SECTION 27 05 29 - HANGERS AND SUPPORT

PART 1 - GENERAL

1.1 SCOPE OF WORK
   A. Furnish and install a system of cabling supports above ceilings for network, voice, and CATV cabling as set forth hereinafter.

1.2 REFERENCE STANDARDS
   A. See SECTION 27.01.00 REFERENCE STANDARDS
   B. See SECTION27.11.13 Communications Grounding and Bonding

PART 2 - PRODUCTS

2.1 Basket Tray
   1. All wire trays are to be UL classified.
   2. All wire tray shall be approved for grounding.
   3. All wire tray shall be approved for installations in overhead or under-floor applications.
   4. All wire tray shall have shaped cross members to reduce cable strain.
   5. All wire tray shall be 100% recycled steel content.
   6. Manufacture: Hubbell Pre-Galvanized HBT series (size dependent)

2.2 Ladder Tray
   2. Durable powder coat.
   3. Stringer dimensions: 0.375” W x 1.5” H.
   4. Rung spacing: 9.0”.
   5. Weight capacity: 45 lbs./foot.
   6. Manufacture: Hubbell HLS series
      - Use 18-inch-wide in all entrance and telecommunications rooms.
      - Use other sizes as needed in corridors (size dependent).

2.3 J-Hooks
   1. J-Hooks are not to be used except when no basket tray or ladder tray can be used.
2. Non-Metallic J-Hooks for CAT6 is limited to maximum of 10 cables. All cables (CAT5E, CAT6, Coax) must be secured every 4’-5’, anchor J-hooks to studs.
3. J-hooks shall be as follows:
   a. J-Hooks
      i. Caddy
      ii. Panduit
      iii. B-Line

PART 3 - EXECUTION

3.1 INSTALLATION

   A. Entire installation shall be in accordance with manufacturer's recommendations. All supports, and hangers shall be installed to support this project per manufacturer’s requirements.

   B. Provide two separate sets of low-voltage cabling supports along entire length of low-voltage cabling runs above ceiling. One set of supports shall be of Category 6 network wiring. The second set of supports shall be for CATV wiring. Locate supports well clear of acoustical lay-in ceiling tiles. Supports shall be located such that tiles can be removed without interfering with support system. Where architectural, structural, or acoustical members or supports prohibit the use of two separate cabling supports, using only one set of supports is permissible.

   C. Coordinate installation of low-voltage supports with other trades as required.

   D. All trays shall be bonded and grounded to the telecommunications grounding system per SECTION27.11.13 Communications Grounding and Bonding.

END OF SECTION 27 05 29
PART 1 - GENERAL

1.1 DESCRIPTION
A. Furnish and install telecommunications outside plant (OSP) facilities as indicated on drawings and set forth hereinafter.

1.2 REFERENCE STANDARDS
A. See section 27.01.00 REFERENCE STANDARDS.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Inner Duct: MaxCell 3x3 (MXD3456), locatable for OSP, with color ID.
C. Phone Cable: 25 pair PE89 BSW (Buried Service Wire) Phone Cable-as manufactured by Essex or General Cable.
D. Handholes - Handhole lids with "Communications" logo on cover of lid.
   a. as manufactured by Quazite
   b. to be determined on a per project basis.
E. Splice Box Quazite
   a. Lids are to be identified with “Communications” and have pull slots center pins.
F. Splice Enclosures
   a. 3M 505 series (for Copper)
   b. 3M (for Fiber Optics)
G. Duct Seal
   a. Polywater ATF-16 (OIT to duct seal all conduits)
PART 3 - EXECUTION

3.1 INSTALLATION

Prior to commencing with work, a pre-construction meeting will be held between the contractor's telecommunications cabling installer and appropriate representatives of the University of Tennessee Knoxville Physical Plant, ITS Department. Installation requirements shall be carefully discussed at the pre-construction meeting. Discrepancies between contract documents and pre-construction meeting shall be called to the attention of Project Engineer immediately prior to commencing with any telecommunications installation work.

A. Underground requirements:
1. 5” PVC Schedule 40 conduit only between Handholes (HH) and into buildings.
2. 5” PVC Schedule 80 conduit under parking lots, streets, and driveways encased in concrete with warning tape on top of encasement.
3. A minimum of 30” from top of conduit to finished grade.
4. Minimum of 12” separation from electrical power, 24” from steam lines.
5. Minimum of four 5” conduits from Handholes (HH) to HH with 2 of the four conduits to have 4 3X3 DETECTABLE MaxCell installed.
6. Minimum of three 4” conduits from HH to Building. UTK OIT will determine if more are required.
   a. At least one of the 4” conduits are to have 3 3X3 DETECTABLE MaxCell installed.
   b. Each MaxCell is to have different color ID markings and be locatable.
   c. Plastic flexible inner duct not allowed.
7. All conduits (including when filled with MaxCell) are to have a pull rope (no strings) install 3/8” nylon rope with a pull rating of 200lb or more. Conduits 1” or less, fill with polyline (Greenlee 430).
8. Conduits entering the buildings must be sloped away from building.
9. HH’s are to be manufactured by Quazite, open bottom (on top of 4” of rock), and with a minimum size of 30”X 48”, cover labeled “Communications”.
10. Cover to have pull slot with center pin.
11. HH covers are to be heavy duty and be traffic/drive over rated.
   a. Manholes shall a minimum of 7’X7’X7” inside dimensions and should be manufactured in top and bottom halves.
   b. Each manhole shall be equipped with steps and ladders.
   c. They shall have racks in all 4 corners mounted to corner brackets and 2 racks equally spaced on each side wall which are mounted on S brackets.
12. HH’s are to be installed at a maximum distance of 150’ intervals for straight...
runs. This distance could be shorter after calculating bends and cable pulling tensions.

13. No 90° bends in conduit. Communications sweeps are to be used.
   a. No “elbows or LB’s” (Smart LB allowed, see figure below), terminate conduit in an appropriately sized pull box (PB)

14. All conduit shall be installed such that the top of the conduit is a minimum of 24” below grade.

15. Use Schedule 80 PVC, under sidewalks, driveways, etc.
   a. Use Schedule 40 PVC elsewhere.
   b. Conduit to be free of water and debris throughout.
   c. Provide caps on ends.

Figure 3: Front View of Racks Lay-o-Smart Conduit Body – Telecommunications LB

16. When tying into an existing HH, first consult with UTK OIT to determine if a HH needs to be replaced with a larger size.

17. When entering a HH, enter at bottom, do not drill or punch holes in sides of HH.
   a. Any exceptions to this must be cleared with UTK Telecommunications.
   b. A HH is not to be used in lieu of a bend.
   c. Handholes (HH) shall be 36"x48"x 36" minimum size, with open bottom (on top of 4" rack).
   d. Seal conduits at each HH to keep moisture, insects, and rodents out of building. Conduits entering building must be sloped.
   e. All Handholes where fiber splices are made shall be 36”x60”x36” minimum.
f. Use Quazite PG style with pull slot center pins, lid shall be labeled “COMMUNICATIONS”.

18. All OSP cabling shall be installed in neat and workmanlike manner. Cabling to be routed and secured around edges of HH to create additional space for future cabling.

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**B. Cable Installation Requirements**

1. Seal conduits with pliable / non-hardening duct seal to keep out rodents and moisture (Ideal 31-605 or Gardner Bender GB-DS-110N or equivalent).
2. Cabling is to be neat and professional inside HH & PB’s.
3. Route and secure cables around edges to free up room for future cabling.
4. All cables are to be labeled inside HH or PB. Consult UTK OIT.
5. Install “Caution Telecommunication” detectable Orange tape, along the cable pathway 12” below the final grade.
6. All OSP cabling shall be installed in neat and workmanlike manner. Cabling to be routed and secured around edges of HH to create additional space for future cabling.
7. Provide 25-foot maintenance loop for fiber optic lines in one HH. Service loop to side of HH.
8. When splicing is necessary; use approved splicing methods and enclosures.
9. All coax connectors are to be enclosed with heat shrink, with at least 2” of shrink tube covering outer jacket.
10. Use flame spread head to avoid scorching and melting center dielectric.
11. Consult with UTK OIT before any splicing is designed or requested.
12. Before backfilling, all underground installations must pass UTK OIT inspections.

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**C. Labeling and final installation work**

1. OSP conduits shall be marked with Detectable Warning Tape, CH Hansen 16626 or equal.
2. Using Quazite PG style with pull slot center pins, lid shall be labeled “COMMUNICATIONS”.

3. All OSP cabling shall be installed in neat and workmanlike manner. Cabling to be routed and secured around edges of HH to create additional space for future cabling.

4. Label all OSP cabling as follows:
   a. "Caution Fiber Optic" adhesive marker every HH. Label to include SM an MM fiber count and "to and from".
   b. "Caution Fiber Optic" adhesive marker every 50' of exposed fiber in building (including in cable tray). Label to include SM and MM fiber count and "to and from".
   c. OSP UTP cables shall be labeled with permanent, neat penmanship in every HH with "to and from".

5. Prior to backfill, contractor shall arrange for inspection of OSP installation with University of Tennessee Knoxville ITS Department.

END OF SECTION 27 05 28
SECTION 27 05 53 - ADMINISTRATION / LABELING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Provide administration and labeling of entire communications infrastructure in accordance with University of Tennessee Knoxville ITS Department requirements and as set forth hereinafter. Administration and labeling shall include but not be limited to all work area outlets (WAO's), patch panels, 110 blocks, conduits, cable trays, backbone cables, etc.

1.2 REFERENCE STANDARDS

A. See SECTION 27.01.00 REFERENCE STANDARDS

PART 2 - PRODUCTS

2.1 MATERIALS

A. Products shall be as set forth elsewhere in these specifications.

B. Provide labeling sample for outlets, patch panels and racks to University of Tennessee Knoxville OIT prior to application.

PART 3 – EXECUTION

3.1 INSTALLATION

A. All WAO's, patch panels, 110 blocks, conduits, cable trays, backbone cabling, outside plant cabling, etc., shall be labeled according to ANSI/TIA Standards with specific labeling scheme provided by the University of Tennessee Knoxville ITS Department and shall use only a Panduit LS8E Label Printer. Labeling is also to include the following:

1. "Caution Fiber Optic" adhesive marker every 20' of exposed fiber in building (including in cable tray). Label to include SM and MM fiber count and "to and from".

B. Provide a sample of all labeling and labeling schematic prior to application.

C. Installation Labeling Requirements

1. Network cable labeling is similar to ensuring everyone involved in your network speaks the same language and anyone who comes in to augment or service your network can easily understand the architecture. It has become more important to accurately document every outlet and every port, so the information can assist in a
911 database. All WAO’s, patch panels, 110 blocks, conduits, trays, backbone cables, grounding, and racks shall be labeled with specific labeling scheme of UTK OIT.

2. The key factor of a good administration system is the component labelling. Records cannot be established and maintained without good labelling during and after installation.

3. Work Area Outlet Labeling Schematic

4. The label shall contain a unique identification, as outlined in the documentation and/or drawing, and must be indelible and placed behind a transparent cover.

![Figure 11: Data Circuit Labeling Schematic](image-url)
D. Rack Labeling

1. The label shall contain only the first 6 characters of the circuit labeling schematic for that SER and printed or generated by a mechanical device.

![Figure 12: Samples of Equipment Rack Label](image)

E. Patch Panel Labeling

1. Each RJ45 socket must be individually labeled. The label shall contain a unique identification, as outlined in the documentation and/or drawing, must be indelible and placed behind a transparent cover, and printed or generated by a mechanical device.

![Figure 13: Samples of Patch Panel Labeling](image)
F. Work Area Outlet Labeling

1. Each RJ45 socket must be individually labeled. The label shall contain a unique identification, as outlined in the documentation and/or drawing, must be indelible and placed behind a transparent cover, and printed or generated by a mechanical device.

2. All WAO labeling must be completed and verified before the installation of the furniture.

3. If the contractor is providing and installing the station patch cable in accordance to the contract, they must remember that both ends of the station patch are to be labeled with the WAO in which it is connected.

