Stephen F. Austin State University

Division 27 00 00 Specification

Communications

Telecom/Networking
4/15/2024 REV:0

Communications - Contents

Stephen F. Austin State University

Division 27 40 00 Specification

Audio Visual

ITS ACADEMIC SUPPORT
4/15/2024 REV:0

Contents

SECTION 27 05 00
COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contractor is responsible for knowledge and application of most recent versions of the various standards and codes. In cases where listed standards and codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation.

B. ANSI/TIA

1. ANSI/TIA-526-7-A Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
2. ANSI/TIA-526-14-C Optical Power Loss Measurements of Installed Multimode Fiber FCable Plant
3. ANSI/TIA-568.0-E Generic Telecommunications Cabling for Customer Premises
4. ANSI/TIA-568-E.2 Balance Twisted Pair Communications and Components Standards
5. ANSI/TIA-568-E.2-2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard, Addendum 2: Additional Considerations for Category 6A Patch Cord Testing
6. ANSI/TIA-568-E.4 Broadband Coaxial Cabling Components Standard
7. ANSI/TIA-568.1-E Commercial Building Telecommunications Infrastructure Standard
8. ANSI/TIA-569-D Telecommunications Pathways and Spaces
9. ANSI/TIA-598-D Optical Fiber Cable Color Coding
10. ANSI/TIA-606-C Administration Standard for Telecommunications Infrastructure
11. ANSI/TIA-606-C-1 Administration Standard for Telecommunications Infrastructure Addendum 1- Automated Infrastructure Management Systems - Addendum to ANSI/TIA-606-C
12. ANSI/TIA-607-D Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
13. ANSI/TIA-758-B Customer-Owned Outside Plant Telecommunication Infrastructure Standard
14. ANSI/TIA-862-A Building Automation Systems Cabling Standard

15. ANSI/TIA-942-A Telecommunications Infrastructure Standard for Data Centers
16. ANSI/TIA-942-A-1 Telecommunications Infrastructure Standard for Data Centers, Addendum 1 - Cabling Guidelines for Data Center Fabrics
17. ANSI/TIA-1005-A Telecommunications Infrastructure Standard For Industrial Premises
18. ANSI/TIA-1005-A-1 Telecommunications Infrastructure Standard For Industrial Premises, Addendum 1- M12-8 X-Coding Connector - Addendum to TIA-1005-A
19. ANSI/TIA-1183-1 Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems, Extending Frequency Capabilities to 2 GHz - Addendum to TIA-1183
20. ANSI/TIA-1152 Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
21. ANSI/TIA-1183 Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems
22. TIA-TSB-155-A Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T
23. TIA-TSB-184 Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling
24. TIA-TSB-4979 Practical Considerations for Implementation of Multimode Launch Conditions in the Field
25. TIA-TSB-190 Guidelines on Shared Pathways and Shared Sheaths
26. TIA-TSB-162-A Telecommunications Cabling Guidelines for Wireless Access Points
27. TIA-568-E.3 Optical Fiber Cabling Components Standard
28. TIA-568-E.3-1 Optical Fiber Cabling Component Standard- Addendum 1, Addition of OM3 Cabled Optical Fiber and array connectors
29. All version to be the most current and responsibility of the contractor to adhere to

C. National Electric Codes

1. National Electrical Safety Code (NESC) (IEEE C2-2012)
2. ANSI/NFPA 70-2011, National Electrical Code© (NEC©)
3. ANSI/IEEE C2-207, National Electrical Safety Code®
4. National Electrical Code (NEC) (NFPA 70)
5. Check with State and Local AHJ for NEC version

D. OSHA Standards and Regulations – all applicable

E. Local Codes and Standards – all applicable

F. BICSI – Building Industry Consultative Services International

1. BICSI 004-2012, Information Technology Division Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
2. ANSI/BICSI 005-2013, Electronic Safety and Security (ESS) System Design and Implementation Best Practices
3. Information Transport Systems Installation Methods Manual (ITSIMM), 6th Edition
4. ANSI/BICSI 002-2014, Data Center Design and Implementation Best Practices
5. Network Systems and Commissioning (NSC) reference, 1st Edition
6. ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
7. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
8. ANSI/BICSI 001-2009, Information Transport Systems Design Standard for K-12 Educational Institutions
9. BICSI-003-2014 Building Information Modeling (BIM) Practices for Information Technology Systems
10. Telecommunications Distribution Methods Manual, 13th Edition
11. AV Design Reference Manual, 1st Edition
12. Network Design Reference Manual, 7th Edition
13. Outside Plant Design Reference Manual, 5th Edition
14. Wireless Design Reference Manual, 3rd Edition
15. Electronic Safety and Security Design Reference Manual, 3rd Edition
16. Commercial Installation On-the-Job Training Booklet
17. Telecommunications Project Management (TPM) reference, 1st Edition

G. Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.

H. Knowledge and execution of applicable standards and codes is the sole responsibility of the Contractor.

I. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense.

1.2 DEFINITIONS

A. Provide: Furnish, install, terminate, label, test and certify a complete operating cabling system.

B. Contract Documents (CD): Design drawings, specifications, sketches and schedules provided by the Engineer as they directly relate to this scope of work and this project.

C. Structured Cabling Systems (SCS) wiring is defined as all required equipment and cabling including hardware, termination blocks, cross connect wire or cordage, patch panels, patch cords, telecommunication outlets, work area cords, UTP and fiber cable installed and configured to provide computer data and voice connectivity.

D. NET-POP Rooms: The area where the outside plant media/carrier services appear in the facility. The NET-POP contains equipment used by owner or carrier to handoff/transition cable from outside plant into inside plant type.

E. Network Center/Main Distribution Frame (MDF) Areas: This technology space houses Layer 2/3 network switching gear and other main network distribution equipment and acts as the mid-connection point between the Core/Network and the IDF/access zones for all connections.

F. Intermediate Distribution Frame (IDF): is the location for the termination of backbone cables and for termination of horizontal cables, and for the interconnection of each. The space also hosts access-layer switches and user network connections within each floor.

G. Active Equipment: electronic equipment used to develop various WAN, LAN, and voice services, e.g., digital multiplexers, RS-232 controllers, Ethernet hubs, switches, routers, PBX, etc.

H. Campus Backbone: cabling system consisting of media and termination hardware interconnecting POE, Net-Pop's and Future onsite buildings.

I. Building Backbone: cabling system consisting of media and termination hardware interconnecting MDFs to IDFs.

J. Horizontal: cabling system consisting of media and termination hardware interconnecting the Telecommunication Outlets (TOs) and the IDFs.

K. Bonding: permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and the capacity to conduct safely any current likely to be imposed on it.

L. Cable Tray: vertical or horizontal open supports, usually made of aluminum or steel, which are fastened to the building structure. Cables are laid in and fastened to the trays.

M. Cabinet: free standing, floor-mounted or wall-mounted modular enclosure designed to house and protect rack-mounted electronic equipment and passive terminations.

N. Channel: The end-to-end transmission path between two points at which application specific equipment is connected; encompasses all the elements of the horizontal cabling link, plus the

equipment cords in the telecommunications spaces and work area.

O. Cross-Connect: equipment used to terminate and tie together communications circuits.

P. Cross-Connect Jumper: a cluster of twisted-pair conductors without connectors used to establish a circuit by linking two cross-connect termination points.

Q. Grounding: a conducting connection to earth, or to some conducting body that serves in place of earth.

R. Jack: receptacle used in conjunction with a plug to make electrical contact between communications circuits, e.g., eight-position/eight-contact modular jacks.

S. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

T. LAN: Local area network.

U. Link: Horizontal cabling link encompassing all components of the horizontal cabling (TO, patch panels, blocks, jumpers and patch cords that join them in the horizontal cross-connect). It is distinguished from a channel because it does not include the equipment cables/cords at the telecom spaces or work area.

V. Media: twisted-pair, and fiber optic cable or cables used to provide signal transmission paths.

W. Mounting Frame: rectangular steel framework, which can be equipment rack or wall mounted to support wiring blocks, patch panels, and other communications equipment.

X. Outside Plant (OSP): generally, any and all portions of the cable system that runs outside of an environmentally enclosed structure and/or building with each end terminated at different buildings. This specifically includes inter-building cables, conduits, manholes, hand-holes, and innerduct.

Y. UTP: Unshielded Twisted Pair.

AA. FO: Fiber Optic

BB. Passive Equipment: non-electronic hardware and apparatus, e.g., equipment racks, cable trays, electrical protection, patch panels, wiring blocks, fiber optic shelves, etc.

CC. Patch Cords: a length of wire or fiber cable with connectors on one or both ends used to join communications circuits at a cross-connect.

DD. Patch Panel: system of terminal blocks or connectors used with patch cords that facilitate administration of cross-connect fields.

EE. Pathway: facility for the placement of communications cable. A pathway facility can be composed of several components including conduit, wireway, cable tray, surface raceway, under

floor systems, overhead systems, raised floor, ceiling support wires, etc.

FF. Protectors: electrical protection devices used to limit foreign voltages on metallic communications circuits.

GG. Raceway: an enclosed channel designed expressly for holding wires or cables; may be of metal or insulating material. The term includes conduit, tubing, wire ways, under floor raceways, overhead raceways and surface raceways; does not include cabletray.

HH. Racks: An open, freestanding, floor-mounted structure, typically made of aluminum or steel, used to mount equipment; usually referred to as an equipment rack.

II. Riser Backbone: The Riser Backbone subsystem links the main cross connect (DC/NC) in the equipment room to the distribution rooms (IDFs).

JJ. Structured Cabling System (SCS): A SCS is defined as all required cabling including hardware, termination blocks, cross connect wire or cordage, patch panels, patch cords, telecommunication outlets, work area cords, UTP and fiber optic cable installed and configured to provide computer data and voice connectivity from each data or voice device to the network file server or voice network/switch designated as the service point of the local area network.

KK. Telecommunication Outlet (TO): Connecting device mounted in a work area used to terminate horizontal cable and interconnect cabling with station equipment.

LL. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

MM. Work Area Subsystem: The connection between the telecommunications outlet and the station equipment in the work area is provided by the Work Area Subsystem. It consists of cords, adapters, and other transmission electronics.

NN. Wireless Access Point (WAP): Telecom outlet designated for use with wireless network devices. Such outlet shall be mounted above ceiling.

OO. Contractor – The successful bidder engaged to provide the work of this specification

1.3 SUBMITTALS

A. Comply with Section 013300 - Submittal Procedures.

B. Comply with Section 013323 – Shop Drawings, Product Data, and Samples.

C. Product Data: Submit catalog data for each equipment rack, termination device, cable, and outlet device.

D. Field Test Data: Field testing results after installation in electronic format, both PDF and native test format.

1.4 QUALITY ASSURANCE

A. Contractor Qualifications

1. Contractor shall have at least 5 years of experience installing and testing structured cabling systems.
2. Contractor shall employ at least one BICSI Registered Communication Distribution Designer (RCDD), and the RCDD shall sign-off on all designs offered, including stamping the design with their current BICSI/RCDD stamp.
3. Contractor shall have the responsibility to obtain any of the necessary permits, licenses, and inspections required for the performance of data, voice, and fiber optic cable installations.
4. Contactor shall be a current Panduit ONE℠ Partner, Registered and above, that has completed the Structured Cabling Deployment Training (Panduit Certified Installer). A copy of the corporate Panduit manufacturer certification shall be included with all quotes.
5. At least 50 percent of the technicians on the job must have a current Panduit Certified Copper Technicians certificate to install Panduit Copper Distribution Systems.
6. At least 50 percent of the technicians installing any Fiber Distribution Systems must have a current Panduit Certified Fiber Technicians certificate to install Fiber Distribution Systems
7. The Telecommunications contractor must provide a project manager to serve as the single point of contact to manage the installation, speak for the contractor and provide the following functions:
    i. Initiate and coordinate tasks with the Stephen F. Austin State University Project Manager and others as specified by the project schedule.
    ii. Provide day to day direction and-site supervision of Contractor personnel.
    iii. Ensure conformance with all contract and warranty provisions.
    iv. Participate in weekly site project meetings.
    v. This individual will remain project manager for the duration of the project. The contractor may change Project Manager only with the written approval of Stephen F. Austin State University Information Services.

B. References

1. Communications Contractor shall provide with bid, a list of three reference accounts where similar Data, Voice, Fiber Optic Cable, and related equipment installation work was performed within the last year or twelve-month period.

C. Termination of Services

1. Stephen F. Austin State University reserves the right to terminate the Communication

Contractor's services if at any time Stephen F. Austin State University determines the Communication Contractor is not fulfilling their responsibilities as defined within this document.

2. Contractor's appearance and work ethics shall be of a professional manner, dress shall be commensurate with work being performed.
3. Dress displaying lewd or controversial innuendos will strictly be prohibited.
4. Conduct on Stephen F. Austin State University' property will be professional in nature.
5. Any person in the Contractor's employ working on a Stephen F. Austin State University project considered by Stephen F. Austin State University to be incompetent or disorderly, or for any other reason unsatisfactory or undesirable to Information Services, such person shall be removed from work on the Stephen F. Austin State University project.
6. Upon termination, the Communications Contractor shall be restricted from the premises and compensated for the percentage of work completed satisfactorily.

D. Other Contractor Responsibilities

1. Contractor is responsible for the removal and disposal of all installation and construction debris created in the process of the job. All work areas will be cleaned at the end of each workday and no tools or materials shall be left in a manner as to pose a safety hazard
2. Contractor must coordinate removal of abandoned cable per Article 800 of the National Electrical Code and per TIA and BICSI standards, recycling these materials where possible. This is mandatory; Contractors must consider this when placing bids
3. Contractor shall abide by the regulations set by Stephen F. Austin State University's Security Policy pertaining to access, and conduct while on Stephen F. Austin State University property
4. Contractor shall all obey all posted speed limits and parking regulations.

1.5 WARRANTY

A. General

1. Contractor shall provide a 25-year Certification PLUS™ System Warranty on all copper and fiber permanent cabling links.
2. This is a system performance warranty guaranteeing for 25 years from acceptance that the installed system shall support all data link protocols for which that copper Category or fiber OM designation is engineered to support per IEEE and TIA standards.
3. Upon acceptance of Warranty, Panduit will mail a notification letter to the installer and a notification letter and warranty certificate to Stephen F. Austin State University.

B. Contractor Warranty Obligations

1. Contractor shall provide a 25-year Certification PLUS™ System Warranty on all copper and fiber permanent cabling links.
2. This is a system performance warranty guaranteed for 25 years from acceptance that the installed system shall support all data link protocols for which that copper Category or fiber OM designation is engineered to support according to IEEE and TIA standards.
3. Upon acceptance of Warranty, Panduit will mail a notification letter to the installer and a notification letter and warranty certificate to Stephen F. Austin State University.

4. Installation firm must be a current Panduit ONE℠ Partner, Registered and above, that has completed the Structured Cabling Deployment Training (Panduit Certified Installer). A copy of the corporate Panduit manufacturer certification shall be included with all quotes.
5. Contractor shall name a supervisor to serve on site as a liaison responsible to inspect and assure all terminations are compliant to factory methods taught in Panduit Technician Certification Training and per all Standards cited in the Regulatory References section of this document.
6. Contractor liaison shall have a current, up-to-date Panduit Certified Technician (PCT) certificate in both copper and fiber. Copies of the copper and fiber certificates of the Panduit liaison shall be submitted with the bid.
7. New fiber installations shall be SingleMode. In instances where the new installation does not match the existing installation the contractor shall notify Stephen F. Austin State University Project Manager for direction.
8. All new fiber optic installations shall utilize an appropriate construction of SingleMode as specified herein.
9. All UTP cable pulled and terminated shall use Category 6 cable, unless otherwise noted in project specific documents or RFP.
10. All UTP terminations within Stephen F. Austin State University facilities shall be terminated using the T568B pin out (wire map).
11. Contractor shall install all racking and support structures per cited TIA Standards in such fashion as to maintain both Standards and Manufacturer recommendations for uniform support and protection, segregation of different cable types,
12. Contractor is responsible for maintenance of maximum pulling tensions, minimum bend radius, and approved termination methods as well as adhering to industry accepted practices of good workmanship.
13. Contractor is responsible for understanding and submitting to Panduit all documents required prior to project start to apply for the Panduit Certification PLUS system warranty. These include but are not limited to the project information form and SCS warranty agreement.
14. Contractor is responsible for understanding and submitting to Panduit all documents required at project end. These include completed warranty forms, passing test reports and drawings of floor plans showing locations of links tested.
15. Test results shall be delivered in the tester native format (not Excel) and represent the full test report. Summaries shall not be accepted. Contact your Panduit representative for a current list of approved testers, test leads and latest operating systems.

1.6 RESPONSIBILITIES AND COORDINATION

A. The contractor shall provide all materials, qualified labor and services required to ensure a complete and operational system, installed in accordance with the intent of the Contract Documents
B. The contractor shall furnish and install all incidental items not actually shown or specified, but which are required by best practices to provide complete functional systems.
C. The contractor shall coordinate the details of facility equipment and construction for all specification divisions, which affect the work covered under this Division.
D. The contractor shall coordinate all activities with the overall construction schedule.

E. The contractor shall develop a bill of materials, perform material management and efficient use of the materials whether they are issued by Owner or purchased by the Contractor.
F. The contractor shall ensure materials in excess of those required to complete the project are kept in their original condition and packaging for restocking.

PART 2 - PRODUCTS

A. The following product sets are pre-approved for this project. No exceptions or substitutions allowed.
   1. Structured Cable Systems – Copper & Fiber:
      i. Panduit shall be used for all copper and fiber systems, i.e., jacks, patch panels, fiber optic enclosures.
      ii. Corning Fiber tips, couplers, and fiber can be used.
      iii. General Cable maybe used as an alternate copper and/or fiber cable solution.
   2. Racks, cabinets, frames and associated fastening devices
      i. Panduit shall be used for all racks, cabinets, cable management, shelves and other accessories.
      ii. Chatsworth Rack may substituted.
   3. Bonding & Grounding
      i. Panduit shall be used for all telecommunication grounding and bonding applications.
      ii. May be substituted with National Electrical Code approved materials.
   4. Labeling
      i. Panduit or others meeting requirements of the ANSI/TIA 606 labeling standard shall be used for all labeling.

PART 3 – EXECUTION

3.1 WORKMANSHIP

A. Manufactured products, materials, equipment, and components shall be provided, conditioned, applied, installed, connected, and tested in accordance with the manufacturer's specifications and printed instructions.
B. The installation of all system components shall be carried out under the direction of qualified personnel. Appearance shall be considered as important as mechanical and electrical efficiency. Workmanship shall meet or exceed industry standards.

3.2 INTENT OF DRAWINGS

A. The technology drawings show only general locations of equipment, devices, raceways, cable pathway, boxes, etc., unless specifically dimensioned.
B. The contractor shall be responsible for the proper placement and routing of equipment, cable, raceways, cable runway, and related components, per the Contract Documents and subject to prior review by the Owner and structured cabling engineer.
C. The contractor shall refer any conflicts within the Contract Documents to the Construction Manager and/or Owner for resolution.

3.3 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
B. Comply with ANSI/TIA-607-D and the National Electrical Code.

3.4 FIRESTOPPING

A. Comply with requirements in the National Building Code and the National Electrical Code,
B. Comply with Section 078413 “Penetration Firestopping”.

3.5 SERVICE CONTINUITY

A. Maintain continuity of communications services to all functioning portions of the process or buildings during hours of normal use.
B. Arrange temporary outages for cutover work with CM. Keep outages to a minimum number and a minimum length of time to provide minimum impact.

3.6 LAYOUT AND TOLERANCES

A. Follow as closely as practicable the schematic design shown on the drawings. Make all necessary measurements in the field to verify exact locations and ensure precise location and fit of specified items in accordance with the drawings. Make no substantial alterations without prior approval of the Owner and the Engineer.

3.7 CONSTRUCTION REVIEW

A. The Engineer and Owner will review and observe installation work to ensure compliance by the contractor with requirements of the Contract Documents.
B. The contractor shall inspect and test completed communications installations to demonstrate specified performance levels including the following:
   1. Furnish all instruments and personnel required for the inspections and tests.
   2. Perform tests in the presence of the Engineer and Owner.
   3. Demonstrate that the system components operate in accordance with the Contract Documents.
C. Review, observation, assistance, and actions by the Engineer and Owner shall not be construed as undertaking supervisory control of the work or of methods and means employed by the contractor. The Engineer and Owner review and observation activities shall not relieve the contractor from the responsibilities of these Contract Documents.
D. The fact that the Engineer and Owner does not make early discovery of faulty or omitted work shall not bar the Owner from subsequently rejecting this work and withholding payment until the contractor makes the necessary corrections.
E. Regardless of when discovery and rejection are made, and regardless of when the contractor is ordered to correct such work, the contractor shall have no claim against the Engineer or Owner for an increase in the Subcontract price, or for any payment because increased cost, damage, or loss.

3.8 PROJECT RECORD DOCUMENTS

A. Provide detailed project record documentation for sections l isted above, in addition to the standard requirements, within 30 days after completion of the work. Maintain separate sets of redlined record drawings for the communications work, which show the exact placement, and identification of as-built system components. These are subject to weekly review by the CM, Owner, or its representative.

B. Provide communication room record drawings which indicate exact placement for all components; e.g., conduit, pathway, cable tray, backboards, equipment cabinets, equipment racks, and cross-connect equipment, etc.

C. Provide communication wiring and cabling record drawings and schedules which indicate exact placement, routing, and connection details for all components, e.g., twisted-pair cables, splices, cable cross-connect termination locations, enclosures, telecommunications outlets, and cross-connect jumpers, patch cords, etc.

D. Provide network schematics when appropriate.

E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for IDFs, backbone pathways and cables, entrance pathways and cables.

3.9 DEFINITION OF ACCEPTANCE

A. System acceptance shall be defined as that point in time when the following requirements have been fulfilled:

1. All submittals and documentation have been submitted, reviewed, and approved.
2. The complete system has successfully completed all testing requirements.
3. Panduit 25 Year Warranty documentation has been provided.

B. All punch list items have been corrected and accepted.

END OF SECTION 27 05 00

SECTION 27 05 26
TELECOMMUNICATION GROUNDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial building grounding and bonding requirements for telecommunications infrastructure.
2. Requirements for bonding and communications cabling, equipment, pathways, spaces, and mounting equipment.

B. Related Sections:

1. Section 01 33 00 – Submittal Procedures.
2. Section 26 05 26 – Grounding and Bonding for Electrical System.
3. Section 27 00 00 - Telecommunications.
4. Section 27 05 28 - Pathways for Communication Systems.

1.2 REFERENCES

A. ANSI/NFPA-70, 2011 National Electrical Code (NEC)

B. ANSI/IEEE 1100, 2005, Recommended Practice for Powering and Grounding Electronic Equipment

C. ANSI/IEEE C2, 2007 National Electrical Safety Code (NESC)

D. TIA-607-D (September 2011) Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises

E. ANSI/TIA-606-C (March 2012) Administration Standard for Telecommunications Infrastructure

F. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings

G. OSHA Standards and Regulations – all applicable

H. Local Codes and Standards - all applicable

I. Anywhere low-voltage cabling Standards conflict with electrical or safety Codes, Contractor shall defer to NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.

