



DESIGN & CONSTRUCTION GUIDELINES

DIVISION 27 COMMUNICATIONS

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SECTION 27 05 36 CABLE TRAYS FOR COMMUNICATIONS SYSTEMS**PART 1 - GENERAL****1.1 USF GENERAL DESIGN REQUIREMENT**

- A. Electrical distribution shall be separated from horizontal cabling distribution by a minimum of 12 inches.
- B. Do not mix systems, such as power, communications, and data processing, in a single cable tray.
- C. Do not mix cables with separate insulation levels, such as 600, 5,000, and 15,000 V in a single cable tray.
- D. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different levels, such as 600, 5,000, and 15,000 V.

1.2 SUMMARY

- A. Section Includes:
 - 1. Ladder cable trays-use for intermediate distribution frame (IDF) and building distribution frames (BDF).
 - 2. Wire-basket cable trays-used for horizontal cable distribution.
 - 3. Single-rail cable trays. (not permitted)
 - 4. Trough cable trays. (not permitted)
 - 5. Fiberglass cable trays. (not permitted)

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cable tray.
 - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
 - a. Provided scaled, coordination drawings both printed and CAD.
 - 2. Vertical and horizontal offsets and transitions.
 - 3. Clearances for access above and to side of cable trays.
 - 4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.

PART 2 - PRODUCTS**2.1 GENERAL REQUIREMENTS FOR CABLE TRAYS**

- A. Cable Trays and Accessories: Identified as defined in National Fire Protection Association (NFPA) 70 and marked for intended location, application, and grounding.
 - 1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: Identify size and configurations using a Cable Tray Schedule on Drawings. Indicate specific requirements for types, materials, sizes, maximum spans, and maximum concentrated loads and configurations.
- C. Structural Performance: for specific values for the following parameters:
 - 1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to National Electrical Manufacturers Association (NEMA) VE 1.
 - 2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
 - 3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.2 LADDER CABLE TRAYS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product from manufacturers listed below.
1. Cablofil/Legrande
 2. Cooper B-Line, Inc.

2.3 WIRE-BASKET CABLE TRAYS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product from manufacturers listed below
1. Cablofil/Legrande
 2. Cooper B-Line, Inc.
- B. Description:
1. Configuration: Wires are formed into a standard 2 inches X 4 inches wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.
 2. Materials: High-strength-steel longitudinal wires with no bends.
 3. Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manufacturing to maintain integrity of cables and installer safety.
 4. Sizes:
 - a. Straight sections shall be furnished in standard 118 inches lengths.
 - b. Wire-Basket Depth: 2 inches usable loading depth by 12 inches, 18 inches, or 24 inches wide.
 5. Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
 6. Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
 7. Hardware and Fasteners: As recommended by wire basket cable tray manufacturer.

2.4 MATERIALS AND FINISHES

- A. Steel:
1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of American Society for Testing and Materials, ASTM A 1011/A 1011M, SS, Grade 33 or ASTM A 1008/A 1008M, Grade 33, Type 2.
 2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
 3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A, 510M, Grade 1008.
 4. Finish: Powder-coat enamel paint.
 - a. Powder-Coat Enamel: Cable tray manufacturer's recommended primer and corrosion-inhibiting treatment, with factory-applied powder-coat paint.
 - b. Hardware: Chromium-zinc plated, ASTM F 1136.
- B. Aluminum: (not permitted)
- C. Stainless Steel: (not permitted)

2.5 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Covers: Solid, Louvered, Ventilated-hat, 2-in-3 pitch type made of same materials and with same finishes as cable tray.
- C. Barrier Strips: Same materials and finishes as for cable tray.
- D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.6 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect cable trays according to NEMA VE 1.

PART 3 - EXECUTION**3.1 CABLE TRAY INSTALLATION**

- A. Install cable trays according to NEMA VE 2.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.
- E. Fasten cable tray supports to building structure.
- F. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lbs. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- G. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- H. Support bus assembly to prevent twisting from eccentric loading.
- I. Install center-hung supports for single-rail trays designed for 60% versus 40% eccentric loading condition, with a safety factor of three (3).
- J. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.
- K. Support center support hangers, trapeze hangers for wire-basket trays with 3/8 inch diameter rods.
- L. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.
- M. Make changes in direction and elevation using manufacturer's recommended fittings.
- N. Make cable tray connections using manufacturer's recommended fittings.
- O. Seal penetrations through fire and smoke barriers.
- P. Install capped metal sleeves with no more than a 40% fill ratio for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- Q. Install cable trays with enough workspace to permit access for installing cables.

3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in [Section 26 05 26, Grounding and Bonding for Electrical Systems](#).
- B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. Cable trays with control conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- D. When using epoxy or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
- E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, and Size of Equipment Grounding Conductors.
- F. Bond all transitions of metallic pathways.

3.3 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 18 inches.

- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.
- E. Tie MI cables down every 36 inches where required to provide a 2 hour fire rating and every 72 inches elsewhere.
- F. In existing construction, remove inactive or dead cables from cable trays.

3.4 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect pathways to cable trays according to requirements in NEMA VE 2.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
 - 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
 - 4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
 - 5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
 - 6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorqued in suspect areas.
 - 7. Check for improperly sized or installed bonding jumpers.
 - 8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 - 9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.
- B. Prepare test and inspection reports.

3.6 PROTECTION

- A. Protect installed cable trays and cables.
 - 1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
 - 2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
 - 3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 27 05 36

SECTION 27 10 00 STRUCTURED CABLING SYSTEMS -- CATEGORY 6A CABLING**PART 1 - GENERAL****1.1 SCOPE OF WORK**

- A. This document specifies University of South Florida (USF) requirements for product design, performance, quality assurance, and Contractor responsibilities for execution of work to install a complete Category 6A structured cabling system. Execution of work includes delivery and storage of materials, preparation, installation, field-testing, and project completion tasks. System certification and warranty submittal requirements for completed work and future Moves, Adds and Changes (MAC's) are also specified in this document. Compliance to applicable codes, standards and regulations is required for all construction work performed.

1.2 SUMMARY

- A. Section includes products and execution requirements pertaining to Division 27, Communications systems. Copper and fiber backbone and horizontal cabling along with support systems are covered under this document.
- B. Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities for all cabling products shall be provided as required to complete cabling to all work stations as shown on floor plans.
- C. The Approved Contractor shall furnish the required materials and labor to complete the Category 6A cabling infrastructure specified in the contract documents.
- D. Construction work shall comply with contract drawings, specifications, project completion schedules, and applicable codes and standards.
- E. Work shall include all detailed execution requirements, such as preparation, installation, system certification, and project closeout activities according to the contract.
- F. The same manufacturer's product shall be utilized throughout the entire project for all copper and fiber optic cabling and connectivity.
- G. Substitutions: No substituted products shall be installed except with written approval by Owner.

1.3 DATA AND VOICE COMMUNICATIONS CONTRACT WORK

- A. General:
1. Furnish all labor, materials, tools, equipment and services for the installation in accordance with general provisions of the specifications and the Contract Drawings.
 2. Completely coordinate with work of all other trades.
 3. Provide all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation, whether or not specifically indicated in the Contract Documents.
 4. Provide all floor penetrations, floor sleeves, conduit raceways, wall penetrations, etc. not shown on the electrical plans but needed for the routing of cabling provided herein.
 5. Provide firestopping.
 6. Provide labor for patch cord installation at horizontal patch panel in the TR and TC.
 7. Provide labor for testing horizontal and backbone cabling.
 8. Provide labor for Wireless LAN Access Point, Antennas and Power Injector installation and system testing.
 9. Provide Telecommunications grounding and bonding.
- B. Provide complete installation for Structured Telecommunications Cabling System including but not limited to:
1. Category 6A UTP horizontal cables.
 2. Multimode & Singlemode optical fiber backbone cables.
 3. Work area telecommunication outlets.
 4. Wall mounted outlets.
 5. Equipment mounting racks and rack enclosures.
 6. Category 6A modular patch panels.
 7. Optical fiber patch panels.
 8. Optical fiber connectors.
 9. Data and Voice Category 6A patch cords

10. Optical fiber patch cords.
11. Wire management panels.
12. Field testing.
13. Conduit floor sleeves, conduit and supports required for installation of all cabling.
14. Firestopping.