Figure 14: Samples of WAO Labeling
SECTION 27 08 00 - Commissioning of Communications

PART 1 - GENERAL

1.1 DESCRIPTION

A. Telecommunications systems shall be provided as indicated on drawings and as called for hereinafter.

1.2 REFERENCE STANDARDS

A. University of Tennessee Knoxville OIT standards.


C. ANSI/NECA/BICSCI-568, Standard for Installing Commercial Building Telecommunications Cable.

D. ANSI/TIA 569-C, Pathways and Spaces.

E. ANSI/TIA 568-C.0, Generic Telecommunications for Customer Premises Standard Series
   i. 568-C.1 Commercial Building Cabling
   ii. 568-C.2 Copper Cabling Components
   iii. 568-C.3 Fiber Cabling Components
   iv. 568-C.4 Coax Cabling Components

F. ANSI/TIA 606-B, Addendum 1, Administration Standard for Commercial Telecommunications Infrastructure.

G. ANSI J-STD-607-B, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

H. ANSI/TIA 758-B, Customer owned Outside Plant Telecommunications Cabling Standard

I. ANSI/TIA-526, 7&14, Telecommunications Measurements of Optical Fiber Single and Multi-Mode Power Loss


K. ANSI/TIA 310-D, Cabinets, Racks, Panels, and Associated Equipment.

L. FCC Part 68, Connection of Terminal Equipment to the Telephone Network.

M. ADA of 2010 and Telecommunications Act of 1996, Physically Impaired and Accessibility.


O. IEEE 802.11ax Wireless LAN’s


S. ETA Electronic Technician Association Fiber Optics Installer

T. FOA Fiber Optics Association Certified Fiber Optics Technician

U. ANSI/SCTE 77 Underground Enclosure Integrity

1.3 Reference Specifications

A. See section 27.01.00 for standards.

B. See section 27.05.53 Administration/Labeling.

C. See section 27.05.26 Grounding and bonding.

D. See section 27.15.00 Voice and Network Horizontal Cabling System

PART 2 - PRODUCTS

2.1 Inspections and Walk Through

A. All work is subject to inspection and review at any time by qualified University of Tennessee Knoxville personnel.

B. All rough in work will be inspected by University of Tennessee Knoxville personnel before finished walls and ceilings are installed.

C. Final walk through inspections must be done prior to turning in final documentation and test results. The preliminary documentations will be made available for review during this walk-through inspection.

D. Cables with visible defects, kinks, twists, crushed, cuts or smashed will be replaced regardless if they pass tests.

E. Installer must take reasonable steps to protect their installation in a construction environment. Free of dirt, defects and debris

PART 3 - EXECUTION

3.1 Commissioning

A. University of Tennessee Knoxville ITS requires the newly installed infrastructure to be tested and certified. Follow the Standards of ANSI/TIA -568-C.1,2,3,4 for testing criteria of the permanent link. See Appendix D in the University of Tennessee Knoxville Telecommunications Design and Installations Guidelines, current edition for approved test equipment to obtain a manufacture warranty.

B. Testing shall commence only after all materials are permanently installed, adjusted, bonded and labeled. Installer must retest and save both the original and retested results when any of the above occurs.

C. Testing shall commence only in a clean environment, free of moisture, dirt, dust and debris. Terminations exposed to such environments after testing will require retesting.

D. In addition to the cabling being commissioned and certified, the electrical grounding and bonding systems must also be tested and certified.

E. The electrical contractor is responsible for testing the Alternating Current (AC) Grounding Electrode System.
F. The telecommunications installer is responsible for testing the Equipment Grounding (Bonding) System.

G. Refer to the BICSI TDMM latest edition, for approved test equipment and acceptable results.

H. Manufactures 25-year installation warranty
   a. UTK OIT requires all installations to have a 25-year warranty.
   b. This warranty shall include all types of telecommunications services such as Power over Ethernet (PoE), Voice over IP (VoIP), LAN Security Cameras, Wireless LAN, Fiber applications, and any future services that meet ANSI/TIA/EIA and or IEEE telecommunications cabling standards.

I. T-Drawings
   1. Telecommunications drawings shall be identified as “T” series (Telecommunications) drawings in the approved construction drawings, separated from “E” (Electrical) drawings. The T-series drawings shall include:
      a. Floor layout, showing work outlets, cable path (j-hooks or cable tray, horizontal and riser), sleeves, conduits.
      b. Legends using industry standard symbols
      c. Satellite Equipment Room (SER) layout / elevations
      d. Equipment rack layout
      e. Detailed Work Area Outlet (WAO) with labeling
      f. Riser diagram and cabling for voice, data and cable television (CATV)
      g. Outside plant, cabling, methods and paths, with footages and bends
      h. Schedule of jacks and rooms
      i. Pull Box detail

   2. T-Drawings shall be given at the time of the walk-thru.

END OF SECTION 270800
SECTION 27 11 10 - TELECOMMUNICATIONS SPACES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Telecommunications spaces shall be provided as indicated on drawings and as called for hereinafter.

B. There shall be one equipment room (SER) for the entire building.

C. There shall be, at minimum, one telecommunications room (SER) on each floor per 10,000 sq. Ft.

D. UTK OIT typically refers to the Satellite Equipment Room as an SER. It may also be referred to as a Telecommunications Room (TR), Intermediate Distribution Frame (IDF), Main Distribution Frame (MDF), or Uplink Room.

1. The SER houses the terminations of horizontal and backbone cabling and its interconnects to the necessary hardware. The SER provides a controlled environment to data networks. Due to the sensitivity of the data contents and the availability requirements of the connected devices on the university network:
   • All SERs must be secured at all time.
   • Unauthorized port activations are NOT PERMITTED
   • Equipment must remain powered on once installed.
   • If equipment is to be turned off, notification must be given prior to interruption to OIT Network Operations, University of Tennessee Police Department, and Facilities Services.

2. Use and Restrictions
   • No SER shall be used as passageways 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.

   • SERs shall be dedicated to telecommunications functions and related support facilities.

   • SERs shall not be shared with electrical equipment, building services, or other equipment.

   • SERs should not contain systems such as audio-visual (A/V) equipment, fire alarm panels, building management systems, cable tv, or computer servers.

   • If the SER is to contain other systems, including but not limited to audio-visual (A/V) equipment, fire alarm panels, building management systems, cable tv, camera systems, or computer servers, usage shall be approved by the OIT Chief Information Officer or his/her delegate prior to construction.
1.2 REFERENCE STANDARDS

A. See section 27.01.00 for standards.

B. See section 27.05.53 Administration/Labeling.

C. See section 27.05.26 Grounding and bonding.

D. See section 27.13.13 Communications Copper Backbone Cabling

E. See section 27.15.13 Communication Copper Horizontal Cabling

F. See section 27.15.43 Communications Faceplates and Connectors

PART 2 - PRODUCTS

2.1 MATERIALS

A. SER layouts shall include network racks-wall and floor mount, vertical wire management, horizontal wire management, cable trays, and associated facilities. Each SER shall include, but not be limited to, the following equipment:

1. Distribution and Network Racks shall be Hubbell No. CS1976H, 84" x 19" with 6" Z channel vertical wire management or equivalent. Provide a Hubbell RKTGB grounding bus bar in each equipment room. Provide a Hubbell HPWPWR for each network rack. Provide cable management components at each rack including Hubbell HM24C (2 per patch panel) horizontal management, Hubbell MCCPSR4 cable management rings, and Hubbell 110RA cable management troughs. Provide Hubbell MCCCS19P equipment shelves. Provide Hubbell HRRP3 rack base insulator kit.

2. Wall mount racks shall be Hubbell HPWWMR series-sized per University of Tennessee OIT and per architectural drawings.
   a. All wall mount racks will be grounded and securely mounted.
   b. Provide a Hubbell HPWPWR power strip for each wall mount rack.

3. All Racks and equipment mounted to the cement floor shall use cement anchoring bolts. Use Hubbell HPWRRA.


5. Where Category 5e is specified use Hubbell HP5E48 with HM24C, black. Provide 25% extra capacity for future growth.

6. Fiber patch panels shall be Hubbell FCR series-sized per requirement of installation. Include the FSPLCDS12 adapter panels necessary to complete the installation with room for 25% growth.

7. Ladder Tray: In each SER room, provide 18" wide cable tray around room and to each rack. Cable tray shall be Hubbell Next Frame 18" "HL" Series or approved equal.

8. Plywood Backboards: All walls of each SER room shall be provided with 3/4" AC grade plywood, covered on all six sides with two coats of Benjamin Moore M59-220 (white) paint, with up to 2 ounces of tint allowed per gallon.

9. All fiber, OSP and Riser shall be terminated and installed per the University of Tennessee OIT requirements.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish and install at each SER location a grounding conductor from grounding bus in local SER Room AC panel board to grounding bus bar mentioned in 2.01, A, Materials. Grounding conductors shall be copper, with "THHN/THWN" insulation, with green tape marking to indicate grounding conductor. Refer to drawings for grounding conductor sizes. Grounding and bonding shall be in accordance with BICSI TDMM current edition, Chapter 8, and NFPA 70.

B. Before any terminations and installation of equipment, the SER must be in finished stage, free of dust and debris with all walls and ceilings painted to finish coats and finished flooring installed and treated. After terminations and equipment are installed, contractor shall keep ER room door closed and locked at all times.

C. Location within a facility

1. There are a number of factors that need to be considered when placing SERs within new or remodeled facilities. Site selection factors for the various rooms are addressed below. Of these factors, the two most important are “stacking” of the spaces and providing a location that would allow the spaces to be expanded, if required, in the future.
   a. Horizontal_location(s): The SER shall be centrally within the floor area it serves in order to maximize the number of horizontal cable plant WAO connections it can service. The maximum cable length allowed from the SER termination to that cable’s WAO termination is 295 feet (90 meters).
   b. Vertical_Location(s): In multi-story buildings requiring multiple SER rooms, the SER rooms shall be in vertical stack alignment.
   c. Avoid locations that limit expansion such as structural steel, stairwells and elevator shafts, outside walls, or other fixed building walls.
   d. SERs should be easily accessible and accessed directly from public hallways. Access should not be through offices, bathrooms, other utility spaces or janitorial spaces.

2. SERs should not service WAOS on more than one floor.

3. SERs and the cabling they support shall be separated from sources of electromagnetic interference such as induction devices, transformers, ballasts, power supplies, elevator equipment, generators, motors, X-ray generators, photo copiers, microwave ovens, and similar equipment nor be located near sources of mechanical vibration.
   a. The location of SERs shall allow easy access to cable distribution pathways.

4. SERs shall not be in any place that may be subject to water or steam infiltration, humidity from nearby water or steam, heat, and any other corrosive atmospheric or environmental conditions.

5. SERs shall have proper grounding as defined by current TIA 607 standard and shall include electrostatic discharge (ESD) ports for connecting wrist grounding straps.
   a. Telecommunications Grounding Static Discharge Strap and ESD port
      i. HGBESDBM
D. Environmental Requirements

1. Space Allocation
   a. SER must be a rectangular room with no obstructions or protrusions (beams, columns, etc.) that decrease the usable square footage available in the room. There shall be, at minimum, one SER per building.
   b. The building main equipment room/entrance facility shall be at minimum 10’x16’
   c. If the floor serving area is 5,000ft² or less, the SER shall be at minimum 10’X10’
   d. If the floor serving area is 5,000ft² to 8,000ft², the SER shall be at minimum 10’X11’
   e. If the floor serving area is 8,000ft² to 10,000ft², the SER shall be at minimum 10’X16’
   f. If floor serving exceeds 10,000ft² another SER shall be created on floor
   g. It is not recommended by UTK OIT to house other services in the SER, due to network security.
   h. If other systems, as noted in the Use and Restrictions section, are installed then space requirements must be increased by at least 20% as determined by OIT.
   i. Equipment not related to the support of the SER (e.g., piping, ductwork, pneumatic tubing, etc.) shall not be installed in, pass through, or enter the SER.