J. Knowledge and execution of applicable codes is the sole responsibility of the Contractor. Any code violations committed at the time of installation shall be remedied at the Contractor's expense.

K. Contractor is responsible to bring any perceived conflicts between project documents and referenced Standards or Codes to the attention of Stephen F. Austin State University for resolution.

1.3 SYSTEM DESCRIPTION

A. Provide a communications bonding and grounding system as described in this document, documents and drawings specific to that project, and in compliance with the above cited Codes, Standards and Agencies.
B. Comply with the requirement of Code of Practice for Info-Communications Facilities in Buildings.
C. Comply with the requirement for Section 26 05 26 – Grounding and Bonding for Electrical System.
D. Bond the following items within the telecommunications grounding system.
    1. All communications system active equipment.
    2. All POU and surge protection equipment.
    3. Raised floor systems.
    4. Underfloor grounding grids (a.k.a. “supplemental bonding grids” or SBGs) for computer or telecommunications rooms.
    5. Metallic raceway systems, including metallic cable trays.
    6. Communications equipment enclosures (cabinets) or cross-connect frames.
    7. Broadband passive devices.
    8. Metallic splice cases.
    9. Metallic cable screens, armor or shields.
    10. All metal cable conduit.
    11. Electrical service panels in entrance facilities, telecommunications and equipment rooms.
    12. Wall and rack mounted grounding busbars.
    13. Exposed building steel that is within 6 feet of equipment racking systems.
    14. Building steel extending to earth in outside-plant.
    15. All related bonding accessories.

1.4 DESIGN REQUIREMENTS

A. Quality Assurance:
    1. Grounding to conform to applicable building codes.
    2. Cable and equipment to be installed in a neat and workmanlike manner.
    3. Methods of construction that are not specifically described or indicated in the contract documents to be subject to the control and approval of Stephen F. Austin State University or their official representatives.
    4. Equipment and materials specified shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed.
    5. Materials and Methods shall comply in every way with above cited Standards and Codes.
B. Materials Substitution Policy:
    1. This is a performance-based specification developed from the experience of the Stephen F. Austin State University IT Division in providing exceptional solutions for all our facilities and departments. As such, substitution of specified products or systems is not allowed.

2. Contractor shall assume all costs for removal and replacement of any product installed in substitution of those specified. Such costs shall include but not be limited to labor, materials as well as any penalties, fees or costs incurred for late completion.

1.5 SUBMITTALS

A. Make submittals in accordance with Section 01 33 00, Submittal Procedures.

B. Action Submittals:

1. Shop drawings showing construction details and locations of components, and description and routing of interconnecting cabling.
2. Manufacturers cut sheets, specifications and installation instructions for additional products (submit with bid).

PART 2 PRODUCTS

2.1 SYSTEM COMPONENTS

A. Comply with ANSI/TIA-607-D

2.2 Cable

A. Products: Subject to compliance with requirements, available products that may be incorporated into the work include, but are not limited to the following:

1. Panduit Corp.
2. General Cable

B. Comply with UL 486A-486B.

C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
2. Cable Pathway Equipment Grounding Wire: No. 6 AWG.

D. Cable Pathway Grounding Jumper:

1. Not smaller than No. 6 AWG and not longer than 12 inches (300 mm). If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer. Cable tray connections fittings that maintain continuity and UL listing are acceptable as well.

E. Bare Copper Conductors:

1. Stranded Conductors: ASTM B 8
2. Bonding Backbone Conductor: No. 3/0 AWG, Stranded Conductor.

2.3 CONNECTORS

A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the work include, but are not limited to the following:

1. Panduit Corp.

C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.

1. Electroplated tinned copper, C and H shaped.

D. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

E. Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two bolt connection to the busbar.

2.4 GROUNDING BUSBARS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the work include, but are not limited to the following:

1. Panduit Corp.

B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, 20 inches in length. The busbar shall be NRTL listed for use as TMGB and shall comply with ANSI/TIA-607-D.
    1. Predrilling shall be with holes for use with lugs specified in this Section.
    2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
    3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
C. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches in cross section, 12 inches in length. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with ANSI/TIA-607-D.
    1. Predrilling shall be with holes for use with lugs specified in this Section.
    2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch ((50-mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.)
    3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

2.5 LABELING

A. Products: Subject to compliance with requirements, available products that may be incorporated into the work include, but are not limited to the following:
    1. Panduit Corp
B. Comply with ANSI/TIA-606-C and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:

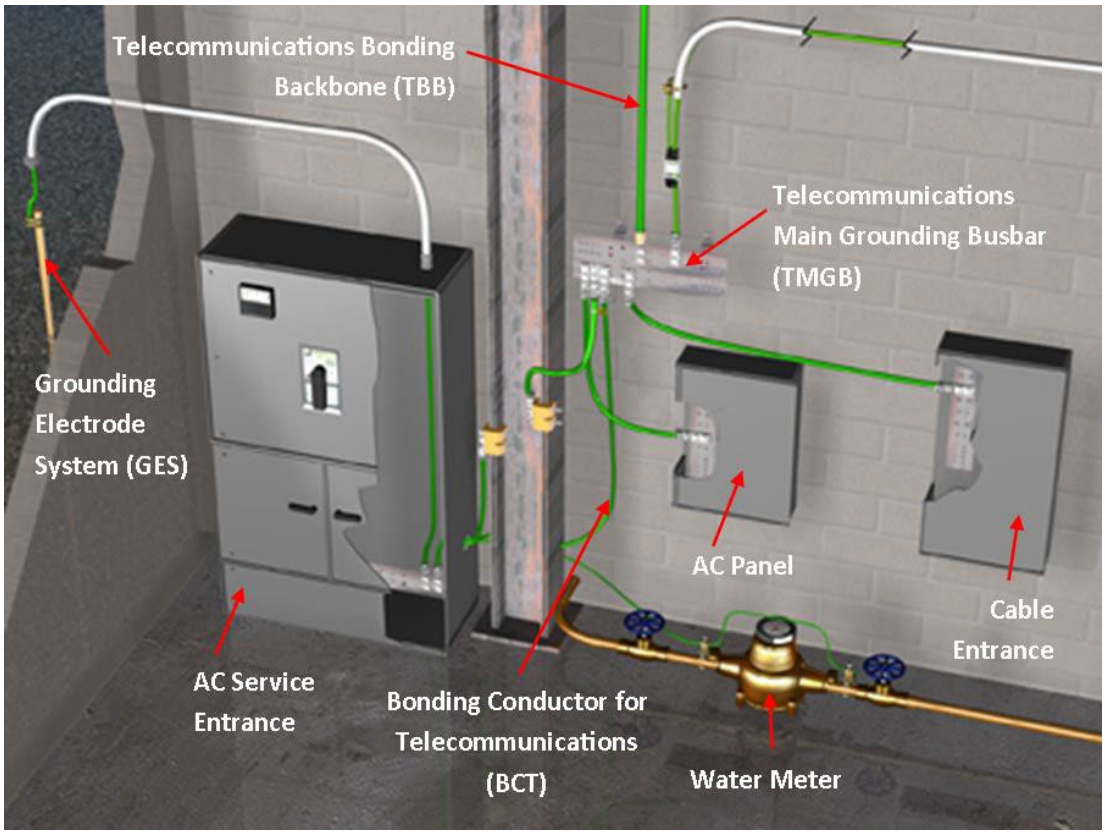
1. This Specification document describes a generic enterprise communications bonding and grounding system for the construction of a complete and functioning grounding system without prior knowledge of the particular facilities where it will be used. It is the responsibility of the installing contractor to adapt these general guidelines and principles to the requirements of the actual environments where the systems are to be implemented.
2. System shall provide equipment ground connections (bonds) from the premises entrance facility and outside-plant earthing system to each telecommunication room telecommunication ground busbar, through the racking systems to bond the network equipment.
3. Entire grounding link from equipment to earth should be visually verifiable except where hidden by walls, conduit or pathways.
4. Installing contractor shall label all elements of the communications bonding network per guidelines defined in ANSI/TIA-607-D and ANSI/TIA 606-C.
5. It is the responsibility of the installer to be knowledgeable of all previously cited Standards and Codes and to bring to the attention of Stephen F. Austin State University any conflicts or discrepancies to achieve a fully functioning, standards-compliant earthing system.
6. Contractors working around, or adding to existing legacy systems shall bring to the attention of Stephen F. Austin State University previously installed network elements that may not comply with modern grounding requirements for possible remediation.

B. Telecommunications Bonding Backbone (TBB):

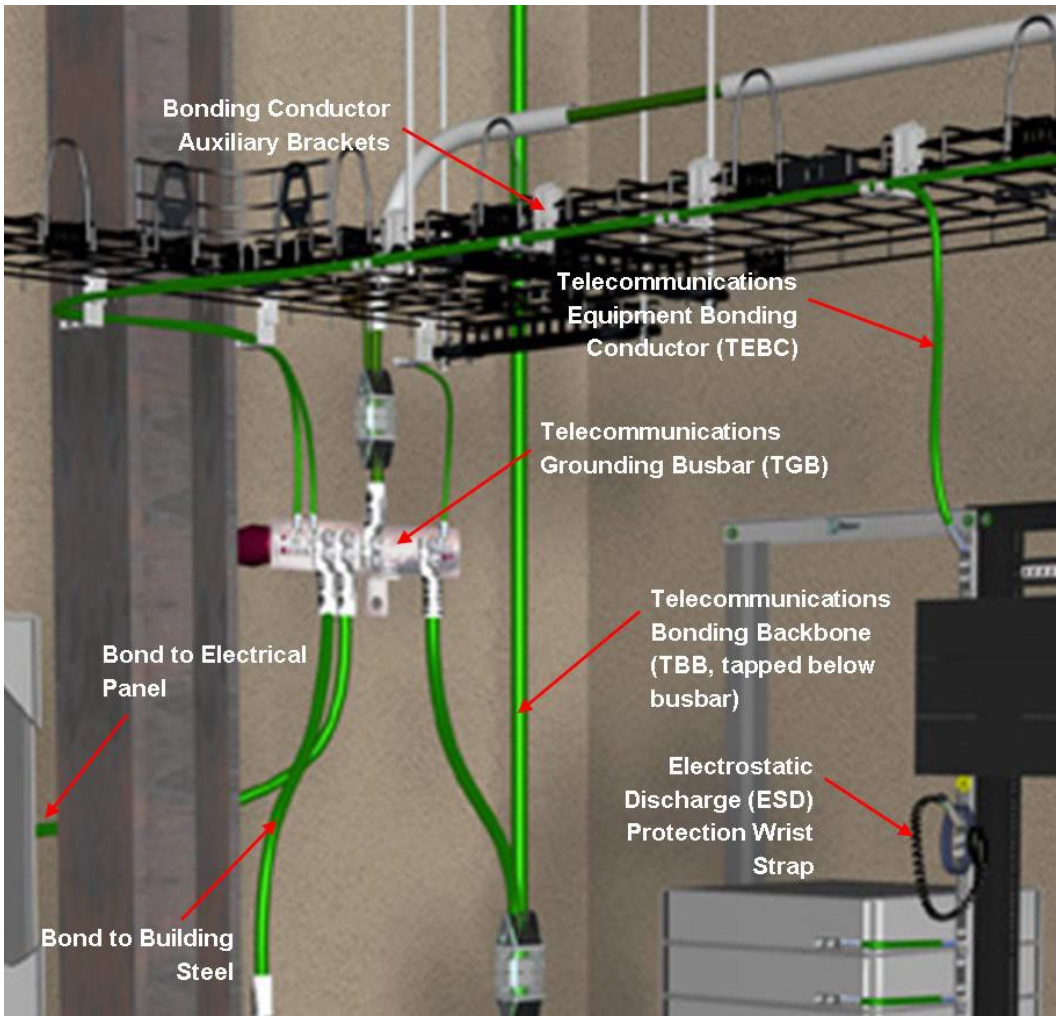
1. Bonding and grounding conductors may be insulated or un-insulated and shall not decrease in size as the grounding path moves closer to earth.
2. Connections (bonds) between the telecommunications grounding network and associated electrical panels shall be done by a qualified electrician in accordance with guidelines in ANSI/TIA-607-D and applicable electrical codes.
3. Bonding Conductors should be continuous and routed in the shortest possible straight-line path, avoiding changes in elevation and sharp bends.
4. TBB conductors shall be protected from mechanical damage and built to minimize splicing. Where splicing is unavoidable they shall be done using irreversible compression splices (C-TAPS) built to that purpose.
5. TBB in multi-story buildings with multiple risers (multiple TBBs) shall employ a grounding equalizer (GE) between vertical grounding backbones at the top floor of the building and minimally at every third floor in between to the lowest floor level. The GE shall be no smaller than the largest sized TBB.
6. Conductors: Install solid conductor for No. 6 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

i. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 3/0 AWG.
ii. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 3/0 AWG.

C. Entrance Facilities and Telecommunications Main Grounding Busbar (TMGB):
1. TMGB shall be located in the entrance facility, near the electrical panel to which it will be bonded but installed to maintain clearances required by applicable electrical codes.
2. TMGB shall be sized per the anticipated number of bonded connections needed
3. TMGB shall have tinned surface to restrain oxidation and be cleaned and antioxidant paste applied prior to fastening conductors.
4. Connectors on TBB which attach to TMGB shall be of two-hole, long-barrel compression lugs of the LCC series as specified in the "Materials" section of this document.
5. Building steel within six feet of the communications grounding system should be bonded into the system with appropriate hardware listed in "Materials" section of this document.
6. All cables containing a metallic shield or armor shall have that shield properly bonded into the communications grounding system using the appropriately sized Armored Cable Grounding Kit listed in the "Materials" section of this document.
7. The illustration below depicts for reference the general location and layout of the TMGB and associated grounding elements in a typical entrance facility.

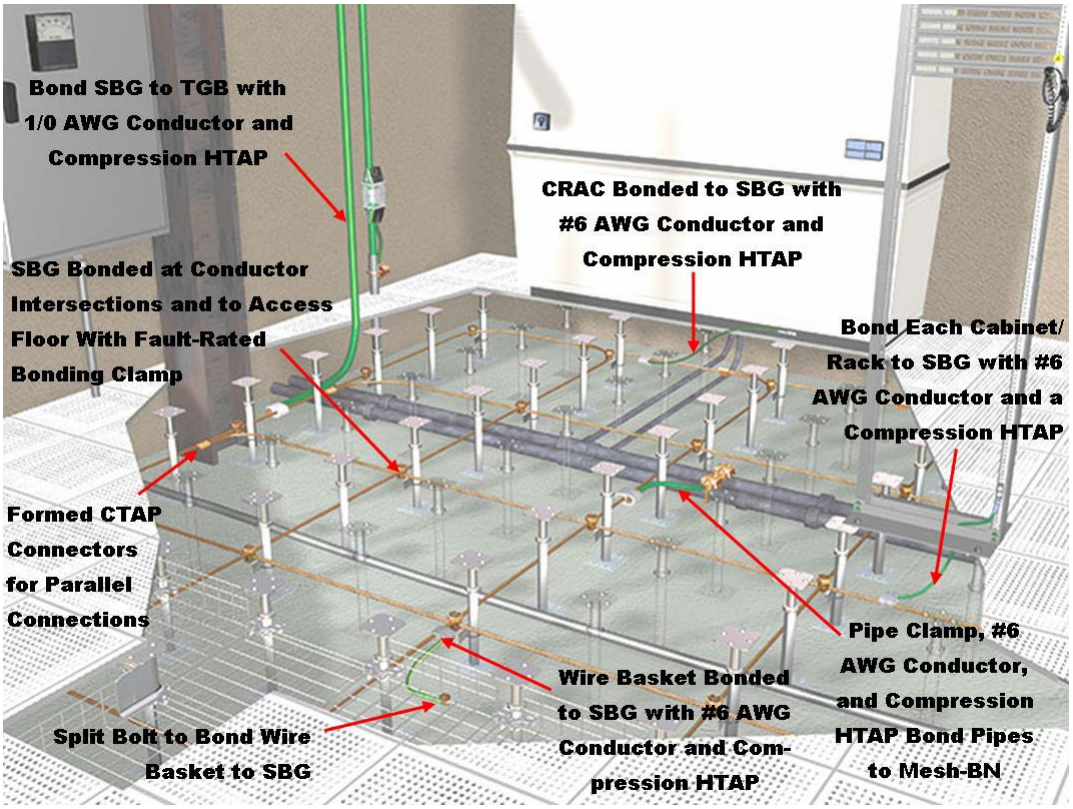


D. Telecommunications Rooms and Telecommunications Grounding Busbar (TGB):
    1. Each telecommunications room shall have its own TGB to which equipment and dead steel (building steel and support structures) in that room are bonded.
    2. The TGBs shall have a tinned surface to inhibit oxidation and be sized according to the anticipated number of bonded connections that will be needed.
    3. TGBs shall be sized according to the anticipated number of bonded connections needed.
    4. TMGs shall have tinned surfaces to restrain oxidation and shall be cleaned and have an antioxidant paste applied to both bonding surfaces prior to fastening conductors.
    5. Connectors on backbone and rack/cabinet bonding conductors which attach to TGB shall be of two-hole, long-barrel compression lugs of the LCC series as specified in the "Materials" section of this document.
    6. Building steel within six feet of the communications grounding system should be bonded into the system with beam clamps and other hardware appropriate to that purpose listed in "Materials" section of this document.
    7. Racks and cabinets shall have individual Rack Bonding Conductors (RBC) bonding to the Telecommunications Equipment Bonding Conductor (TEBC) or underfloor "Supplemental Bonding Grid - DAISY CHAINING OR SERIAL CONNECTIONS OF ONE RACK OR CABINET TO ANOTHER WILL NOT BE ACCEPTED.
    8. In smaller Telecommunications Rooms (3-5 racks) it is acceptable to have telecommunications equipment bonding conductors (TEBC) that go directly from each individual rack to the TGB. DAISY CHAINING OF RACKS WILL NOT BE ACCEPTED.
    9. Rack Bonding Conductors (RBC) or above rack row grounds (TEBC) shall be installed to maintain a minimum of 2" separation from all other types of cable - power or communications.
    10. To maintain this segregation of cables some telecommunications rooms may lend themselves to the installation of Auxiliary Conductor Brackets for routing bonding conductors outside of, yet parallel to ladder rack or basket tray. See "Auxiliary Brackets" in "Materials" section of this document.
    11. Bonding conductor support systems like auxiliary brackets shall be spaced no further apart than three foot intervals.
    12. All cables containing metallic shielding or armor shall be properly bonded into the communications grounding system using the appropriately sized Armored Cable Grounding Kit listed in the "Materials" section of this document.
    13. The illustration below depicts for reference the general location and layout of a typical telecom room and associated bonding connections into the TGB.



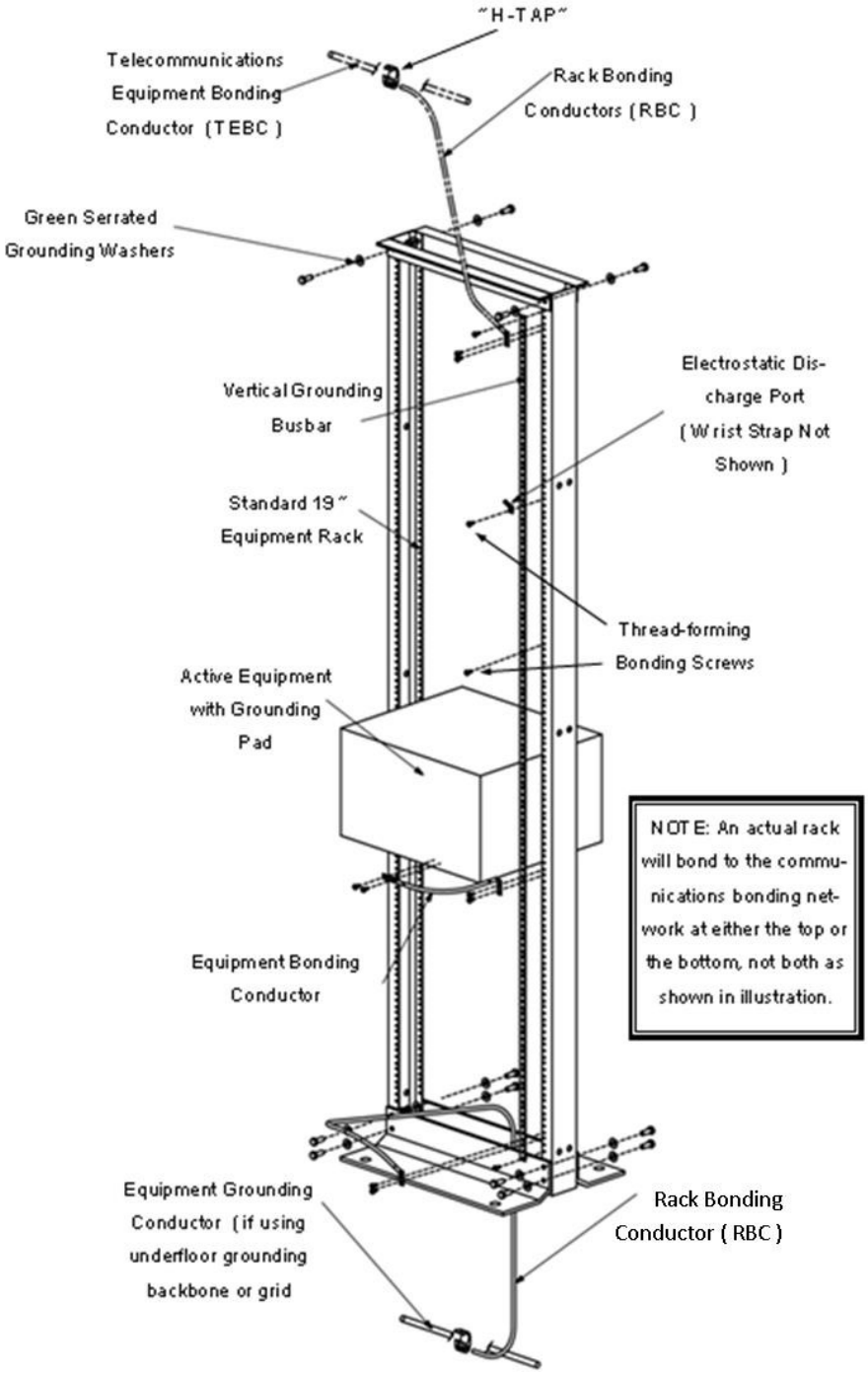
E. Supplemental Bonding Grid (SBG) (a.k.a. Underfloor Grounding Grids):
   1. Large Equipment Rooms and Data Centers may have Mesh Bonding Network or Mesh-BN which consist of the information technology equipment (ITE), racks and cabinets, underfloor supplemental bonding grids (SBG, a.k.a. underfloor bonding grids), and pathways
   2. Flooring system must be made electrically continuous, with the grid bonded a minimum of every fifth pedestal in each direction as per TIA 607-D Standard, using a minimum size #6 AWG stranded copper conductor and the pedestal clamps listed in the "Materials" section of this document. Specifications for individual Stephen F. Austin State University projects requiring larger conductor sizes or greater clamp density shall take precedent over these guidelines.
   3. Underfloor SBG shall bond to the TMGB or TGB in the computer room with a conductor of 1/0 AWG or larger.
   4. Racks and cabinets shall bond to the SBG with a conductor size of #6 AWG or larger.

