - 3. ANSI/TIA-526
  - 4. ANSI/TIA-568
  - 5. ANSI/TIA-606 - including the requirements specified by the customer, unless the customer specifies their own labeling requirements.
- B. Trained technicians who have successfully attended an appropriate training program, which includes testing with an OLTS and an OTDR and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
  - 1. Manufacturer of the fiber optic cable and/or the fiber optic connectors.
  - 2. Manufacturer of the test equipment used for the field certification.
  - 3. Training organizations (e.g., BICSI, A Telecommunications Association headquarters in Tampa, Florida; ACP [Association of Cabling Professionals™] Cabling Business Institute located in Dallas, Texas)
- C. The PP&C Project Manager or his/her designate shall be invited to witness and/or review field-testing.
  - 1. The PP&C Project Manager or his/her designate shall be notified of the start date of the testing phase five (5) business days before testing commences.
  - 2. The PP&C Project Manager or his/her designate will select a random sample of 5% of the installed links. The PP&C Project Manager or his/her designate shall test these randomly selected links and the results are to be stored in accordance with Part 3 of this document. The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor shall repeat 100% testing at no cost to UCSC. Comply with Section 27 00 00 - Communications.

## 1.4 MATERIAL SUBSTITUTIONS

Comply with Section 27 00 00 - Communications.

## 1.5 SUBMITTALS

- A. Manufacturer's catalog sheets and specifications for fiber optic field-test instruments including Certifying optical loss test sets (OLTS; power meter and source) and optical time domain reflectometer (OTDR).
- B. A schedule (list) of all optical fibers to be tested.
- C. Sample test reports
- D. Comply with Section 27 00 00 - Communications

## 1.6 ACCEPTANCE OF TEST RESULTS

A. Each cabling link shall be in compliance with the following test limits:

1. Optical loss testing
  - a. Singlemode link attenuation shall be calculated by the following formulas as specified in ANSI/TIA-568.
    - i.  $\text{Link Attenuation (dB)} = \text{Cable\_Attn (dB)} + \text{Connector\_Attn (dB)} + \text{Splice\_Attn (dB)}$
    - ii.  $\text{Cable\_Attn (dB)} = \text{Attenuation\_Coefficient (dB/km)} * \text{Length (Km)}$
    - iii.  $\text{Connector\_Attn (dB)} = \text{number\_of\_connector\_pairs} * \text{connector\_loss (dB)}$
    - iv. Maximum allowable connector\_loss = 0.4 dB
    - v.  $\text{Splice\_Attn (dB)} = \text{number\_of\_splices} * \text{splice\_loss (dB)}$
    - vi. Maximum allowable splice\_loss = 0.05 dB

b. The values for the Attenuation\_Coefficient (dB/km) are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation coefficient (dB/km)	Wavelength (nm)	Attenuation coefficient (dB/km)
Single-mode (Inside plant)	1310	1.0	1550	1.0
Single-mode (Outside plant)	1310	0.5	1550	0.5

- c. OTDR testing not required if fiber passes required optical loss testing.
  - i. Reflective events (connections) shall not exceed 0.4 dB.
  - ii. Non-reflective events (splices) shall not exceed 0.05 dB.

B. All installed cabling links shall be field-tested and pass the test requirements and analysis as described in Part 3. Any link that fails these requirements shall be diagnosed and corrected. Any corrective action that must take place shall be documented and followed with a new test to prove

that the corrected link meets performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with Part 3.

- C. Acceptance of the test results shall be given in writing after the project is fully completed and tested in accordance with Contract Documents and to the satisfaction of UCSC.

## **PART 2 - PRODUCTS**

### **2.1 OPTICAL FIBER CABLE Testers**

The field-test instrument shall be within the calibration period recommended by the manufacturer.