1.4 SUBMITTALS

- A. Submittals shall be complete and at one time. Partial submittals will not be considered.
- B. Material lists, schedule of values, lists of subcontractors, and proof of Contractor qualifications shall be provided to Engineer upon request and shall follow the guidelines as stated in the [Division 1, General Requirements](#).
- C. Show drawings shall be submitted. All communication system shop drawings shall include:
 1. Manufacturer's data (specifications, cut sheet).
 2. Wiring diagrams for all installed cabling.
 3. Equipment rack/cabinet layouts.
 4. Proposed labeling schemes and labeling method.
 5. List of cabling distances (typical and maximum) for all structured cabling
 6. Submit copies of certifications for all technicians and the project manager who will support this project. The certifications shall include:
 - a. Structured Cabling and termination equipment installation certifications for copper and optical fiber connectivity and cabling.
 - b. Approved manufacturer classes satisfactorily completed.
 7. Contractor shall submit a test plan that defines the tests required to ensure that the system meets technical, operational, and performance specifications twenty (20) work days prior to proposed test date.
 8. Contractor will submit prior to testing, all Certificates of Calibration(s) for test equipment being used on the project
 9. Work shall not proceed without the Owner's approval of the submitted items.
- D. Drawings & Inspection of Site:
 1. Floor plan drawings are to scale and typically are not dimensioned. The Contractor shall not use scale drawings for equipment placement and clearances. Dimensions given on drawings shall always take precedence over scaled drawings.
 2. Any existing wires, utilities, or equipment shown on the drawings are shown for general information and to the best knowledge of the Engineer. The Contractor shall field verify all existing wires, utilities, or equipment.
 3. The Contractor shall field verify distances and equipment placements coordinating locations with other trades, construction managers, and general Contractor prior to installation.
 4. The Contractor shall review all site conditions prior to submitting a bid on this project. Any obvious discrepancies between the site conditions and bidding documents shall be brought to the attention of the Engineer at the time of bidding so clarification can be made by addendum.
 5. Change order requests for additional costs related to the Contractors misunderstanding related to the amount of work involved and lack of knowledge related to the site conditions will not be allowed.
- E. Test Reports:
 - A. Submit copies of complete reports of all testing performed to the General Contractor (Contractor), with copies to the Contractor and Engineer upon completion of job.

1.5 APPROVED CONTRACTOR

- A. The Contractor shall have experience in the installation and testing of similar systems as specified herein and shall provide references upon request (including the project name, address, date of implementation, client name, title, telephone number, and project description).
- B. All members of the installation team must be certified by the manufacturer as having completed the necessary training to complete their part of the installation. All personnel shall be adequately trained in the use of such tools and equipment as required.

- C. The Contractor bidding on communication systems specified herein shall be certified by the connectivity Manufacturer to install, service, and warranty the specified product prior to the time of bid and throughout the duration of the installation. Manufacturer certifications shall not be project specific and should be valid for any and all projects completed by Contractor.
- D. The Contractor must be certified to install a Fire-Stop system.
- E. The Contractor shall own and maintain tools, installation equipment, and test equipment necessary for successful installation and testing of optical and Category 5e, 6 & 6A premise distribution systems.
- F. The Owner reserves the right to require the Contractor to remove from the project any such employee the Owner deems to be incompetent, careless or insubordinate.
- G. The contractor shall have his place of business, official office not a residential dwelling, located no more than 140 miles from the job site.
- H. The Contractor must maintain a state Contractor's license as required by the state.
- I. The Contractor shall provide copies of certificates for proof of manufacturer's training, manufacturer's certified installer, authorized distributor in the shop drawing submittal and at the request of the engineer to verify compliance with specification prior to recommendations for awarding bid.
- J. The Approved Contractor shall assume the following responsibilities:
 - 1. Execute construction in accordance with contract drawings and specifications.
 - 2. Adhere to project schedules and job site rules.
 - 3. Adhere to the quality, regulatory, logistics, and documentation requirements.
 - 4. Furnish the cabling system certification and warranty provisions outlined in [Section 27, 10 00, Part 1](#).
 - 5. Adhere to the product requirements outlined in [Section 27, 10 00, Part 2](#).
 - 6. Adhere to the Execution guidelines outlined in [Section 27, 10 00, Part 3](#).
- K. Contractor shall also be included in the approved contractors list through USF Purchasing / USF Information Technology (USF-IT) current Invitation to Negotiate (ITN) contract.

1.6 APPROVED PRODUCT MANUFACTURER

- A. The manufacturer of the Connectivity products specified in this document, as required for construction of the cabling Infrastructure per contract documents shall be:
 - 1. Hubbell Premise Wiring Category 6A
- B. The manufacturer of the Cabling products specified in this document, as required for construction of the copper cable Infrastructure per contract documents shall be:
 - 1. General Cable Corporation Category 6A
- C. The manufacturer of the fiber optic cabling products specified in this document, as required for construction of the Fiber Optic cable per contract documents shall be:
 - 1. Optical Cable Corporation (OCC)
- D. Product substitutions are permitted under the [Section 27 00 00, Paragraph 1.7, Product Substitution](#) herein below.

1.7 PRODUCT SUBSTITUTION

- A. Product substitutions from other manufacturers are prohibited and shall require the approval of USF representative 20 days prior to bid opening.

1.8 QUALITY ASSURANCE

- A. Installed Category 6A balanced UTP and fiber cabling systems, pathways and distribution facilities shall adhere to manufacturer's instructions, contract drawings and specifications, and applicable codes, standards and regulations.
- B. Installed Category 6A balanced UTP cabling systems and field test results shall strictly adhere to requirements of American National Standards Institute/Telecommunications Industry Association, (ANSI/TIA-568-C.0, ANSI/TIA-568-C.1 and American National Standards Institute/Telecommunications Industry Association/Electronic Industry Association, ANSI/TIA/EIA-568-C.2.
- C. Installed optical fiber cabling systems and field test results shall strictly adhere to requirements of ANSI/TIA-568-C.0 and ANSI/TIA/EIA-568-C.3.

- D. Where applicable, all equipment, components, accessories and hardware shall be UL listed for the intended purpose of the installation.
- E. Installed products shall be manufactured by an International Standards Organization, ISO 9001 certified facility.
- F. Installed products shall be free from defects in material or workmanship from the manufacturer, and shall be of the quality indicated.
- G. All methods of construction that are not specified in the contract documents shall be subject to control and approval by the Owner or Owner's Representative.
- H. Installed products shall be lot-traceable by date code.
- I. All critical internal manufacturing operations for installed products shall have documented in-process inspection and testing according to ISO 9001.

1.9 DRAWINGS

- A. Approved or preliminary contract drawings furnished at the time of bid solicitation shall serve as the basis for product selection, creation of bills of material, and determination of labor content.
- B. Changes, additions, or deletions to contract drawings prior to awarding of the contract, shall require an amendment to the original bid.
- C. Prior to submitting the bid, in reviewing the contract drawings, the Approved Contractor shall:
 - 1. Request the attention of the Engineer, Owner, or Design Agency to clarify any materials, apparatus or work believed to be incorrect, inadequate, omitted, or in violation of applicable codes, standards or regulations.
 - 2. Note any contingencies related to unknown aspects of any drawings or specifications.
- D. Contract drawings, prior to execution of the project, shall be formally approved and released by the Engineer or Design Agency, and shall be approved by the Owner or Owner's Representative.
- E. Execution of work shall be according to approved drawings, in addition to applicable specifications and contractual obligations.