5. Each rack or cabinet will have individual bonding conductors into the grounding grid. Serial connections (or "daisy-chaining") between communications bays is strictly forbidden and will not be accepted.
6. Power Distribution Units (PDU) shall bond into the Mesh-BN per requirements of NEC 250.122 and per manufacturers' recommendations.
7. Heating, ventilating and air-conditioning (HVAC) shall have bonding conductors into the underfloor grid of #6 AWG or larger.
8. Each HVAC unit shall have its own connection and may not be daisy-chained or attached serially.
9. Each steel column in the communications room shall bond into the Mesh-BN with a conductor of minimum size #4 AWG.
10. All metal cable trays shall be bonded into the grid with a minimum conductor size of #6 AWG or larger. These may be bonded in series.
11. All metallic conduits, water pipes and air ducts shall be bonded to the grid with a minimum conductor size of 6 AWG or larger. These may be bonded in series.
12. The following graphic illustrates for reference a typical underfloor SBG and the bonds made to it.



F. Bonding within Racks and Cabinets:
   1. Racks and Cabinets shall be bonded into the communications bonding network with conductors of #6 AWG or larger.

2. Depending on size of the telecommunications room, Rack Bonding Conductors (RBC) may tap into underfloor or overhead grounding conductors, or for smaller TRs (3-5 racks or cabinets), may go directly from the rack to the wall mounted busbar.
3. Racks, cabinets and similar enclosures shall not be attached serially (daisy-chained) but must have individual RBC into the grounding system.
4. None Panduit racks and cabinets shall have vertical grounding busbars installed along one rail to provide clean bonding landing point for all rack mount equipment. For vertical busbar part numbers, see "Materials" section of this document.
5. All painted components of racks/cabinets shall be assembled using serrated grounding washers and thread-forming screws to ensure electrical continuity between the different structural components of the rack/cabinet. When using Panduit racks, these green washers come with the rack.
6. Larger equipment (chassis switches) with integral grounding terminals or pads shall be bonded to the vertical busbar with equipment grounding kits attached to those terminals and bonding them to the rack-mounted busbars. For kit part numbers see the "Materials" section of this document.
7. Anywhere two metallic surfaces are to be bonded, contractor shall clean the contact areas of paint or oxidation using abrasive pads, and apply film of anti-oxidation compound between surfaces prior to bonding.
8. All cable fittings shall be of two-hole (LCC series) compression-type. Mechanical screw-lugs on racking systems will not be accepted and must be removed and replaced at contractor's expense.
9. All screws used to affix compression lugs to rack-mounted vertical busbars shall be of the thread forming type made specifically for electrical bonding.
10. Smaller equipment (servers, TOR switches) not having integral grounding pads must be bonded to the rack through the equipment mounting flanges using green thread-forming grounding screws with serrations under the head to cut through paint, coatings and oxidation that may be present on the equipment flange. Such equipment shall have minimally one grounding screw per piece of equipment.
11. Existing (installed) racking systems containing live active equipment may be retrofitted for Standards-compliant bonding using rack retrofitting kits listed in the "Materials" section of this document.
12. ESD (electro-static discharge) ports and wrist straps shall be provided minimally every other rack or bay to be within reach of any active equipment. On larger 4-post racks or cabinets - ESD ports and wrist straps shall be installed on the front and back to be accessible when servicing any active equipment.
13. As a condition of employment, any internal or contracting technicians servicing active equipment must be wearing a properly grounded wrist strap to dissipate ESD charges prior to touching any Stephen F. Austin State University active equipment.
14. The following illustration demonstrates how the racks shall be bonded:


"H-TAP"
Telecommunications Equipment Bonding Conductor (TEBC)
Rack Bonding Conductors (RBC)
Green Serrated Grounding Washers
Vertical Grounding Busbar
Electrostatic Discharge Port (Wrist Strap Not Shown)
Standard 19" Equipment Rack
Thread-forming Bonding Screws
Active Equipment with Grounding Pad
NOTE: An actual rack will bond to the communications bonding network at either the top or the bottom, not both as shown in illustration.
Equipment Bonding Conductor
Equipment Grounding Conductor (if using underfloor grounding backbone or grid
Rack Bonding Conductor (RBC)

3.2 FIELD QUALITY CONTROL

A. On installations confined to a single telecommunications room, the installing contractor shall visually verify continuity of communications bonding system from equipment, through racking systems, to overhead or underfloor backbone to the wall mounted busbar in that telecommunications room.

B. Contractor shall further verify the use of all appropriate bonding accessories in the racking systems such as grounding washers, thread-forming grounding screws and the presence of electro-static discharge ports and wrist straps within reach of all equipment to be maintained.

C. On greenfield (new) projects involving installation of a building-wide telecommunications backbone, installing contractor is further responsible for visually verifying sizing and sound installation of the telecommunications bonding backbone including presence of properly sized and installed grounding equalizer conductors between backbones contained in separate risers.

D. Inspecting Contractor shall verify that any conduit longer than 3 feet through which a grounding conductor passes is properly bonded to the grounding conductor as described in this document.

E. During inspections contractor, shall verify compliance with all stipulations specified in this document and compliance with all regulatory references (Standards and Codes) cited.

F. All opens or gaps in the bonding system during final inspections will be recorded in the inspection report and remedied.

G. During inspections, contractor shall check all grounding and bonding system conductors and connections for tightness and proper installation, including checking proper dies were used on compression taps and fittings by checking embossed die numbers on those connections.

H. Stephen F. Austin State University may request a test of 10% of bonded connections within the grounding system with a volt-ohm meter. Resistance tests taken on either side of a compression or exothermic bond shall be less than .2 (2/10) of one ohm in resistance.

I. Bonded joints to be tested may be random or individually tagged by a representative of Stephen F. Austin State University.

J. Contractor shall Test system at bonded points indicated and provide results in report form.

K. Based upon test results, Stephen F. Austin State University reserves the right to request testing on 100% of exothermic and compression bonds within the installed grounding system.

L. All bonded connections failing the test described above shall be remedied and retested by the installation contractor at contractor's expense.

END OF SECTION 27 05 26

SECTION 27 05 28
PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL REQUIREMENT

1.1 GENERAL

A. Drawings and general provision of the Contract, including General and other Conditions and other General Requirements sections, apply to the work specified in this section.

B. This section and all related sections shall be performed by a qualified Contractor as outlined in the specifications.

1.2 DESCRIPTION OF WORK

A. This contract shall be responsible for all hangers and support mechanisms required to properly support all telecommunications cables to satisfy the local Authority Having Jurisdiction.

B. This contract shall be responsible for all pathways as called out on Drawings, specifically:

1. Various conduits and “J-Boxes” as detailed on “T” series Drawings to accommodate Telecommunications Outlets (TO) and Wireless Access Points (WAP) locations. Any necessary penetrations shall accommodate a minimum of a Trade Size 2” EMT conduit.

C. The Contractor shall coordinate with the General Contractor and all other trades prior to final placement of telecommunications pathways. Placement shall be such that pathway will be accessible for future additions requiring placement of telecommunications cable.

D. The Contractor shall provide all labor, equipment and supplies to furnish and install the communications pathway, hangers and supports.

E. Installation shall include the actual physical installation of the hardware and/or support structure, sleeves, firestopping, testing and documentation.

1.3 RELATED SECTIONS

A. Section 26 0533 - Raceways and Boxes for Electrical Systems

B. Section 27 0528.29 - Hangers and Supports for Communications Systems

C. Section 27 0528.33 - Conduits and Backboxes for Communications Systems

D. Section 27 0528.36 - Cable Trays for Communications Systems

E. Section 27 0528.39 - Surface Raceways for Communications Systems

1.4 SUBMITTALS

A. The following information shall be provided:

1. Manufacturer's literature and catalog cuts indicating:
2. Physical dimensions, including dimensions (if appropriate)
3. Materials of construction

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment installed under this contract shall be new, unused, free of defects, and of current manufacture. Equipment and material shall carry Underwriters Laboratory certification if required by local, state or national codes. Products are to be from the acceptable manufacturer listed below. In no case, will field fabrication or "shop built" cable support products be acceptable.

2.2 SURFACE MOUNTED RACEWAY

A. Surface Mounted Raceway (SMR) shall be provided as per Section 27 0528.39 with all fittings including but not limited to mounting clips and straps, couplings, flat, bend limiting internal and external elbows, cover clips, bushings, device boxes and other incidental and miscellaneous hardware required for a complete SMR.

B. Acceptable manufacturers:

1. Panduit or comparable to.

2.3 J-HOOKS

A. Fastener is to be installed using dedicated wire/rod with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments. Product is to be UL® Listed for the application.

B. Acceptable manufacturers:

1. Panduit or comparable to.

2.4 FIRESTOPPING SYSTEMS TELECOM RACEWAYS

A. Comply with the requirements of Section 07 8400

B. Acceptable products for wall penetrations are as follows:

1. Specified Technologies
2. 3M™
3. Hilti

C. Acceptable products for less than 2" penetrations are as follows

1. Resilient elastomeric caulk and re-enterable putty manufactured by 3M, Specified Technologies or Hilti.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install per manufacturer's instruction per weight loading.

B. SMR shall be securely supported using mechanical fasteners at intervals not exceeding 10 feet or in accordance with manufacturer's installation instructions.

C. Telecommunication Outlets shall be surface mount outlet boxes compatible with the raceway specified.

D. The path of the SMR shall minimize impact on molding, tack boards and other architectural elements. Vertical runs of raceway from the ceiling to outlets shall be installed on walls near

corners wherever possible. Raceway may be installed horizontally at the same height as the outlets or near to the ceiling. Entrance end fittings will be supplied at the ends of raceway runs to transition to conduit sleeves through walls, ceilings or floors. SMR shall be installed parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.

E. Metal components shall be bonded and grounded in accordance with applicable code and ANSI/TIA-607-D.
F. J-hooks are to be supported by dedicated wires or rods installed by this contract. In no case, will ceiling grid wires be used to support J-hooks. J-hooks will be attached to ceiling grid wires (where applicable) to satisfy seismic bracing requirements and to prevent swinging.
G. Adjustable cable support systems are to be securely attached to building structure and loaded as per manufacturer's instruction.
H. Fire Rated wall and floor penetrations shall be fire-stopped in accordance with the manufacturer's instructions using the product set referenced in 2.4 above.

END OF SECTION 27 05 28

SECTION 27 05 28.36
CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to completely execute a complete wire basket cable tray system as described in this specification and as shown on the Drawings.

B. Wire basket cable tray systems are defined to include, but are not limited to straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, drop outs, supports and accessories.

C. Material listed in this section is for use non-telecommunications room spaces. See section 27 1123 for cable tray in telecommunications room spaces.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM) International:

1. ASTM A1011 / A1011M - Standard Specification for Steel, Sheet and Strip, Hot- Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
2. ASTM A123 / A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A510 - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
4. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
5. ASTM A580 – Standard Specification for Stainless Steel Wire
6. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
7. ASTM A641 / A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
8. ASTM A653 / A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
9. ASTM D769 - Standard Specification for Black Synthetic Iron Oxide

B. National Electrical Manufacturers Association:

1. NEMA FG 1 - Fiberglass Cable Tray Systems.
2. NEMA VE 1 - Metal Cable Tray Systems.
3. NEMA VE 2 - Cable Tray Installation Guidelines.

C. NFPA 70: National Electrical Code (2008)

D. ANSI/TIA-568-E.0 – Generic Telecommunications Cabling for Customer Premises

E. ANSI/TIA-569-C – Commercial Building Standard for Telecommunications Pathways and Spaces

1.2 DRAWINGS

A. The Drawings, which constitute a part of these specifications, indicate the general route of the wire basket cable tray systems. Data presented on Drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.

B. Specifications and Drawings are for assistance and guidance, but exact routing, locations, distances and levels will be governed by actual field conditions. Contractor is directed to make field surveys as part of his work prior to submitting system layout drawings.

1.3 QUALITY ASSURANCE

A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the owner or owner's representative.

B. Supply all equipment and accessories new and free from defects.

C. Supply all equipment and accessories in compliance with the applicable standards listed in Part 1.02 of this section and with all applicable national, state and local codes.

D. All items of a given type shall be the products of the same manufacturer.

E. Zinc plated wire basket cable tray shall be classified by Underwriters Laboratories (UL).

F. Wire basket cable tray shall be a minimum of 12" wide and of uniform quality and appearance.

G. Comply with the National Electrical Code (NEC®), as applicable, relating to construction and installation of cable tray and cable channel systems (Article 392, NEC®).

H. Comply with NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems.

1.4 SUBMITTALS

A. Submittal Drawings: Submit drawings of wire basket cable tray and accessories including connector assemblies, clamp assemblies, brackets, splice plates, splice bars, grounding clamps and hold-down plates showing accurately scaled components. Indicate wire basket cable tray dimensions, support points, and finishes.

B. Product Data: Submit manufacturer's data on wire basket cable tray system including, but not limited to, types, materials, finishes and inside depths.

C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under references. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual routing of cable tray and locations of supports.

1.6 PRE-INSTALLATION MEETINGS

A. Convene a minimum of two week(s) prior to commencing work of this section. Meeting shall include General Contractor and all sub-contractors involved with the installation of duct work, plumbing or other such fixtures that will be placed in shared space above the dropped ceiling.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Ship and store wire basket cable tray system equipment in its original packages and in a clean, dry space to prevent damaging from weather, construction traffic or foreign matter. All handling performed in accordance with manufacturer's recommendations. Provide protective coverings during construction.

B. Deliver wire basket cable tray systems and components carefully to avoid breakage, bending and scoring finishes. Do not install damaged equipment.

C. Replace at no expense to Owner, equipment or material damaged during storage or installation as directed by the Architect.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Coordinate selected product with Section 26 0536.

B. Subject to compliance with these specifications, wire basket cable tray systems to be installed shall be as manufactured by the following:

1. Panduit or comparable to.

2.2 WIRE BASKET CABLE TRAY SECTIONS AND COMPONENTS

A. Provide wire basket cable tray of types and sizes indicated with connector assemblies, clamp assemblies, connector plates, splice plates and splice bars. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the additional construction highlighted in Section 2.02.

B. All straight section longitudinal wires shall be constructed with a continuous top wire safety edge. Safety edge must be kinked and T-welded on all tray sizes.

C. Wire basket cable tray shall be made of high strength steel wires and formed into a standard 2 inch by 4 inch wire mesh pattern with intersecting wires welded together. All mesh sections must have at least one bottom longitudinal wire along entire length of straight section.

D. Wire basket cable tray sizes shall conform to the following nominal criteria:

1. Straight sections shall be furnished in standard 118.3 inch lengths.
2. Wire basket cable tray shall be sized to accommodate no more than 30% fill ratio.

E. In order for a system to be approved as an equipment ground conductor (EGC), all splicing assemblies shall be UL® Classified or CSA approved as an EGC. When using, powder coated wire mesh cable tray as an EGC, the paint must be completely removed at all contact points of splice/ground bolt attachments. When Panduit Wyr-Grid is used, it has integrated bonding screws at intersections and junctions.

F. Material and Finishes: Material and finish specifications for are as follows.

1. Non-exposed cable tray shall be bright zinc plated, as manufactured.
2. In exposed areas, the cable tray may be black powder coat.

G. All fittings shall be field formed from straight sections in accordance with manufacturer's instructions.

H. Wire basket cable tray supports shall be center support hangers, trapeze hangers or wall brackets from the manufacture of the tray.
I. Trapeze hangers or center support hangers shall be supported by 3/8" or ½" inch diameter rods.
J. Special accessories shall be furnished as required to protect, support and install a wire basket cable tray system.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install wire basket cable tray in accordance with NEMA VE 2 to ensure that the cable tray equipment complies with the requirements of the NEC®, applicable portions of NFPA 70B, and the National Electrical Contractors Association's (NECA) 'Guide to Quality Electrical Installations' pertaining to general electrical installations practices.
B. All trays should be supported using a minimum of 3/8" All Threaded Rod (ATR).
C. Special accessories shall be furnished as required to protect, support and install a wire basket cable tray system.
D. Coordinate wire basket cable tray with other electrical work as necessary to properly interface installation of wire basket cable tray with other work.
E. Support trays and fasten to structure. Install supports at each connection point, at end of each run, and at other points to maintain spacing between supports of 5 feet maximum.
F. Install firestopping in accordance with local and NFPA regulations to sustain ratings when passing wire basket cable tray through fire-rated elements.
G. Ground and bond metal cable tray in accordance with NFPA 70, National Electrical Code Article 392: Cable Trays. Additionally;
    1. Bond cable tray system to a known source of building ground.
    2. Provide continuity between wire basket cable tray components. Powder coating must be thoroughly removed at grounding device connection point.
    3. Make connections to tray using mechanical, compression or exothermic connectors.
    4. If required, ground cable trays by mounting up to two #6 AWG bare copper wires to each wire basket cable tray section, bonded with a grounding clamp
H. Provide sufficient space encompassing wire basket cable tray to permit access for installing and maintaining cables.

3.2 TESTING

A. Test wire basket cable tray support systems to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. See NFPA 70B, Chapter 20, for testing and test methods.
B. Manufacturer shall provide test reports witnessed by an independent testing laboratory of the "worst case" loading conditions outlined in this specification and performed in accordance with the latest revision of NEMA VE-1.

END OF SECTION 27 05 28.36

SECTION 27 05 28.39
SURFACE RACEWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL REQUIREMENT

1.1 SECTION INCLUDES

A. Surface mounted raceway (SMR).

1.2 RELATED SECTIONS

A. Section 26 0533 - Raceways and Boxes for Electrical Systems
B. Section 27 0528 – Pathways for Communications Systems
C. Section 27 0528.29 - Hangers and Supports for Communications Systems
D. Section 27 0528.33 - Conduits and Backboxes for Communications Systems
E. Section 27 0528.36 - Cable Trays for Communications Systems

1.3 SUBMITTALS

A. Submit under provisions of Section 27 0513
B. Samples: If other than specified product is bid, Contractor must submit a 24-inch length of proposed product. Show finished detail with boxes, faceplate, connectors, angles and transitions.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms regularly engaged in manufacturer of raceway systems, boxes and fittings of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years. Provide fittings and boxes produced by a manufacturer listed in this section.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver raceways and distribution systems in factory labeled packages.
B. Store and handle in strict compliance with manufacturer's written instructions and recommendations
C. Protect from damage due to weather, excessive temperature, and construction operations.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. Provide surface mount raceway distribution components as manufactured by Panduit.
B. SMR shall be manufactured by Panduit. All fittings and transitions pieces are to be of the same manufacturer; however, low voltage receptacles may be from a different manufacturer so long as the product is designed to be an integral part of the completed system.
C. SMR shall be a low-profile product and may be nonmetallic if product satisfies the Authority Having Jurisdiction.

2.2 SURFACE MOUNTED RACEWAYS AND FITTINGS

A. General:
   1. System: Surface raceway systems shall consist of bases, covers, appropriate fittings, mounting brackets, workstation boxes / enclosures and device mounting brackets and fasteners necessary for a complete installation.
   2. Surface mounted raceways shall be a rectangular design with removable covers or solid construction, constructed of shatter-proof thermoplastic (or similar) raceway, utilizing elbows, couplings, and connectors of the same material.
   3. Mounting Brackets: Surface mounted raceway shall be secured to wall using properly rated anchors or mounting brackets. Brackets shall provide un-obscured inspection of fastening bolts at point of wall penetration. In no case, whatsoever will surface mounted raceways be attached with drywall screws.
   4. Fittings: Fittings shall include flat, internal and external elbows, tees, couplings for joining raceway sections, wire clips, blank end fittings, and device mounting brackets and plates as applicable. Provide full capacity corner elbows and fittings to maintain a controlled 2-inch cable bend radius, meeting the specification for Fiber Optic and UTP cabling and exceeding the ANSI-TIA-569-C requirements for communications pathways.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions under which raceways, boxes, distribution systems, accessories, and fittings are to be installed and substrate that will support raceways. Notify the Owner's Representative in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Strictly comply with manufacturer's installation instructions and recommendations and approved installation practices. Care should be taken to prevent "over tightening" of fastening devices.

B. The SMR shall be surface mounted on the wall using properly rated anchors or brackets. The top edge of the SMR shall be horizontally level below the suspended ceiling line or the true ceiling line, whichever is lower, shall be installed to permit visually inspection to verify the physical integrity of the raceway for its entire run, shall not block doorways or access to emergency exits, shall not inhibit the operation of windows, and shall not run across windows.
   1. Support: SMR shall be supported by properly rated anchors or mounting brackets at intervals not to exceed 5 feet or in accordance with manufacturer's installation sheets.
   2. Accessories: Provide accessories as required for a complete installation.

3.3 FINAL FINISH

A. All surfaces are to be left completely smooth and finished. No cut edges are to be exposed. In the event a metallic product is used; all rough edges are to be dressed and covered with appropriate fittings that prevent any access whatsoever with sharp edges.

B. The Contractor shall coordinate with General Contractor to schedule paint of metallic product to match wall. Non-metallic product shall not be painted.

3.4 CLEANING AND PROTECTION

A. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer.

B. Protect raceways and boxes until acceptance.

END OF SECTION 27 05 28.39

SECTION 27 05 53
IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL REQUIREMENT

1.1 WORK INCLUDED

A. Provide all labor, materials, tools, and equipment required for the complete labeling of the telecommunications infrastructure.

1.2 SCOPE

A. This section includes all telecommunications cables and the associated infrastructure in the telecommunications rooms and telecommunications cabinets.

1.3 QUALITY ASSURANCE

A. All cable identification tags and labels shall be installed in a neat and workmanlike manner.

PART 2 - PRODUCTS

2.1 LABEL TAGS – CABLE AND FACEPLATES

A. The labels shall be machine generated.
B. The label background shall be white with black ink.
C. Lettering on sleeves shall be 1/8-inch high

2.2 ENGRAVED SIGNAGE

A. Engraved signage shall be laminate (color as specified) with engraved white letters.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General
   1. All horizontal (station) cables and outlets in which they terminate shall be identified by the Contractor at both ends of the wiring run using TIA-606C Labeling scheme.
   2. All fiber tie cables shall be labeled at each end. The standard nomenclature for labeling is “From <Room-1> to <Room-2>”, where “Room-1” is the originating location and “Room-2” is the destination.

B. Telecommunication Room and Telecom Enclosures shall be identified as per TIA-606C

C. Horizontal (Station) Cables
   1. All cables will be labeled the same at both ends. The tag shall be secured to the sheath no more than 4 inches from the end of the cable.
   2. Relative position identification shall commence to the immediate left of the entrance door with the position identifier starting at “A” and increasing through the alphabet in a clockwise direction.