#### **A. Certifying Optical loss test set (OLTS)**

1. Singlemode optical fiber light source
  - a. Provide dual laser light sources with central wavelengths of 1310 nm ( $\pm 20$  nm) and 1550 nm ( $\pm 20$  nm).
  - b. Output power of  $-10$  dBm minimum.
  - c. Acceptable manufacturers
    - i. Fluke Networks DSX-5000 or better
2. Power Meter
  - a. Provide 850 nm, 1300/1310 nm, and 1550 nm wavelength test capability.
  - b. Power measurement uncertainty of  $\pm 0.25$  dB.
  - c. Store reference power measurement.
  - d. Save at least 100 results in internal memory.
  - e. PC interface (serial or USB).
  - f. Acceptable manufacturers
    - i. Fluke Networks (Fluke DSX-5000 or better)

#### **B. Optional length measurement**

1. An OLTS that is capable of measuring the optical length of the fiber shall be used.

#### **C. Optical Time Domain Reflectometer (OTDR)**

1. Singlemode OTDR
  - a. Wavelengths of 1310 nm ( $\pm 20$  nm) and 1550 nm ( $\pm 20$  nm).
  - b. Event dead zones of 3.5 m maximum at 1310 nm and 1550 nm.
  - c. Attenuation dead zones of 10 m maximum at 1310 nm and 12 m maximum at 1550 nm.
  - d. Distance range not less than 10000 m.
  - e. Dynamic range at least 10 dB at 1310 nm and 1550 nm
  - f. Acceptable manufacturers

- i. Fluke Networks or equal

## 2.2 ADMINISTRATION

- A. Administration of the documentation shall include test results of each fiber link.
- B. The test result information for each link shall be recorded in the memory of the field-test instrument upon completion of the test.
- C. The test result records saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records.

## PART 3 – EXECUTION

### 3.1 GENERAL

- A. All tests performed on optical fiber cabling that use a laser or LED in a test set shall be carried out with safety precautions in accordance with ANSI Z136.2.
- B. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to field-testing. Any testing performed on incomplete systems shall be redone on completion of the work.

### 3.2 OPTICAL FIBER CABLE TESTING

- A. Field-test instruments shall have the latest software and firmware installed.
- B. Link test results from the OLTS shall be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.
- C. Testing shall be performed on each cabling segment (connector to connector).
- D. Testing of the cabling shall be performed using high-quality test cords of the same fiber type as the cabling under test. The test cords for OLTS testing shall be between 1 m and 5 m in length.
- E. Optical loss testing
  1. Backbone link
    - a. Singlemode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA-526, Method A.1, One Reference Jumper or the equivalent method.
    - b. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
    - c. Use the One Reference Jumper Method specified by ANSI/TIA-526, Method B and ANSI/TIA-526, Method A.1 or the equivalent method. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.
    - d. Each fiber link shall be tested in both directions.



#### F. Polarity Testing

1. Paired duplex fibers in multi-fiber cables shall be tested to verify polarity in accordance with Clause E.5.3 of ANSI/TIA-568. The polarity of the paired duplex fibers shall be verified using an OLTS.

### 3.3 TEST RESULTS DOCUMENTATION

- A. Test results saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of the test records. These test records shall be uploaded to the PC unaltered, i.e., "as saved in the field-test instrument". The file format, CSV (comma separated value), does not provide adequate protection of these records and shall not be used. PDFs shall not be used
- B. The test results documentation shall be available for inspection by the Owner or the Owner's representative during the installation period and shall be passed to the Owner's representative within 5 working days of completion of tests on cabling served by a telecommunications room or of backbone cabling. The installer shall retain a copy to aid preparation of as-built information.
- C. The database for the complete project, including twisted-pair copper cabling links, if applicable, shall be stored and delivered on CD-ROM prior to Owner acceptance of the building. This CD-ROM shall include the software tools required to view, inspect, and print any selection of the test reports.
- D. Circuit IDs reported by the test instrument should match the specified label ID
- E. The detailed test results documentation data is to be provided in an electronic database for each tested optical fiber and shall contain the following information
  1. The identification of the customer site as specified by the end-user
  2. The name of the test limit selected to execute the stored test results
  3. The name of the personnel performing the test
  4. The date and time the test results were saved in the memory of the tester
  5. The manufacturer, model and serial number of the field-test instrument
  6. The version of the test software and the version of the test limit database held within the test instrument
  7. The fiber identification number
  8. The length for each optical fiber
  9. The index of refraction used for length calculation when using a length capable OLTS
  10. Test results to include OLTS attenuation link measurements at the appropriate wavelength(s) and the margin (difference between the measured attenuation and the test limit value).
  11. The overall Pass/Fail evaluation of the link-under-test for OLTS measurements