2. Enclosing Walls
   a. SER walls shall extend to the structural ceiling above.

3. Ceiling
   a. False (lay-in tile) or hard lid ceiling shall not be installed in any SER space.
   b. Minimum clear ceiling height shall be 10 feet (10’).

4. Floor
   a. SER floors shall be floor slab, no raised or false floor.
   b. Floor finish shall be smooth, dust-free, and not susceptible to static electricity build-up.
   c. Acceptable finishes are low static composition tile, static dissipating tile (SDT), vinyl composition tile (VCT) or sealed concrete.
   d. Floors are to be light in color to enhance lighting.

5. Door
   a. Doors shall be a minimum of 36” wide and 7’6” tall.
   b. Doors must swing out of room or increase room size 3’.
   c. SER doors shall be secured using card access/readers. The rooms must be accessible during power outages.

6. Windows
   a. SERs shall not have windows.

7. HVAC
a. Design for a minimum of 8,000 BTU’s from equipment, for up to 144 work area outlets (WAO), add 1,000 BTU’s for every 48 additional work area outlets (WOA) served.
b. A stand-alone wall-mount unit is preferred to avoid any water damage to electrical equipment.
c. It is required that the SER’s HVAC be tied into the backup power.
d. The ambient temperature and humidity shall be measured at a distance of 5 ft. above floor level, after equipment is in operation, at any point along an equipment aisle centerline.
e. A SER's HVAC must be designed for 24 hours per day, 365 days per year operation.
f. Each SER shall have its own thermostat.
g. HVAC systems shall not use the same electrical panel that is used to support the outlets servicing the electronics housed within a SER.
h. The temperature in a SER shall be maintained in the range of 68°F to 77°F.
i. The humidity range should be maintained at 40% to 55% relative humidity.
j. A SER shall ventilate at the rate of one air change per hour.
k. If other systems, as noted in the Use and Restrictions section, are installed HVAC requirements must be provided for those systems.

8. Electrical Power

a. It is required that the electrical feed to the SER be backed up by a generator, including all convenience outlets to conform with current National Fire Protection Association (NFPA) code.
b. Outlets and faceplates with a generator feed shall be red and labeled with the panel designation and breaker position of the servicing electrical panel.
c. A separate supply circuit serving the SER shall be provided and terminated in its own electrical panel inside the SER.
d. A minimum of two dedicated non-switched 3 wire 12-gauge single phase 120V ac 20amp duplex electrical outlets for equipment power, each on separate branch circuits. These outlets shall be mounted one each above each rack. Note: A twist lock receptacle shall be required.
e. Racks will be appropriately grounded as required by latest TIA 607 standard.
f. In addition, OIT requires a ground lug on the rack capable of being used as a splicer.
   i. There must be at least one unused connector hole that can accept #6 - #14 wire.
   ii. This lug should be on the back side of the rack (same side as the copper termination) and, where possible, on the vertical support farthest from the copper termination.
   iii. Each SERs shall have a Telecommunications Grounding Bus Bar (TGBB) that shall be connected by a home run copper ground wire properly sized per the latest TIA 607 standard.
   iv. The rack(s) shall have a horizontal mounted 19” X 0.75” grounding bus bar mounted at the top of the equipment rack. This grounding bus bar shall be connected by a home run grounding wire from the SERs TGBB.
g. Separate quad 120v ac convenience outlets for tools, test equipment etc., are to be placed at maximum of 6’ (wall space) intervals around perimeter of room and below the plywood.
h. All power, including power to all mechanical systems, in the SER shall be installed to the buildings generator.
i. If other systems, as noted in the Use and Restrictions section, are installed electrical requirements must be provided for those systems.
j. In SERs that contain more than 150 WAOS, additional power may be required as determined by the OIT.

9. Lighting  
   a. Provide a minimum of 500 lux measured 3’ above finished floor.  
   b. Locate light(s) at a minimum of 8.5’ above finished floor.  
   c. Power for lighting should not come from the power panel located inside the SER.  
   d. All lighting shall be connected to backup power.  
   e. The walls and ceiling of the SER shall be painted in light colored paint to enhance lighting.  
   f. Coordinate the lighting layout with equipment layout, especially cable trays.  
   g. SER should be equipped with an on/off switch inside the room.

10. Water Infiltration  
    a. Measures must be taken to prevent water intrusion.  
    b. Water, sewer, chemical, or drain piping of any kind shall not be routed through/within a SER.  
    c. Drainage systems for HVAC units shall not pass above equipment and shall tie in to the building drainage system.  
    d. If a pump is needed to drain HVAC, it must be powered by emergency power.

11. Sprinkler Systems  
    a. Do not install sprinklers directly above the equipment racks.

12. Wall Plywood Sheeting  
    A. All walls shall be covered with ¾” Fire Rated Plywood  
    B. Plywood shall be above electrical outlets (17” above finished floor typical) and extend to above cable tray.  
    C. Layouts vary for analog/traditional phones and VoIP:  
       1. VoIP circuits should be treated like any other data circuit. They will be terminated with the data circuits in the same patch panels.  
       2. Terminate riser cables for traditional/analog phones in the fiber rack with an RJ-45 panel  
    D. The contractor shall be responsible for getting the plywood approved by the fire marshal before painting.

END OF SECTION 27 11 10

SECTION 27 11 13- Communication Entrance Protection

PART 1 - GENERAL

1.1 DESCRIPTION  
   A. Telecommunications systems shall be provided as indicated on drawings and as called for hereinafter.
1.2 REFERENCE STANDARDS

A. University of Tennessee Knoxville OIT standards
C. ANSI/NECA/BICSCI-568, Standard for Installing Commercial Building Telecommunications Cable.
D. ANSI/TIA 569-C, Pathways and Spaces.
E. ANSI/TIA 568-C.0, Generic Telecommunications for Customer Premises Standard Series
   i. 568-C.1 Commercial Building Cabling
   ii. 568-C.2 Copper Cabling Components
   iii. 568-C.3 Fiber Cabling Components
   iv. 568-C.4 Coax Cabling Components
F. ANSI/TIA 606-B, Addendum 1, Administration Standard for Commercial Telecommunications Infrastructure.
G. ANSI J-STD-607-B, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
H. ANSI/TIA 758-B, Customer owned Outside Plant Telecommunications Cabling Standard
I. FCC Part 68, Connection of Terminal Equipment to the Telephone Network.
M. ANSI/SCTE 77 Underground Enclosure Integrity

PART 2 - PRODUCTS

2.1 Entrance Facility (EF) UTP protectors
   1. An EF is a space where telecommunications outside plant (OSP) terminates to the inside facilities. The outside plant will most likely be fiber optics LAN, CATV coax, UTP telephone and MaxCell innerduct.

2. UTP protectors shall have the following:
   - Building Entrance Terminals enclosure
   - INDOOR - 110 CONNECTOR
   - 16 AWG Powder Coated Steel Construction
   - Equipped with an Internal 26 AWG Fuse Link
• External Ground Connectors Accept 6 - 14 AWG Wire
• Industry Standard 5 Pin Design
• Exceeds UL497 Primary Protection Standards

PART 3 - EXECUTION
1. OSP cables routed inside a building are influenced by fire codes. The installer should be aware of and adhere to local codes, standards and regulations.

2. OSP cable is to be terminated or transitioned to listed cable as close as practical upon entry to the building. In no case must this termination or transition exceed 50 feet from point of entrance for exposed cable. The installer may extend the point of entry by enclosing the unlisted outside cables in a rigid or intermediate metal conduit that extends beyond the wall or floor of the building and is properly sealed and bonded to a grounding electrode. At no point shall this cable be exposed prior to the termination point.

3. The Entrance Facility shall be at a minimum 10’x16’

4. All telephone and data cables (Cat 3) and (Cat 5) shall be protected at the entrance facility.

5. Manufacture: UTP Protectors (CAT3) Circa 1890 BC1 series, 110 block, 5 pin modules 4B1S-300. CAT5e, Linx CAT5e-75

END OF SECTION 27 11 13
SECTION 27 11 16  COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

PART 1  GENERAL

1.1  INTRODUCTION
A. The Work of this Section shall consist of the labor, materials and equipment required for furnishing and installing cabinets, racks, frames and enclosures as part of a complete and operating telecommunications cabling system.

1.2  RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section
B. Section 27 00 00  Communications
C. Section 27 05 26  Grounding & Bonding for Communications Systems
D. Section 27 05 28  Pathways for Telecommunications Systems
E. Section 27 05 36  Cable Trays for Communications Systems
F. Section 27 11 10  Telecommunications Spaces, Equipment and Fittings
G. Section 27 11 16  Communications Cabinets, Racks, Frames, and Enclosures
H. Section 27 13 23  Communications Optical Fiber Backbone Cabling
I. Section 27 15 13  Copper Horizontal Cabling
J. Section 27 15 43  Communications Faceplates and Modules
K. Section 27 16 19  Communications Patch Cords and Station Cords

1.3  CODE AND STANDARDS
A. Refer to Section 270000 – Communications General
B. Refer to Division 1 – Reference Standards and General Conditions of the Contract

1.4  APPROVED PRODUCT MANUFACTURERS
A. The manufacturer of the products and materials in this section, that <customer> is using as basis of design in this document, as required for construction of the cabling infrastructure per contract documents shall be:
   1. Hubbell Premise Wiring
   2. Product substitutions from other manufacturers shall require the approval of the owner or owner’s representative 30 days prior to bid opening.

1.5  SUBMITTALS
A. Shop Drawings:
   1. Shop drawings shall show the locations where cables are to be routed and where terminating hardware is to be installed.

B. Submit Manufacturer’s Cut Sheets for the following: Refer to Section 270000 – Communications Submittal.

C. Major items not included in the product section of the specification.

D. Submit for approval in accordance with specified submittal procedures:
   1. Racks
   2. Enclosures
   3. Cabinets
   4. Frames
   5. Accessories

1.6 QUALITY ASSURANCE

A. The Contractor shall install work in accordance with the latest UTK OIT Requirements, the latest BICSI Cabling Installation Manual, TIA Standards Telecommunications building cabling systems planning and design manual.

B. Installed UTP and fiber cabling systems, pathways and distribution facilities shall adhere to manufacturer’s instructions, contract drawings and specifications, and applicable codes, standards and regulations.

C. Where applicable, all equipment, components, accessories and hardware shall be UL listed for the intended purpose of the installation.

D. Installed products shall be manufactured by an ISO 9001 certified facility.

E. Installed products shall be free from defects in material or workmanship from the manufacturer and shall be of the quality indicated.

F. All methods of construction that are not specified in the contract documents shall be subject to control and approval by the owner or owner’s representative.

G. Installed products shall be lot-traceable by date code.

H. All critical internal manufacturing operations for installed products shall have documented in-process inspection and testing according to ISO9001.

1.7 DEFINITION

A. See Section 27 00 00

1.8 WARRANTIES:

A. See Section 27 00 00 for details

1.9 MATERIALS:

A. All materials shall be UL or ETL listed and verified and shall be marked as such.
B. Products shall be regularly catalogued items of the manufacturer and shall be supplied as a complete unit in accordance with the manufacturer's standard specifications with any optional items required for proper installation unless otherwise noted.

C. All materials used on this project shall be new. Used and refurbished equipment is not permitted unless approved by UTK OIT. Provide equipment to site in original packaging whenever practical.

1.10 DELIVERY, STORAGE AND HANDLING LOGISTICS

A. Material shall be delivered to the site in the original packing.

B. Materials delivered to the construction site shall be stored in a dry, secure area, preferably indoors. Storage temperature of materials shall adhere to manufacturer's recommendations. Movement of packaged materials shall be in a manner to avoid damage of contents. On-site storage, either indoors or trailer, shall have permission by the owner, and shall not interfere with other construction activity.

C. Installation of the cable shall be within the recommended temperature range specified by the manufacturer. Cable installation temperature range between 50f and 80f is recommended.

D. The contractor is responsible for scheduling all deliveries and providing proper receipt, handling, and storage of all materials. Protect all equipment from physical damages (dents, scratches, dust, water, paint, chemicals, and temperature extremes) and vandalism, or theft. The contractor shall replace any damaged or stolen equipment. The contractor is responsible for all equipment until final project acceptance by owner.