1.10 APPLICABLE STANDARDS, CODES AND REGULATIONS

- A. Installation Standards: Cable installation shall comply with the following:
 - 1. American National Standards Institute (ANSI)
 - a. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises, published 2009
 - b. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard, published 2009
 - c. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard, published 2009
 - d. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard, published 2008
 - e. ANSI/TIA/EIA-569-B, Commercial Building Standards for Telecommunications Pathways and Spaces, 2003
 - f. ANSI/TIA/EIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure, 2002
 - g. ANSI/TIA-607-B, Commercial Building Grounding and Bonding Requirements for Telecommunications, 2011
 - h. ANSI/TIA/EIA-942, Telecommunications Infrastructure for Data Centers, 2004
 - i. ANSI/TIA-1179, Healthcare Facility Telecommunications Infrastructure Standard
 - j. ANSI/ICEA S-83-596, Fiber Optic Premises Distribution Cable, 2001
 - k. ANSI/TIA/EIA-598, Color Coding of Optical Fiber Cables, 2001
 - l. ANSI/ICEA S-87-640, Fiber Optic Outside Plant Distribution Cable, 1999
 - m. ANSI/TIA/EIA-492AAC, Detail Specification for 850nm Laser-Optimized 50um Core Diameter/125 um Cladding Diameter Class 1A Graded Index Multimode Optical Fibers, 2003
 - n. ANSI/TIA/EIA-492CAA, Detail Specification for Class Iva Dispersion-Unshifted Singlemode Optical Fibers, 2002
 - o. ANSI/TIA/EIA-758, Customer-Owned Outside Plant Telecommunications Cabling

- Standard, 2004
- p. ANSI/TIA/EIA-526-7, Optical Power Loss Measurements of Installed Singlemode Fiber Plant: OFSTP-7, 2002
 - q. ANSI/TIA/EIA-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Plant: OFSTP-14A, 2003
 - r. ANSI/TIA/EIA-TSB-125, Guidelines for Maintaining Optical Fiber Polarity Through Reverse-Pair Positioning, 2001
 - s. ANSI/TIA/EIA-TSB-140, Additional Guidelines for Field Testing Length, Loss, and Polarity of Optical Fiber Cabling Systems, 2004
 - t. ANSI/EIA-310-D, Cabinets, Racks, Panels and Associated Equipment, 1992
 - u. ANSI/TIA/EIA-604 (Series), FOCIS Fiber Optic Connector Intermateability Standard, 2000-2003
2. National Fire Protection Association, Inc., NFPA 70
 3. National Electric Code (NEC), 2005
 - a. NEC Article 250: Grounding
 - b. NEC Article 386: Surface Metal Raceways
 - c. NEC Article 388: Surface Non-Metallic Raceways
 - d. NEC Article 800: Communications Circuits
 - e. NEC Article 770: Optical Fiber Cables and Raceway
 4. Underwriter's Laboratory, Inc. (UL)
 - a. UL-5A: Standard for Non-Metallic Raceways and Fittings
 - b. UL-5: Standard for Surface Metal Raceways and Fittings
 - c. UL-5C: Standard for Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits
 - d. UL-50: Standard for Enclosures for Electrical Equipment
 - e. UL-94-V0: Tests for Flammability of Plastic Materials
 - f. UL-498: Attachment Plugs and Receptacles
 - g. UL-1479: Fire Tests of Through-penetration Firestops (in Accordance with ASTM E814)
 - h. UL-1863: Standard for Safety of Communications Circuit Accessories
 5. National Electrical Manufacturer's Association (NEMA)
 - a. ANSI/NEMA WD-6-2002: Wiring Devices – Dimensional Requirements
 - b. NEMA 250-2003: Enclosures for Electrical Equipment
 6. Federal Communications Commission (FCC) Title 47, Code of Federal Regulations, Part 68: Connection of Terminal Equipment to the Telephone Network, 1998
 7. U.S. Public Law 336. 101st Congress, ADA: Americans with Disabilities Act of 1992
 8. Institute of Electrical and Electronics Engineers, IEEE 802.3af, Data Terminal Equipment (DTE) Power Over Media Dependent Interface (MDI), 2003
 9. IEEE 802.3at (current draft), Data Terminal Equipment (DTE) Enhanced Power over Media Dependent Interface (MDI)
 10. IEEE 802.3ae, Specification for 10 Gbit/s Ethernet Operation over Optical Fiber.
 11. Telecommunications Distribution Methods Manual, 12th Edition, Building Industry Consulting Services International (BICSI)
 12. Wireless Design Reference Manual, 3rd Edition, Building Industry Consulting Services International (BICSI)
 13. ANSI/BICSI 001-2009, Information Transport Systems Design Standard for K-12 Educational Institutions, Building Industry Consulting Services International (BICSI)
 14. BICSI 002-2010, Data Center Design and Implementation Best Practices, Building Industry Consulting Services International (BICSI)
 15. ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
 16. Information Transport Systems Building Industry Consulting Services International (BICSI), Installation Methods Manual, 5th Edition
 17. Network Design Reference Manual, 7th Edition, Building Industry Consulting Services International (BICSI)
- B. This document is not a substitute for any code, standard or regulation. The Approved

Contractor must be aware of local codes that may impact the bid submittal or execution of the project. The current revision of any applicable code, standard, or regulation shall take precedence at the point of project execution, unless otherwise recognized by local authorities. Applicable standards or codes that affect construction, which are listed as normative references within any governing document, are also the responsibility of the Approved Contractor for compliance.

1.11 MATERIALS

- A. All materials shall be UL or ETL listed and verified and shall be marked as such.
- B. Products shall be regularly catalogued items of the manufacturer and shall be supplied as a complete unit in accordance with the manufacturer's standard specifications with any optional items required for proper installation unless otherwise noted.
- C. All materials used on this project shall be new. Used and refurbished equipment is not permitted unless approved by USF. Provide equipment to site in original packaging whenever practical.
- D. Material shall be delivered to the site in the original packing.

1.12 DELIVERY, STORAGE AND HANDLING LOGISTICS

- A. Materials delivered to the construction site shall be stored in a dry, secure area, preferably indoors. Storage temperature of materials shall adhere to manufacturer's recommendations. Movement of packaged materials shall be in a manner to avoid damage of contents. On-site storage, either indoors or trailer, shall have permission by the owner, and shall not interfere with other construction activity.
- B. Installation of Category 6A cable shall be within the recommended temperature range specified by the manufacturer. Cable installation temperature above 50 degrees F is recommended.
- C. The Contractor is responsible for scheduling all deliveries and providing proper receipt, handling, and storage of all materials. Protect all equipment from physical damages (dents, scratches, dust, water, paint, chemicals, and temperature extremes) and vandalism, or theft. The Contractor shall replace any damaged or stolen equipment. The Contractor is responsible for all equipment until final project acceptance by Owner.
- D. The Contractor is responsible for cleaning the worksite every business day and remove debris from the facility.

1.13 WARRANTY

- A. USF requires a Link Warranty for the project.
- B. USF requires a Channel Warranty on any PoE Links.
- C. The length of the extended warranty shall be a minimum of 25 years.
- D. Warranty covering all components, equipment and workmanship shall be submitted in writing with system documentation.
- E. The warranty period shall begin on the system's first use by the owner.
- F. Should the cabling system fail to perform its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the Contractor shall promptly make all required corrections without cost to the Owner
- G. Upon Completion of the project the Telecommunication Contractor shall forward the signed Warranty Registration Form and warranty certificate to the Owner.

PART 2 - PRODUCTS

2.1 WORK AREA CONNECTORS

- A. Category 6A Jacks
 1. Jacks shall be standard 8-position, RJ-45 style, un-keyed, FCC compliant.
 2. Jacks shall be designed for 4-pair, 100 ohm balanced unshielded twisted pair (UTP) cable.
 3. Each jack shall be single unit construction, with snap-fit to industry standard keystone opening (.760 inch x .580 inch).
 4. Jack housings shall be high impact UL 94 V-0 rated thermoplastic.
 5. Jacks shall have a temperature rating of -10° C (14° F) to 70° C (158° F).
 6. Jack housings shall fully encase and protect printed circuit boards and IDC fields.