**END OF SECTION 27 15 53**

## 27 15 54 - Communications Copper Cable Plant Testing

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section presents the requirements for post-installation performance testing, performance testing documentation, as-built drawing documentation, and acceptance by the University Representative as installation complete including receipt of required final adjustments to as-built drawings and warranty submittals.
- B. The following Structured Cabling System elements shall be subject to performance testing and as-built drawing documentation:
  - 1. Outside plant (OSP) shielded and Inside plant (ISP) shielded and un-shielded twisted pair (UTP) cable.
  - 2. Riser copper cable.
  - 3. Horizontal UTP cable.
- C. As built drawings: The Contractor's as-built drawing submittals for the Structured Cabling System are hereby integrated as a required part of any post-installation testing documentation submittals.
- D. Those specification Sections of these Division 27 specifications that are particularly applicable to this Section include, but are not limited to, the following:
  - 1. Section 27 00 00 – Communications
  - 2. Section 27 11 19 - Communications Termination Blocks and Patch Panels
  - 3. Section 27 13 00 - Communications Backbone Cabling
  - 4. Section 27 15 00 - Communications Horizontal Cabling
  - 5. Section 27 15 43 - Communications Faceplates and Connectors

### **PART 2 - PRODUCT**

#### **2.1 TESTING TECHNOLOGY**

All UTP copper post-installation testing shall be performed using a Fluke DTX1800, or better, test unit.

#### **2.2 SUBMITTALS**

- A. Structured Cabling System:
  - 1. Submit manufacture's test unit(s) calibration certificate one (1) month before any post-installation testing begins. Date on test unit calibration certificate shall be no longer than one (1) year prior to the date that post-installation testing is scheduled to begin.
  - 2. Submit a copy of the Tester manufacturer's recommended testing procedure for each of the structured cabling system elements listed above in this section.

## **PART 3 - EXECUTION**

### **3.1 STRUCTURED CABLING SYSTEM TESTING**

- A. Outside plant (OSP) shielded cable. Paired and multi-conductor backbone metallic cables: test for continuity, shorts, ground faults and crossed or reversed pairs. Record all results on a spreadsheet.
- B. Inside plant (ISP) backbone un-shielded twisted pair (UTP) cable: Perform Category 3 certification.
- C. Horizontal UTP cable: Test per the Tester manufacturer's recommended testing procedures. Cables must pass TIA Permanent Link Certification for the cable type being installed. A "Marginal" test result is not acceptable.
- D. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to field-testing. Any testing performed on incomplete systems shall be redone on completion of the work.

### **3.2 TEST RESULTS**

- A. Test results shall be submitted electronically and according to Division 1 requirements. Provide in manufacturer software format.
- B. Electronic test result files shall be submitted electronically and according to Division 1 requirements. Provide in manufacturer software format.

### **3.3 AS-BUILT DRAWINGS**

- A. Both hard and soft copies of the as-built drawings shall be submitted.
- B. As-built drawing Computer Aided Design (CAD) files shall be "AutoCAD" or "AutoCAD LT" 2007 or later release.
- C. The list of required as-built drawings is as follows:
  - 1. All cabling outlets with IDs for each connector on the faceplate
  - 2. Two inch (2") and larger conduit pathways to include conduit size label
  - 3. Pull box locations
  - 4. Two inch (2") & four inch (4") J hook runs indicated by a line series of "x"s
  - 5. Telecom room layout labeled per current construction drawing field mark-ups
  - 6. Rack elevation labeled per current construction drawing field mark-ups
  - 7. Backbone copper and fiber schematic drawings with labeling information

### **3.4 ACCEPTANCE TEST PROCEDURE**

After submittal of test result documentation and the associated as-built drawings, the Project Manager or his/her designate shall randomly pick five percent (5%) of the submitted cable plant installation for re-test. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the representative shall repeat 100% testing at no cost to the Owner.

**END OF SECTION 27 15 54**

## **27 20 00 - Data Communications**

All electronics shall be provided by the University.