E. The contractor is responsible for cleaning the worksite every business day and removing debris from the facility.

1.11 COORDINATION WITH OTHER TRADES

A. Coordinate layout of work with other trades. Make minor adjustments in locations required for coordination. Locations of structural systems, heating work and plumbing lines shall take preference over locations of conduit lines where conflict occurs. Structural systems, heating work, and plumbing lines shall not interfere with or otherwise impede the routing of communication cabling with cable tray, raceways, or other pathways dedicated to communications. All potential issues shall be brought to the attention of the General Contractor, Construction Manager, Architect, Engineer or owner immediately, before proceeding with installation.

B. Other than minor adjustments shall be submitted to the General Contractor, Construction Manager, Architect, Engineer or owner for approval before proceeding with the work.
C. Coordinate locations, arrangement, mounting, and support of all communications provisions with Division 26.

D. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

E. To provide for ease of disconnecting the equipment with minimum interference to other installations.

F. To allow right of way for piping and conduit installed at required slope.

G. So that connecting raceways, cables, and cable trays will be clear of obstructions and of the working and access space of other equipment.

H. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

I. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 and Division 26.

J. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08.

K. Coordinate the gauge cables to be used in the telecommunications grounding system.

L. Low Voltage Contractor shall furnish and install the following:
   1. Racks & Accessories
   2. Enclosures & Accessories
   3. Patch Panels
   4. Ladder Rack
   5. Plywood backboards.

M. Electrical Contractor shall furnish and install the following:
   1. Power circuits to telecommunications spaces and equipment.
   2. Contractor shall coordinate location of electrical receptacles to be installed on raceways, racks or inside cabinets.

N. Unless noted otherwise, the following items will be the responsibility of the Owner:
   1. All electronics and active data networking equipment, etc.
   2. Telephones, fax machines and modems, etc.
   3. PC’s, printers, video display terminals, flat panel displays, etc.

O. Contractor shall coordinate with the Owner’s network and computer equipment personnel for specific instructions before starting Work.
P. Contractor shall coordinate with the General Contractor for location and type of blocking to be installed in the walls to support wall mounted equipment.

PART 2 PRODUCTS

2.1 CABINETS

A. Network Cabinets
   1. 3,000 lb. weight capacity
   a) 1,500 lb. dynamic Z4 weight capacity with additional Z4 bracket accessory
   2. Keyed swing handle lock
   3. Perforated front and rear doors
   4. Reinforced in the middle with extra cross support
   5. Reversible without any additional hardware
   6. Flat rear mesh door(s)
   7. Adjustable mounting rails
   8. Mounting rails with orange measuring guides
   9. 42 RRU (77”) and 47 RU (86”) Heights
   10. 42” and 48” Depths
   11. 30” wide
   12. #12-24 threaded rails
   13. Large and multiple removable plates to allow cable entry
   14. Comes with casters and leveling feet installed
   15. Removable side covers
   16. Adjustable mounting rail
   17. Available fan unit (sold separately)
   18. Acceptable Manufacturer:
      a) Hubbell Premise Wiring
         1) H3N4242 - Cabinet, Network, 42RU, 30"W, 42"D
         2) H3N4248 - Cabinet, Network, 42RU, 30"W, 48"D
         3) H3N4742 - Cabinet, Network, 47RU, 30"W, 42"D
         4) H3N4748 - Cabinet, Network, 47RU, 30"W, 48"D

B. Server Cabinet
   1. 3,000 lb. weight capacity
2.2 FLOOR MOUNT RACKS

A. Extruded aluminum construction, black powder coated finish.
B. 19 inches mounting width by 84 inches high with a 24-inch full width base.
C. 1000lb. static weight capacity.
D. 12/24 tapped holes, EIA/ECA-310-E Universal Mounting Pattern
E. 45 rack mount units, +1 on rear for Horizontal Busbar
F. 3-inch-deep mounting rails.
G. Ladder rack mounting plate attached.
H. Furnish and install vertical wire management channels on both side of rack, type as specified.
I. Furnish and install horizontal wire management units, quantity and type as specified.

J. Furnish and install ground terminal block/lug for each rack and #6 ground wire to room ground bus bar.

K. Acceptable Manufacturer:
   1. Hubbell Premise Wiring HPW84RR19

2.3 ACCESSORIES

A. Fan Tray
   1. 2 Fans per tray
   2. Total of 162 CFM
   3. 110 or 230 Volt
   4. Works with Network Cabinet (H3N Series)
   5. Acceptable Manufacturer:
      a) Hubbell Premise Wiring
         1) H3FT110 – 110 volt
         2) H3FT230 – 230 volt

B. Power Strip
   1. Approved Manufacturer:
      a) Hubbell Premise Wiring MCCPSS19
   2. Electrical Specifications: 20A-120V
   3. Receptacle Type: NEMA 5-15R
   4. 10 Outlets
   5. Surge protected
   6. ON-OFF switch

C. Horizontal Cable Management
   1. 1RU front management only
      a) Acceptable Manufacturers:
         1) Hubbell Premise Wiring HM14C
         b) 4” front ring depth
         c) metal construction
         d) Front cover
         e) Pass-thru holes from front to rear
   2. 2RU front management only
      a) Acceptable Manufacturers:
1) Hubbell Premise Wiring HM24C
   b) 4” front ring depth
   c) metal construction
   d) Front cover
   e) Pass-thru holes from front to rear

D. Vertical Cable Management
   1. Equipment Racks
      a) Acceptable Manufacturer:
         1) Hubbell Premise Wiring VS76
         b) 84”H X 4” W X 6” D
         c) 14 gauge cold rolled steel
         d) Door with positive latch
         e) Steel rod support members – all steel construction
         f) Black powder coated

E. 19” FILLER PANELS
   1. 1RU - 1.75” H – MCCBP175
   2. 2RU - 3.5” H – MCCBP350
   3. 4RU - 7.0” H – MCCBP700

PART 3 EXECUTION

3.1 INSTALLATION

A. All termination hardware shall be installed in accordance with manufacturer’s recommended procedures.

B. All hardware shall be placed so as to make efficient use of available space in coordination with other uses. All wiring and associated hardware shall be placed so as to not impair the use or capacity of other building systems, equipment, or hardware placed by others (or existing).

C. Hardware shall be installed as to avoid interference with any other service or system, operation, or maintenance purposes such as access boxes, equipment, mechanical equipment access doors and covers, switches or electrical panels, and lighting fixtures. Hardware shall be installed to maintain a minimum 36 inch working clearances in the front and rear of all racks and cabinets wherever possible.

D. Contractor shall attach all floor mount racks and cabinets to building structure with hardware as required by manufacturer, 3/8-inch hardware minimum. Furnish and install seismic rated hardware where required by local codes. Furnish and
install raised floor mounting kits where racks and cabinets are installed on raised floors.

E. Contractor shall attach all wall mount racks and cabinets to building structure with hardware as required by the manufacturer. All wall mount racks and cabinets shall be mounted on plywood backboards. Wall mount racks and cabinets on gypsum wall board walls shall be attached through the plywood and fastened to wood studs or wood blocking in the wall.

F. Rack configurations indicated on Drawings are typical and may not reflect final installation in all telecommunications spaces. Contractor shall coordinate final rack layouts with fiber termination enclosures, patch panels, wire management panels, equipment and equipment to be furnished and installed by the Owner, prior to installations in the enclosures or racks.

G. Furnish and install quantity of Velcro wraps as required for proper cable bundling, organization and support. Plastic or nylon cable ties will not be accepted for use on any category rated cable.

H. Contractor shall coordinate with General Contractor for placement of blocking in walls where wall mount cabinets are to be installed.

I. Furnish and install 3/4-inch-wide hook and loop fasteners to bundle all cables in telecommunications spaces and other areas of telecommunications cable termination, minimum 8 inches in length.

3.2 SATELLITE EQUIPMENT ROOM LAYOUT

A. A SER houses the terminations of horizontal and backbone cables to connecting hardware including any jumpers or patch cords. It may also contain the interconnect (IC) or main cross-connect (MC) for different portions of the backbone cabling system. The SER also provides a controlled environment to house telecommunications equipment, connecting hardware and splice closures serving a portion of the building. The use of a telecommunications enclosure (TE) is for a specific implementation and not a general case. It is intended to serve a smaller floor area than a SER and may be used in addition to the minimum "one SER per floor" rule.

1. There will be a minimum of two network racks with 6-inch-deep vertical wire management per SER, each rack has a footprint of 2’X2’ and shall be bolted and bonded together.

2. If the size of the room is 10’X10’, there shall be 2 racks.

3. If the size of the room is 10’X12’ or greater, there shall be a minimum of 3 racks.

4. In a 2-rack configuration, the left most rack is for cabling. In configurations with more than 2 racks, the network electronics will be in the middle.
OSP Fiber Demarc patch panels are to be mounted in the top of the center rack.

4RU Fiber Panels shall be used for MDF SER to service the outside fiber plant to the inside the building fiber plant infrastructure.

2RU horizontal cable manager shall be placed above and below each voice cross-connect patch panel.

Mount 2RU, 48-port voice cross-connect patch panel (voice circuits 1–48) above the WAO station cable patch panel. The number of voice cross-connect jacks shall be equal to the number of pairs in the voice riser cable pair count.

Only 2RU, 48-port panels will be used for horizontal cabling.

2RU horizontal cable manager will be placed above and below each copper patch panel.

No more than five (8) 48-port station cable patch panels (data circuits 1–384) will be placed in a rack.

Rack mounted ground bar (rear or rack)

2RU Riser Fiber Patch Panel is to be mounted in the top of the rack.

Network electronics such as edge switches, uplink switches, and firewalls.

Uninterrupted Power Supply (UPD) with network interface card installed

MicroPod Power Distribution Unit

Only 2RU, 48-port panels will be used for horizontal cabling.

2RU horizontal cable manager will be placed above and below each copper patch panel.

No more than ten (10) 48-port station cable patch panels (data circuits 385–916) will be placed in a rack.

No patch panels should be installed below 12 inches from the floor.

Rack will be appropriately grounded.

Figure 1: Front View of MDF Racks Layout
2RU horizontal cable manager shall be placed above and below each voice cross-connect patch panel.

Mount 2RU, 48-port voice cross-connect patch panel (voice circuits 1–48) above the WAO station cable patch panel. The number of voice cross-connect jacks shall be equal to the number of pairs in the voice riser cable pair count.

Only 2RU, 48-port panels will be used for horizontal cabling.

No more than ten (8) 48-port station cable patch panels (data circuits 1–384) will be placed in a rack.

2RU horizontal cable manager will be placed above and below each copper patch panel.

No patch panels should be installed below 12 inches from the floor.

Rack 1
Horizontal Cable Management

Rack mounted ground bar (rear or rack)
2RU Riser Fiber Patch Panel is to be mounted in the top of the rack.
Network electronics such as edge switches, uplink switches, and firewalls.
Uninterrupted Power Supply (UPD) with network interface card installed
MicroPod Power Distribution Unit
Minimum 3 feet clearance on all sides of the rack
Rack will be appropriately grounded.

Rack 2
Network Electronics Management

Figure 2: Typical IDF Two Racks Configuration
2RU horizontal cable manager shall be placed above and below each voice cross-connect patch panel.

Mount 2RU, 48-port voice cross-connect patch panel (voice circuits 1–48) above the WAO station cable patch panel. The number of voice cross-connect jacks shall be equal to the number of pairs in the voice riser cable pair count.

Only 2RU, 48-port panels will be used for horizontal cabling.

No more than ten (8) 48-port station cable patch panels (data circuits 1–384) will be placed in a rack.

2RU horizontal cable manager will be placed above and below each copper patch panel.

No patch panels should be installed below 12 inches from the floor.