D. Copper Tie Cables
   1. Cables shall be labeled “From” – “To”, specifically: From ER to TR-x, where “x” = TR Number

E. Fiber Tie Cables
   1. Cables shall be labeled “From” – “To”, specifically: From ER to TR-x, where “x” = TR Number

F. Telecommunication Outlets (TO)
   1. Each TO shall be labeled at the top of the modular jack enclosure.

G. Telecommunications Racks and Frames
   1. Labeling in the Main Equipment Room and Telecommunications Rooms shall be as per the Drawings. Labels shall be 1” orange or white with ½ inch black letters. Labels shall be placed left-to-right identifying “FRAME-1” through “FRAME-x”, where “x” = number of racks/cabinets present.

H. Patch Panels
   1. Patch panels shall be labeled identical to the cables and telecommunications outlets.

I. Door Signage
   1. The exterior door of the Main Equipment Room (ER) and Telecommunications Rooms (TRs) shall have signage as per the drawings.

END OF SECTION 27 05 53

SECTION 27 11 00
COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL REQUIREMENT

1.1 SECTION INCLUDES

A. Construction Requirements
B. Site Specific Requirements

1.2 RELATED SECTIONS

A. Section 27 0000 – Communications
B. Section 27 0005 – Common Work Results for Communications
C. Section 27 0513 – Communications Services
D. Section 27 0526 – Grounding and Bonding for Communications Systems
E. Section 27 0528 – Pathways for Communications Systems
F. Section 27 0528.29 - Hangers and Supports for Communications Systems
G. Section 27 0528.33 - Conduits and Backboxes for Communications Systems
H. Section 27 0528.39 - Surface Raceways for Communications Systems
I. Section 27 0553 – Identification for Communication Systems
J. Section 27 0800 – Commissioning of Communications
K. Section 27 1116 – Communications Cabinets, Racks, Frames and Enclosures
L. Section 27 1123 – Communications Cable Management and Ladder Rack
M. Section 27 1126 – Communications Rack Mounted Power Protection and Power Strips
N. Section 27 1313 – Communications Copper Backbone Cabling
O. Section 27 1323 – Communications Optical Fiber Backbone Cabling
P. Section 27 1513 – Communications Copper Horizontal Cabling

1.3 CONSTRUCTION REQUIREMENTS

A. This contract is responsible for the build out of the telecommunications spaces to include telecommunications rack(s), ladder racking and all required accessories.

1.4 SITE SPECIFIC REQUIREMENTS

A. As a part of this project, the Main Equipment Room (ER) and Telecommunications Rooms (TR) will be constructed as shown on the Drawings. This contract will be responsible for procurement and installation of all components from the plywood backboards out, i.e., installation of required racks, ladder tray, bonding and grounding and other ancillary equipment as shown on the Drawings or deemed necessary for the operation of a complete system.

PART 2 - PRODUCTS

2.1 GENERAL

A. The use of a manufacturer's name and model or catalog number herein is for the purpose of establishing the product set, which the Contractor is to supply and install.

B. Quantities are to be determined by Contractor unless specified.

2.2 PRE-APPROVED PRODUCT SETS

A. The following product sets only are approved for this project.
    1. Racks, cabinets, enclosures, frames and associated fastening devices
        i. Chatsworth or Panduit racks.
        ii. Panduit enclosures

PART 3 - EXECUTION

3.1 GENERAL

A. Manufacturer's installation instructions and requirements shall be strictly adhered to in the telecommunications equipment installation, fabrication and testing process.
B. Where conflicts arise between the requirements of this Specification and the manufacturer's installation instructions, the Owner's Representative shall be consulted for resolution.
C. Equipment shall be firmly held in place. Fastenings, supports, and hangers shall be adequate to support their loads. Fasteners are to be a minimum of Grade 5 and constructed of stainless steel or zinc plated steel. In no case, will drywall screws be accepted as permanent fasteners.
D. The installation must conform to OSHA standards and comply with state and local safety codes.
E. Installation shall be neat, well organized, and professional.
F. The Contractor shall clean up the work area at the end of each day. At the end of the project all material removed or left over, and/or not being used shall be removed from the project site unless other arrangements have been made. A final clean up shall be made before final payment is made.
G. All wall and penetrations shall be fire stopped at or before substantial completion.

3.2 PREPARATION

A. Before commencing work, the Contractor shall field-investigate each facility and ascertain if the physical and electrical conditions within the facility shall permit commencement of the Contractor's work.
B. Plywood backboards must be painted prior to installation of cabinets or any racking that will bolt to the plywood.
C. Any discrepancies, questions, or concerns noted at that time should be brought to the immediate attention of the Owner's Representative.

3.3 COMPONENT INSTALLATION

A. All equipment is to be bonded as per Section 27 0526
B. Install all telecommunications cabinet and racking materials in accordance with Sections 27 1116 and 27 1123.
C. Wall mounted termination block fields shall be mounted on 4' x 8' x .75" void free plywood. The plywood shall be mounted vertically 12" above the finished floor. The plywood shall be painted with two coats of white fire retardant paint.
D. Wall mounted termination block fields shall be installed with the lowest edge of the mounting frame 18" from the finished floor.

END OF SECTION 27 11 00

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

PART 1 - GENERAL REQUIREMENT

1.1 SECTION SCOPE

A. This section outlines the minimum requirements for equipment racks, cabinets, and enclosures.
B. This section outlines labeling requirements for racks and cabinets.

PART 2 - PRODUCTS

2.1 GENERAL

A. Products and part numbers specified are from Panduit.

2.2 TELECOMMUNICATIONS RACK

A. Freestanding telecommunications racks shall be installed in the Telecommunications Rooms as per the Drawings.
B. Racks shall be 7’ x 19”.
    1. See Appendix A for part numbers
C. Cable runway radius drop,
    1. See Appendix A for part numbers

2.3 TELECOMMUNICATIONS RACK – FOUR POST

A. A four-post server racks shall be installed in the Telecommunications Equipment Room as per the Drawings.
B. Racks shall be 7’ x 24” x 48” (D),
    1. See Appendix A for part numbers

2.4 Enclosed Cabinets

A. Cabinets shall be installed in the Telecommunications Equipment Room as per the Drawings.
B. Cabinets shall be 42RU/45RU/48RU/51RU x 24”/32” (W) x 42”/48” (D)
    1. See Appendix A for part numbers

2.5 LABELING

A. Telecommunications Racks and Frames
    1. Labeling in the Main Equipment Room and Telecommunications Rooms shall be as per the Drawings. Labels shall be 1” orange or white with ½ inch black letters. Labels shall be placed left-to-right identifying “FRAME-1” through “FRAME-x”, where “x” = number of racks/cabinets present.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Racks shall be firmly affixed to the floor using anchors and Grade 5 bolts.
B. Top of rack shall be firmly affixed to ladder tray by means of a mounting plate.
C. Rack shall be bonded to either TGB or TMGB via a #6 AWG conductor.
D. All metallic components shall be bonded.
E. Racks shall be placed with a 36-inch (minimum) clearance from the walls on all sides of the rack. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks and from the wall at each end of the row.
F. When two racks are facing each other, there must be at least a 48” aisle between racks.
G. Rack mount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.
H. Each Rack will accommodate no more than (384) horizontal structured cables. If a situation arises where more than (384) cable are required to be terminated in a rack, contact Stephen F. Austin State University contact, prior for written approval.

END OF SECTION 27 11 16

SECTION 27 11 19
COMMUNICATIONS TERMINAL BLOCKS AND PATCH PANELS

PART 1 - GENERAL

1.1 GENERAL

A. Drawings and general provision of the Contract, including General and other Conditions and other Division 1 – General Requirements sections, apply to the work specified in this section

1.2 WORK INCLUDED

A. Provide all labor, materials, tools, and equipment, including all support structure whether called out for or not, required for the complete installation of work called for in the Contract Documents

B. Install utility supply and special circuit's cables, riser blocks, patch panels, and all support structure in the Equipment and Telecommunication Rooms as outlined on drawings and specifications.

1.3 SECTION INCLUDES

A. This Section addresses the termination of copper backbone and station cables which are to be placed between the Main Equipment Room (ER) and the Telecommunications Rooms (TRs) located throughout the building. Included is all equipment and materials required to allow the Telecommunications Rooms to support all associated serving zones and connect it to the main Equipment Room backbone.

1.4 QUALITY ASSURANCE

A. All equipment shall be installed in a neat and workmanlike manner.

B. All materials shall be installed per manufacturer's specifications.

PART 2 - PRODUCTS

2.1 GENERAL

A. All products must be new and UL Listed for their use.

2.2 PUNCHDOWN BLOCKS

A. 100 pair 66 type punch down blocks with legs.

B. 5 pair connecting clips

C. See Appendix A for part numbers

2.3 PATCH PANELS

A. Modular Flat 24 or 48 port for Category 6 cabling

B. See Appendix A for part numbers.

PART 3 - EXECUTION

3.1 GENERAL

A. All 66 blocks shall be installed as per the detail provided on the Drawings.
B. All patch panels supporting the copper backbone cabling shall be installed in 7’ x 19” equipment racks in the ER and TRs.

3.2 INSTALLATION

A. 66 blocks shall be labeled as per criteria provided on Drawings and Section 27 0553
B. Place unshielded twisted-pair (UTP) cable to maintain the minimum cable bend radius limits specified by the manufacturer.
C. To avoid stretching four-pair horizontal cable conductors during installation, do not exceed a 25-pound force pulling tension (tensile loading).
D. Place copper cables transitioning between the cable trays and cabinets or racks in a neat and orderly manner per NEC 318.11(b) requirements. Hook & Loop tie-wrap transitioning bundles.
E. Directly terminate twisted-pair cable on wiring blocks, patch panels, and TOs in standard T568B color termination scheme.
F. Use wiring block and/or connector manufacturer’s recommended tools with the proper-sized anvils for all copper punch down, wire wrap, and crimp terminations. Stuffer caps are not permitted.
G. Unshielded twisted-pair connecting hardware and material including wiring blocks, patch
H. panels, connectors, TOs, cross-connect jumper wire or cables, patch cords, and other components used to connect unshielded 1 00-ohm twisted-pair cable shall meet or exceed the requirements of EIA/TIA 568-E.2, Specifications for Unshielded Twisted-Pair Connecting Hardware, for the category of use specified in the Contract Documents.
I. Cable Jackets: To reduce untwisting of pairs, maintain the twisted pair cable jacket as close as possible to the point of termination.
J. Multi-pair Cable: Strip back only as much cable jacket as is minimally required to terminate on connecting hardware.
K. Horizontal Cable: Strip back no more than 1 inch of cable sheathing.
L. Pair Twist: Observe the TIA/EIA -568-E recommended practice of preserving wire pair twists as closely as possible to the point of mechanical termination. The amount of untwisting in a pair because of termination to connecting hardware shall be no greater than 1/2 inch for all copper cables. This practice maintains the maximum number of twists in the wire, to minimize signal impairment and reduce potential problems with high-speed transmission.

3.3 PATCH PANELS

A. Patch Panels shall be installed in equipment racks. Note: no more than (384) terminations per rack (Or client preference rack).
B. Patch panels shall be installed per manufacturer's instruction and as indicated in drawings and specifications.

END OF SECTION 27 11 19

SECTION 27 11 23
COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents

B. Install ladder racks, cable trays, and all support structure in the Equipment and Telecommunication Rooms as outlined on drawings and specifications.

C. Equipment installed shall include:

1. Wyr-Grid Pathway
2. Vertical cable management
3. Brackets and support pieces
4. All related materials required to provide cable management and transition pathways within the Equipment and Telecommunications Rooms of this project.

D. Material listed in this section is for use within the telecommunications rooms. See section 27 0528.36 for cable tray in non-telecommunications room spaces.

1.2 RELATED SECTIONS

A. Section 27 1100 – Communications Equipment Room Fittings

B. Section 27 1116 – Communications Cabinets, Racks, Frames and Enclosures

1.3 QUALITY ASSURANCE

A. All equipment shall be installed in a neat and workmanlike manner.

B. All materials shall be installed per standard installation practices and manufacturer's specifications.

PART 2 - PRODUCTS

2.1 GENERAL

A. Approved manufacturers are:

1. Chatsworth
2. Panduit
3. Other National Electric Code approved.

B. Attachment hardware not supplied in kits from manufacturer shall be Grade 5 or greater.

2.2 VERTICAL CABLE WIRE MANAGEMENT

A. Vertical cable managers shall be installed to accommodate the number of cables for that TR or Room. Max fill ratio of 40% for the smaller channel and max fill ratio of 60% for the larger channel, when using dual sided cable managers. Minimum will be 6" W.
    1. See Appendix A for part number

2.3 CABLE TRAYS

A. The telecommunications cable tray shall be 12" wide.
    1. See Appendix A for part number
B. Cable radius drop
    1. See Appendix A for part number
C. Intersection splices
    1. See Appendix A for part number
D. Junction splices
    1. See Appendix A for part number
E. Wall Support Kit shall be 12" wide for attaching cable tray perpendicular to the wall.
    1. See Appendix A for part number
F. Ceiling Support Kit, as required
    1. See Appendix A for part number

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Racks
    1. Equipment racks shall be equipped with a mounting plate suitable for securing a 12-inch width cable tray from the rack to the backboard.
    2. Bolts used to attach the rack to the floor shall be stainless steel or zinc coated steel. Fasteners shall be Grade 5 or higher
B. Cable Tray
    1. The cable tray shall be installed as per Drawings to support cable runs from equipment rack to wall connections.
    2. Appropriate vertical wall brackets, support brackets, and splice kits are to be used when securing the runway. Cut standard straight sections of materials to length in the field.
    3. De-bur and file all rough cable tray and ladder rack edges at any cut sections.
    4. Cable runway locations shown on the drawings are approximate unless dimensioned.

5. Install cable runway as shown on the drawings.
6. All cable runways shall be accessible.
7. Maintain minimum 6-inch clearance between cable runway and piping. Locate cable runway at least 12 inches away from electrical or heat sources such as parallel runs of flues, steam or hot water pipes, and heating appliances.
8. Run exposed and concealed cable runway parallel or perpendicular to walls, structural members, or intersections of vertical planes to maintain headroom and provide a neat appearance.
9. Passageways shall not be obstructed.
10. Install appropriate cable runway bends, dropouts, and other accessories to protect minimum cable bend radius and provide adequate support at all locations where cable direction changes occur.
11. Installation shall be in compliance with the National Build Code and the National Electrical Code.
12. Install aerial pathways complying with recommendations in TIA/EIA-569-B, "Entrance Facilities" Article.
13. Comply with all drawings and BICSI TDMM for layout and installation of communications equipment rooms.
14. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

C. All racks and associated components shall be grounded in accordance with ANSI/TIA- 607-D, National Electric Code®, and the Authority Having Jurisdiction.

D. This contract is responsible for satisfying all requirements pertaining to seismic compliance. All inspections or engineering associated with seismic compliance shall be included in this contract at no additional cost to the Owner.

END OF SECTION 27 11 23

SECTION 27 13 13
COPPER BACKBONE CABLING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.2 SCOPE

A. This section includes the copper backbone cable and the termination requirements.

B. Multi-pair copper cables shall be installed between the Main Equipment Room (ER) and each Telecommunications Room (TR). Cables shall be terminated on 66 blocks in the ER and extended to rack mounted 24-port patch panels in each of the TRs.

1.3 QUALITY ASSURANCE

A. See Section 27 0513

B. All cable shall be installed in a neat and workmanlike manner.

PART 2 - PRODUCTS

2.1 UTILITY SUPPLY CABLE

A. The utility supply cable shall be (6), category 6, 4-pair unshielded twisted pair cables.

B. The cable shall be 24 AWG with a jacket rated for installation in under-slab ducts.

2.2 PATCH PANEL

A. Utility Supply, 24 port panel, rated for Category 6.

1. See Appendix A for approved part numbers

2.3 66 BLOCKS

A. 100 pair with stand off brackets

1. See Appendix A for approved part numbers

PART 3 - EXECUTION

3.1 GENERAL

A. Cable ties must be finger tight. The cable tie must not distort the outer jacket.

B. The bend radius shall be no less than 10 times the outside cable jacket.

C. Only Hook and Loop type wraps shall be used to bundle cables on the back of the equipment racks and in the cable trays located in the Telecommunication and Equipment Rooms.

D. All Ceiling penetrations shall have Conduit Sleeves in place.

3.2 PREPARATION

A. Conduits

1. All conduits and sleeves shall be inspected for bushings prior to cable installation. Missing bushings shall be brought to the attention of the Owner.

3.3 INSTALLATION

A. Copper Riser Cable
   1. Cables shall be installed between punch down blocks in the Main Equipment Room (MDF) and Telecommunications Rooms (IDFs).
   2. The punch down side of the cable shall be terminated 66 blocks. 66 blocks are to be placed on the telecommunications backboard in the main equipment room as per the drawings.
   3. 24 port utility supply patch panels shall be placed as per the Drawings in each of the Telecommunications Rooms. Change to 66 blocks on the wall if you do not want any of this in the racks.
   4. Provide (1) in the MDF and (1) in each of the IDFs.
   5. Place six cables from the 66 block in each room to the patch panel. Terminate all four pairs.
B. Label 66 blocks and patch panels “UTILITY FEED TO IDF-x”, where X = IDF Number, specifically “IDF-1”, “IDF-2” or “IDF-3”

END OF SECTION 27 13 13

SECTION 27 13 23
COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL REQUIREMENT

1.1 WORK INCLUDED

A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.2 SCOPE

A. This section includes the fiber backbone cable and the termination requirements.
B. This document describes the products and execution requirements relating to furnishing and installing
C. This section includes minimum requirements for the following:
    1. Optical Fiber Backbone Cable
    2. Fiber Patch Cords
    3. Optical Fiber Connector Modules
D. All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the Telecommunications contractor as detailed in this document.
E. Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types will be provided as an attachment to this document. If the bid documents are in conflict, formal clarification shall be obtained from in the form of Question Clarification Request. The successful vendor shall meet or exceed all requirements for the cable system described in this document.

1.3 QUALITY ASSURANCE

A. See Section 27 0513
B. All cable shall be installed in a neat and workmanlike manner.

PART 2 - PRODUCTS

2.1 FIBER OPTIC CABLE

A. Single-mode fiber shall be used in all locations
B. Indoor Cables:
    1. Interlocking Armored Cable. In certain instances, an interlocking armored cable shall be used as shown on the project drawings. Interlocking aluminum armor eliminates the need for inner duct or conduit to provide a smaller crush resistant pathway for improved design flexibility and lower installed cost. Use when there is not a homerun conduit from the MDF to each IDF. If installation requires free running and using J-Hook type supports use Interlocking Armored Cable
C. Indoor/Outdoor Cables

1. Indoor/Outdoor fiber optic cables utilize a dry water-blocking feature required for outdoor installations, but without the need to transition to a tight buffer cable within 50 feet of entrance into the facility.

D. Outdoor Cables
   1. Outdoor cables shall utilize loose tube design with a water blocking gel. The cable construction may be with or without a corrugated steel armor to provide additional crush resistance, as required on the drawings.

E. Approved Manufacturers:
   1. Panduit
   2. Corning
   3. General Cable
   4. AFL

2.2 FIBER OPTIC TERMINATION

A. All fibers will be terminated using SC connectors with a fusion spliced pigtail connector.
   1. All fiber jackets shall match in color when splicing

B. Approved Manufacturers:
   1. Panduit
   2. Corning
   3. ILSINTECH
   4. AFL

C. Fiber termination equipment will be:
   1. 4RU frame in MDF location and 4RU frame in IDF locations.
      i. See Appendix A for part numbers
   2. Single-mode fiber shall terminate on SC Fiber adapter panels.
      i. See Appendix A for part numbers
   3. Blank panels shall be used to cover all unused openings in the frames.
      i. See Appendix A for part numbers

2.3 GENERAL

G. Furnish and install all MicroDucts and MicroCables, connectors, adapter panels, fiber distribution units, and equipment as shown on drawings and as specified below.
   1. Fiber optic MicroCables shall be provided based on immediate needs only. No fiber shall be installed that will otherwise remain dark upon installation completion. The Contractor shall furnish and install optical fiber MicroCables as identified on the drawings. Fiber optic MicroCables shall not be spliced or patched at transition points from indoor to outdoor. Fiber optic MicroCables shall be installed end to end or home-run from MDF to application to eliminate splicing and patching. Zero tensile stress shall be placed upon the MicroCables during installation to eliminate micro-fractures within the glass fiber that may result from improper handling of the fiber optic MicroCables.

H. Microduct.

1. Indoor MicroDuct – All MicroDuct shall be composed of dielectric materials. The MicroDuct shall be suitable for installation in cable tray, PVC, or metallic conduit, and conventional innerduct. During installation, MicroDuct cable ends are to be completely sealed to prevent ingress of contaminants, including water. Upon completion of MicroDuct installation, all internal MicroDucts shall pass the standard pressure test and ball bearing test per the cable manufacturer's recommended procedures. All unoccupied MicroDucts shall be plugged on both ends. Indoor MicroDuct specifications are as follows:
    a. Manufacturer: Dura-Line Corporation FuturePath® eABF
    b. Microduct Type: single, 2, 3, 4, 7, 12, 19 and 24 way, 8.5mm OD/6mm ID
    c. Microduct rating: LSZH, Plenum, Riser, Armored, or HDPE
    d. Handling Temperature: 0 degrees C to +40 degrees C
    e. Maximum Pulling Tension: Per Manufacturer's Cable Design
    f. Bending Radius: Based on Manufacturer's Specifications
    g. All MicroDucts shall be tested to and in compliance with Telcordia GR-3155-CORE. MicroDucts must be compliant as a stand-alone element of the air-blown cabling system.