## 27 21 33 - Wireless Access Point (WAP)

### *PART 1 - General*

#### 1.1 SUMMARY

- A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of Wireless Access Points (WAP) as called for in this Section of the Division 27 specifications and conjoined construction drawings.
- B. The Contractor is responsible for determining if all required connectivity pathway and cable is in place for the proper installation of WAPs. Resolve any unclear issues or conflicts with the PP&C Project Manager before beginning any installation of WAP devices.
- C. Those specification Sections of this Division 27 that are particularly applicable to this Section include, but are not limited to the following:
  - 1. Section 27 05 26 – Grounding and Bonding for Communications Systems
  - 2. Section 27 05 29 – Hangers and Supports for Communications Systems
  - 3. Section 27 05 33 – Conduits and Backboxes for Communications Systems
  - 4. Section 27 05 36 – Cable Trays for Communications Systems
  - 5. Section 27 05 39 – Surface Raceway for Communications Systems
  - 6. Section 27 05 41 – Firestopping for Communications Systems
  - 7. Section 27 05 48 – Noise and Vibration Controls for Communications Systems
  - 8. Section 27 05 53 – Identification for Communications Systems
  - 9. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
  - 10. Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures
  - 11. Section 27 11 19 – Communications Termination Blocks and Patch Panels
  - 12. Section 27 11 23 – Communications Cable Management
  - 13. Section 27 13 00 – Communications Backbone Cabling
  - 14. Section 27 15 00 – Communications Horizontal Cabling
- D. Division 16/26- Electrical also has sections that maybe applicable to this section of the Division 27 - Communications specification set

#### 1.2 Quality Control

Comply with Section 27 00 00 - Communications.

#### 1.3 Warranties

Comply with Section 27 00 00 - Communications.

#### **1.4 Material Substitutions**

Does not apply.

#### **1.5 Submittals**

Does not apply.

#### **1.6 Delivery, storage, and handling**

- A. The University shall supply, store and deliver all WAP devices and associated mounting and device patching materials to the contractor. Contractor then accepts full responsibility for all materials delivered and must protect all devices and equipment from damage.
- B. Any unused material and/or devices must be returned to the University promptly upon completion of work related to the specific issuing of the University owned material and devices.

### ***PART 2 - Products***

#### **2.1 Quantity Determination**

- A. The quantity of all devices and associated materials shall be the responsibility of the University.
- B. In the event that quantities delivered by the University do not meet the requirements of the scope of work for any given floor, building, or group of buildings, the contractor must immediately notify the University Representative for remediation and direction.

#### **2.2 WIRELESS ACCESS POINT**

- A. Cisco AIRONET SERIES 2700
  - B. University Provided – Contractor Installed
1. All WAP equipment, bracket, patch and drop cords, locks and required mounting devices shall be furnished by the University
    1. Contractor shall supply all tools, ladder, lifts and other associated materials and/or consumables required to complete the installations.

### ***Part 3 - Execution***

- A. The Contractor shall comply with requirements as listed in ANSI/TIA-569 “Commercial Building Standard for Telecommunications” whether shown on the drawings or not.
- B. Each deployment will be established by room, floor, building, or multiples of all. The contractor will receive the WAP devices and related materials for a single deployment for any of the noted areas. All materials will be packaged by the University for each scheduled deployment.
- C. The Contractor shall make field adjustments and resolve conflicts between construction drawings, specifications, and field conditions before beginning any installation.
- D. Install WAP devices and associated hardware per manufacturer's specifications, instructions, and recommendations. Use accompanying construction drawing set, cable records and University documentation to determine mounting locations and configurations.

1. University documentation will be provided in a spreadsheet format indicating WAP number/name, outlet jack location ID, TR location, switch and switch port. Additional spaces will be on the spreadsheet for input by the contractor. These spaces will be used to track the installation process.
  2. The contractor will be responsible to verify the actual installation, and observed LED status of each WAP being installed. Comments shall also be added by the contractor to indicate any issues or questions to be addressed by the University Representative.
  3. WAPs must be installed in a horizontal orientation wherever possible. Deviations from a horizontal orientation must be approved by a University Representative.
  4. WAP and or jack labels may not be altered, remove or exchanged without approval from the University Representative.
- E. As part of the installation procedure, the following validation process must be followed and documented per University direction.
1. Attach the WAP to the ceiling jack using the bracket, patch cord and lock provided.
  2. A Green light will appear on the WAP.
  3. After completion of WAP deployment, revisit each WAP location with a WiFi device.
  4. Observe the WAP LED for a change from Green to Blue indicating an “attached” device.
  5. Document as directed
- F. In the event that the green or blue light does not appear, or, a red light appears, take the following steps.
1. Verify that the patch cord is properly attached to the WAP and jack
  2. Verify that the patch cord is properly attached from the switch to patch panel in the TR.
    - a. Do not alter patching in the TR
  3. Do not attempt to install a different WAP
  4. Document as directed
  5. Upon completion of the installation and verification process, complete the documentation and return it to the University Representative.
- G. Return all unused University materials to the University Representative. Items should not be retained by the contractor from one deployment to the next.
- H. Deployment Procedures: As we will be depending on an outside contractor to place and activate WAPs, we will need to complete all required steps in preparing the network for deployment of new devices. In order to insure a successful deployment outcome, certain criteria and design parameters must be met. The deployment plan calls for the contractor to place and activate devices. ITS will provide the contractor with the following.
1. Cut Sheet with
    - a. WAP name
    - b. Model