Figure 3: Typical IDF Three Racks Configuration

5. All fiber patch panels are to be mounted in the top of the rack with the network electronics.
6. No patch panels should be installed below 24 inches from the floor.
7. There shall be a minimum of 3 ft. clearance around all sides of the connected racks, measured from equipment mounted on wall, not the wall itself. Install appropriate 48-port patch panels in the cabling rack and the fiber optic patch panel in the network electronics rack.

Figure 6: Side View of Rack Layout
8. There shall be horizontal wire management for patch panels, one installed above and the other underneath the patch panel. When determining the port quantities add 25% for future growth.

![Patch Panel Management Configuration View](image)

**Figure 7: Patch Panel Management Configuration View**

9. A minimum of 18” wide Ladder Rack shall be installed around room and to each rack.
10. 18” Basket Tray is allowed only for cabling pathway from the SERs to the WAOs. Basket tray depth is to be sized for cable run plus 20% for future group.

B. Copper riser cables for analog telephone service should be terminated in an RJ-45 patch panel below the fiber.

**END OF SECTION 27 11 16**
SECTION 271300 - COMMUNICATIONS BACKBONE CABLEING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Furnish and install voice and network cabling for the building as indicated on drawings and as called for hereinafter. This specification is for a voice and network cabling system. The Hubbell products specified hereinafter are utilized as campus standard for University of Tennessee Knoxville. Any proposed replacement products must meet or exceed the published specifications. Alternates must be verified with University of Tennessee Knoxville OIT by furnishing proper documentation of specifications verified by an industry-recognized test laboratory (U.L., ETL, ASTM).

B. This standard also establishes performance criteria for various system configurations and their elements.

C. Installer of cabling installation specified herein must be a certified trained installer using ANSI TIA Standards and the current edition of the BICSI TDMM (Telecommunications Distribution Methods Manual, Current Edition) as a guide for installation of inside cabling and associated components. Installer must be Hubbell Certified. Provide written documentation of these qualifications as part of the submittal process.

1.2 REFERENCE STANDARDS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 27 00 00 Communications

C. Section 27 05 26 Grounding & Bonding for Communications Systems

D. Section 27 05 28 Pathways for Telecommunications Systems

E. Section 27 05 36 Cable Trays for Communications Systems

F. Section 27 11 10 Telecommunications Spaces, Equipment and Fittings

G. Section 27 11 16 Communications Cabinets, Racks, Frames, and Enclosures

H. Section 27 13 23 Communications Optical Fiber Backbone Cabling

I. Section 27 15 13 Copper Horizontal Cabling

J. Section 27 15 43 Communications Faceplates and Modules

K. Section 27 16 19 Communications Patch Cords and Station Cords

PART 2 - PRODUCTS

1.1 SUBMITTALS

A. Provide submittal information for the following submittal sections as described below:

1. Product Data

2. Shop Drawings:

   a. Cable Routing and Grouping Plan: Provide only if cable routing and grouping have not been shown on the Drawings, or if proposing a deviation.
3. Testing
   a. Provide a list of proposed test equipment for use in verifying the installation of the communications cabling system.
      I. Provide for each testing device:
      II. Manufacturer and product number.
      III. Manufacturer documentation showing date and outcome of last recalibration.

4. Testing device shall have been re-calibrated within the manufacturer’s recommended recalibration period.

5. Manufacturer documentation showing software revision. Software revision shall be most current revision available for the device and shall be based upon the most current TIA/EIA testing guidelines.

6. Patch cords and other specialized components.

7. Provide proposed test result forms.

8. Provide the calculated optical fiber cable loss budget for each optical fiber cable in the system.

PART 2 - PRODUCTS
2.1 GENERAL
   A. Communication cabling system components shall be sourced (manufactured) by formally partnered Manufacturers (collectively referred to as the “Manufacturer”).
      1. Products shall not be intermixed between different manufacturers unless the Manufacturer of the chosen communications cabling system has listed (in writing) another manufacturer’s component as an “Approved Alternative Product” and will warrant the “Approved Alternative Product” as part of the Manufacturer’s extended Warranty.
   B. Provide the same Manufacturer for this section as that for Division 27 Section 271500 – Communications Horizontal Cabling unless otherwise noted.
   C. For a given Manufacturer, all cabling products shall be part of a single product line – components shall not be intermixed between a Manufacturer’s product lines.
      1. The product line shall be engineered “end-to-end” (i.e. the system and all its components shall be engineered to function together as a single, continuous transmission path).
      2. Physically verify the following materials on site, prior to purchase and delivery of the materials:
         a. Lengths of conduit and/or pathway to be used for routing backbone cabling. Precut materials of insufficient length shall not be installed.
         b. Fill ratio and overall suitability of raceway for installation of inside plant cabling.
         c. Promptly notify the Engineer of potential overfill, potential for installation problems due to overfill, or raceway which may be otherwise deemed unsuitable for use and shall await the Engineer’s direction prior to purchase and delivery of the materials.

2.2 PERFORMANCE
   A. Protocols/Services:
      At a minimum, the communications cabling system shall support data network protocols/services at
rates up to 10 Gbps. It shall support 10 Mb, 100 Mb, 1 Gb, and 10 Gb Ethernet and other network protocols.

1. The communications cabling system shall additionally support RS-232 and other dedicated point-to-point protocols.

2. The communications cabling system shall support PBX telephone services.
   a. It shall support analog, digital, and ISDN services, and shall be compatible with direct trunk lines (POTS).

B. Category Rating (for copper components):
Copper components (cable, connectors, etc.) shall exceed the transmission requirements for connecting hardware as specified in the TIA standards for the Category for which they are rated.

1. PATCH PANELS Copper Patch Panels
   a. Multi-pair copper riser panels:
      I. Angled Flat rack mountable in 19” rack
      II. Terminate 4-pair, 22-26 AWG, 100-ohm unshielded twisted pair cables with a standard 110 punchdown tool
      III. Support a universal (T568A and T568B) wiring pattern
      IV. Exceed the transmission requirements for connecting hardware as specified in the TIA/EIA standards for the Category for which they are rated.
   b. Bar strain relief
   c. Complete with all incidental materials necessary for mounting

2. Analog phone gateway panels:
   a. 2 RU 48 port flat rack mountable in 19” rack
   b. (48) RJ45 ports

3. Manufacturer:
   a. Hubbell 48 port Nextspeed Punchdown Patch Panel HP648E
   b. Approved equal

C. Fiber Patch Panels

1. Enclosures:
   A. Accept modules for the termination of multimode and/or single mode fiber backbone cables and shall be sized (port/fiber count and rack units) as shown on the Drawings.
   B. Rack mountable with sliding doors and strain relief
   C. Blank adapter panels for unused openings
   D. Complete with fiber connectors and receptacle adaptors (see “Connectors” below) and with incidental materials necessary for mounting.

2. Connectors:
   A. Factory prepolished with fusion splice mounted in fiber adapter panels inside fiber enclosure.
      1. Multimode: Duplex LC connectors for 50/125 μm multimode fiber
2. Singlemode Duplex LC connectors for singlemode fiber

B. Manufacturers:
   1. Corning

3. Products: Fiber Optic Connector Housing
   b. Corning CCH series or
   c. Hubbell FCR series

4. Fiber Optic Connectors
   a. Corning 000201R4Z31003M
      i. Corning 000412R8120003M

2.3 COPPER TERMINATION FRAMES AND BLOCKS

A. 110-Style Blocks:
   2. 100-pair (or as noted on drawings) connecting blocks, designation strips, and labels for each 25-pair strip.
   3. Label colors per TIA standards.
   4. UL listed blocks without legs as required for mounting on frames.
   5. 66-style blocks are not acceptable.

B. Manufacturer:
   1. P110 Blocks Rack Mount 100 pair with wire management
      a. Hubbell 110rm15 or
      b. Panduit P110B100R4YJY with P110C5 connecting blocks

2.4 CABLE

Cables shall be manufactured by:

A. CAT5E Cable
   1. Hubbell or
   2. Hitachi or
   3. General or
   4. Panduit or
   5. Mohawk

B. CAT6 Cable
   1. Hubbell or
   2. Hitachi or
   3. General or
   4. Panduit or
   5. Mohawk

C. Fiber Optic OSP Cable
   1. Fiber shall be single mode manufactured by Corning

D. Fiber Optic Riser Cable
   1. Fiber shall be single mode manufactured by Corning
E. Coax
   1. to be determined on a per project basis.

F. OSP Coax, Flooded
   2. to be determined on a per project basis.

E. OSP Phone CAT3 Buried Service Wire (BSW)
   1. Essex Cable PE89 and/or PE22 as determined by UTK OIT or
   2. General Cable PE89 and/or PE22 as determined by UTK OIT

G. Riser Phone CAT3 - Copper riser shall be ARMM manufactured by:
   1. General or
   2. Superior/Essex

2.5 CABLE ASSEMBLIES (PATCH CORDS) AND CROSS-CONNECTS
A. Same as Copper Patch Cables: Provide per Division 27 Section 271500 – Communications Horizontal Cabling.
B. Fiber Patch Cables:
   1. Provide fiber patch cables for fiber cross-connects. Fiber patch cables shall be pre-manufactured (factory-terminated) with a UL rating of OFNR.
   2. Fiber patch cables shall be manufactured by the selected communications cabling Manufacturer.
C. Quantities and sizes: Provide 3-meter patch cables. Provide for 25% of all multimode ports.
   1. Color: Aqua

2.6 CABLE SUPPORTS
   1. Provide per Division 27 Section 270529 –Hangers and Supports for Communication Systems.

2.7 CABLE STRAPS
   1. Reusable Velcro hook-and-loop style straps to secure cable bundles. Plastic tie wraps are unacceptable.

2.8 TESTING
A. General
   1. Testing of the systems shall be in accordance with the manufacturer’s recommendations and with the Governing Requirements.
   2. Test reports shall be complete and in accordance with the appropriate Governing Requirements.
   3. Where testing discloses deficiencies in the work, rework, repair, or replace equipment and systems found deficient.
4. Continue remedial measures and retesting until satisfactory results are obtained. Remedial measures and retesting shall be at no additional cost to the Owner.
5. Testing of product or equipment prior to installation shall include performance testing to establish the applicability of equipment for its intended purpose.
6. Establish the required test procedures from required Governing Requirements and manufacturer’s recommendations.
7. Provide necessary test equipment, power, and consumables to perform the test.
8. Notify the OIT of test schedule(s) at least one week in advance.

B. Perform test
1. Provide test result documentation to OIT.
2. Final testing and start-up of product, equipment, and systems shall include establishing proper capacity, operation, maintenance, and compliance with Governing Requirements.
3. Provide the services of manufacturer’s representatives for systems to be tested and started up.
4. Establish the required test procedures from required Governing Requirements and manufacturer’s recommendations.
5. Provide necessary test equipment, power, and consumables to perform the test.
6. Notify OIT of test schedule(s) at least one week in advance.
7. Test records for each cable within the system shall be printed directly from the tester and shall be submitted in paper form (in a binder) and on USB drive to the Owner and Consultant for review.
8. Handwritten test results will not be accepted.

C. For copper cables:
1. Testing device shall be an ANSI/TIA-568-C Level 4 testing instrument re-calibrated within the calibration period recommended by the manufacturer, with the most current software revision based upon the most current TIA/EIA testing guidelines.

D. For fiber cables:
1. Testing devices shall consist of a light source/power meter with a stabilized light source for end-to-end attenuation testing and an Optical Time Domain Reflectometer (OTDR) for testing on the reel, for continuity and quality testing, for accurately determining cable length, and for locating and correcting problems noted during attenuation testing.
2. Testing equipment shall be calibrated and traceable to the National Institute for Standards and Technologies (NIST), with an operating range of 850 ±30 nm or 1300 ±20 nm in accordance with TIA/EIA-526-14 for multimode testing, and an operating range of 1310 ±10nm or 1550 ±20 nm in accordance with TIA/EIA-526-7 for single mode testing.
3. To ensure quality connectorization/splicing, a microscope of not less the 200x magnification shall be used to visually inspect connectors and splices after installation.