7. Modular jack contacts shall accept a minimum of 2000 mating cycles without degradation of electrical or mechanical performance.
 8. Jack contacts shall maintain a minimum deflection force of 100 grams while mated with an FCC-standard RJ-45 plug.
 9. Jack contacts shall be formed flat for increased surface contact with mated plugs.
 10. Jack contacts shall be constructed of Beryllium copper for maximum spring force and durability. Contact plating shall be a minimum of 50 micro-inches of hard gold in the contact area over 50 micro-inch of nickel.
 11. Jack termination method shall follow the industry standard 110 IDC punch-down. Jacks shall be compatible with single conductor standard 110 impact termination tools.
 12. Jacks shall have the Category 6A designation, visible from the front when installed.
 13. Jacks shall terminate 26-22 AWG solid or stranded conductors.
 14. Jacks shall not require special cords, specialty tools or special installation requirements.
 15. Stuffer cap shall have four (4) retention snaps to assure conductor strain relief.
 16. Jacks shall NOT accept FCC compliant 6 position plugs.
 17. Jacks shall accept optional hinged dust covers.
 18. Jacks shall be compatible with ANSI/TIA/EIA-606-A color code labeling.
 19. Jacks shall accept snap-on icons for specific identification.
 20. Jacks shall be available in various colors to meet specific customer applications.
 21. Jacks shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
 22. Category 6A jacks shall be backward compatible with existing Category 3, 5, 5e, and Category 6 cabling systems for fit, form, and function.
 23. Jacks shall be manufactured in the USA.
 24. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
 25. The manufacturer shall provide Category 6A component compliance certificates from third party testing organization upon request.
 26. Jacks shall be UL listed 1863.
 27. Jacks shall be UL listed CSA certified.
 28. Jacks shall exceed IEEE 802.3af DTE Power specification to four (4) times the rated current limits with no degradation of performance or materials.
 29. Jacks shall be tested to IEEE 802.3af, 802.3at and 802.3bt
 30. Jacks shall be third party verified, error free 10 Gigabit Ethernet performance to IEEE 802.3an.
 31. Category 6A jacks shall meet or exceed the 4-connector channel performance requirements of Category 6A, per the ANSI/TIA/EIA-568-C.2 standard.
 32. Category 6A modular jacks, as specified in the Contract Documents, shall be:
 - a. Hubbell (HXJ6A**) **= COLOR
 - Green = data
 - Yellow = wireless access points
 - Purple = security cameras
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.
- B. Fiber Optic - LC Duplex Flush Mount Keystone Adapter
1. Keystone adapters are factory loaded with LC MM simplex adapters.
 2. Keystone adapters are used when fiber connectors are needed at the work area.
 3. Flush mounted.
 4. Insertion Loss: <0.5 dB
 5. High retention phosphor bronze alignment sleeve.
 6. Meets TIA/EIA-568-C.3 specification.
 7. Adapter snap-in force: 15 +/- 5 lbs.
 8. White adapter bezel.
 9. Fiber optic adapter, SC simplex, Flush mount, as specified in the Contract Documents, shall be:
 - a. Hubbell (SFFLCW)
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.

- C. Fiber Optic - SC Simplex Flush Mount Keystone Adapter
 - 1. Keystone adapters are factory loaded with SC MM simplex adapters.
 - 2. Keystone adapters are used when fiber connectors are needed at the work area.
 - 3. Flush mounted.
 - 4. Insertion Loss: <0.5 dB
 - 5. High retention phosphor bronze alignment sleeve.
 - 6. Meets TIA/EIA-568-C.3 specification.
 - 7. Adapter snap-in force: 15 +/- 5 lbs.
 - 8. White adapter bezel.
 - 9. Fiber optic adapter, SC simplex, Flush mount, as specified in the Contract Documents, shall be:
 - a. Hubbell (SFFSCW)
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.

2.2 FACE PLATES

- A. Rear Loading with Designation Window
 - 1. Faceplates shall be constructed of high impact, UL94 V-0 rated thermoplastic.
 - 2. Faceplates shall be compatible with standard NEMA openings and boxes.
 - 3. Faceplates shall be 2.75 inches W x 4.5 inches H (69.8 mm x 114.3 mm) for single gang and 4.5 inches x 4.5 inches (114.3 mm x 114.3 mm) for double gang.
 - 4. Port size in each faceplate shall fit the Category 6A Modular Jack or Snap-Fit fiber optic, audio, and video modules for multimedia applications.
 - 5. Faceplates shall provide for ANSI/TIA/EIA-606-A compliant workstation outlet labeling.
 - 6. #6-32 pan head Phillips/slotted mounting screws shall be included with each faceplate.
 - 7. Faceplates shall be UL listed and CSA certified.
 - 8. Work area faceplates, as specified in the Contract Documents, shall be:
 - a. Hubbell (IFP Series)
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.

2.3 CABLE

- A. Category 6A UTP
 - 1. Cable construction shall be four twisted pairs of 23 AWG insulated solid conductors, with a ripcord, surrounded by a tight outer jacket.
 - 2. Ripcord shall be directly underneath the outer jacket.
 - 3. Cable shall be marked with Manufacturer and pertinent information. UL, ETL, or CSA agency certification or verification markings shall be marked on the cable jacket according to the certifying agency's requirements.
 - 4. Color coding of the pairs shall be as follows:
 - a. Pair 1: White/Blue; Blue
 - b. Pair 2: White/Orange; Orange
 - c. Pair 3: White/Green; Green
 - d. Pair 4: White/Brown; Brown
 - 5. Plenum OR RISER rated jackets.
 - 6. Cable shall be supplied in 1000 feet spools.
 - 7. Cable shall exceed Category 6A transmission requirements specified in ANSI/TIA/EIA-568-C.2.
 - 8. Cable shall be UL and C (UL) listed.
 - 9. Category 6A UTP horizontal distribution cable, as specified in the Contract Documents, shall be
 - a. General –Riser – (7133852) Yellow
Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.
 - b. General –plenum – (7132852) yellow
Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.
- B. Backbone Distribution Cable – Fiber Optic
 - 1. Multimode and singlemode fiber backbone distribution cable shall be available in multi-strand constructions for intrabuilding applications. Multimode fiber backbone distribution

- cable for 10/40/100 Gbit/s applications shall be constructed with 50/125 micron laser-optimized optical fiber, om3 or om4.
2. Laser-optimized 50/125 micron fiber shall be Class 1A fiber in compliance with ANSI/TIA/EIA-492AAC.
 3. OFNR or OFNP will be determined at each site.
 4. The Contractor will be responsible to assure that the proper type of jacketing is being used. Failure to meet the local code will be cause for replacement of cable at no expense to USF.
 5. Fiber shall be fusion spliced with factory terminated connections at each termination point.
 6. Singlemode fiber shall be dispersion un-shifted fiber in compliance with ANSI/TIA/EIA-492CAA.
 7. Intra-building fiber distribution cable design shall be according to ANSI/ICEA S-83-596.
 8. Multimode and singlemode backbone fiber distribution cable, when installed, shall exceed the performance requirements of ANSI/TIA/EIA-568-C.3.
 9. Multimode and singlemode backbone fiber distribution cable, as specified in the Contract Documents, shall be:
 - a. Hitachi
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.
- C. Backbone Distribution Cable – Optical fiber, Indoor/Outdoor
1. Multimode and singlemode fiber backbone cable shall be available in multi-strand constructions. Cable design shall be suitable for the environmental and mechanical conditions of the installation.
 2. Riser (OFNR) and plenum (OFNP) fiber optic cables.
 3. These cables can be installed in conduits or inner ducts.
 4. The tight buffer feature of these indoor/outdoor cables eliminates the need for breakout kits and or other special termination equipment.
 5. The outer jacket is comprised of a rugged UL listed sunlight resistant polymer that allows for the cable to be exposed to direct sunlight without the concern of material degradation and greatly reduces moisture migration.
 6. Fiber shall be fusion spliced with factory terminated connections at each termination point.
 7. 900 Im tight buffered fibers - All Dielectric.
 8. Multimode Indoor/Outdoor distribution cable for 10 Gbit/s applications shall be constructed with 50/125 micron laser-optimized optical fiber. Laser-optimized 50/125 micron fiber shall be Class 1A fiber in compliance with ANSI/TIA/EIA-492AAC.
 9. Multimode and singlemode backbone OSP fiber distribution cable, as specified in the Contract Documents, shall be:
 - a. Hitachi
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.
- D. Backbone Distribution Cable – Optical Fiber, Loose-Tube
1. Multimode and singlemode fiber backbone OSP cable shall be available in multi-strand constructions for outside plant (OSP) applications. Cable design shall be suitable for the environmental and mechanical conditions of the installation.
 2. Loose Tube OSP cable will be used in areas that excessive moisture is present. Applications requiring good ozone, moisture, weather resistance.
 3. Building Interconnections and data trunk.
 4. Ducts between buildings and aerial lashing.
 5. Dielectric central strength member.
 6. Dry or Waterblock Gel blocking for moisture protection.
 7. Polyethylene jacket for weather and UV protection.
 8. Installer must follow termination instructions from the manufacturer.
 9. Breakout Kits will be required for termination.
 10. Fiber shall be fusion spliced with factory terminated connections at each building termination point.
 11. Multimode and singlemode backbone OSP fiber distribution cable, as specified in the Contract Documents, shall be:
 - a. OCC manufacturer
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.