- c. MAC Address
  - d. Serial Number
  - e. Floor
  - f. Jack ID both Alpha and numeric per jack schedule on SFMI drawings
  - g. TR
  - h. Switch ID and Port assignment
  - i. Floor Plan
  - j. WAP placement locations indicated.
    - i. Placement marked by “n”
    - ii. Pre-wired location marked by “ac”
2. All required material (consumables not included)
- a. Pre-labeled WAP
  - b. Mounting bracket
  - c. Drop cord (used at WAP location)
  - d. Patch Cord (used in TR)
  - e. Port to Jack Cut Sheet
- I. Assumptions: the process for delivery of WAPs to the contractor for deployment is dependent on the following conditions and assumptions
1. ITS will complete Acceptance Testing
- a. 100% of all WAP outlets verified
  - b. 10% of all WAO verified
  - c. Confirmed WAP design
  - d. SFMI and Connect802 design concurrence
  - e. 100% NOC design
  - f. 100% Cut Sheet
  - g. Network switch is fully programmed and operational
  - h. WAP ports are configured

**END OF SECTION 27 21 33**

## 27 32 23 - Elevator Telephones

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of elevator phones as called for in this Section of the Division 27 specifications and conjoined construction drawings.
- B. The Contractor is responsible for determining if all required connectivity pathway and cable is in place for the proper installation of elevator phones. Resolve any unclear issues or conflicts with the University Representative before beginning any installation of elevator phones.
- C. Those specification Sections of this Division 27 that are particularly applicable to this Section include, but are not limited the following:
  - 1. Section 27 00 00 – Communications
  - 2. Section 24 05 26 - Grounding and Bonding for Communications Systems
  - 3. Section 27 05 29 - Hangers and Supports for Communications Systems
  - 4. Section 27 05 33 - Conduits and Backboxes for Communications Systems
  - 5. Section 27 05 41 - Fire Stopping for Communications Systems
  - 6. Section 27 11 16 - Communications Cabinets, Racks, Frames, and Enclosures
  - 7. Section 27 11 19 - Communications Termination Blocks and Patch Panels
  - 8. Section 27 13 00 - Communications Backbone Cabling
  - 9. Section 27 15 00 - Communications Horizontal Cabling
  - 10. Section 27 15 43 - Communications Faceplates and Connectors
  - 11. Section 27 15 53 - Communication Cable Plant Testing
- D. Division 14 – Conveying Systems
- E. Division 16/26- Electrical also has sections that may be applicable to this section of the Division 27 - Communications specification set
- F. Division 28 - Electronic Safety and Security also has sections that may be applicable to this section of the Division 27 - Communications specification set.

#### **1.2 QUALITY CONTROL**

Comply with Section 27 00 00 - Communications.

#### **1.3 WARRANTIES**

Comply with Section 27 00 00 - Communications.

#### **1.4 MATERIAL SUBSTITUTIONS**

Comply with Section 27 00 00 - Communications.

#### **1.5 SUBMITTALS**

Comply with Section 27 00 00 - Communications.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

Comply with Section 27 00 00 - Communications.

### ***PART 2 - PRODUCTS***

#### **2.1 QUANTITY DETERMINATION**

Comply with Section 27 00 00 - Communications.

#### **2.2 ELEVATOR TELEPHONES**

- A. Furnish all required elevator telephones - see Section 27 06 00 - Communications Product Schedule.
- B. Furnish all piece parts required for the total and complete installation of furnished elevator phones – see Section 27 06 00 - Communications Product Schedule

### ***PART 3 - EXECUTION***

- A. The Contractor shall comply with requirements as listed in ANSI/TIA-569 “Telecommunications Pathways and Spaces” whether shown on the drawings or not.
- B. The Contractor shall make field adjustments and resolve conflicts between construction drawings, specifications, and field conditions before beginning any installation.
- C. Install elevator phones per manufacturer's specifications, instructions, and recommendations. Use accompanying construction drawing set to determine mounting locations and configurations.

**End of Section 27 32 23**