PART 3 - EXECUTION
3.1 GENERAL
A. CONNECTORS
1. Fiber connectors and splices:
a. Visually check fiber connectors/splices after splicing with a minimum 200x magnification microscope to ensure that no physical damage has occurred during the installation process.  
b. Fiber splices shall be fusion and shall be required for all fiber strands.  
c. Mechanical splices are not acceptable. Each fusion splice shall be protected in a splice tray or similar protective device that is designed to mount within the enclosure.  
d. Bare/stripped optical fiber strands shall be protected with a heat shrink or silicon adhesive to prevent exposure to moisture.  

B. COPPER TERMINATION BLOCKS  
1. Cable shall be routed horizontally along base of backboard until it reaches the termination block column on which it is to terminate and then shall route vertically to the termination block.  
2. Termination block punch downs shall be as follows:  
   a. Punch down cable sequentially across the termination strips.  
   b. Punch down cable using only the selected communication cabling system  
   c. Manufacturer approved impact tool.  

3.2 CABLE  
A. General (applicable to all cable types):  
1. Cable shall be installed in strict compliance with the manufacturer’s recommendations.  
2. Maintain separation from other conductors (power, fire alarm, etc.) per NEC requirements and TIA/EIA standards.  
3. The bending radius and pull strength requirements of all cable as detailed in the TIA/EIA standards and the manufacturer’s installation recommendations shall be strictly observed during handling and installation.  
4. Pull cables simultaneously where more than one cable is being installed in the same raceway  
5. Use pulling compound or lubricant where necessary.  
6. Use compounds that will not damage conductor or insulation (Polywater or approved equal).  
7. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cable or raceway.  
8. Cable jackets shall not be twisted during installation. Cables showing evidence of twisting shall be replaced at no additional cost to the Owner, regardless of the outcome of cable testing.  
9. Cable shall be installed in a continuous (non-spliced) manner unless otherwise indicated.  

B. Cable installed in conduit and/or ducts:  
1. Fill ratios shall not exceed NEC requirements.  
2. Cable shall not be pulled into conduit/ducts until the conduit/duct ends have been prepared for cable installation (i.e. reamed to eliminate sharp edges and insulated throat bushings installed). Cables pulled into conduit/ducts prior to conduit/duct end preparation shall be replaced at no additional cost to the Owner.  
3. Reinstate pull-wires in conduits and ducts after use to facilitate future addition of cables.  

C. Cable installed in cable tray:  
1. Cable shall not be attached to the cable tray (i.e. cable shall be left “loose”) with the exception of cable installed in cable tray (cable runway) within telecommunications rooms (see “Cable in telecommunications rooms” below).  
2. Cable shall be laid in tray in such a way as to present a neat and professional appearance.
3. For cable tray serving both backbone (riser) and horizontal cabling, install cable in cable tray in such a manner that backbone cabling does not overlap with horizontal cabling – reserve approximately one-fourth of the space in the tray for backbone cabling and the remaining three-fourths for horizontal cabling.

4. Where cables in cable trays are required to maintain specific distances between each other, they shall be firmly secured to maintain this distance at fire rated penetrations.

D. Cable not installed in conduit/ducts or cable tray:
   1. Cables shall be strapped or fastened with reusable Velcro hook and loop style cable straps/fasteners for support.
   2. Staples and tie-wraps are not acceptable:
      i. Straps and fasteners shall not be over-tightened.
      ii. Cables showing evidence of over-tightening shall be replaced at no additional cost to the Owner, regardless of the outcome of cable testing.
   3. Straps and fasteners installed in plenum spaces shall be plenum rated.
   4. Cables shall be bundled by application (horizontal or backbone) and by cable type (Cat 3, Cat 5E, Cat 5, Cat 6, Cat 6A, MM Fiber, SM Fiber, etc.).
   5. Cable applications and types shall not be intermixed within a bundle.
   6. Cables in suspended cable runs shall be supported at varying intervals.
   7. Cable spans shall be limited to 5 feet or less, and the length of spans shall vary along the cable path (i.e. a given span should not be the same length as the span preceding or following it – “exact” spans can degrade cable performance).
   8. See Division 27 Section 270528 – Communications Raceways and Pathways for requirements.
   9. Cable installed on exposed surfaces or structural members shall be installed parallel and perpendicular to the surfaces.
   10. Surface contours shall be followed wherever possible. Cables shall be attached to surfaces at intervals not to exceed 3 feet.
   11. Attaching cables to pipes, electrical conduit, mechanical items, existing cables, or the ceiling support system (grids, hanger wires, etc. – with the exception of ceiling support anchors) is not acceptable.

E. Cable in telecommunications rooms:
   1. Cable straps: Install per Division 27 Section 271100 – Communications Rooms.

F. Cable on backboards:
   1. Cable shall be routed as close as possible to the ceiling, floor, sides, or corners to ensure that adequate wall or backboard space is available for current and future equipment and for cable terminations.
   2. Lay cables via the shortest route directly to the nearest edge of the backboard from mounted equipment or blocks. Secure all similarly routed and similar cables together and attach to D-rings vertically and/or horizontally, then route over a path that will offer minimum obstruction to future installations of equipment, backboards or other cables.
   3. See “Part 3 – Execution: Copper Termination Blocks” herein for details on routing copper cabling to termination blocks.
G. Cable Slack:
   1. Provide cable slack (service loops) at cable ends (both ends) to accommodate future cabling system changes.
   2. Provide slack length as follows:
      a. For fiber: Provide a minimum of 25 feet.
      b. For copper and coaxial: Provide a minimum of 25 feet.

H. Copper Cable:
   1. All pairs within a cable shall be terminated. Un-terminated cable pairs are not acceptable.
   2. Provide strain relief at the patch panels to ensure durable connections.
   3. For shielded/armored cable, bond both ends of the metallic shield (or metallic strength member) to the nearest TGB.

I. Fiber Cable:
   1. All fiber strands within a fiber cable shall be spliced/connectorized. The installation of “dark fiber” is not acceptable.
   2. Cable shall be tested on reel prior to installation.

J. Cable assemblies and patch cords
   1. Provide cable assemblies to Owner.

3.3 TESTING
A. General
   1. Test devices shall be in calibration throughout the testing period. Tests performed on equipment without up to date calibration shall be rejected and shall be repeated at no additional cost to the Owner.
   2. Notify the Consultant and Owner seven (7) days in advance of each type of test to be conducted.
   3. The Owner and/or Consultant may, at their discretion, witness all testing.
   4. The Owner and Consultant shall be invited to attend and inspect the first instance of each type of test to be conducted.
   5. Tests conducted prior to first inspection shall be at the sole risk of the Contractor, and as such are subject to rejection.
   6. Such tests will be repeated at no additional cost to the Owner.

B. Systems Specific Testing: Communications Cabling System
   1. All interior (inside plant) and exterior (outside plant) fiber cables shall be tested on the reel upon delivery to the job site prior to installation.
   2. Test results shall be permanently affixed to the reel and a copy given to the Owner and Consultant for review prior to installation.
   3. Testing shall demonstrate compliance with the factory test results as shipped with the reel.
   4. Cables that fail to pass shall not be installed and replace the cable at no additional cost to the Owner.
   5. Repair of damaged cable is not acceptable.
   6. Test the communications cabling system for compliance to the Governing
   7. Requirements and all applicable standards as follow:
a. Visually inspect all labels at the station locations (faceplates/ports), patch panels/ports, and on each end of each cable to ensure that all cables and equipment are correctly identified.

C. Copper Cable:
1. For Backbone Distribution (inside and outside plant): Test each cable, all pairs, for length, shorts, opens, continuity, polarity reversals, transposition (wire map), and the presence of AC voltage.
2. Test entire channel, from termination block to termination block.
3. Test results shall demonstrate compliance with:
   a. The criteria specified in TIA/EIA-568-C for all Category of cables

D. Fiber Cable:
1. Prior to testing, calculate the cable loss budget for each optical fiber cable and shall be clearly shown on the test documentation.
2. Maximum loss shall be calculated by the following formula, assuming no splices:
3. For Backbone Distribution:
   a. Max Loss = (allowable loss/km) * (km of fiber) +(0.4 dB) * (# of connectors) + (0.3 dB) * (# of splices)
   b. A mated connector-to-connector interface is defined as a single connector for the purposes of the above formula.
4. A given fiber cable shall not exceed its calculated maximum loss (per the above formula).
5. Test all strands. Testing shall consist of a bi-directional end-to-end Optical Transmission Loss Test Instrument trace performed per ANSI/TIA-568-C, TIA/EIA-455-61 and/or a bidirectional end-to-end power meter test performed per ANSI/TIA-568-C and TIA/EIA-455-53A.
6. Loss numbers shall be calculated by taking the sum of the two bi-directional measurements and dividing that sum by two.
7. All backbone fiber cables shall be tested with an OTDR in addition to attenuation testing performed with a power meter.
8. The number of samples (averages) for each OTDR test shall be such that the noise amplitude is significantly less than the smallest loss of any component under test.
9. Multimode fiber testing shall incorporate use of a mandrel wrap of fiber jumper to induce macro bends in the fiber.
10. Test measurements shall be provided as follows:
    a. For Multi-mode Cable: Test at both 850 and 1300 nm.
    b. For Single mode Cable: Test at both 1300 and 1550nm.
11. Test results shall demonstrate compliance with:
    a. The criteria specified in TIA/EIA-568-C
    b. The calculated loss budget above.
    c. The criteria specified in IEEE 802.3z (1000Base-X Gigabit Ethernet) and IEEE 802.3ae (10GBase-X 10 Gigabit Ethernet)
12. In addition to the above, tests performed shall be both those recommended and mandated by the communications cabling system Manufacturer.
3.4 CABLES AND EQUIPMENT THAT DO NOT PASS
1. Cables and equipment that do not pass shall be identified to the Consultant.
2. The source of the non-compliance shall be determined, corrected or replaced, and re-tested at no additional cost to the Owner.
3. Provide new test results to the Consultant in the same manner as above.
4. If it is determined that a cable is at fault, remove the damaged cable and replace it with a new cable. Cable “repairs” are not acceptable.
5. The procedure for removing the cable shall be as follows:
   a. Prior to removal of the damaged cable and re-pull of the new cable:
   b. Any cables which are in the same conduit, duct or innerduct as the damaged cable shall be tested, regardless of whether or not they are new cables installed as part of this project or existing cables installed prior to this project.
6. If the damaged cable is a backbone or outside plant cable:
   a. The Owner and Consultant shall be informed of the schedule for the removal and re-pull.
   b. The new cable shall be tested on the reel prior to installation.
   c. All test results shall be provided to the Consultant for approval.
7. The damaged cable shall be removed, and the new cable shall be pulled in.
8. After the removal of the damaged cable and re-pull of the new cable:
   a. The new cable shall be tested.
   b. Any cables which are in the same conduit, duct or innerduct as the damaged cable shall be tested, regardless of whether they are new cables installed as part of this project or existing cables installed prior to this project.
   c. All test results shall be provided to the Consultant for approval.
9. Existing cables which are in the same conduit, duct or innerduct as the damaged cable, and which are damaged by the extraction and re-pull process, shall be removed and replaced at no additional cost to the Owner.
10. Existing damaged cables that are replaced shall be subject to the testing procedures of this section in its entirety.

END OF SECTION 271300
PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install voice and network cabling for the building as indicated on drawings and as called for hereinafter. This specification is for a voice and network cabling system. Products specified hereinafter are for a complete communication connectivity solution including jacks, patch panels, patch cords, and faceplates - all shall be utilized. The Hubbell products specified hereinafter are utilized as campus standard for University of Tennessee Knoxville. Any proposed replacement products must meet or exceed the published specifications. Alternates must be verified with University of Tennessee Knoxville OIT by furnishing proper documentation of specifications verified by an industry-recognized test laboratory (U.L., ETL, ASTM).

   a. See OIT SER and Structured Cabling Requirements document for approved equals for all products referenced in this specification.

      I. Latest OIT SER and Structured Cabling Requirements document found on the UTK website.

   b. UTK OIT approved equals are in the appendices of the OIT SER and Structured Cabling Requirements.