2. Outdoor MicroDuct – All MicroDuct shall be composed of all dielectric materials. The MicroDuct shall be suitable for underground, buried or aerial applications as appropriate. During installation, MicroDuct cable ends and individual tubes are to be completely sealed to prevent ingress of contaminants, including water. Upon completion of MicroDuct installation, all internal tubes shall pass the standard pressure test and ball bearing test per the manufacturer's recommended procedures. All unoccupied MicroDucts and/or tubes shall be plugged on both ends. Outdoor MicroDuct specifications are as follows:
    a. Manufacturer: Dura-Line Corporation FuturePath® eABF
    b. MicroDuct Type: Single, 2, 3, 4, 7, 12, 19, and 24 way, 8.5mm OD/6mm ID
    c. MicroDuct Rating: FP (OSP)
    d. Handling Temperature: -20 degrees C to +40 degrees C
    e. Maximum Pulling Tension: Per Manufacturer's Cable Design
    f. Bending Radius: Based on Manufacturer's Specifications

I. Indoor/Outdoor Air-blown Fiber Optic cable Specifications
1. Fiber optic cable shall meet the latest revision of the Telcordia GR-409 Interconnect Cable specification for premise building cabling applications. The cable shall be meet the following specifications
    a. Cable must be listed as OFNP or OFNR as a stand-alone element of the air-blown cable system.
    b. Cable shall have a maximum cable diameter of 4.5mm and be suitable for installation in micro-ducts/micro-tubes with a nominal inside diameter of 6.0mm.
    c. Cable design must support the air-blown system requirement to install up to 96-fibers per each 6.0mm micro-duct/micro-tube.
    d. Cable shall exhibit sufficient mechanical attributes to support its installation in 6.0 mm inside diameter micro-ducts/micro-tubes for a minimum, straight and level run distance of 200 feet using a cable installation push-blow device with drive wheels/belts powered by a non-air delivery system. Example of this push-blow machine is the Plumettaz, model UltimaZ V-20.

e. Cable shall be water-blocked per water penetration requirements of GR-20-CORE. Water-blocking of pathway alone will not be considered sufficient for adequate protection against water-ingress in the fiber optic cable
f. Cable will have an operating temperature range of -40C to +70C per requirements of GR-20-CORE.
g. Cable shall be tested to and in compliance with Telcordia GR-409-CORE. Cable must be compliant as a stand-alone element of the air-blown cabling system. The use of add-on micro-duct/micro-tube or furcation tubes will not be permitted as means to protect the cable/fibers after exiting the distribution micro-duct/micro-tube pathway. This requirement is in place to provide optimum optical fiber density in the cable management pathways within the termination/network equipment rack spaces.
h. Cable shall be suitable for installation in all NFPA/NEC fiber optic cable pathway system that is either riser or plenum rated.
i. Optical fiber options shall be available as defined in the following table:

	Maximum Attenuation (dB/km)			**Overfilled Launch Min. Bandwidth (MHz·km)**		**1 Gigabit Ethernet Min Link Distance (meters)**	**10Gigabit Ethernet Min Link Distance (meters)**		
Fiber Type	**850 nm**	**1300 nm**	**1550 nm**	**850 nm**	**1300 nm**	**850 nm**	**1300 nm**	**850 nm**	**1300 nm**
(6) 62.5 Giga-Link 300	3.5	1.2	N/A	200	600	300	550	32	-
(5) 50 Giga-Link 600	3.5	1.2	N/A	500	500	600	600	82	-
(L) 50 Laser-Link 300	3	1.2	N/A	1500*	500	900	550	300	-
(C) 50um Laser-Link 550	3	1.2	N/A	3500*	550	900	550	550	
(9) SM	N/A	0.5	0.5	N/A	N/A	N/A	5,000	N/A	10,000

J. Fiber Distribution Units (FDU's)
1. The Fiber Distribution Units (FDUs) housing fiber optic terminations shall be sized to accommodate the total fiber count to be installed at each location as defined in the drawings.
2. Connector panels and connector couplings (sleeves, adapter panels, etc.) adequate to accommodate the number of fibers to be terminated shall be furnished and installed by the Contractor.
3. FDU's shall provide for strain relief of incoming cables.
4. FDU's shall incorporate radius control mechanisms to limit bending of the fibers to the manufacturers recommended minimums or 3", whichever is larger.
5. All patch panels shall have a common key lock that opens all panels installed for this project.
6. All terminated fibers shall be mated to LC couplings for singlemode and SC couplings for multimode, mounted on adapter panels. Adapter panels, in turn, snap into the housing assembly. Adapter panels shall be available to accommodate LC connectors

and SC connectors as needed.

7. Patch panels shall be cabinet/rack-mounted in the floor IDF's and rack-mounted in the MDF unless otherwise specified on the drawings.
8. Manufacturers:
    a. AFL
    b. Substitutes: No Substitutions.
9. ANSI-TIA-568-E.3 Compliant.

K. Splice Closures
1. The splice closure for use within buildings shall be a minimum 24" W x 24"H x 12"D (dependent upon number of MicroDucts and conduit entries) NEMA 1 pull box. Provide strain relief for MicroDucts directly entering the splice closure from cable trays.
2. The splice closure for use above ground outside of buildings shall be a minimum 24"W x 24"H x 12"D (dependent upon number of MicroDucts and conduit entries) NEMA 4X pull box. Provide strain relief for MicroDucts directly entering the splice closure from cable trays. Substitutions as approved by the Engineer.
3. The splice closure for use in below ground vaults shall be Preformed Armadillo NEMA 6P (IP68) rated. Size is dependent upon number of tube bundles. Provide strain relief for MicroDucts directly entering the splice closure.

L. Strain Relief Grips
1. Strain relief grips shall be installed at all splice closures where the MicroDucts directly enter the splice closure from cable trays and where conduit entries require the support of the tube bundle as in vertical runs.
2. Where strain relief grips are used for MicroDucts directly entering splice closures from cable trays, care shall be used to prevent the crushing or deformation of the MicroDuct when tightening the strain relief grip around the tube bundle.
3. Manufacturer's:
    a. Substitutes: As approved.
    b. ETA/DETA Dura-Line Corporation

M. Optical Fiber Patch Cables
1. Optical fiber patch cables shall incorporate LC UPC (Ultra Physical Contact) connectors for singlemode and SC UPC connectors for multimode. The connector body shall be of materials like that used in the proposed couplings. Channels shall be of equal length.
2. The optical fiber patch cables shall be singlemode optical fiber and multimode optical fiber utilizing tight buffer construction. The optical fiber patch cables shall be a minimum of 1.5 meters long (verify length needed prior to purchase). The Contractor shall provide two (2) duplex optical fiber patch cables of the appropriate type (singlemode or multimode) for each fiber link.
3. Manufacturer:
    a. AFL
    b. Substitutions: No substitutions
4. Field terminated optical fiber patch cables and jumpers shall not be allowed. All patch cords and jumpers shall be factory manufactured.

N. Connectors
1. Connector type shall be LC for singlemode optical fiber and SC for multimode optical fiber.
2. The attenuation per mated pair shall not exceed 0.75 dB (individual) and 0.5 dB

(average).

3. Connectors shall sustain a minimum of 200 mating cycles per EIA/TIA-455-21 without violating specifications.
4. The connector shall meet the following performance criteria:

Test	Procedure	Maximum Attenuation Change (dB)
Cable Retention	FOTP-6	0.2 dB
Durability	FOTP-21	0.2 dB
Impact	FOTP-2	0.2 dB
Thermal Shock	FOTP-3	0.2 dB
Humidity	FOTP-5	0.2 dB

5. Manufacturers:
    a. AFL
    b. Substitutes: No Substitutions
6. ANSI-TIA-568-E.3 Compliant.

PART 3 - EXECUTION

3.1 GENERAL

A. Cable ties must be finger tight. The cable tie must not distort the outer jacket.
B. The bend radius shall be no less than 10 times the outside cable jacket.
C. Only Hook and Loop tie wraps shall be used to bundle cables on the back of the equipment racks and in the cable trays located in the Telecommunication and Equipment Rooms. Cable ties or zip ties are not allowed.

3.2 PREPARATION

A. Conduits - all conduits shall be inspected for bushings prior to cable installation.

3.3 INSTALLATION

A. Install per manufacturer's instructions.
B. MicroDuct Installation
    1. Beginning installation means contractor accepts existing conditions.
    2. Contractor shall furnish all required tools to facilitate MicroDuct installation without damage to the microduct. Such equipment is to include, but not limited to, sheaves, winches, cable reels, cable reel jackets, duct entrance funnels, pulling tension gauges, and similar devices. All equipment shall be of substantial construction to allow steady progress once pulling has begun. Makeshift devices that may move or wear in a manner to pose a hazard to the microduct shall not be used. Pulling MicroDuct with a motorized vehicle is not acceptable.
    3. MicroDuct pulling shall be done in accordance with the manufacturer's recommendations. Manufacturer's recommendations shall be part of the MicroDuct submittal. Recommended pulling tensions and minimum bending radii shall not be exceeded. Any microduct bent or kinked to a radius less than recommended shall not be installed.
    4. During pulling operation an adequate number of workers shall be present to allow

observation at all points of duct entry and exit as well as to feed MicroDuct and operate pulling equipment.

5. Pulling lubricant shall be used to ease pulling tensions. Lubricant shall be of a type that is non-injurious to the MicroDuct sheath material used. Lubricant shall not harden or become adhesive with age.
6. Avoid abrasion and other damage to MicroDuct during installation.
7. Prior to pulling MicroDuct, thoroughly mandrel conduits to remove foreign materials. Verify cable trays are free of foreign debris, sharp edges and protruding uncapped bolts.
8. Verify tubes are sealed prior to pulling MicroDuct.
9. Pull MicroDuct with Kellum grips and break away swivels using the manufacturer's recommended pulling tension for break point.
10. A minimum of 24 hours shall be maintained between the installation of the MicroDuct and the installation of fiber units per manufacturer's specifications.
11. The following three test sequences shall be followed per manufacturer's specifications after installation of microduct:
    a. Air Flow Testing
    b. Pressure Testing
    c. Continuity Testing
12. Contractor shall verify that any water in MicroDucts is removed prior to jetting any fiber unit.

C. Fiber Optic MicroCable Installation

1. Prior to jetting fiber optic MicroCable, thoroughly test MicroDucts.
2. Beginning installation means contractor has fulfilled prerequisites of MicroDuct installation and testing per manufacturer's specifications and pre-installation testing of fiber optic MicroCable per this specification.
3. Contractor shall furnish all required tools to facilitate MicroCable jetting without damage to the cable jacket. Such equipment is to include, but not limited to, blowing head and wheel, air compressor, air preparation kit, blowing beads, and similar devices. All equipment shall be of substantial construction to allow steady progress once jetting has begun. Makeshift devices or devices not approved by the manufacturer shall not be used. Pulling MicroCables is not acceptable.
4. Jetting of the fiber optic MicroCables shall be done in accordance with the manufacturer's recommendations. Manufacturer's recommendations shall be part of the MicroCable submittal. Recommended minimum bending radii shall not be exceeded. Any fiber optic cable bent or kinked to a radius less than recommended shall not be installed.
5. During jetting operation, an adequate number of workers shall be present to allow cable observation at all points of cable entry and exit as well as to feed cable and operate jetting machinery.
6. "Pulling" lubricant shall not be used during jetting of MicroCables.
7. Avoid abrasion and other damage to cables during installation.
8. Cable slack shall be provided in each MicroCable. Follow recommended procedures from the manufacturer regarding length of slack cable ensuring a minimum of 5 meters (approximately 15 feet) of cable that shall be coiled and secured at each termination location. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion as to protect

it from cable damage. The use of suitable enclosures designed for this purpose is encouraged.

9. Fiber optic MicroCables shall be indoor/outdoor rated.
10. Fiber optic MicroCables shall be installed in a continuous length. Splices are not acceptable.
11. Fiber optic MicroCables shall be installed according to manufacturer's recommendations.
12. Slack in each fiber MicroCable shall be provided as to allow for future re-termination in the event of connector or fiber end-to end damage. Adequate slack shall be retained to allow termination at a 30" high workbench positioned adjacent to the termination enclosure(s). A minimum of 1 meter (39") of slack shall be retained at the work area, and minimum of 3 meters (approximately 10') of slack shall be retained in equipment rooms and telecommunications rooms. Label each fiber bundle.
13. Qualified personnel utilizing state-of-the-art equipment and techniques shall complete all optical fiber terminations.

D. Install the fiber optic cable by hand or by using a mechanical pulling machine. If a mechanical pulling machine is used, equip the machine with a monitored or recording tension meter. Ensure that at no time the manufacturer's recommended maximum pulling tension is exceeded. Ensure that the central strength member and aramid yarn are attached directly to the pulling eye during cable pulling. Use pulling attachments, such as "basket grip" or "Chinese finger" type, to ensure that the optical and mechanical characteristics are not degraded during the fiber optic cable installation.

E. Ensure that excess cable is coiled in a figure eight and fed manually when pulling through pull boxes and splice boxes by hand. If pulleys and sheaves will be used to mechanically pull through pull boxes and splice boxes, provide a drawing of the proposed layout showing that the cable will never be pulled through a radius less than the manufacturer's minimum bend radius. Use large diameter wheels, pulling sheaves, and cable guides to maintain the appropriate bend radius. Provide tension monitoring at all times during the pulling operation. Ensure that cable pulling lubricant used during installation is recommended by the optical fiber cable manufacturer.

F. Label fiber patch panels in the MDF as: "Feed to IDF-x", where x = IDF number

G. Label fiber patch panels in the IDF as "Feed from MDF"

H. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.

I. Each cable shall be individually attached to the respective fiber enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.

J. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.

K. Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.

L. All spare strands shall be installed and stored into spare splice trays.

3.4 FIBER TESTING

A. All installed fiber shall be tested in accordance with ANSI/TIA-568-E.1 section 11.
B. For horizontal cabling system using Single Mode optical fiber, attenuation shall be measured in one direction at either 1310 nanometer (nm) or 1550 nm using an LED light source and power meter.
C. Backbone Single mode fiber cabling shall be tested at both 1310 and 1550 nm (or 850 nm and 1300 nm for multi-mode) in both directions.
D. Test set-up and performance shall be conducted in accordance with ANSI/TIA-526-14 Standard, Method A.
E. Where links are combined to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. ONLY BASIC LINK TEST IS REQUIRED. The contractor can optionally install patch cords to complete the circuit and then test the entire channel. The test method shall be the same used for the test described above. The values for calculating loss shall be those defined in the ANSI/TIA Standard.
F. Attenuation testing shall be performed with a two meter (2m) cable assembly using a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements. Refer to Panduit document PN445 “Permanent Link Testing of Fiber Optic Cabling Systems”

3.5 SYSTEM DOCUMENTATION

A. Test Results documentation shall be provided in electronic format within three weeks after the completion of the project. The media shall be clearly marked on the outside front cover with
the words “Project Test Documentation”, the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
B. Printouts generated for each optical fiber shall be submitted as part of the documentation package. Alternately, the telecommunications contractor may furnish this information in electronic form. The media shall contain the electronic equivalent of the test results as defined by the specification along

with the software necessary to view and evaluate the test reports.

C. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

D. The As-Built drawings are to include cable routes and outlet locations. Their sequential number as defined elsewhere in this document shall identify outlet locations. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (DWG, AutoCAD rel. 14) formats on which as-built construction information can be added. These documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner.

E. The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD rel. 14) form

3.6 WARRANTY

A. Submit to Owner at project closeout a signed and registered manufacturer's 25 Year Warranty consisting of extended product warranty and applications assurance in accordance with the warranty program.

B. Submit to Owner at notice to proceed, the most current copy of the manufacturer's certificate of registration and the warranty terms and conditions that apply to the manufacturer's solution.

C. Submit to Owner, at notice to proceed, a statement of any Contractor warranties in addition to the manufacturer's stated and supplied warranties. Submit at closeout signed copies of the Contractor provided warranties that are in addition to manufacturer's stated and supplied warranties.

END OF SECTION 27 13 23

SECTION 27 15 13
COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL REQUIREMENT

1.1 WORK INCLUDED

A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

B. Install horizontal cable as outlined on drawings and specifications. Also included is sleeves for any ceiling or wall penetrations not provided by the General or Electrical Contractor; fire stopping as directed by the most stringent of these specifications or code; and all support structure needed to install the above components.

C. Verify actual counts on prints and drop detail.

1.2 SCOPE OF WORK

A. This document describes the products and execution requirements relating to furnishing and installing Telecommunications Cabling for the horizontal cabling comprised of Copper Cabling and support systems are covered under this document.

B. Install a structured cabling system that will be able to support interconnections to active telecommunications equipment for voice and data applications in a multi-vendor, multi-product environment. The structured cabling system should adhere to ANSI/TIA 568 E; 569-B; 606-C; ANSI/TIA-607-D, TSB-184A, TIA-942 standards and the NEC 2017 code with respect to pathways, distribution, administration, and grounding of the system. The structured cabling system to be installed should also follow the guidelines spelled out in this RFP in accordance to local codes and regulations.

C. Each Standard drop will consist of a minimum (3) cables and terminations shall be 3 data terminations. The color of these jacks will Blue for Data.

D. Any Single wall-mounted telephone, Stainless Steel plate with integral phone mounting lugs shall be used. Acceptable product: Panduit KWP3, Plate assembly.

E. Install, terminate, test, and guarantee each drop according to customer and all applicable standards and customer preferences.

F. Category 6 cables will be UL Limited Power (LP) Certified, which eliminates the need to consult the PoE ampacity table in the NEC 2017 code regarding maximum bundle sizes and meet the TIA-TSB-184A standard.

G. Standard horizontal cables will be UL Limited Power (LP) Certified Category 6. The Horizontal cables will home run back to a floor serving telecommunications room and will terminate on individual CAT 6 jacks to populate a modular 48 port flat patch panel. All cables will be patched at cutover as an interconnection into the floor serving active equipment using RJ45 modular equipment cables rated to Category 6.

H. Wireless Access Points (WAPs) cabling will be UL Limited Power (LP) Certified Category 6. The WAP cables will be home run back to a telecommunications room and terminated on individual

Cat 6 Blue jacks to populate a 48 port patch panel. Each WAP drop will consist of (2) cables and terminations will utilize Panduit's field terminable RJ45 plug.

I. All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the Telecommunications contractor as detailed in this document.

J. Compliant with NEC Article 800, Type CMP rating for use in return air plenum as well as complies with Category 6 performance standards. Conductor wire 24 AWG, impedance: 100 ohms, plus or minus 15 ohms. Frequency attenuation at 60 degrees Fahrenheit les that 6.5 dB per 100 ft at 100 MHz.

K. Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types will be provided as an attachment to this document. If the bid documents are in conflict, formal clarification shall be obtained from in the form of Question Clarification Request. The successful vendor shall meet or exceed all requirements for the cable system described in this document.

1.3 QUALITY ASSURANCE

A. All cable shall be installed in a neat and workmanlike manner.

B. Strictly adhere to all Category 6 installation practices when installing horizontal cabling.

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to Section 27 0513 for General Requirements.

B. The horizontal UTP cabling system shall be a Category 6 warranted link system, including the patch cords, patch panels, cables, and telecommunications outlets.

C. Approved Manufacturers:

1. Panduit
2. General Cable

2.2 COPPER CABLE

A. The horizontal copper cable supporting all locations except as noted on Drawings, shall be 4-Pair balanced twisted pair, UL Limited Power (LP) Certified for category 6. Color to be blue.

B. Backbone cable shall be 4-Pair balanced twisted pair rated for category 6. Jacket shall be rated for wet locations and black in color.

PART 3 - EXECUTION

3.1 GENERAL

A. Shall be installed in accordance with manufacturer's recommendations and best industry practices.

B. Hook and loop cable ties must not distort the outer jacket.

C. The bend radius shall be no less than 4 times the outside cable jacket diameter for the horizontal UTP cable and 10 times the outside cable jacket diameter for both the fiber and multi-pair copper riser cable.
D. Only hook and loop type cable wraps shall be used to bundle cables on the back of the equipment racks and in the cable trays located in the Telecommunication and Rooms.
E. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
F. Cable raceways shall not be filled greater than the TIA/EIA-569-A maximum fill for the raceway type or 40% fill ratio.
G. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.
H. Where transition points, or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.
I. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
J. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch (1.2 to 1.5 meter) intervals. At no point, shall cable(s) rest on acoustic ceiling grids or panels.
K. Horizontal distribution cables shall be bundled in groups of no more than 48 cables. Cable bundle quantities more than 48 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.
L. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
M. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.
N. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.
O. Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification and ANSI/TIA-606.
P. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
Q. Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a four-pair UTP cable.

3.2 PREPARATION

A. Conduits
    1. All conduits and sleeves shall be inspected for bushings prior to cable installation.
    2. Missing bushings shall be brought to the attention of the owner or authorized representative.

3.3 INSTALLATION

A. Copper Horizontal Cables

1. Installation shall be in a manner to meet the specifications as outlined by the cable manufacturer for the product set being installed.
2. Copper horizontal cables shall be pulled from the TR to the workstation.
3. Service loops of
    i. 10 feet minimum shall be left coiled high as high as possible in the MDF or IDF.
    ii. 10 feet of slack shall be neatly coiled and secured with Hook & Loop ® at the telecommunications outlet (typically in the ceiling) used for Wireless Access points
    iii. Placement of service loops subject to verification by Owner.
4. Location and label shall be annotated on the as built drawings.
5. Locations coiled for wireless shall have ½" black on white labels placed below the outlet on the ceiling grid.
6. Cables shall be dressed and terminated in accordance with the recommendations made in the TIA 568-E standard, manufacturer's recommendations and best industry practices.
7. Pair untwist at the termination shall not exceed 3.18 mm (0.25 inch).
8. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
9. The cable jacket shall be maintained as close as possible to the termination point.
10. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

B. Work Area Outlets
    1. Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. In hollow wall installations where box-eliminators are used, excess wire can be stored in the wall. No more than 12" of UTP and 36" of fiber slack shall be stored in an in-wall box, modular furniture raceway, or insulated walls. Excess slack shall be loosely configured and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
    2. Cables shall be dressed and terminated in accordance with the recommendations made in the TIA -568-E document, manufacturer's recommendations and best industry practices.
    3. Pair untwist at the termination shall not exceed 3.18mm (0.25 inch).
    4. Bend radius of the cable in the termination area shall not be less than 4 times the outside diameter of the cable.
    5. The cable jacket shall be maintained to within 25mm (one inch) of the termination point.

3.4 TESTING AND ACCEPTANCE

A. General

1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions per the requirements of ANSI/TIA -568-E-1 Section 11. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
2. All cables shall be tested in accordance with this document, the ANSI/TIA standards, the Panduit System Warranty guidelines and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

B. Copper Channel Testing
   1. All twisted-pair copper cable links shall be tested for compliance to the requirements in ANSI/TIA-568-E.2 for the appropriate Category of cabling installed.

C. All "category" cable paths shall be tested at each jack for the following parameters and meet the requirements imposed by the ANSI/TIA-568-E.2 and the manufacture's written specification.

Category 6	**Category 6A**
Wire Map	Wire Map
Cable Length	Cable Length
Pair-to-pair NEXT	Insertion Loss
Power Sum NEXT	Next Loss
Attenuation	PS Next Loss
Pair-to-Pair ELFEXT	ACR-F Loss
Power Sum ELFEXT	PS ACR-F Loss
Return Loss	Return Loss
Propagation Delay	Propagation Delay
Delay Skew	Delay Skew

3.5 System Documentation

A. Test Results documentation shall be provided in electronic format within three weeks after the completion of the project. The media shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

B. The field test equipment shall meet the requirements of ANSI/TIA/EIA-568-E. The appropriate level III tester shall be used to verify Category 6 cabling systems.
C. Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. Alternately, the telecommunications contractor may furnish this information in electronic form. The media shall contain the electronic equivalent of the test results as defined by the specification along with the software necessary to view and evaluate the test reports.
D. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.
E. The As-Built drawings are to include cable routes and outlet locations. Their sequential number as defined elsewhere in this document shall identify outlet locations. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (DWG, AutoCAD rel. 14) formats on which as-built construction information can be added. These documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner.
F. The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD rel. 14) form

END OF SECTION 27 15 13

SECTION 27 15 43
COMMUNICATIONS FACEPLATES AND CONNECTORS

PART 1 - GENERAL REQUIREMENT

1.1 GENERAL

A. Drawings and general provision of the Contract, including General and other Conditions and other General Requirements sections, apply to the work specified in this section.