2.4 CONNECTORS – FIBER OPTIC

A. Connector, SC

1. Pre-polished SC connectors shall require no field polishing AND REQUIRE NO ADHESIVES FOR TERMINATION.
2. Pre-polished fiber connector basic design shall be a factory pre-polished SC-style optical fiber connector pigtail.
3. Pigtails shall be fusion spliced in the field at <0.5 dB loss.
4. Connector materials shall be designed to comply with:
5. ANSI/TIA/EIA-568-C.3.
6. Telcordia GR-326
7. IEC61754-20 a
8. TIA-604-10
9. Connector design and termination technique shall be independent of cable type or manufacturer and shall be compatible for either 900 micron buffer or 250 micron buffer distribution cables.
10. Pre-polished SC fiber connectors, when properly installed onto qualified cable, shall meet the 10 Gb/s Ethernet performance requirements of IEEE802.3.
11. SC fiber connectors, properly installed onto qualified cable, shall exceed the mechanical and environmental performance requirements of ANSI/TIA/EIA-568-C.3.
12. SC optical fiber Optic Connectors, as specified in the Contract Documents, shall be:
 - a. OCC manufacturer.
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.

B. Connector, LC

1. Pre-polished LC connectors shall require no field polishing AND REQUIRE NO ADHESIVES FOR TERMINATION.
2. Pre-polished fiber connector basic design shall be a factory pre-polished LC-style optical fiber connector pigtail.
3. Pigtails shall be fusion spliced in the field at <0.5 dB loss.
4. Connector materials shall be designed to comply with:
 - a. ANSI/TIA/EIA-568-C.3
 - b. Telcordia GR-326
 - c. IEC61754-20 a
 - d. TIA-604-10
5. Connector design and termination technique shall be independent of cable type or manufacturer and shall be compatible for either 900 micron buffer or 250 micron buffer distribution cables.
6. Pre-polished LC fiber connectors, when properly installed onto qualified cable, shall meet the 10 Gb/s Ethernet performance requirements of IEEE802.3.
7. LC fiber connectors, properly installed onto qualified cable, shall exceed the mechanical and environmental performance requirements of ANSI/TIA/EIA-568-C.3.
8. LC optical fiber Optic Connectors, as specified in the Contract Documents, shall be:
 - a. OCC manufacturer
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.

2.5 PATCH CORDS

A. Category 6A

1. Category 6A patch cords shall be stranded UTP cable construction using a smoke-colored polycarbonate 8-position RJ-45 plug with a low-profile over-molded strain relief boot on each end.
2. Plug shall have vertically staggered, trifurcated copper alloy contacts, each having 50 micro-inches of gold plating over nickel under-plate.
3. Patch cords shall be constructed with Category 6A patch cable, with 24 AWG 7/32 tinned copper stranded conductors, each insulated with polyethylene, with a tight overall jacket.
4. Plug dimensions and function shall comply with FCC CFR-47, Part 68.5.
5. Plug shall be a 2-piece design, with an outer body, pre-loaded with 8 trifurcated contacts,

- and a dielectric wire pre-alignment element to aid in plug termination during manufacturing.
6. Dielectric wire pre-alignment element shall position individual conductors in a manner to optimize near-end crosstalk (NEXT) performance. Pre-alignment element shall also control variability of NEXT performance in the manufacturing process.
 7. Patch cord strain relief boots shall have an integral snag-less feature to protect plug release tab during cable routing. Strain relief boot shall be over-molded PVC. Strain relief boot shall be a low profile, tight-fit design to maximize clearance with adjacent patch cord connections. Strain relief boot design and material properties shall aid in suppression of alien crosstalk (ANEXT) with adjacent patch cord connections.
 8. Jacket material shall be flame-retardant PVC.
 9. Patch cords shall be manufactured using a T568B wiring format and shall function suitably for either T568A or T568B wiring schemes.
 10. Standard patch cord lengths shall range from 3 feet to 20 feet.
 11. Custom make-to-order patch cords shall be available in lengths, ranging from 25 feet to 75 feet and with a delivery lead-time quotation.
 12. Category 6A patch cords shall be backward compatible with existing Category 3, 5, 5e, and 6 cabling systems for fit, form, and function.
 13. All transmission parameters shall be independently verified by a UL or ETL third party testing organization. Transmission testing shall be to 625 MHz. The TIA/EIA-568-C.2 specification limit is 500 MHz. The manufacturer shall provide compliance certificates from third party testing organization upon request.
 14. Patch cord plug and contacts shall withstand 2,000 mating cycles with standard Category 6A FCC-compliant jacks or panels.
 15. Category 6A patch cords shall exceed transmission requirements specified in ANSI/TIA/EIA-568-C.2.
 16. Patch cords shall be UL listed 1863 and CSA certified.
 17. Patch cords shall exceed IEEE 802.3 DTE Power specification to four (4) times the rated current limits with no degradation of performance or materials.
 18. Category 6A patch cords shall meet or exceed 4-connector channel performance requirements of ANSI/TIA/EIA-568-C.2 standard.
 19. Category 6A patch cords as specified in the Contract Documents shall be
 - a. Hubbell (NextSpeED Ascent HC6A**YY Series) **= COLOR YY= LENGTH
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.
- B. Fiber Optic
1. Optical fiber patch cords and cross-connect cords shall be standard SC, LC, and SC-to-LC hybrid constructions. Patch cords for 10 Gbit/s applications shall be constructed with laser optimized 50/125 micron optical fiber.
 2. Installed multimode fiber patch cords, when installed, shall exceed the performance requirements of ANSI/TIA/EIA-568-C.3.
 3. Optical fiber patch cords shall be constructed with aramid-reinforced PVC loose-jacket duplex or simplex cable, with optical fiber(s) having a 900-micron PVC buffer coating diameter.
 4. Connector terminations on each end of the fiber patch cord shall be heat-cured epoxy type with a machine polish, inspected 100% for polish quality and mated-pair insertion loss.
 5. The aramid (Kevlar) strength member shall be mechanically secured at each connector to provide tensile strain relief of the optical fiber.
 6. Factory mounted connectors on each end of the patch cords shall comply with the applicable ANSI/TIA/EIA-604 Intermateability standard.
 7. Duplex fiber patch cords shall have reverse-pair polarity according to ANSI/TIA/EIA-568-C.3 and TIA/EIA-TSB-125.
 8. Fiber A-B polarity shall be clearly marked on each end of duplex patch cords.
 9. Multimode patch cords shall have a maximum mated-pair insertion loss of 0.60 dB per end, with a minimum return loss of -20 dB.
 10. Multimode and singlemode fiber patch cords shall exceed the Gigabit Ethernet performance requirements of IEEE 802.3z standard.
 11. Optical fiber patch cords, as specified in the Contract Documents shall be:

- a. OCC manufacturer
- b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.

2.6 PATCH PANELS – CATEGORY 6A MODULAR PATCH PANEL

- A. Keystone 48 port 1RU patch panel.
- B. Panel frames shall be black powder coated 14-gage steel with rolled edges top and bottom for proper stiffness.
- C. Panels shall accommodate 48 ports for each rack mount unit (1 RMU = 1.75 in).
- D. Panels shall be designed for 4-pair, 100 ohm balanced unshielded twisted pair (UTP) cable.
- E. Category 6A panels shall be backward compatible with existing Category 3, 5, 5e, and Category 6A cabling systems for fit, form, and function.
- F. Panels shall accept a clip-on rear cable management support bar to provide cable strain relief.
- G. Panels shall be manufactured in the USA.
- H. Panels shall be UL listed 1863 and CSA certified.
- I. Category 6A patch panels, as specified in the Contract Documents, shall be:
 - a. Hubbell (Udx48E1u)
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.