B. This standard also establishes performance criteria for various system configurations and their elements.

C. Installer of cabling installation specified herein must be a certified trained installer using ANSI TIA Standards and the current edition of the BICSI TDMM (Telecommunications Distribution Methods Manual, Current Edition) as a guide for installation of inside cabling and associated components. Installer must be Hubbell Certified. Provide written documentation of these qualifications as part of the submittal process.

1.2 CABLING STRUCTURE

A. The elements of a cabling system are listed below:

   1. Horizontal Cabling
   2. Work Area Outlets (WAO)
   3. SER Rooms (See Section 27.11.00)
   4. TR Rooms (See Section 27.11.00)

B. HORIZONTAL CABLING

   1. Horizontal cabling shall be of star topology; each work area connector shall be terminated in the telecommunications room. The maximum horizontal distance from SER to the WAO shall be 90 meters. When deductions are made for mandatory minimum slack, the cable distance is approximately 85 meters (281 feet).

   2. The amount of untwisting of individual pairs to terminate shall be less than or equal to .5 in. for
Category 6 and 5E.
3. Minimum bend radius shall be 4 times the cable diameter.

C. REFERENCE STANDARDS

1. See section 27.01.00 for standards.
2. See section 27.05.53 Administration/Labeling.
3. See section 27.05.26 Grounding and bonding.
4. See section 270800 Commissioning of Communications

D. ADMINISTRATION STANDARD FOR COMMUNICATIONS INFRASTRUCTURE:

1. Purpose: The purpose of this standard is to provide a uniform administration scheme that is independent of the applications. This standard defines guidelines for contractors involved in the installation of the computer cabling system.
2. Scope: This standard specifies the administrative requirements of the communications infrastructure within a building or campus.
3. Areas to be administered are as follows:
   a) Terminations for the communications media
   b) Communications media between terminations
   c) Pathways between terminations
   d) Spaces where terminations are located
   e) Bonding and grounding
4. Pathway and Space Administration: All spaces must be labeled. Labels should be affixed at the entrance of the space.
5. Wiring System Administration: This section describes the administration of cables, termination hardware, splices and termination position. As changes are made, effected labels, records, drawings and reports shall be updated.
   a. Horizontal and backbone subsystem cables shall be labeled at each end.
   b. Each termination hardware or label shall be marked with an identifier.
   c. Each termination position label shall be recorded with an identifier.
   d. Each splice closure or label shall be marked with an identifier.
   e. Each grounding conductor and grounding bar shall be marked with an identifier.
      a. EXAMPLE: "TMGB" shall be marked on the Telecommunications Main Grounding Busbar.

E. LABELING AND COLOR CODING:

1. All labeling shall be completed using a Panduit Panther LS8E Label Maker
2. Labels are divided into 3 categories:
   a) Adhesive labels shall meet adhesion, defacement and legibility requirements defined in U.L. 969. Labels shall also meet exposure requirements in U.L. 969.
b) Insert labels shall also meet U.L. 969 requirements for defacement, legibility and general exposure.
c) Other labels include special purpose labels, such as tie-on labels.
d) Hand marking is only used during the rough-in stage of installation
   A. Labels shall be used instead of marking the cable for final installation.

3. All bar codes shall be either Code 39 or Code 128 confirming to USS-39 and USS-128 respectively. All Code 39 bar code ratios shall be within 2.5:1 to 3.0:1. If a wand scanner is to be used, a minimum quiet zone of 6.35mm is required on each side of the bar code.

4. Adhere to Section 270553 in this specification

5. Refer to OIT Guidelines, Section 12.0 Labeling

F. COLOR CODING RULES:

1. Termination labels at the two ends of the cable shall be of the same color.
2. Orange is used for the demarcation point.
3. Yellow is for the network connections on the customer side of the demarcation point.
4. Yellow is for termination of Wi-Fi wireless access circuits.

G. DIFFERENTIATION OF TERMINATION FIELDS BY PERFORMANCE CATEGORY

1. If cables are of different performance classes, their ends should indicate the difference. The labels shall be marked with the proper category of the cable.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wall-Station Jacks: All jacks are to be considered for data use and not voice.
   1. Jacks shall be standard 8-position, RJ-45 style, un-keyed, FCC compliant.
   2. Jacks shall be designed for 4-pair, 100 ohm balanced unshielded twisted pair (UTP) cable.
   3. Jacks shall terminate 26-22 awg solid or stranded conductors.
   4. Jacks shall include a dust cap for wire retention.
   5. Jacks shall accept FCC compliant 6 position plugs.
   6. Jacks shall have attached wiring instruction labels to permit either T568a or T568b wiring configurations.
   7. Category 6 jacks shall be backward compatible with existing category 3, 5, and 5e cabling systems for fit, form, and function.
   8. Jacks shall be manufactured in the USA.
   9. Category 6 jacks shall be Component compliant per ANSI/TIA-568.2-D
   10. Jacks shall be UL listed and CSA certified.

B. All Jacks shall exceed the TIA standard for performance.
C. Products approved:
   1. **CAT5E Jacks**
      a. Hubbell HXJ5EB or
      b. PANDUIT CJ5E88TGBU
   2. **CAT6 Jacks**
      a. Hubbell HXJ6Y or
      b. Panduit CJ688TGYL
   3. **Coax RG6 F-Fittings**
      a. Thomas and Betts SNS1P6U or
      b. Thomas and Betts plenum SNS6PLA or
      c. Ideal 92-660
   4. **Coax RG11 Fitting**
      a. Thomas and Betts SNS11AS
   5. **Coax F-81 Jack** - (office only, not student rooms)
      a. Hubbell SFFEX or
      b. Panduit CMFEI

D. Wall-Station Faceplates
   1. Faceplates are required at all wall mounted locations.
      A. Rear loading w/designation window
         I. Faceplates shall be constructed of high impact, UL94 v-0 rated thermoplastic.
         II. Faceplates shall be compatible with standard NEMA openings and boxes.
         III. Faceplates shall be 2.75” x 4.5” h (69.8 mm x 114.3 mm) for single gang and 4.5” x 4.5” (114.3 x 114.3 mm) for double gang.
         IV. Port size in each faceplate shall fit the category 6 modular jack or snap-fit fiber optic, audio, and video modules for multimedia applications.
         V. Faceplates shall be provided with clear plastic and color-matched label field covers. Faceplates shall provide for ANSI/TIA-606-B compliant workstation outlet labeling.
         VI. #6-32 pan head phillips/slotted mounting screws shall be included with each faceplate.
         VII. Faceplates shall be UL listed and CSA certified.
2. The locations with their faceplate are listed below.

3. All unused ports shall be provided with blank inserts, Hubbell SFBGY10 Series. Provide blank inserts as required.

4. Approved Product:
   A. **Work Area Outlet (WAO)**
      a. Coordinate faceplate color with electrical faceplates
      b. Hubbell IFP14W (WHITE) or
      c. Panduit CBEIWy (uses CHF2IW-X mini-com inserts) or
      d. Panduit CFPL4WHY MINICOM Faceplate

   B. **Office/Classroom Faceplate (4 port)**
      a. Hubbell IFP14W (WHITE) or
      b. Panduit CBEIWy (uses CHF2IW-X mini-com inserts) or
      c. Panduit CFPL4WHY MINICOM Faceplate

   C. **Office/Classroom Faceplate (6 port)**
      a. Hubbell IFP16W or
      b. Panduit CFPL6WHY

   D. **Office/Classroom Faceplate (9 port)**
      a. Hubbell IFP212W or
      b. Panduit CFPF12WH-2G

   E. **Student Room Faceplate (2 port)**
      a. Hubbell IFP12W or
      b. Panduit CFPL2WHY

   F. **HON Furniture Faceplate (2 port)**
      a. Hubbell FP2BK (black)
      b. Hubbell FP2GY (gray)
c. Panduit CFFPA2BL (black)
d. Panduit CFFPA2IG (gray)

G. Blank Faceplate inserts (White)
   a. Hubbell SFB series or
   b. Panduit CMBWH-X

H. Blank Faceplate inserts (Black)
   a. Hubbell SFB series or
   b. Panduit CMBBL-X

I. Blank Faceplate inserts (Gray)
   a. Hubbell SFB series or
   b. Panduit CMBIG-X

E. Wireless Access Points
   1. All access points (AP) will have the outlet terminated in a two-port surface mount plenum outlet box (WAO) on the nearest wall or column or ceiling. Must have a 25-foot maintenance loop feeding the WAO box. The AP outlet shall have two Cat 6 Yellow jacks.
      a. Network AP: Hubbell Nextspeed, yellow, HJ6Y.
      b. Network AP: Surface mount plenum box, Hubbell ISB2OWP

F. Copper Patch Panels: Use Patch Panels that match the category of product being terminated.
   1. Allow for 25% growth.
   2. Terminated patch panels shall have:
      a. Non-keyed, unshielded, 4-pair
      b. 8-position, 8-wire (RJ-45)
      c. Accommodates T568A and T5698B wiring.
      d. Useable bandwidth beyond 250 MHz
      e. Nose Contacts:
      f. Beryllium copper with a minimum of 50-micro inch gold plating over nickel
      g. Insulation displacement terminals.
      h. 110 blocks: Polycarbonate.
      i. Jack Contacts: Phosphor bronze with 100 micro-inch tin lead 60/40 over nickel under plating.
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j. Terminates 22-24 AWG solid conductors.
k. Minimum Contact Force: 100 grams with FCC compliant 8-position plug.
m. Component Performance shall exceed ANSI/TIA-568-2D Category 6 component requirements.
n. Panel shall be constructed of 14-gauge steel, rolled edge construction with black powder coat finish. Panel shall be standard 19-inch rack mount.
o. Includes rear cable management to the panel.

3. Approved products:
   a. Hubbell 48 port Nextspeed Punchdown Patch Panel HP648E or
   b. Hubbell unloaded Patch Panel HPJ48 with HXJ6Y jacks
   c. Panduit CP48WSBLY with CJ688TGYL jacks or
   d. Panduit DP48888TGY Punchdown Patch Panel

G. Network Copper Cable shall be approved by University of Tennessee Knoxville OIT department.
   1. For all Category 6 copper cable use:
      a. Hubbell or
      b. Hitachi or
      c. General or
      d. Panduit or
      e. Mohawk

H. Equipment Racks: See Section 27.11.10.

I. SER Basket Tray and Ladder Rack: See Section 27.11.10.

J. Patch Cords: Provide 2 patch cables for every installed port, 1 for the equipment end and 1 for the WAO end. All lengths and colors will be determined by the University of Tennessee Knoxville ITS department.
   1. Provide two patch cables per patch panel port.
   2. Access points patch cords: Provide 2 pink patch cables for every WAP location. Lengths will be determined by the University of Tennessee Knoxville ITS department.

K. Fiber Patch Panels
   1. All fiber patch panels shall be installed in the proper equipment and distribution racks per the University of Tennessee Knoxville OIT design and per the drawings.
   2. Approved Fiber Patch Panels:
      A. Fiber Optic Rack Mount
         i. Corning CCH series or
         ii. Hubbell FCR series or
         iii. Panduit FCE series
      B. Fiber Optic Wall Mount
         i. Corning WCH series or
L. Fiber connectors

1. Shall be fusion spliced on connectors with a 1-meter LC pigtail single mode.
   a. Fiber Optic Prepolished Fusion Spliced Connectors
      i. Corning 000412R8120003M

2. Field termination of fiber with a factory connector requires OIT approval
   i. Corning Unicam LC connectors
   ii. Corning Part Number 95-200-99

M. Firestopping:

1. putty shall be installed inside the conduits.
2. A re-entry sleeve shall be used outside and around the conduits.
3. All firestopping shall be label as required by ANSI/TIA 606B.

   a. Products approved:
      i. STI SSP100 Firestopping putty
      ii. For wall pass through, STI EZ-Path product shall be used.
      iii. Hilti “Moldable Pliable Putty” CP-618.
         a. Tube putty and caulk that cures to an elastomeric solid is not approved in conduit.
      iv. Hilti FS-ONE around the conduit.