B. This section and all related sections shall be performed by a qualified Contractor as outlinedin the specifications.

1.2 WORK INCLUDED

A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.3 QUALITY ASSURANCE

A. See Section 27 0513

B. All faceplates shall be installed in a neat and workmanlike manner.

PART 2 - PRODUCTS

2.1 OUTLET FACEPLATE

A. Telecommunications Outlet faceplate shall be a sized to support the required number of jacks.

B. Color shall be coordinated with owner.

C. All faceplates shall accommodate a mechanically generated label.

D. All unused faceplate opening shall be filled with a blank.

2.2 TERMINATION – WAP

A. Termination for cables supporting WAPs is to be made using a data category jack. Each WAP location shall be two cables placed in a white, two port biscuit box.

B. Termination shall provide a 20 foot slack loop to be coiled and secured with Hook & Loop ®. Biscuit box shall be affixed to structure.

2.3 OUTLET JACK

A. The termination jack for the standard connections shall be an 8-pin (4 pair) modular jack T568E rated for category 6.

B. Jacks color shall be coordinated with owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install faceplates as per manufacturer's instructions. Care must be taken to provide a plumb and level appearance.

B. WAP locations shall be labeled on the dropped ceiling or wall in a manner that is clearly visible (1/2” black on white label) and allows Owner to quickly determine which ceiling panel covers the WAP.

END OF SECTION 27 15 43

Appendix A – Stephen F. Austin State University Approved Part Numbers

Racks

Part #	Description
R2P	Panduit 19” Two post, Black
46353-X03	Chatsworth 19” Two Post, Black 45U

Wyr-Grid and Mounting

Part #	Description
WG12BL10	12" wide x 10' long pathway section used to carry cables horizontally throughout the system. Snap-on sidewalls attach for job specific height requirements. Uses splice connector WGSPL1218BL to connect straight sections and intersection splice WGINTSPLBL to connect pathways at an intersection.

Vertical Cable Management

Part #	Description
WMPV45E	Panduit vertical cable manager, 6” wide
PRV8	Panduit vertical cable manager, 8” wide
PRD8	Panduit vertical cable manager door, for PRV8
PRV10	Panduit vertical cable manager, 10” wide
PRD10	Panduit vertical cable manager door, for PRV10
PRV12	Panduit vertical cable manager, 12” wide
PRD12	Panduit vertical cable manager, for PRV12
30094-X03	Chatsworth vertical Cable Manager, 4.4” wide
30095-X03	Chatsworth vertical Cable Manager, 6” wide
30096-X03	Chatsworth vertical Cable Manager, 10” wide

Faceplates

Part #	Description
CFPL2SY	Panduit faceplate, 2 Port, Single Gang, Classic, Stainless Steel
CFPE2IWY	Panduit faceplate, 2 Port, Single Gang, Classic, Ivory
CFPL4SY	Panduit faceplate, 4 Port, Single Gang, Classic, Stainless Steel
CFPE4IWY	Panduit faceplate, 4 Port, Single Gang, Classic, Ivory
CFPL6SY	Panduit faceplate, 6 Port, Single Gang, Classic, Stainless Steel
CFPE6IWY	Panduit faceplate, 6 Port, Single Gang, Classic, Ivory
CFPE10IWY	Panduit faceplate, 10 Port, Double Gang, Classic, Ivory

Category 6

Part #	Description
CJ688TG*	Panduit Category 6, RJ45, 8-position, 8-wire, 10 Gb/s UTP Mini-Com® universal jack module has TG-style termination, *To designate color, add suffix IW (Off White),EI (Electric Ivory), IG (International Gray), AW (Arctic White), BL(Black),

	BU (Blue), RD (Red), YL (Yellow), GR (Green), OR (Orange,) BR (Brown), GD Gold), LB (Light Blue), PK (Pink) or VL (Violet).
PUP6004BU-UY	Panduit Copper Cable, Cat 6, 4-Pair, 23 AWG, UTP, CMP, Blue, 1000ft/305m reel, 0.233 OD
PUP6C04BU-ULP	Panduit Copper Cable, Cat 6, 4-Pair, 23 AWG, UTP, CMP, Blue, 1000ft/305m reel, 0.220 OD
CPP24WBLY	Panduit Mini-Com 24-port, 1 RU, flat patch panel with labels with front removable snap-in faceplates
CPP48WBLY	Panduit Mini-Com 48-port, 2 RU, flat patch panel with labels with front removable snap-in faceplates
FP6X88MTG	Cat6 field terminable RJ45 plug
7131800	General Cable Cat 6 23awg Plenum

Fiber

Part #	Description
FCE1U	Panduit OptiCom rack mount fiber enclosure, 1 RU, up to 4 cassettes
FCE2U	Panduit OptiCom rack mount fiber enclosure, 2 RU, up to 8 cassettes
FCE4U	Panduit OptiCom rack mount fiber enclosure, 4 RU, up to 12 cassettes
FAP12WBUSCZ	**F**iber optic adapter Panels, 12 SM Simplex SC
012E8F-31131-29	FREEDM One Tight-Buffered Cable, Riser 12 F, Single-mode OS2
024E8F-31131-29	FREEDM One Tight-Buffered Cable, Riser 24 F, Single-mode OS2
012E8P-31131-29	FREEDM One Tight-Buffered Cable, Plenum 12 F, Single-mode OS2
024E8P-31131-29	FREEDM One Tight-Buffered Cable, Plenum 24 F, Single-mode OS2

Backbone and 66

Part #	Description
7507601	General Cable 100 pair riser cable for voice and digital transmission ARMM, 24 AWG, CMR, Gray
P10KB1005Y	Panduit field terminated 5-pair connector kith with five 5-pair connectors per row of 25 pairs

Grounding and Bonding

Part #	Description
ACG24K	Panduit #6 AWG (16mm2) jumper for armored cable diameter up to 0.84" (21.3mm); 24" (609.6mm) length; factory terminated on one end with LCC6 two-hole copper compression lug and the other end with grounding terminal; provided with two each #12-24 and M6 thread-forming screws and a black polypropylene terminal cover.
LCC series	Two-hole compressing lugs for code conductors in BICSI hole spacing.
HTCT series	HTAPs must be selected according AWG size of run and tap conductors.
CLRCVR series	Clear covers for HTAPs. Must be selected according to HTAP being covered.

RGS134-1Y	Panduit Grounding strip (vertical busbar) for newly installed racks or cabinets with screw rails. 78.65" (2m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker and three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
RGCBNJ660P22	Panduit Jumper kit for bonding individual racks or cabinets into grounding backbone. #6 AWG (16mm²) jumper; 60" (1.52m) length; 45° bent lug on grounding strip side; provided with .16 oz. (5cc) of antioxidant, two each #12-24 x 1/2", M6 x 12mm, #10-32 x 1/2" and M5 x 12mm thread forming screws and a copper compression HTAP* for connecting to a #6 to #2 awg sized bonding backbone.
GJ672UH	Panduit Rack jumper (and cabinet) kits for smaller TR (5 bays or less) to bond individual rack or cabinet directly back to wall mounted busbar. One 72" length #6 AWG green wire with yellow horizontal stripe. Jumper is pre-terminated on one end with LCC6-14JAWH-L and the other end with LCC6-14JAW-L. This rack grounding jumper is 72" long. For other lengths replace the "72" in the part number. Available lengths are 72, 96, 120, 144, 168, 192, 216, 240, 264 and 288 inches.
RGESD2-1	Panduit Two-hole ESD port with 5/8" hole spacing; provided with an ESD protection sticker, .16 oz. (5cc) of antioxidant, and two each #12-24 x 1/2" and M6 x 12mm thread-forming screws. LOCATE ONE WITHIN REACH OF ALL EQUIPMENT. WORKS WITH WRIST STRAP RGESDWS.
RGESDWS	Panduit Adjustable fabric ESD wrist strap with 6' coil cord, banana plug, 1 megaohm resistor and 4mm snap. LOCATE ONE WITHIN REACH OF ALL EQUIPMENT. WORKS WITH ESD PORT RGESD2-1.
RGTBSG-C	Panduit Green thread-forming bonding screws for use to mount equipment that does not have a built-in grounding pad (terminal).
RGEJ1024PHY	Panduit 24" long pre-terminated equipment grounding jumper #10 AWG (6mm²) jumper; bent lug on grounding strip side to straight lug on equipment; provided with .16 oz. (5cc) of antioxidant and two each #12-24 x 1/2", M6 x 12mm, #10-32 x 1/2" and M5 x 12mm thread-forming screws. FOR EQUIPMENT LIKE CHASSIS SWITCHES WITH BUILT-IN GROUNDING PAD (TERMINAL).
RGEJ1036PFY	Panduit 36" long pre-terminated equipment grounding jumper#10 AWG (6mm²) jumper; bent lug on grounding strip side to straight lug on equipment; provided with .16 oz. (5cc) of antioxidant and two each #12-24 x 1/2", M6 x 12mm, #10-32 x 1/2" and M5 x 12mm thread-forming screws. FOR EQUIPMENT LIKE CHASSIS SWITCHES WITH BUILT-IN GROUNDING PAD (TERMINAL).

GB2B0306TPI-1	Panduit Wall mounted telecommunications busbar suitable for small telecom room. Pre-assembled with BICSI/TIA-607-D hole spacing. Bar is 1/4" x 2" x 12" in size.
GB2B0514TPI-1	Panduit Wall mounted telecommunications busbar suitable for med telecom room. Pre-assembled with BICSI/TIA-607-D hole spacing. Bar is 1/4" x 2" x 24" in size.
GB4B0624TPI-1	Panduit Wall mounted telecommunications busbar suitable for main grounding busbar in medium sized facility. Pre-assembled with BICSI/TIA-607-D hole spacing. Bar is 1/4" x 4" x 20" in size.
LTYK	Panduit Wall mounted busbar label kit. Label kit includes printed tag and one flame retardant cable tie.

NETWORK LABELING SOFTWARE – FOR INK JET/LASER PRINTER

Part #	Description
PROG-EM2GO	Panduit Easy-Mark Labeling Software for PC, supplied on USB Flash Drive. For preprinting communications labels on laser/inkjet printer.
S100X150YAJ	Panduit Self-laminating cable labels for Category 6 cable for use with Easy-Mark software and laser/ink jet printer.
C261X035Y1J	Panduit Patch Panel labels for use with Easy-Mark software and laser/ink jet printer.
C195X040Y1J	Panduit Faceplate labels for single gang stainless or sloped plastic - use with Easy-Mark software and laser/ink jet printer.
C288X040Y1J	Panduit Faceplate labels for double gang stainless - use with Easy-Mark software and laser/ink jet printer.
S100X650YAJ	Panduit Cable label for indoor/outdoor tight-buffered armored fiber optic cable. For use with Easy-Mark software and ink jet printer.
NWSLC-3Y	Panduit Label and turn-tell sleeve for labeling fiber jumpers. For use with Easy-Mark software and ink jet printer.
C200X100FJJ	Panduit 1" high, white, vinyl tape labels for labeling grounding busbars, racks, cabinets and pathways. For use with laser/ink jet printer.
Alternate	Equivalent Label software with same capabilities and specifications allowed.

NETWORK LABELING – HANDHELD LABELER

Part #	Description
LS8EQ-KIT-ACS	Panduit PanTher hand-held label printing system in kit. Includes LS8EQ printer with QWERTY keypad, one cassette of S100X150VAC self-laminating labels, six AA alkaline batteries, LS8E-ACS, LS8-CASE, LS8-PCKIT, LS8-IB, LS8-WS, quick reference card and operator's manual. USE FOR LABELS THAT MUST BE PRINTED ON THE JOB SITE.
S100X150VAC	Panduit Self-laminating cable labels for Category 6 cable for use with PanTher LS8E hand-held printer.
C261X035Y1C	Panduit Handheld printer labels for modular faceplate patch panels.
C195X040Y1C	Panduit Faceplate labels for single gang stainless - use with PanTher handheld labeler.
C288X040Y1C	Panduit Faceplate labels for double gang stainless - use with PanTher handheld labeler.
S100X650VAC	Panduit Cable label for indoor/outdoor tight-buffered armored fiber optic cable. For use with handheld labeler.
NWSLC-3Y	Panduit Label and turn-tell sleeve for labeling fiber jumpers. For use with hand-held labeler.
T100X000VPC-BK	Panduit 1" high, continuous black on white, vinyl tape labels for labeling racks, cabinets and pathways with PanTher LS8E handheld labeler.
Alternate	Equivalent Labeler with same capabilities and specifications allowed.

CABLE TIES – HOOK AND LOOP

Part #	Description
TTS-35RX0 10 rolls.	.75" wide, continuous roll Hook and Loop Cable Ties, black. 35 ft. roll. Carton qty
HLSP1.5S-X12	Plenum rated hook and loop cable ties for air return spaces. Maroon color, perforated at 6" length.
HLSP3S-X12	Plenum rated hook and loop cable ties for air return spaces. Maroon color, perforated at 6" length.

Appendix B – Rack Elevation and Room Sizing Diagrams

These diagrams are to be used for approximation only. Valid drawings must be submitted for rooms prior to building.

General Room Sizing and Rack Clearances and Design Requirements

PART 1 – General

1.1 Summary

A. Provide a minimum of one telecommunications room each floor, stacked vertically within the building and easily accessible from the building central delivery point.

B. The length of horizontal cable from each communications room shall be a maximum of 295 electrical cable feet (physical cable length is shorter due to the pair-twist within the cable).

C. The area of this space should be at least 120 square. Preferred dimensions are 10'-0" x 12'-0" with a minimum 8'-0" clear ceiling height. The closet should be provided with a 36" x 80" door, at a minimum.

D. Telecommunications rooms shall house only equipment directly related to the telecommunications systems, television, video surveillance and access control systems and, as required, the room's environmental support systems.

E. Telecommunications rooms shall not share space with other building services such as building mechanical, plumbing, electrical, or custodial. Neither shall they be accessed by passing through any other building service space. All telecommunications rooms shall be accessed directly from a corridor.

F. All floor penetrations sleeves shall extend 6" above the finished surface.

G. All floor penetrations will be stacked vertically from one telecommunication room to the next above or below.

H. A slot or slots shall be installed to accommodate cable runway entry from a corridor and a UL approved fire rated assembly. The formed slot shall not have burrs or sharp edges.

I. Telecommunications rooms shall be located so as to not to be in proximity of a flood threat. For example, locations that are below or adjacent to areas of potential water hazard (e.g., restrooms and kitchens) shall be avoided. Additionally, areas having floor drains shall be avoided.

J. Telecommunications rooms shall be located away from sources of electromagnetic interference (e.g., electrical power supply transformers, motors, generators, x-ray/MRI equipment radio or radar transmitters).

PART 2 – Specific Design Requirements

2.1 Room Finishes

A. Walls should be lined with rigidly installed, wall-to-wall, ¾" fire retardant plywood.
B. Equipment not related to the support of the telecommunications room (e.g., piping, ductwork, pneumatic tubing) shall not be installed in, pass through, or enter a telecommunications room. With exception of piping for fire sprinklers, all pipes shall be routed around telecommunications rooms.
C. Exposed ceiling and sealed concrete flooring is preferred.

2.2 Furnishings/Equipment Needs

A. Horizontal Ladder Rack will be installed from all cabling entry points of the room to the racks.
B. Vertical Ladder Rack will be installed from the floor to the ceiling between the wall and the floor penetrations where floor penetrations exist. It will also be installed from any cabling entry points to the Horizontal Latter Rack.
C. At minimum one 7 foot, 2 post 19 inch rack will be installed with wire management on either side.
D. At top of rack will be fiber can. Then start with a 24 port patch panel, Panduit CPP24WBLY, space for switch, then 48 port patch panel, Panduit CPP48WBLY, then space for switch, etc. *Will need to be reviewed on a building by building bases.
E. Acceptable Fiber Cans are: 1 U - Panduit FCE1U, 2 U – Panduit FCE2U, 3U – Panduit FRME3, 4U – Panduit FRME4
F. Acceptable Fiber Adapter Panels – FAP12WBUSCZ
G. Acceptable Wire Management - Panduit WMPV45E

2.3 Utilities

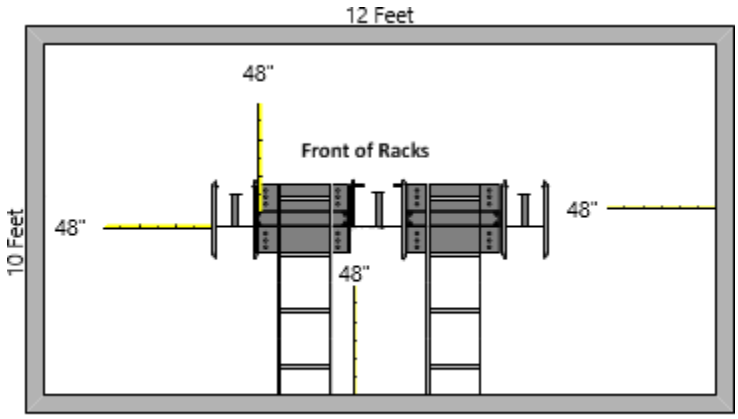
A. HVAC systems shall operate continuously throughout the year. If the building's system cannot ensure continuous operation, a standalone system should be installed.
    1. Should be designed to maintain a temperature between 65° F. and 78° F. and humidity between 30% and 50%.
B. The closet should have uniform lighting.
C. Communications room lighting shall be an integrated switch/sensor control that is located at the entrance of the room. Additional sensors may be required to sense that the room is occupied.
D. Provide the following electrical requirements:

1. Communications rooms shall contain their own dedicated circuit's specific to the equipment within that room.
2. Electrical feeders/branch circuits shall not be placed or run through any communications room, except as required to service those rooms.
3. The perimeter of the communications room shall have convenience 20A 120V NEMA 5-20R duplex outlets mounted 18" AFF at 6 feet intervals around perimeter walls.
4. Bonding and grounding shall meet the requirements of ANSI-J-607-D and NECA/BICSI-607.

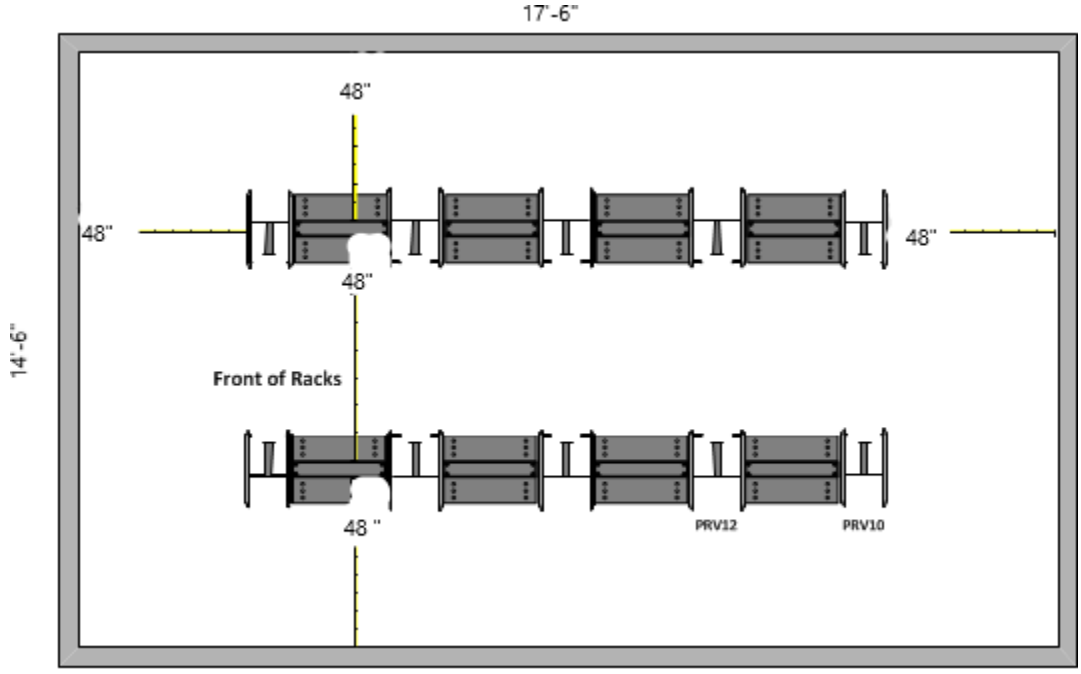
E. Provide the following networking equipment electrical requirements

1. Label circuits on each outlet located on the racks
2. Each equipment rack within a telecommunications room shall have a minimum of one dedicated 20A 120V NEMA 5-20R quad outlet supplied by two separate circuits, mounted on the back side of the rack at the top, facing to the rear, fed from the ceiling.