2.7 RACKS – FREE STANDING

- A. Each basic rack delivered shall consist of: Equipment Rack, Isolation pads, vertical & Horizontal Cable Organizers, Mounting Hardware, a Single Sided Solid Shelf- Rack Mounted, 18 inches wide Black Ladder Rack & mounts to secure to Rack, a vertical Electrical 20 amp Outlet strip (Minimum 6 receptacles) with Mounting Brackets.
- B. Rack material shall be STRUCTURAL ALUMINUM with a durable black polyurethane powder coat finish.
- C. Installed racks shall have a static load capacity of 500 lbs.
- D. racks shall be available in either 19 inches or 23 inches standard rack configurations.
- E. Tapped holes in the vertical rails for mounting of panels shall be #12-24 thread size. Coating shall not interfere with thread fit.
- F. Standard rack heights of 7 feet (84 inches), and have a capacity of 45 RMU.
- G. Rack base angles shall be pre-drilled for floor mounting, and for assembly to vertical rails.
- H. Each Rack shall be provided with, Racks shall accommodate expansion of cable capacity and added volume for Category 6A cabling.
- I. Free standing racks and accessories, as specified in the Contract Documents, shall be:
 - a. Hubbell (HPW84rr19d)
OCC/RackMax (CMR45)
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.

2.8 CABLE MANAGEMENT – VERTICAL

- A. Finish shall be a black powder coat.
- B. Vertical Management shall have a means to attach to the equipment rack.
- C. Cable pass-through holes of 4-inch diameter shall be located at regular intervals for front-to-rear cable routing. Pass-through holes shall accept clip-on spools for bend radius control of fiber cabling.
- D. Cable routing gates shall be fabricated from 14-gage CRS.
- E. Gates shall have rolled edges to control cable bend radius.
- F. Covers may be specified as an option to conceal cables in the vertical organizer.
- G. Hinged Front Cover shall be fabricated from 20-gage CRS.
- H. Covers shall clip onto installed gates without fasteners.
- I. Vertical Cable Management and accessories, as specified in the Contract Documents, shall be:
 - a. Hubbell (VM1220)
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.

2.9 CABLE MANAGEMENT – HORIZONTAL

- A. Horizontal management will be constructed of 16-gage cold-rolled steel (CRS).

- B. Finish shall be a Durable, black powder coat.
- C. The Duct Panel has 6-pass through rings, 7-rings and a hinged cover.
- D. Size: 1 & 2RU
- E. Front Ring Depth: 4 & 7 inches
- F. All steel construction - rugged, non-flammable, no fasteners to wear or break, no fingers to fuss with.
- G. Modular components easily configured in field to adapt to demanding applications.
- H. Generous space between rings alleviates congestion.
- I. Pass-thru holes with rolled edges.
- J. Horizontal Cable Management and accessories, as specified in the Contract Documents, shall be:
 - a. Hubbell (HM14c – hm24c – hm17c – hm27c)
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.

2.10 CABINETS, ENCLOSURES AND ACCESSORIES

- A. Consolidation Point Enclosures
 - 1. Consolidation point (CP) enclosures shall be constructed of 16-gage cold-rolled steel, with zinc galvanized finish.
 - 2. CP enclosures shall have a removable front cover, constructed of 20-gage cold rolled steel, with electrostatic powder coat finish in either black or electric ivory colors.
 - 3. CP enclosures shall be supplied complete with detailed instructions, wall-mounting screws, panel-mounting fasteners, fiber storage spools and fiber FSP adapter mounting bracket.
 - 4. CP enclosures shall have optional accessories available, including a trim ring, louvered door, and lock kit.
 - 5. CP enclosures shall have features to permit mounting between studs on 16-inch centers flush to wall, or direct wall surface mounting.
 - 6. Stud-locating tabs shall be located on each side of the CP enclosure to facilitate positioning onto wall studs.
 - 7. Cable entry knockouts shall be located on the top, bottom, and sides of the CP enclosure. A knockout shall also be furnished for mounting a lock.
 - 8. CP enclosures shall have two vertical mounting rails, pre-tapped with #10-24 holes. Tapped mounting holes along the rails shall be located on 9.1-inch centers and 10.2-inch centers.
 - 9. Mounting features shall be located within the enclosure to accept a removable fiber FSP panel-mounting bracket, with capacity to accept two (2) FSP or Jack-Pack panels for multi-media applications.
 - 10. Capacity of the CP enclosure shall be five (5) rack-mount units (RMU), each accepting either a 100-pair block or 89-D bracket for 12-port panels.
 - 11. Vertical mounting rails shall accept 110-style/100-pair punch-down blocks and 89-D brackets in any RMU location.
 - 12. Zone ceiling boxes shall be UL listed, and plenum rated for use in ceiling space applications.
 - 13. Consolidation point enclosures used in horizontal cable runs, using wall-mount, in-floor, or ceiling-mount installation shall be designed and UL listed specifically for the intended purpose.
 - 14. Consolidation point enclosures, as specified in the contract documents shall be:
 - a. Hubbell (CPEI)
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.
- B. Cabinets – Full Size Network and Server
 - 1. Network and server cabinets shall be free standing, full-size enclosed cabinets, with a formed, welded and powder coated construction.
 - 2. Network and server cabinets shall be suitable for equipment rooms, telecommunications rooms, entrance facilities and data centers. Heavy-duty, welded four-post frame.
 - 3. Choice of 19 inches or 23 inches EIA square hole or #12-24 tapped rails.
 - 4. Ventilation options for doors, side panels, top, and base, including perforation, vents, and fans.

5. Available in a variety of sized for any application and equipment standard.
 6. Network and server cabinets, and accessories, as specified in the Contract Documents, shall be:
 - a. Hubbell cabinets
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.
- C. Cabinets – Wall Mount
1. Basic design shall be a three-piece modular swivel-type, 14-gage steel, reinforced welded enclosure with a removable front door, and removable rear section.
 2. Shall be constructed of 14-gage cold rolled steel (CRS).
 3. Finish shall be black or office white durable powder coat on all surfaces.
 4. Installed cabinets shall have a static load capacity of 400 lbs in the open or closed position. Full load capacity shall not cause interference with opening or closure of center section.
 5. Cabinets shall be equipped with panel-mounting rails compliant to ANSI/EIA-310-D. Rail location shall be adjustable, with notches to facilitate positioning.
 6. Standard cabinet heights of 24 inches, 36 inches, and 48 inches shall be available, each in depths of 20 inches, 26 inches, and 36 inches.
 7. Rear section shall be removable to facilitate wall installation and have a 16 inches hole pattern suitable for mounting to plywood backboards, steel or wood studded walls, cinder block or concrete walls.
 8. Rear section top surface shall have eccentric knockouts for conduit entry. Eccentric knockouts shall accommodate conduit sizes including 3/4 inch, 1.0 inch, 2.5 inches, and 3.0 inches.
 9. Cabinet shall have dedicated bonding points for proper grounding according to ANSI-J-STD-607A.
 10. Center section shall have slots for ventilation and shall accept dust filters for cooling fan applications. A gasket kit shall be available separately to enhance protection from dust entry.
 11. Cabinet shall have provisions for mounting to an accessory mobile base for use as a floor-standing unit. Mobile base shall be available separately.
 12. Cabinets shall be UL listed.
 13. Wall-mounted cabinets shall be formed/welded and powder coated construction, sized appropriately for the cable installation, and shall accept 19-inch patch panels.
 14. Wall-mounted cabinets may serve as a small telecommunications room, horizontal or intermediate cross connect facility, or consolidation point.
 15. Wall-mount cabinets and accessories, as specified in the Contract Documents, shall be:
 - a. Hubbell (QuadCab)
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.
- D. Frames – Wall Mount - Hinged
1. Supports heavy or deep equipment in locations with limited floor space.
 2. Quick release latches – rake frame hinges both left and right.
 3. Cable tie slots along both sides and inside top and bottom for securing cables.
 4. Frame will be constructed of 16-gage.
 5. All surfaces will be finished with a durable black powder coat.
 6. 70 lbs load capacity.
 7. Mounting holes will be 16 inches on center for easy attachment to any standard wall studs.
 8. EIA-310-D universal spacing tapped #12-24 front and back.
 9. Wall-mount Hinged Frames and accessories, as specified in the Contract Documents, shall be:
 - a. Hubbell (HPWWMR**)
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.
- E. Brackets – Wall Mount – Hinged
1. Bottom or side hinges allows access to the rear of components mounted on the wall.
 2. Wall Brackets will be constructed of 16-gage steel.
 3. All surfaces will be finished with a durable Black Powder Coat.
 4. Will be available in 1RU to 6RU.
 5. Mounting holes will be 16 inches on center for easy attachment to any standard wall studs.