PART 3 - EXECUTION

3.1 INTERIOR BUILDING INSTALLATION:

All wiring/cables shall be color coded and terminated.

A. Installation of all voice and network wiring facilities shall be by Installers certified by the manufacture of the system(s) they are installing and be able to certify the installation for the manufacturer’s warranty.

1. Hubbell Premise Wiring will be the benchmarked used for equal or equivalent for material, methods and warranties for all local area network cabling.

B. All copper cabling shall be terminated to T568A wiring scheme.
C. All communications cabling that has become abandoned as part of new renovation projects, previous renovation projects, or temporary communication cables used during the construction process shall be completely removed.

1. Refer to detailed manufacturer’s guidelines for deployment of category 6 cable. Certain restrictions apply, and specific techniques are recommended.

2. All cabling shall be installed in accordance with manufacturers’ written bend radius and pulling tensions. General industry guidelines recommend the following bend radius and pulling tensions:
   A. Tensile loading on a single 4-pair copper UTP cable shall not exceed 25 lbf.
   B. Bend radius of a single 4-pair copper UTP cable shall not exceed 4 times the diameter of the cable.
   C. Bend radius of multi-pair copper UTP and optical fiber cable shall not exceed 10 times the diameter of the cable.

3. All conduits and conduit sleeves shall have bushings or grommets shall be installed prior to the installation of communications cables to avoid damage and abrasions to cable sheathing and insulation. If bushings have installed by the electrical contractor, the communications cabling contract shall furnish and install bushings prior to pulling communications cabling.

4. Horizontal cable length for 4-pair copper UTP cables shall not exceed 295 feet. Prior to bidding and installation, the contactor shall review the drawings and verify no cable run exceeds 295 feet and notify the communications designer of cable runs that may exceed 295 feet.

5. Splices are not permitted in any voice or data cable unless other specified or shown on drawings.

6. Avoid placing copper cables near sources of extreme heat (i.e. boilers, radiators, heat coils).

7. Maintain cable twists for all UTP cables. For terminations cable sheathing shall be stripping back no more than ½” back from termination point for all Category 6 cables.

8. All cables shall be supported by wire basket tray, ladder rack, or j-hooks. When large quantities of cables leave trays or runways, cables shall be supported by drop-outs or cable support hardware manufactured specifically for supporting cables. J-hooks shall be installed a minimum of every 5 feet and cabling shall maintain minimal deflection and strain (less than 12” deflection). Cables shall not be supported from ceiling grid wires. Cables shall not run above iron joists.

9. All cables shall be separated and bundled into like groups.

10. Service loops shall be provided at both ends of installed horizontal and backbone cabling. An 8” service loop shall be installed in the ceiling space near workstation outlets (excessive cable shall not be coiled in outlet boxes). A 10’ service loop shall be provided in communication rooms and shall be installed to allow for future equipment rack/cabinet relocations without the need to re-terminate patch panels; the 10’ service loop shall be neatly bundled and secured in ceiling space with large d-rings or place in ladder rack. Cable slack and service coils shall be stored properly above the ceiling or under the access floor.

11. Any cabling installing in equipment rooms shall be neatly placed in cabling trays, cabling runways, or horizontal and vertical rack/cabinet cable managers.
12. Velcro straps shall be utilized in the TR and inside TC enclosures for all cable bundling. Tie wraps shall be prohibited in the telecommunication rooms.

13. Separation: maintain the following distances between cables, other system cables and other building systems:
   A. One (1) foot from fluorescent lights.
   B. One (1) foot from power cable in parallel
   C. One (1) foot from electrical conduits, other systems cables or other electrical equipment.
   D. Four (4) feet from motors and transformers
   E. Three (3) feet from hot water piping or other mechanical equipment.
   F. Ten (10) feet from bus conductors or high-current branch circuits
   G. All low voltage cables shall be run parallel or at right angles to building structural framework. Do not run cables diagonally across ceiling space without written authorization by the architect’s electrical engineer or OIT representative.
   H. Communications cabling that must cross power cables or conduit shall cross at 90-degree angle and shall not make physical contact.

14. Fire seal around all cables running through rated floors and walls. Firestop all cables and pathways that penetrate fire-rated barriers using approved methods and according to local codes.

15. Leave spare pull string with every outlet installed.

16. Do not install cable in wet areas, or in proximity to hot water pipes or boilers.

17. Cable ends for termination shall be clean and free from crush marks, cuts, or kinks left from pulling operations. Installed cable jackets shall have no abrasions with exposed conductor insulation or bare copper “shiners”. The installer is responsible to replace damaged cables.

18. Backbone cables shall be installed and bundled separately from horizontal distribution cables. Backbone and horizontal cable bundles shall be loose and random.

19. Backbone cables spanning more than three floors shall be supported at the top of the cable run with a wire mesh grip and on alternating floors, unless otherwise specified by local codes or manufacturer’s guidelines.

20. Vertical runs of backbone cables entering each SER shall be securely fastened along a properly prepared wall in the SER on each floor. Use of cable ladder is recommended.

C. Submit shop drawings for approval.
   1. Drawings should be in a DWF compatible format.
   2. Provide all As-Built drawings at the time of project completion, both in hard and electronic versions to Facilities Services.

D. Testing shall conform to ANSI/TIA-568-C standard.
   1. Testing shall be accomplished using a Hubbell approved tester.
   2. Include tester calibration date.
3. Electronic copies of test results should be in PDF format.
4. Provide all test results and As-Built drawings at the time of project completion, both in hard and electronic versions to Facilities Services.
5. Refer to OIT for Commissioning, Warranties, and Documentation.

E. All testing shall meet or exceed manufacturer’s recommendation for 25-year warranty program.

1. Testing shall be done per section 271300
   A. Field testing of copper cables shall include the following parameters for each pair of each cable installed:
      I. Name of the person performing the test.
      II. Test equipment manufacturer and model number.
      III. Cable I.D on the test sheets will be in numerical order by cable I.D.
      IV. Date of test.
      V. Wire map (pin to pin connectivity and polarity check)
      VI. Length (in feet)
      VII. Insertion loss.
      VIII. Near end crosstalk (NEXT).
      IX. Power sum near end crosstalk (PSNEXT).
      X. Equal-level far end crosstalk (ELFEXT).
      XI. Power sum equal-level far end crosstalk (PSELFEXT).
      XII. Return loss.
      XIII. Delay skew.
      XIV. Attenuation to crosstalk ratio (ACR).

   B. A “pass” indication shall be obtained for each link, using at minimum a level iv tester that complies with ANSI/TIA-568.0-D field test requirements.

   C. Record test results for each cable and turn over to the general contractor upon completion of the job. Correct malfunctions when detected, and re-test to demonstrate compliance. Note: test equipment shall be a type IV cable tester.

2. Any replacement of cable deemed necessary shall be done at no expense to the University of Tennessee Knoxville.

G. During installation of cabling, the bend radius of cables is not to be less than the manufacturer's specific recommendation.

   1. Minimum bend radius shall be 10 times the diameter of the cable for fiber optic cable, and 4 times the diameter of the cable for copper cable.

   2. Contractor shall take and precaution not to exceed maximum tensile rating of cabling during installation.

H. Each horizontal cabling run shall include 10' of slack at telecommunications room end and 8" of slack at the outlet end.
1. There shall also be one meter (3.28') of slack above each wall outlet.

2. Station cables in the telecommunications rooms can be stored in a "Figure 8" configuration to maintain the proper bend radius and provide the needed slack.

I. All cables with noticeable signs of damage, kinks, crush, or stress marks shall be replaced regardless of test results at no additional cost to the University of Tennessee Knoxville.

3.2 EXECUTION

A. Labeling of cables, wall outlets, 110 blocks, conduits, cable trays, patch panels, and backbone cabling shall be performed in accordance of Section 270553

   1. All Labeling requirements of the University of Tennessee Knoxville OIT Department shall be met.

B. Building Automation System (BAS) Connection: Cabling connecting BAS to the University of Tennessee Knoxville ITS network must follow the standards set forth in ANSI/TIA 862.

C. All Grounding requirements shall be met as found in section 270526 Telecommunications Grounding and Bonding.

   1. All grounding requirements of the University of Tennessee Knoxville OIT Department shall be met.

D. All Firestopping and Smoke Sealing requirements shall be met as found in section 270528.28 Firestopping, Smoke, and Acoustical Sealing Telecommunications and Data Cabling.

   1. All grounding requirements of the University of Tennessee Knoxville OIT Department shall be met.

E. All Hangers and Support requirements shall be met as found in section 270529 Hangers and Support for Telecommunications and Data Cabling.

   1. All Hanger and Support requirements of the University of Tennessee Knoxville OIT Department shall be met.

F. Administration and Labeling requirements shall be met as found in section 270553 Administration and Labeling for Telecommunications and Data Cabling.

   1. All Administration and Labeling requirements of the University of Tennessee Knoxville OIT Department shall be met.

G. Commissioning of Communications requirements shall be met as found in section 270800 Commissioning of Communications.

   1. All Commissioning of Communications requirements of the University of Tennessee Knoxville OIT Department shall be met.

END OF SECTION 27 15 00
PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install a complete a 1 GHz CATV wiring system as described on drawings and called for hereinafter.

B. The catalog numbers specified herein are those of the Blonder-Tongue Company and constitute the type and quality of the products to be installed.

C. The quality and type of CATV materials must be accepted by industry standards. All passive and active equipment must be two-way and pass signals up to one GHZ "passive" and 750 MHZ "active".

1.2 INSTALLER QUALIFICATIONS

A. Installation of CATV cabling system shall be done by personnel regularly engaged in installation of such facilities. Installers shall have NCTI, SCTE, and BICS I certifications. Provide documentation of these certifications as part of the submittal process. Installer shall have working knowledge of all codes/standards related to CATV wiring installation.

1.3 REFERENCE STANDARDS

A. SECTION 27.01.00 – REFERENCE STANDARDS

B. ANSI/SCE 74 2003, Specification for braided 75 Ohm Flexible Coaxial Cable.

C. FCC Part 76, Cable Television Service.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Splitters: In the Telecommunications Room, install splitters to take the cable TV feed and distribute it to each individual room. Splitters/combiners shall be vertical ports, capable of passing one GHZ signal with built-in grounding lug, Truespec DSVXG or equivalent. "X" represents the number of ports. Arrange splitters/combiners so that signal is evenly distributed among all ports.

B. Wall Plates: Wall plates for CATV outlets shall be flush mounted with single-gang Standard F81 through connector with 0 dB isolation, and one data jack, Hubbell AFP14EI.

C. Coaxial Cable: Coaxial cable shall be installed from each television outlet location shown on drawings to the Telecommunications Room on a homerun basis. No series wiring for TV shall be permitted. The coaxial cable from the outlet to the Telecommunications Room shall be Belden 7915A Series RG6 cable, aluminum braid shield, flame retardant PVC jacket meeting NEC Article 820V rating, ETL listed or equivalent.
D. Coaxial Connectors: Use compression type, Belden Thomas and Betts FSNS6U.

E. RG11 Coax installation:
   1. RG11 Riser Coax shall be Belden 9011 if under 300 feet and CommScope PIII750JCASS over 300ft.
   2. RG11 Fitting shall be Thomas and Betts 716SNS1P11H

PART 3 - EXECUTION

3.1 INSTALLATION

A. Each coaxial cable shall be tested for signal loss, length of cable, and meet the manufacturers specifications. Testing shall be in accordance with FCC Part 76 signal leakage requirements. Coaxial cable tests will involve continuity and RF leakage, 20-uV/m leakage limit (10 feet from network). Limit will yield a dipole level of -43.67 dBmV 75 ohms. Carefully coordinate tie-in of incoming line with local cable operator. Complete TV feed to each individual outlet to verify that a proper signal is being distributed. After proper documentation disconnect each room at the headend location and make each connection for proper identification.

B. Cable drops shall be bundled by use of approved plastic ties. Tape shall not be permitted to bundle cable drops.

C. Grounding will meet NEC requirements for CATV. Refer to Article 820 of National Electrical Code for information.

END OF SECTION 27 15 33