Sample Room Design and Sizing

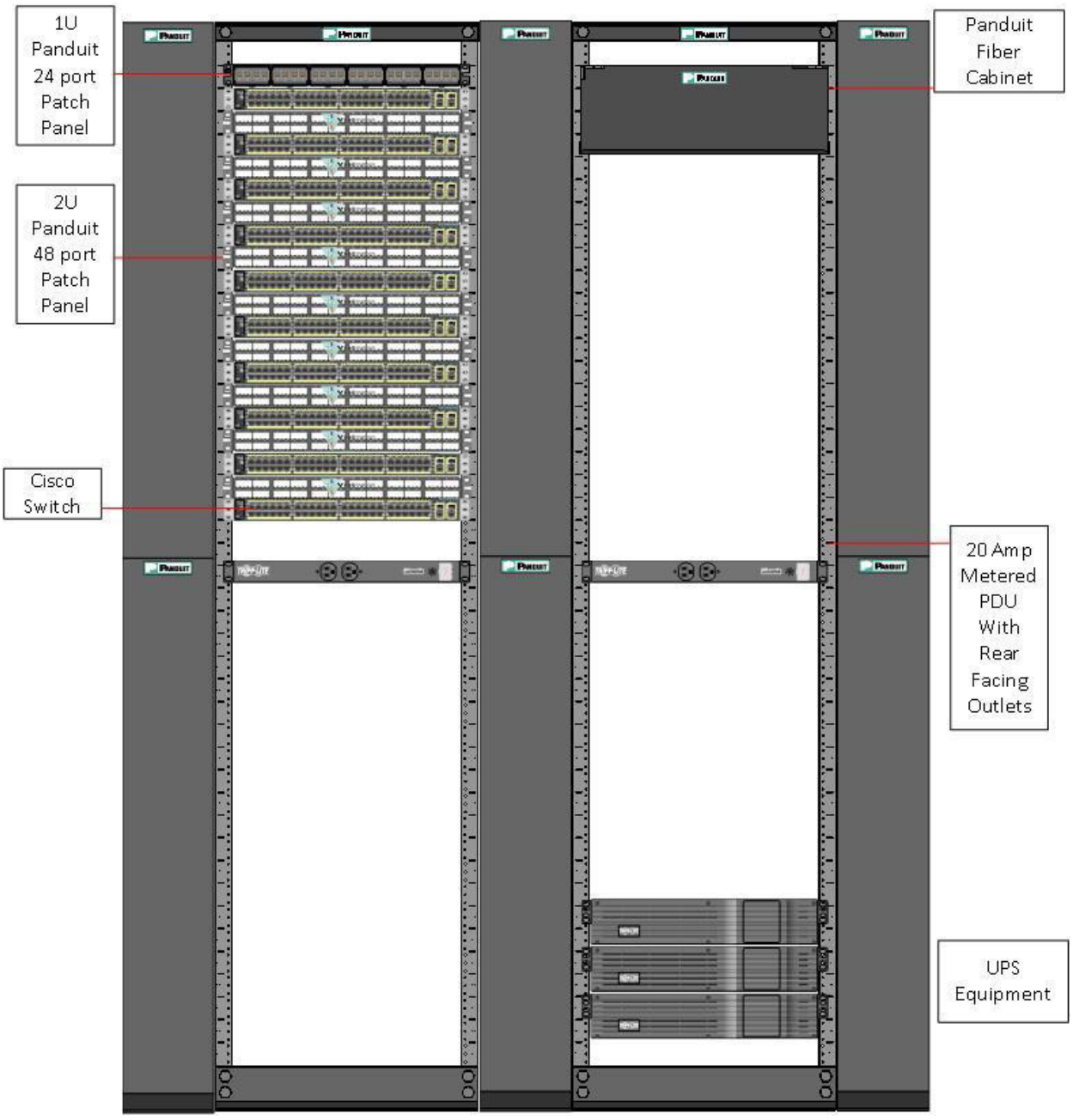


Single Row, multi rack



Multi Row, multi rack

Sample Rack Elevation



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Stephen F. Austin State University

Division 27 40 00 Specification

Audio Visual

ITS ACADEMIC SUPPORT
4/15/2024 REV:0

1 General - Audio Visual

1.1 Related Documents

A. Contractor is responsible for knowledge and application of current versions of all applica-ble standards and codes. In cases where listed standards and codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation

B. AVIXA

1. **AVIXA**, F501.01:2015 *"Cable labeling for Audiovisual System (CLAS)"*
2. **AVIXA**, F502.01:2018 *"Rack Building for Audiovisual Systems"*
3. **AVIXA**, V202.01:2016 *"Display Image Size for D2 Content in Audiovisual Systems"*
4. **AVIXA**, D401.01:201X *"Standard Guide for Audiovisual Systems Design and Coordina-tion Processes"*
5. **AVIXA**, *"AV/IT Infrastructure Guidelines for Higher Education"*
6. **AVIXA**, *"AV Implementation Handbook (to be used with ANSI/INFOCOMM 2M-2010)"*
7. **AVIXA**, A102.01:2017 *"Audio Coverage Uniformity in Listener Areas"*
8. **AVIXA**, V201.01:201X *"Projected Image System Contrast Ratio"*
9. **AVIXA**, S601.01:201X *"Audiovisual Systems Energy Management"*

C. United States Department of Justice (USDOJ)

1. **USDOJ**, *2010 ADA Standards for Accessible Design*

D. Supplemental Documents: Refer to the sections identified below for additional require-ments.

1. **SFASU**, 27 05 00 *"COMMON WORK RESULTS FOR COMMUNICATIONS"*
2. **SFASU**, 27 05 26 *"GROUNDING & BONDING FOR COMMUNICATIONS SYSTEMS"*
3. **SFASU**, 27 05 28 *"PATHWAYS FOR COMMUNICATION SYSTEMS"*
4. **SFASU**, 27 15 13 *"COMMUNICATIONS COPPER HORIZONTAL CABLING"*
5. **SFASU**, 27 15 43 *"COMMUNICATIONS FACEPLATES AND CONNECTORS"*

1.2 Definitions

A. **SFA(SU)** – Stephen F. Austin State University.

B. **ITS** – Information Technology Services at SFA.

C. **ITS CS** – ITS Classroom Support departmental staff.

D. **ADA** – The Americans with Disabilities Act which prohibits discrimination against people with disabilities in several areas, including employment, transportation, public accom-modations, communications and access to state and local government' programs and services

E. **ANSI** – The American National Standards Institute (ANSI), a private, not-for-profit organi-zation dedicated to supporting the U.S. voluntary standards and conformity assessment system and strengthening its impact, both domestically and internationally.

F. **Audiovisual Integrator** – Any person or company commissioned by SFASU or ITS to perform work on audiovisual systems apart from ITS CS staff.

G. **AV Systems** – Audiovisual Systems include all equipment necessary to fulfil the intent of communicating audio and/or video content to an audience.

H. **AVIXA** – A trade association representing the professional audiovisual and information communication industries worldwide.

I. **DSP** – Digital Sound Processor, a microprocessor that is dedicated to receiving the signal from the source and then routing it to an amplifier.

J. **HDBaseT** – Promoted and advanced by the HDBaseT Alliance, is a consumer electronic (CE) and commercial connectivity standard for transmission of uncompressed high-definition video (HD), audio, power, home networking, Ethernet, USB, and some control signals, over a common category cable (Cat5e or above) using the same 8 Pin 8 Connector modular connectors used by Ethernet.

K. **HDCP** – High-bandwidth Digital Content Protection is a form of digital copy protection developed by Intel Corporation to prevent copying of digital audio and video content as it travels across connections.

L. **HDMI** – High-Definition Multimedia Interface, a proprietary audio/video interface for transmitting uncompressed video data and compressed or uncompressed digital audio data from an HDMI-compliant source device, such as a display controller, to a compatible computer monitor, video projector, digital television, or digital audio device.

M. **PoE** – Power over Ethernet, a technology that lets network cables carry electrical power.

N. **Rack (cabinet, enclosure)** – A frame or enclosure with mounting rails to house AV equipment.

O. **RU** – Rack unit which, as defined in IEC 60297-3-100: 1 rack unit = 44.45 mm (1.75 inch) height.

1.3 System Description

A. Furnish, install, test, and place into satisfactory and successful operation all equipment, materials, devices, and necessary appurtenances associated with AV cabinets, racks, frames, enclosures, cable management, and power hardware to support standards-compliant AV systems as shown on the Contract Documents.

B. Each type of material and equipment shall be of the same manufacture and product family throughout the work.

C. The work shall include all materials, equipment, software, and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working system, compatible with and complementary to the existing campus systems.

1.4 Submittals

A. Comply with Section 01 33 00 – Submittal Procedures

B. Comply with Section 01 33 23 – Shop Drawings, Product Data, and Samples.

C. Product Data: Submit catalog data for each equipment rack, cable, and AV device.

D. Submittals shall be provided with cut sheets and design drawings during the design phase and approved by ITS CS.

E. As built drawings shall be provided in PDF and DWG or DXF digital format upon completion of the project. Digital copies of all manuals shall be part of the final submissions.

F. All AV Cable Testing documentation shall be provided to ITS CS for review before the final inspection of the system.

1.5 SFA Point of Contact

A. The Assistant Director of Classroom Support will be the point of contact (POC) for any communication regarding AV Systems for SFA Projects, unless otherwise assigned to a member of ITS CS.

1.6 Information Technology Procedures

A. All equipment utilizing networks (wired or RF/wireless) shall comply with SFASU Division 27 specifications, ITS policies, and ITS Security Office policies.

B. Prior to conducting work initiating projects for communications cabling, within communi-cation rooms or related to RF/wireless, review scope and procedures with ITS Networking to obtain approval.

C. Coordinate with Division 27 communication cabling contractor for any interconnect wiring that could potentially carry network traffic (e.g. balanced-twisted pair, optical fiber, etc.).

1.7 Scope of Work

A. The work for designers and/or consultants shall include to a minimum the following tasks:

1. Define system functionality, configuration, and features per user's requirements.
2. Establish a responsibility matrix indicating who is providing the different compo-nents of the system.
3. Provide architectural considerations related to AV systems for the spaces to the project architect. These recommendations shall include room layout, lighting and acoustics.
4. Provide design drawings and specifications based on the information previously collected for the project.
5. Assist the owner or construction manager in the bid process by checking installer's qualifications and equipment list provided by the bidders.
6. Establishing the scope of work for the installer and composing the complete set of bid documents (design drawings and specifications).
7. Review shop drawings and answer RFIs.
8. Test the system with the installer after completion and verify close-out information.

B. The work for the AV installers shall include, but not limited to the following tasks:

1. Preparation of shop drawings, submittal's, training and as-built information for the system.
2. Procurement, installation and warranty of all AV hardware, cabling and wiring related to the AV System.
3. Programming labor of the AV System, including initial software set up, software registration, and initial data input, unless otherwise noted in a specific specification section.
4. Attend project plan meetings with the Owner and the Consulting Engineer (A/E) to fine tune data interchange details, network configuration and other user requirements:

1.8 Certification Requirements and Quality Assurance

A. Contractor shall have at least five years of experience installing and testing AV systems in an education environment.

B. The Contractor shall employ personnel to be responsible for each of the following aspects of work:

1. Project Management
2. Technical Documentation
3. Control System Programming
4. DSP Programming
5. Leadership of Field of Work (Person who is present for all field work)

C. Contractor shall have the responsibility to obtain any of the necessary permits, licenses, and inspections required for the performance of data, video, audio, and control cable installations.

D. Contractor shall be an authorized dealer for the equipment listed in Appendix F.

E. The AV designer(s) or consultant(s) working on SFA projects shall have as a minimum an AVXIA Certified Technology Specialist (CTS) designation and a Crestron DM Engineer Certification. It is highly recommended the designer(s) and consultant(s) also have an AVIXA CTS-D certification.

F. The AV Project Manager and/or lead installer assigned to SFA projects shall have previous experience in installing and integrating AV Systems and must have either an AVIXA CTS-I or CTS-D Certification. Other industry standard certification may be accepted after ITS CS approval.

G. The AV Project Manager will also serve as the single point of contact to manage the installation, speak for the contractor and provide the following functions:

i. Initiate and coordinate tasks with the SFA Project Manager and others as specified by the project schedule.
ii. Provide day to day direction and site supervision of contractor personnel.
iii. Ensure conformance with all contract and warranty provisions.
iv. Participate in all site project meetings.
v. Will remain project manager for the duration of the project. The contractor may change project manager only with the written approval of ITS CS.

H. The AV Programmer assigned to SFA Projects shall be employed full time by the contractor and shall have the following certifications/qualifications:

1. Crestron Certified Programmer.

    i. With approval of ITS CS, full Crestron programming certification can be substituted with proof of completion of Crestron CTI-P201 and portfolio of completed projects.

2. Biamp TesiraFORTE
3. QSC Q-SYS

If the contractor does not have a full-time programmer on staff, written approval from ITS CS must be obtained for the contractor to use a third-party programmer. This programmer must meet the above requirements and submittal of a portfolio of completed projects is required.

I. The contractor and/or installer shall provide the following documentation with their bid package, as evidence that the requirements for the qualifications have been satisfied:

    1. A list of three references for jobs of similar size performed within the last year or twelve-month period.
    2. Specific street address of the location of the office from where installation and warranty work will be performed. It is preferred that the Installer has established and maintains a permanent office within 200 miles of SFA.
    3. Copies of Manufacture certification certificates. It is required that the contractor and/or installer possess the following certifications:
        i. Certifications mentioned above
        ii. Crestron Certified Installer

J. Progress reports shall be provided to ITS CS at least once per month during construction and once per week once principal installation of AV equipment has begun.

2 Classroom Design Standards

2.1 Classroom Definitions

A. The following room types are defined for AV systems:

1. Standard Classrooms
    i. Small Classroom: General academic spaces with a capacity of up to 39 stu-dents.
    ii. Medium-Sized Classroom: General academic spaces with a capacity between 40 and 79 students
    iii. Auditorium Classrooms/Assembly: Large Classrooms with capacity of 80 to up to 200 students, occasionally used for nonacademic purposes.
2. Non-Classrooms

i. Huddle Spaces: Small spaces used for meetings with a capacity of up to 10 persons.
ii. Conference Rooms: Small spaces used for meetings with a capacity between 11 and 20 persons.

2.2 Standard Room Configurations

A. All spaces defined in Section 2.1 are required to have every item listed in the following feature sets. Any changes or deviations must require written approval from ITS CS.

B. All rooms should be designed for mono audio unless otherwise specified by program plan.

C. If any room has a projector screen installed, the screen must have the option to be controlled manually by a low voltage switch installed at the lectern location. Written approval from ITS CS is required to move the switch in a different location. Additionally, if more than one screen is installed then each screen **must** have its own separate switch for individual control. Wiring multiple screens to the same switch is **NOT** permitted. The switch must also allow the capability for a control system to be integrated in.

D. Small Classroom Required Features:

1. Approved ADA Lectern
2. Sources:
    i. Podium Computer and Display (specs provided by SFA ITS)
    ii. Document Camera
    iii. Blu-ray Player (If needed for the academic area)
    iv. Wireless Presentation Device
    v. Cable Caddy containing Power and HDMI Cable for user input
3. Touch Panel AV Controller
4. AV Switcher and control system
5. 16:10 Electric Wall Mounted Screen
6. Laser Projector
7. Flat Panel Display for viewing far side audience during a video conference.
8. DSP for Video Conferencing and Lecture Capture.
9. In-Ceiling Speakers
10. PTZ Cameras
11. Array Microphone to capture instructor and students.
12. AV Bridge device to capture camera, program audio, and microphone output and connect over USB to the Podium Computer.
13. If the space allows, then a second projector or display can be added with the ability to display to split different sources between the two outputs.

E. Medium-Sized Classroom
    1. A medium-sized classroom requires the features of a small classroom with the addition of:
        i. Second Projector or Display for content viewing (if applicable to room usage and furniture layout).
        ii. The ability in the AV Switcher and control system to split different sources between the two content outputs.

F. Auditorium Classrooms/Assembly
    1. An auditorium classroom or a room defined as an assembly hall requires the features of a medium-sized classroom with the addition of:
        i. Additional Displays for improved content viewing if room design allows.
        ii. Wireless lavalier and/or handheld microphones with an option for sound rein-forcement

G. Huddle Spaces
    1. A huddle space requires the following features:
        i. Flat Panel Display
        ii. Wall mounted video input
        iii. AV Control System
        iv. Button AV Controller
        v. Video Conference Soundbar (If needed)

H. Conference Rooms
    1. A conference room requires the following features:
        i. Flat Panel Display or Laser Projector
        ii. Wall mounted Computer (specs provided by SFA ITS)
        iii. Device Connectivity at meeting desk for user device connection (If applicable).
        iv. AV Switcher (If applicable)
        v. Video Conference Soundbar
        vi. USB Switch
        vii. AV Control System
        viii. Button or Touch Panel AV Controller

2.3 Room Add-ons

A. Rooms can be upgraded from the standard configuration with the following options:

    1. Video Teleconference Room: Enhances the teleconferencing equipment in the room by adding the ability to use a software-based conference room system in the space and adds the following:
        i. Conference Room System Dedicated Computer (specs provided by SFA ITS)
        ii. Conference Room System Dedicated Controller (specs provided by SFA ITS)
    2. Active Learning: Furniture and AV upgrades to rooms that may include movable furniture that can be configured into groupings, multiple projection viewing systems, and multiple whiteboards or writing surfaces. The following may be added in addition to the required features of the room:
        i. Flexible/movable furniture with an option for student device charging.
        ii. Multiple displays to meet program plan needs.
        iii. Multiple inputs and power options to meet program plan needs.
        iv. Matrix switching system or distribution amp.

3 Equipment

3.1 Equipment Specified

A. Any equipment specified by make and model as indicated on the design drawings must be provided by the Installer. Substitutions are not permitted unless absolutely necessary and written approval from ITS CS has been obtained.

B. If drawings do not indicate a specific make and model for any equipment then the Installer is free to select from the approved list noted in Appendix F. If one is not listed, or a substitution is needed, then written approval from ITS CS is required before installing.(Please note that ITS CS reserves the right to ask for a sample piece to conduct testing prior to approval).

C. The designer and/or consultant should check with ITS CS to make sure the list noted in Appendix F is the most up to date approved list of equipment; the advancement of classroom technologies may change the list as written.

3.2 Physical Requirements for AV Systems

3.2.1 Equipment racks

A. AV equipment will be mounted in standard 19-inch racks.

B. AV equipment racks must have a minimum clearance to one side, the front, and rear of the rack of 36 inches.

C. AV equipment racks shall have a minimum of 4 data jacks terminated inside, capable of PoE power.

D. Some AV equipment may not have the ability to be mounted or attached to the rack. Therefore, a rack shelf of appropriate RU height needs to be installed, and the equipment must be secured to the shelf using adhesive Velcro.

E. To support future growth at the University, only 80% of rack space shall be used. Blank panels should be installed in spaces not being utilized.

F. AV equipment and shelving must use Phillips head rack screws. Any other rack screw is not permitted.

G. The AV equipment rack must be locked with a lock/keyset provided by ITS CS specifica-tions. Two keys for each lock will also be provided. Keys provided by Mid Atlantic and/or Spectrum Industries are acceptable.

H. The AV Equipment for the presenter is to be mounted in suitable 19-inch wide racks, within the lectern rack area.

I. For any AV equipment that cannot be installed in an AV rack (user accessible or display mounted), it is acceptable to mount equipment behind a display or on a lectern surface, pending ITS CS approval.

J. For AV Systems with limited equipment requiring storage, it is acceptable to place all equipment in an easily accessible backbox, pending ITS CS approval.

K. The use of a rack must have approval from ITS CS and its location will be determined during the design phase in conjunction with ITS CS.

L. Equipment Rack Power:

1. AV Equipment Rack power shall have a 20A quad 120V outlet on separate circuits and isolated ground.
2. 120V AC, 20 Amp rack mounted power conditioners with power overload switches must be used, for equipment installed.
3. 15 Amp power conditioners can be used if load calculations allow, pending approval of ITS CS.
4. Power conditioners will have no more than 77% of load to allow for high startup loads.
5. Load calculations will be provided to ITS CS before installation of equipment.
6. Additional power conditioners must be added if additional outlets are required, or load limits are reached.
7. Power strips and extension cords are not permitted for AV installations.

3.2.2 Lecterns

A. Each learning space must have a rack and lectern with accompanying AV rack. The AV rack must be accessible from both the front and the back for serviceability of AV equipment.

B. If a lectern is to be excluded, written permission from ITS CS must be provided in advance.

C. If a Conference room needs an AV rack, then the use an AV Credenza with removable AV Rack is preferred.

D. Lectern (or Credenza) location will be determined during the design phase and must be approved by ITS CS and the appropriate academic department.

E. Equipment being used by the faculty will be installed above the rack door and equipment not being used by the faculty will be placed below the door.

F. The AV Equipment rack at the lectern must have the ability to lock and has the same requirement as noted in the section above.

G. All power, network, audio, and relay cables required for the AV equipment must be terminated inside the equipment rack, not at the lectern or behind lectern kick-plates.

H. Lecterns shall have a minimum of 4 data jacks, capable of PoE power, mounted in a floor box no more than one foot away from the lectern.

I. Lectern equipment outside the AV Equipment Rack must be in the layout noted below.

J. Lectern layout will be provided by the SFA Design Center.

3.2.3 Ventilation

A. Regardless of location, there must be enough ventilation to prevent unwanted tempera-tures (temperatures more than manufacturer recommendations).

B. All equipment should remain at an acceptable operating temperature to prevent the equipment from:

1. Failure due to overheating
2. Reduced life due to prolonged overexposure to high temperatures.

C. Temperatures should be managed per AVIXA F502.01 Rack Building standards.

3.2.4 Room Layout

A. Any final lectern position must comply with ADA regulations and laws.

B. Lectern must be out of the view of any screen and positioned in a place most conducive to effective instruction must have signed approval from ITS CS.

C. Sightlines must be checked in both plan and elevation documents to ensure all students have an unobstructed view of all areas of the screen and whiteboard.

1. This includes the placement of the lectern and all mounted AV equipment.

3.2.5 Projection Surfaces

A. Screen Size
    1. Screen sizes need to be determined in advance per AVIXA “DISCAS” standards.
    2. Screens that do not meet these standards will require written permission from ITS CS.

B. Single Screen Projection
    1. Image and screen will be centered and provide acceptable viewing angles and sightlines to all seating positions.
    2. Final screen position will be determined during the design consultation process, and any variation to this will not be accepted unless written permission is supplied by ITS CS before installation.

C. Dual Screen Projection
    1. Final screen positions need to be consulted with ITS CS to make sure desired specifications are achieved for maximum viewing capabilities and sightlines for students.
    2. In dual screen projection systems, both screens must provide acceptable viewing angles and sightlines to all seating positions.

D. Specialty Screens
    1. For any screen that is not an ITS CS standard, consult with ITS CS and the associated department staff during the design phase.
    2. These applications include screening rooms as well as huddle space rooms.

3.2.6 Display Devices

A. All display devices must have a minimum native resolution of 1920x1080.

B. All display devices must be in 16:9 format.
    1. Exception to the rule is projectors that can be 16:10 format with a minimum resolution of 1920x1200.

C. All display devices must have the required type and number of digital inputs for the program plan of that specific space, without the use of adapters or converter boxes.

D. All display devices must have ports for RS-232C, LAN connections, and be a Crestron Connected® device for control via a control system or room management software.

E. Projectors
    1. ITS CS requires laser projectors for any room requiring a projector. Model will be determined by the room size and needs.
    2. Projectors should be placed such that the screen can be filled with a projected image, using the standard lens for that model. If this is not possible, please consult with ITS CS to obtain approval for any nonstandard lens configuration.
    3. Final product selection and mounting position will be determined during the design consultation process and any variation to this will not be accepted unless written permission is supplied to ITS CS before installation.

F. Flat Panel Displays and Mounts

1. ITS CS requires commercial-grade flat panel displays (FPD) for any room requiring an FPD. Model and size will be determined by the room size and needs.
2. Flat panel mounts must be installed per the manufacturers' recommended specifi-cations and should not exceed the recommended weight capacity.
3. Displays should be installed using a mount that is rated for a maximum capacity that is 2x the weight of the panel being used.
4. Panels larger than 75 inches must have a mount that provides easy access to the wall or wall box area behind the panel without the need of removing the TV from the mount.
5. Final product selection and mounting position will be determined during the design consultation process and any variation to this will not be accepted unless written permission is supplied to ITS CS before installation.

3.2.7 AV Control and Switching

A. SFA control and AV switching equipment is exclusively Crestron.

B. Most spaces with AV equipment will require a control system beneficial to the room's size and layout and leave room for future additions.

C. If Crestron has no product able to meet specifications and needs of the room, consult with ITS CS to find an acceptable product.

D. Specialty spaces, such as theater auditoriums, can use control systems other than Crestron, pending ITS CS approval.

E. ITS CS will not accept a nonstandard control system from the AV integrator without written permission prior to installation.

3.2.8 Audio

A. Due to variants of room space and size, consultation with ITS CS must be used during the design phase to support audio for voice reinforcement and playback.

B. Mono audio is preferred to provide a uniform audio experience everywhere in the room.

C. Only when specified in the functionality of a space would stereo or surround sound be appropriate.

D. Final speaker specification and installation location must be determined in consultation with ITS CS during the design process.

E. The audio in each space will need to be individually tuned to maximize the audio quality for each room.

F. Microphones and lavalier mics are dependent on the room space and the room use. Please consult with ITS CS during design phase to see if the room requires voice rein-forcement.