6. EIA-310-D universal spacing tapped #12-24 front and back.
 7. Height will be from 24 inches (12RU) to 48 inches (26RU).
 8. Wall-mount Hinged Brackets, as specified in the Contract Documents, shall be:
 - a. Hubbell (HPWWB*U*)
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.
- F. Enclosures – Wall Mount
1. Remote equipment box basic design shall be a one-piece, 16-gage steel, reinforced welded enclosure with a pre-configured left-hinged door.
 2. Basic unit delivered shall include: one (1) wall mount enclosure body with vented door assembled, with two (2) sets of universal #12-24 tapped mounting rails for communications equipment, two (2) sets of hub mounting brackets, two (2) NSQ locks, and one (1) set of panel mounting brackets.
 3. Body and door material shall be 16-gage Cold Rolled Steel (CRS).
 4. Basic dimensions shall be standard heights of 24.5 inches, 32.5 inches or 42.5 inches by 24.2 inches width, in 7 inches or 10 inches depth versions.
 5. Finish shall be light gray or black durable polyurethane powder coat on all surfaces.
 6. Installed cabinets shall have a static load capacity of 100 lbs.
 7. Installed mounting rails shall accept 19 inches rack-mount panels and equipment with ANSI/EIA-310-D mounting pattern.
 8. Cabinet shall accept a maximum hub depth of 14.5 inches for 32 inches height units, and 22 inches for 42 inches height units.
 9. Installed cabinet shall have sufficient storage capacity for the maximum number of feeder and distribution cables.
 10. Body shall have a pattern of key-shaped holes on 16 inches on centers for stud-mounting. Mounting is suitable for 3/4 inch plywood backboards, steel or wood studded walls, cinder block, or concrete walls.
 11. The weight of the cabinet shall not exceed 50 lbs (22.7 kg).
 12. Body inner back wall shall have clip features to accept optional mounting brackets for equipment, such as panels, 110 blocks, hubs, switches, routers, UPS units, power supplies, audio/video, coax splitters, fiber brackets, and other suitable networking devices.
 13. Body shall have eccentric knockouts in the top, bottom, and sides for conduit entry. Eccentric knockouts shall accommodate conduit sizes including 3/4 inch, 1.0 inch, 2.5 inches, and 3.0 inches.
 14. Cabinet shall have dedicated grounding and bonding locations according to ANSI J-STD-607-A.
 15. Door shall be lockable.
 16. Ventilation: Door ventilation pattern shall meet the requirements of UL1950 for fire containment and ingress of foreign particles.
 17. Remote equipment cabinets shall be UL listed.
 18. Installed cabinets shall perform to NEMA 2 rating.
 19. Tamper resistance, ventilation, and heat dissipation performance shall meet design requirements.
 20. Wall-mounted enclosures may serve as a small telecommunications room, horizontal or intermediate cross connect facility, or consolidation point.
 21. Wall-mount enclosures and accessories, as specified in the Contract Documents, shall be:
 - a. Hubbell (REBOX enclosures)
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.
- G. Enclosures – Fiber Rack Mount
1. Rack-mounted, powder coated formed cold rolled steel enclosure.
 2. Swing-out or pull-out inner tray shall provide access to inner cables and connections and maintain proper cable bend radius throughout the range of motion.
 3. Fiber rack-mount enclosures shall be a 19-inch formed/welded and powder coated modular design, sized according to the cable installation.
 4. Fiber rack-mount enclosures may serve as a main, horizontal, or intermediate cross connect facility.
 5. Panel mounting brackets shall be configurable to either 19 inches or 23 inches racks per

ANSI/EIA-310-D.

6. Enclosure chassis shall have two mounting bracket locations for either flush mount or center mount on the rack.
 7. Inner tray mounting posts for modular FPR3SP panels shall also accept multi-media FSP panels for integration of twisted pair (UTP) coaxial, or other cable media.
 8. Inner tray shall have a threaded mounting boss to accept a mounting stud for splice trays. Splice tray capacity shall be two (2) 10 inches splice trays, each with 24-splice capacities (48 splices total). Splice tray mounting boss shall also accept a stud for mounting 1-RMU blown fiber adapter brackets.
 9. Inner tray mounting posts for modular panels shall also accept 12-fiber MTP-style cassettes for plug & play installations.
 10. Inner tray shall have rear cable tie-down features to accept various diameter backbone cables entering the enclosure.
 11. Enclosures shall be constructed of 16 gage cold rolled steel (CRS).
 12. Fiber rack-mount enclosures and accessories, as specified in the Contract Documents, shall be:
 - a. Hubbell (FCR or FPR series)
OCC (RTC series)
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.
- H. Enclosures – Fiber Wall Mount
1. Basic fiber enclosure design shall be a formed cold rolled steel enclosure with a single hinged cover.
 2. Enclosure material shall be 16-gage cold rolled steel (CRS).
 3. Finish shall be durable black electrostatic powder coat on all surfaces.
 4. Enclosures shall be available in 24 port and 48 port capacities.
 5. Enclosures shall be supplied complete with manufacturer's instructions and hardware. Screws for wall mounting are not included.
 6. Enclosure rear side shall have pre-punched, key-shaped holes to permit fastening to suitable structures and wall surfaces.
 7. Enclosure top and bottom shall have a knockout, each vertically aligned, to permit conduit and cable entry, and vertical stacking of multiple units.
 8. Cover shall be lockable with a keyed lock available separately.
 9. Enclosures shall be supplied with cable routing clips.
 10. Fiber wall-mount enclosures shall be a formed/welded and powder coated design, sized according to the cable installation. Fiber wall-mount enclosures may serve as a horizontal cross connect, consolidation point, or MUTOA enclosure.
 11. Fiber wall-mount enclosures and accessories, as specified in the Contract Documents, shall be:
 - a. Hubbell (FCW or FTU series)
OCC (WTC Series)
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.
- I. Adapter Panels – Optical Fiber
1. Optical fiber Adapter panels shall be a modular design powder coated stamped metal construction.
 2. Available in SC, ST, LC, and MT-RJ adapter configurations.
 3. High or low-density versions.
 4. Adapter panels shall have quick-release snap fasteners to fit directly into fiber enclosures.
 5. Fiber patch panels, as specified in the Contract Documents, shall be:
 - a. Hubell (FSP series panels)
OCC (600 series)
 - b. Acceptable Manufacturers: Basis of Design or equivalent as approved by USF-IT.

2.11 FIRE STOP MATERIAL

- A. Cables passing through fire-rated floors or walls shall pass through fire-rated wiring devices which contain an intumescent insert material that adjusts automatically to cable additions or subtractions.