G. All microphone lines must be balanced with XLR or Phoenix/Euroblock inputs.

3.2.9 Lighting

A. All rooms with projection screens must have board lights that can be turned off.

4 Execution

4.1 General

A. The audiovisual integrator is to install all equipment for the audiovisual system as outlined throughout this scope of work/specification for the project.

B. All work done should meet or exceed AVIXA standards and more importantly, with a fully functioning audiovisual system handed over at completion of the project, which includes the following:

1. All hardware supporting equipment shall be up to AV and safety standards.
2. All equipment shall adhere to the networking guidelines set by SFA described in Section 4.5.1.
3. No undesired noise should be coming out of the audio system.
4. Video on screen, projection or otherwise, is to be free of any unwanted images, artifacts, and/or blurriness, etc.
5. Projector must be installed in a location away from HVAC equipment, lighting, etc. If this is unavoidable, consult with ITS CS to determine the appropriate mount.
6. When upgrading an AV system, the equipment and functionality of the existing AV system shall not be altered or affected unless specified in the design. Likewise, any part of the system that is intended to be replaced according to the scope must have all old equipment and cabling removed during the installation of the new/upgraded AV system.

4.2 Project Coordination

A. Coordination process adheres to ANSI/INFOCOMM 2M-2010 Standard Guide for Audiovisual Systems Design and Coordination Processes.

4.3 Execution of the Work

4.3.1 Workmanship

A. The AV installers shall adhere to, at a minimum, the following installation practices:

1. Securely mount equipment plumb and square in place. Where equipment is installed in cabinets, provide mounting bolts in all equipment rack fastening holes.
2. If any equipment packaged by the manufacturer are without mounting accessories, then the AV installer shall provide all required accessories necessary to mount the equipment within the designated cabinets and/or rack locations.
    i. These accessories may include (but not limited to) rack ears, brackets, shelves, and security mounts.
3. Provide appropriate ventilation panels, vents, and/or fans to assure sufficient venti-lation for adequate cooling of all equipment as stated in Section 3.2.3.
4. The AV installer shall provide solutions to avoid overheating when equipment is to be installed in casework or closed lecterns.
5. Insulate all non-insulated, stranded conductors before making termination when connecting to equipment terminals.
6. All wiring is to be free from ground loops, shorts, opens, and reversals.
7. Neatly tie all cabling within equipment cabinets, housings, and terminal cabinets with hook-and-loop fastener straps (commonly referred to as “Velcro”) at not more than 8 inch intervals. Install in accordance with the latest EIA installation standards.
8. Cable routing shall not braid or cross with other wires in parallel more than once.
9. Secure all cables in equipment cabinets and terminal cabinets to provide strain relief at all raceway exits in accordance with NFPA 70 including all supplements. All plugs and receptacles are to be the grounding type.
10. Connect all equipment power to power conditioner(s).

4.4 Cabling

A. All cables must be secure and routed in a way that meets AVIXA standards.

B. Use a consistent color scheme throughout the project, matching the existing scheme in the building.

C. Cables terminating at the equipment racks or lecterns will have 1-meter slack provided so any moving of the lectern will not damage equipment.

D. Cables terminating at the equipment, data projectors, speakers etc. must have a 1-meter tail provided.

E. Velcro-style wraps must be used to secure cabling at/inside racks as stated above.

F. The use of nylon tie wraps (also known as zip-ties) is prohibited everywhere, with the exceptions listed below. When used, they should not be tightened down excessively, as doing so may damage cables. Excess shall be removed using flush-cut tools to produce a cut flush with the ratchet head, without leaving sharp or snagging remnants.

    1. Permanently affixed power wiring.
    2. As a cable management pathway affixed to spot anchors attached to the inside of furniture, creating a loop for Velcro to pass through and anchor cables.

G. Any cables that are not contained within a rack, above the ceiling, or behind a wall display should be wrapped in a cable snake.

    1. Do not use tape, tie wraps, or Velcro-style straps to bundle cables inside cable snake and conduits. Cables shall be loose inside mesh sleeves and conduits, allowing them to be pulled out individually and replaced without disturbing the other cables.
    2. The ends of the cable snake must be secured using Velcro-style straps. **Cable ties are prohibited.**

H. Any in-ceiling cable must be suspended above ceiling tiles using cable trays. J-hooks may be used as an alternative with approval. Conduit is required when either of the options are not possible.

I. No cables should be lefts hanging so that they touch the ceiling tiles below.

J. At least one pull string must be run from the AV rack to the ceiling space.

    1. If more than one conduit is present at the AV rack, then there should be at least one pull string per conduit at the AV rack.

K. All connections must be to industry standard. Any terminations on site must be high quality and meet AVIXA standards.

4.4.1 Cable Labeling

A. All cables must be labeled within a minimum of 1 inch and a maximum of 12 inches from the point where:
    1. The cable exits the connector or strain relief.
    2. The outer jacket is removed.
    3. A cut end of an unterminated cable exists.
B. Typical label placement is about 6 inches and consideration must be given to cable bundling when placing the cable label to provide maximum visibility of the label on each cable.
C. The label should state the output location of the cable or input value if at the end of the video source.
    1. EX: If a document camera is plugged into HDMI 1 of an AV switcher, then the cable should be labeled "HDMI 1" on the document camera end and "Document Camera" on the AV switcher end.
D. Power cables must be labeled on both ends identifying the device that the corresponding power cable connects to.
E. The labeling system shall have a design life equal to or greater than the cable to which it is attached to.
F. The labeling system shall be capable of withstanding moisture, heat, UV light, chemical elements, scratches, abrasions, and other incidents that may routinely occur at the point of the cable installation.
G. Handwritten labels must not be used for labeling cables and will not be accepted by ITS CS.
H. Please refer to document F501.01:2015 “Cable labeling for Audiovisual System (CLAS)” from AVIXA for more specific information.
I. Any deviations or substitutions from this publication requires consultation with ITS CS for permission.

4.4.2 Cable Specifications

A. The use of different colors to differentiate between different standards such as, RS-232, Relay, Speaker, etc. is allowed and highly recommended.
B. Cables installed in plenum spaces need to be rated properly as such. Contractor is responsible for verifying the installation requirements.
C. Cables should be of high quality. Cables should be certified for use by the brand of control system being used. (i.e. Crestron).
D. The following is a list of signal types and the cables to be used for those signals.
    1. HDMI Cables: Provide at least HDMI 2.0 Cables should be used to future-proof rooms for future resolutions. Cable lengths should be no more than 10 meters or 33 feet.
        i. Should the distance of a video run surpass the acceptable HDMI cable length, then an HDMI extender **MUST** be used and documented to the owner per location.
    2. Ethernet and HDBaseT cables: Provide UTP Category 6A shielded cable. Refer to SFA Division 27 10 00 for guidelines. Use yellow cables for AV signal cables, blue for data.
    3. Line level audio signal cable: Provide one twisted pair cable for mono signals and two twisted pair cables for stereo signals. Twisted pair cables to be 22 AWG stranded (7x30) tinned copper conductors with overall foil shield (100% coverage), with 22 AWG stranded tinned copper drain wire.
    4. Microphone level audio signal cable: Provide one twisted pair cable, 20 AWG stranded (7x28) tinned copper conductors with overall foil shield (100% coverage), with 20 AWG stranded tinned copper drain wire.
    5. Control cable: For signals using Serial RS-232, IR, or Contact closure, provide one cable with 1 or 2 twisted pair 22 AWG stranded bare copper conductors with overall aluminum/polyester foil (100% coverage) and a 24 AWG tinned copper drain wire. Pair count depends on manufacturer’s specifications.
    6. Speaker Cable: Provide two 16 AWG stranded conductors, with overall jacket.

E. The AV Installer shall provide connectors and plates to terminate all wiring for the AV system.

F. Refer to SFA Division 27 10 00 for termination of UTP Category 6 or 6A cabling.

4.5 Network and Security Infrastructure Requirements

4.5.1 Networking

A. All devices must be able to be managed remotely from the SFA Network.

B. All devices when deployed will have the latest stable version of firmware installed.

C. Serial numbers and MAC addresses for all devices must be provided to ITS CS at least two weeks prior to installation to ensure connectivity during the installation.

D. The AV Installer must consult with ITS CS and/or ITS Networking to determine the specified VLANs for each device.

E. It is preferred that network switches be included in any AV system with 3 or more network-connected devices.

1. Switch specifications and configuration will be provided by SFA Networking.
2. Each device must have its own port connected directly to the network.
3. Unmanaged switches are permitted if and only if the control system and its ac-cessories (such as DSP, Mics, cameras, etc.) are connected to the switch and not directly to the SFA network.
4. If more ports are needed in the AV rack than what is designed, then the AV Installer shall consult with ITS CS and ITS Networking to determine the best option to move forward.
5. Any switch not approved by ITS Networking is prohibited.
6. The AV installer must receive written permission from ITS CS and ITS Networking and keep it isolated from the SFA Network to use a non-standard switch (i.e. for Crestron NVX).
7. Any network switch that is managed by ITS Networking that is installed in a room other than the telecommunications room must be installed in a cabinet that is to remained locked at all times. If the podium does not have the ability to lock and prevent access from users separate from the other technology in the podium, then the switch will need to be moved into the closest telecommunications room following the guidance listed in Division 27 Sections listed in Section 1.1
8. A dedicated switch or switches for AV purposes can be installed in IT telecommuni-cations Rooms following the guidance listed in the Division 27 Sections listed in Section 1.1.

F. Devices that require PoE power should receive power from a PoE Port from the network closet or a PoE capable in-rack switch.

4.5.2 Floor boxes

A. Floor boxes are preferred over wall plates except when an existing AV system already uses a wall plate.

B. Floor boxes shall provide the interface for power, communication and/or audio/visual cabling in an above grade floor.

C. Floor boxes shall be flush style, shall exceed UL scrub water exclusion requirements for tile and carpet floors, and shall be complete with covers, brackets, and hardware to support installation as shown on Drawings.

D. Floor boxes must be installed in a location that is determined by AV design and positioned in such a way that all AV equipment does not interfere with sight lines.

E. Floor boxes may be combined for use by both power and communications where shown on the Drawings. When combined, provide metal dividers separating power from com-munications and provide separate conduits for power and communications.Floor boxes shall be complete with brackets, cover plates, and/or other means to support power, communications, and/or audio-visual type connectors shown on the Drawings or called for in the Specifications.

F. Floor boxes shall be complete with brackets, cover plates, and/or other means to support power, communications, and/or audio-visual type connectors shown on the Drawings or called for in the Specifications.
Floor boxes shall be deep enough that transformer style plugs can be used in the floor box fully and still have the capability to close the box/cover.

G. All connections in the floor box must be terminated at an interface plate. Pass through cables will not be accepted.

H. If the existing system uses a floor box, the existing floor box should be used instead of adding a new wall plate.

4.5.3 Wall Plates

A. Wall plates are preferred over floor boxes when an existing AV system already uses a wall plate or the location of a floorbox is not feasible.

B. New wall plates should be installed as close as possible to any existing wall plates and at the same elevation.

C. Any cables passing through a wall plate must be terminated at the wall plate, like the floor box requirements above.

D. Please consult with ITS CS when determining the location of new wall plates.

4.6 Programming, Testing, and Commissioning

4.6.1 Programming Requirements and Integrations

A. After receiving the notice to proceed, the AV installer must request at least one or more briefing sessions with the Owner and/or design engineer to go over the expectation of each system and clarify any points that might not be clear in the design documents.

B. Many AV systems would benefit from integration with other building systems. This practice is encouraged and supported by SFA. However, both ITS CS and SFA Physical Plant must be consulted before an integration is approved.

C. Lighting Integration

1. Rooms with programmed lighting controls (multiple lighting “scenes”) or rooms with multiple lighting zones should have control functionality programmed into the AV touch panel and be simple to use.
2. Preset lighting scenes should be selectable and should mirror the selections on wall switches.
3. When projection begins board lights should turn off to enhance screen contrast (this may be overridden by the user).
4. Any room that has lighting control must have the ability to be overridden during emergency alerts as per SFA standards.

D. Shade Integration: Rooms with programmed shade controls should have control func-tionality programmed into the AV touch panel. These controls should be simple to use and should mirror the selections on wall switches.

E. Occupancy Sensor Integration: Rooms with occupancy sensors should provide feedback to the AV processor. This feedback may be used for a variety of functionality including:

1. Turning on/off the AV system is small spaces (conference rooms/huddle spaces) when no other AV controls are needed.
2. Occupancy information for Creston Fusion tracking.
3. System power off after a period of room inactivity (30 minutes).

F. After the briefing, ITS CS will provide example programming files to match closely to any new equipment.

G. The touch interface must match the example file to the best of the programmer’s ability. Any major deviations must have written approval from ITS CS.

H. ITS CS will provide temporary credentials for setting up new equipment and any device requiring admin logins must have these credentials set before commissioning.

4.6.2 Commissioning

A. Provide a comprehensive verification of all A/V equipment and systems using a commis-sioning agent. Determine whether A/V systems meet the construction specifications, Contract Document requirements, standards, objectives, and manufacturer-listed perfor-mance guidelines.

B. Prior to beginning the commissioning process, the Contractor and commissioning agent shall hold a meeting with the Owner to review the commissioning requirements, com-missioning process, and required metrics.

C. Any shortcomings discovered during the commissioning process shall be resolved by the Contractor.

D. ITS CS also reserves the right to conduct an independent commissioning process.

4.6.3 Testing

A. If at any time during installation, ITS CS wants to assess the work performed, ITS CS will coordinate with the AV Installer to make sure that assessment will not interfere with any work being done on the project.
B. After all AV equipment has been installed on site and the system has been programmed, the AV installers must request at least one or more working sessions with the Owner and/or design engineer to verify in the field the functionality of the AV system. Some important notes about this step are:
    1. The AV installers shall have different AV media and sources to test all features in the AV system.
    2. Physical installation of all devices will be checked by the Owner and/or the Design Engineer.
    3. ITS CS reserves the right that anytime during the testing phase to verify control system interface matches the set standard from the example file and request any changes if needed.
    4. Any deviations in the installation of the equipment part of the AV System from this section and previous meetings, will be noted by the Design Engineer in a “punch list”. This punch list will be sent to the AV installers within the next 5 days of the working session for immediate corrective action. One punch list will be prepared for each room with AV.
    5. No final sign-offs of punch lists will occur until all items have been corrected.

4.7 Training

A. The AV Installer must also provide training to ITS CS and any other SFA faculty/staff who are directly involved in the use of the room.

B. This training will be done at the end of the project at the handover stage after every issue, defect and improvement has been made or accepted.

4.8 Deliverables

1. Programming: All complete programs in uncompiled format, including graphics files, must be supplied to the University on a USB memory stick and via email upon completion of project.
2. Documentation: A project folder needs to be given to ITS CS at the end of the project. This folder needs to include the following (if applicable):
    1. A list of equipment and support numbers of manufacturers for an easy reference guide for any warranty work that may need to be done after the warranty period has ended.
    2. The list should include warranty end date as well as important product information (serial number, mac address, building, room number, IP Address, etc.).
    3. All equipment manuals, software and all items that came with each piece of equip-ment.
    4. A copy of the as-builts. This is usually a copy of the design documents ITS CS agreed upon, as deviations needed to be agreed upon by ITS CS. The only exception is anything with written permission from ITS CS. This should be supplied on a USB drive with the uncompiled copy of the Crestron programming/graphics.
    5. Line drawings of the final room configurations should be included that details the connections to each piece of the AV system and where each connection is made in the system. These should be exported in a PDF format.
    6. Any other documentation that may have been missed.

4.9 Purchasing, Device Registration, and Reward Points

A. Any Crestron device purchase should use our A+ Rewards number. Consult with ITS CS for this information.

B. Any device that requires device registration must have the serial number(s) provided by the AV installer to ITS CS for SFA to register.

4.10 Warranty and Service Support

A. The AV Installer will be responsible for all labor costs and transportation of equipment costs within 200 miles of the SFA Campus during the 12-month warranty period.

B. All equipment supplied under the audiovisual contract must be guaranteed free of defects in hardware and software arising from faults in materials or poor workman-ship/programming for 12 months from the date of project handover.

C. All reasonable efforts must be made by the audiovisual integrator to have faulty equip-ment repaired and returned to the University within 5 working days.

    1. If a part is available, and as part of this warranty section, the AV Installer is required to temporarily install a University provided replacement to any faulty component (unless the installer has a temporary part on site), ensuring possible teaching space audiovisual system downtime is kept to a minimum.
    2. This replacement process should be done within 48 hours if classroom is available.
    3. ITS CS will work with the installer to schedule a time that works for both parties.

Appendix F. Acceptable Equipment List

F.1 Display Options

F.1.1 Projectors

Type/Model	Description	Manufacturer
NP-525WL	Standard Laser 5200 Lumen Projector	NEC
NP-PA653U	6500 Lumen Laser Projector	NEC
NP-PV710UL-W	7100 Lumen Laser Projector	NEC

F.1.2 Projection Screens

Type/Model	Description	Manufacturer
Contour Electrol	Electric Ceiling or Wall Mounted Projection Screen	Da-Lite

F.1.3 Flat Panel Displays

Type/Model	Description	Manufacturer
QB Series	4K UHD Crestron Connected Commercial Display	Samsung
BE Series	4K UHD Commerical Display	Samsung

F.1.4 Interactive Displays

Type/Model	Description	Manufacturer
MX Series	Interactive Display with no on board PC	SMART

F.2 Display and Projector Mounts

F.2.1 Flat Panel Display Mounts

Type/Model	Description	Manufacturer
Chief	XTM1U	Flat Tilt Adjustable Wall Mount
Chief	TS525TU	Articulating Adjustable Wall Mount

F.2.2 Projector Mounts

Type/Model	Description	Manufacturer
Chief	CMA440	Above Tile Suspended Ceiling Kit
Chief	CMA455	Suspended Ceiling Tile Replacement Kit
Chief	CMS Series	Fixed Extension Column, Pole
Chief	RPMAU	RPA Elite Universal Projector Mount with Keyed Locking

F.3 AV Control and Switching Options

F.3.1 AV Controller

Type/Model	Description	Manufacturer
RMC4	AV Room Controller	Crestron
CP4N	AV Room Controller	Crestron
Core 8 Flex	AV Room Controller with DSP	QSC Q-SYS
Core 110f	AV Room Controller with DSP	QSC Q-SYS
Core 610	AV Multi-Room Controller	QSC Q-SYS
NV-32-H Core Capable	AV Room Controller with Video Capabilites	QSC Q-SYS

F.3.2 User Interface

Type/Model	Description	Manufacturer
TS-770	7-Inch Tabletop Touch Panel	Crestron
TS-1070	10-Inch Tabletop Touch Panel	Crestron
TSW-770	7-Inch Wall Mounted Touch Panel	Crestron
TSW-1070	10-Inch Wall Mounted Touch Panel	Crestron
TSC-70-G3	7-Inch Wall or Table Top Touch Panel	QSC Q-SYS
TSC-101-G3	10-Inch Wall or Table Top Touch Panel	QSC Q-SYS

F.3.3 Video Switching

Type/Model	Description	Manufacturer
HD-PS401	4x1 HDMI Switch with HDBT Out	Crestron
HD-PS402	4x2 HDMI Switch with HDBT Out	Crestron
HD-PS621	6x1 HDMI Switch with 2 additional HDBT in and HDBT Out	Crestron
HD-PS622	6x2 HDMI Switch with 2 additional HDBT in and HDBT Out	Crestron
HD-MD4X1-4KZ-E	4x1 HDMI Switch	Crestron
HD-MD4X2-4KZ-E	4x2 HDMI Switch	Crestron
DM-NVX-360(C)	AV Over IP Endpoint (Encoder or Decoder)	QSC Q-SYS
NV-32-H	3x2 HDMI and AV Over IP Endpoint (Encoder or Decoder)	QSC Q-SYS
NV-21-HU	2X1 HDMI and Av Over IP Endpoint (Encoder or Decoder)	QSC Q-SYS

F.4 Audio

F.4.1 Digital Sound Processors

Type/Model	Description	Manufacturer
TesiraForte X Series	Compact Audio DSP	Biamp
TesiraForte AVB/DAN VT4	Fixed Audio DSP 4x4 Analog In/Outs	Biamp
TesiraForte AVB/DAN CI	Fixed Audio DSP 12x8 Analog In/Outs with AEC	Biamp
TesiraForte AVB/DAN AI	Fixed Audio DSP 12x8 Analog In/Outs without AEC	Biamp
Tesira Server	Multiroom Audio DSP	Biamp
Devio SCR-20	Conference Hub DSP	Biamp
Core 8 Flex	AV Room Controller with DSP	QSC Q-SYS
Core 110f	AV Room Controller with DSP	QSC Q-SYS
Core 610	AV Multi-Room Controller	QSC Q-SYS
SSP 200	7.1 Digital Surround Sound Processor	Extron

F.4.2 Amplifiers

Type/Model	Description	Manufacturer
AMP-X75	75 Watt Amplifier	Crestron
SPA-Q 60x2	60/120 Watt Network Amplifier	QSC Q-Sys
AMP-A460H	60/120 Watt Amplifier	Biamp

F.4.3 Microphones

Type/Model	Description	Manufacturer
MXA920	In-Ceiling Microphone Array	Shure
MXA710	Ceiling/Wall Mount Microphone Array	Shure
Parle TCM-1(EX)	Pendant Beam Microphone Array	Biamp
Parle TCM-X(EX)	Low-Profile Beam Microphone Array	Biamp
Parle TTM-X(EX)	Tabletop Microphone Array	Biamp
Devio DCM-1	Pendant Beam Microphone Array	Biamp
Devio DTM-1	Tabletop Microphone Array	Biamp

F.4.4 Speakers

Type/Model	Description	Manufacturer
SAROS ICT5T-22-W-T-EACH	In-Ceiling Tile Loudspeaker	Crestron
Desono DX-IC6	In-Ceiling Loudspeaker	Biamp
Control 20 Series	Wall Mounted Loudspeaker Monitor	JBL

F.4.5 Soundbars

Type/Model	Description	Manufacturer
Parle VBC 2500	Conferencing Video Bar	Biamp
Parle VBA 2500	Conferencing Audio Bar	Biamp

F.5 Video

F.5.1 Document Cameras

Type/Model	Description	Manufacturer
PX-10E	Document Camera	Elmo
TT-12W	Document Camera	Elmo

F.5.2 Conferencing Cameras

Type/Model	Description	Manufacturer
PTZ 12x80	PTZ Camera	QSC Q-Sys
Cam 520 Pro	PTZ Camera	Aver
Parle VBC 2500	Conferencing Video Bar	Biamp

F.5.3 Other Video Source Devices

Type/Model	Description	Manufacturer
AM-3100	AirMedia Wireless Sharing	Crestron
UBPX700	UHD Blu-ray Player	Sony
HD-CONV-USB-300	USB HDMI Capture Card	Crestron
AV.io HD	USB HDMI Capture Card	Epiphan
4K2USB3	USB HDMI Capture Card	Inogeni