- B. The device (per code requirements) shall include both internal and external firestopping.
- C. Cables penetrating through fire-rated floors or walls shall utilize fire-rated pathway devices capable of providing an F rating equal to the rating of the barrier in which the device is installed.
- D. The device shall be tested for smoke leakage (L rating) and shall not require the use of any optional sealing materials to achieve the published rating.
- E. The device shall utilize a fire and smoke sealing system that automatically adjusts to the addition or removal of cables.
- F. Wiring devices shall be capable of allowing a 0% to 100% visual fill of cables.
- G. Wire devices shall be of a sufficient size to accommodate the quantity and size of electrical wires and data cables required and shall be suitable for use with new or existing cable installations.
- H. The installed device (in normal use) shall require no maintenance and shall accommodate future cable changes without mechanical adjustment and/or removal or replacement of protective materials.
- I. Wire devices to be provided with steel wall plates allowing for single or multiple devices to be ganged together.
- J. The device shall be modular and shall provide mechanical installation options for common wall and floor constructions as well as common construction conditions including over-sized or damaged openings or existing sleeves.
- K. Acceptable Manufacturers:
 - 1. Specified Technologies Inc. (EZ-PATH) or approved equal.

2.12 INNERDUCT

- A. Fiber Optic Cable shall be installed with Innerduct for protection of fiber cables in a shared pathway.
- B. The inner duct will be rated for the environment that it is being installed in. Plenum and riser rated.
- C. Three inner Ducts will be run between closets. One for current installation, two spare for future applications.
- D. Size: 1 inch
- E. Flexible & Lightweight for ease of handling.
- F. pre-threaded with pull line.
- G. Inner duct, as specified in the Contract Documents, shall be:
 - 1. Premier Conduit

2.13 PROTECTION UNITS – COPPER CABLE

- A. UL listed protection for data communication circuits. The 4-pair block protects networks from transients that can harm sensitive electronic equipment.
- B. Ultra low capacitance solid state technology allows for CAT 6 performance while providing quick reaction to hazardous electrical surges without network degradation.
- C. Designed to protect data networks operating below 65 volts.
- D. these protectors provide optimum transmission performance for protocols operating at transmission speeds up to 250 MHz.
- E. UL listed.
- F. 65V model is ideal for Power Over Ethernet (POE) circuit protection.
- G. 110 Termination.
- H. Cover included.
- I. Factory loaded with 65V solid state modules.
- J. Inner duct, as specified in the Contract Documents, shall be:
 - 1. Porta Systems (606)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Cable pathways and Firestops
 - 1. Cable pathways, including conduit, cable tray, ladder rack, raceway, slots, sleeves, etc. shall be located and mounted according to contract drawings and manufacturer's

- instructions. Pathways shall not be installed in wet areas.
2. NOTE: USF is requiring the use of 1-1/4 inches Conduit to stub in the workstation.
 3. Cable pathway fill ratio, bend radius, run length, number of bends, and proximity to EMI sources shall be in accordance with ANSI/TIA/EIA-569-B. Maximum cable count of the initial installation shall not exceed 40% fill ratio in any pathway.
 4. In accordance with NEC 2005, power wiring and communications cabling shall not share the same pathway or outlet unless separated by a physical barrier.
 5. Cable pathways shall be secured to a structural member of the building, or permanent wall studs. Wall surfaces for raceway mounting should be finished complete.
 6. Metallic pathways shall be electrically continuous, free of sharp edges, and properly bonded to an approved ground. EMI sources such as ballasts, motors, and bus conductors shall be avoided by using proper separation distances.
 7. Pathways that penetrate fire-rated barriers shall be fire stopped according to local codes and recognized practices. Fire stop materials or devices shall be qualified to UL-1479, in accordance with ASTM E814. Fire stop method shall have P.E. approval.
 8. Core drilling of holes for fire-rated poke-through outlet devices shall have approval by a structural engineer or P.E. on the contract drawings prior to start of work.
 9. Pathways for vertical cable runs, such as slots and sleeves, shall be installed in the proper location in accordance with applicable codes and standards.
- B. Telecommunications rooms and equipment rooms
1. Telecommunications room (TR) layout, location and design shall be in accordance with the guidelines of ANSI/TIA/EIA-569-B. TR's on each floor of the building should be centrally located and vertically aligned to simplify backbone cable and pathway routing. TR's shall not be installed in wet areas, or near EMI sources or caustic chemicals. Alternate locations shall be coordinated with USF representative.
 2. Layout of rack, cabinet or enclosure locations shall be according to contract drawings.
 3. Racks and cabinets shall be secured to the floor using proper anchors and fasteners.
 4. All walls should be covered with 3/4 inch, A-C grade plywood. This plywood shall be fire-rated to meet applicable codes and securely fastened to the wall. The plywood will be installed to give up to 8 feet of workspace on the wall and shall be 6 inches off the finished floor. The wall should be light in color workspace to enhance room lighting, unless altered by USF Representative.
 5. Mount and assemble racks, cabinets, brackets and enclosures per manufacturer's instructions. Mount patch panels and cable management accessories in the specified locations.
 6. Adjoining pathways (ladder rack, cable tray, etc.) shall be properly secured and positioned to allow adequate bend radius of cables entering the rack or cabinet.
- C. Wall outlets and recessed wall boxes
1. Wall outlet and cable drop pathway location shall be according to contract drawings. Guidelines from ANSI/TIA/EIA-569-B should be followed for location with electrical outlets and outlet height above finished floor.
 2. Outlet boxes shall be fastened securely to a wall stud or structural element, in a manner to permit flush mounting of the faceplate with the finished wall.
 3. Multi-connect boxes shall be installed in a manner to comply with separation rules for power and communications wiring in proximity.
 4. Refer to specific manufacturer's recommendations for wall outlet selection, cable deployment, and termination of jacks into faceplates. NOTE: Due to the larger size of future cables, USF is requiring the installation of a 2-gang box with a Single Gang mud ring to allow for proper cable bend radius when the faceplate is installed.

3.2 INSTALLATION

A. Cable Support

1. This Contractor shall furnish and install all supports for cables specified in this section.
2. Cable supports shall be spaced randomly, but no further than 5 feet-0 inch apart.
3. In each telecommunications room the inner ducts entering the space will be combined, in a size appropriate metallic box that is mounted on the wall. The combined innerducts will

- then be routed to the rack and the fiber bay.
4. Provide all additional cable management products, sleeves or conduit raceways as required to protect exposed cabling and complete the installation of cables in a neat manner.
 5. A horizontal conduit system consists of conduits radiating from the telecommunications room to the workstation outlets in the floor, walls, ceilings, and columns of a building. When using a conduit distribution system utilize the most direct route following the building lines.
 6. The size and number of conduits or sleeves used for backbone pathways depends on the usable floor space served by the backbone system. at least three 4 trade size sleeves are recommended.
 7. Conduit is only required if building codes or environmental conditions necessitate it. Rigid or EMT metal conduits are deemed suitable for building installation. Adequate planning should allow for a minimum of one 1-1/4 inch conduits to each workstation location if code requires conduit for voice and data cables.
 8. Conduit fill ratios shall not exceed 40%; contact your cable manufacturer to get recommendation on fill rates.
 9. No conduit run should be designed with more than two (2), 90-degree bends between pull points or pull boxes. If a run requires more than two 90-degree bends, install a pull box.
 - a. Exceptions:
 - i. The total run is no longer than 33 feet.
 - ii. The conduit size is increased to the next trade size.
 - iii. One of the bends is located within 12 inches of the cable feed end. (This exception only applies to placing operations where cable is pushed around the first bend.)
 10. All conduits will be equipped with a contiguous length of plastic or nylon pull string with a minimum rating of 200 lbs (90 Kg).
 11. A conduit run should not be designed with continuous closed sections longer than 100 feet without pull points or pull boxes installed.
 12. All conduits should terminate above or in the installed ladder racks and allow for proper cable racking. Cable waterfalls should be considered in areas that have excessive distance between the conduit and ladder rack.
 13. Trays and conduits located within the ceiling shall protrude into the room at distance of 1 to 2 inches without a bend and above 8 feet high. Clear, unobstructed access to the ladder rack and conduits shall be provided within telecommunications rooms.
 14. Conduits entering through the floor shall terminate at least 2 inches above the finished floor.
 15. Locate slot/sleeve systems in places where pulling and termination will be easy.
 16. If possible, locate sleeves, slots, and/or conduits on the left side of the room; this placement enhances the use of wall space from left to right.
 17. When possible, entrance conduit and distribution conduit/cable tray should enter and exit on the same wall; if this is not possible, ladder rack inside the room should be provided for distribution from wall to wall.
 18. All floor penetrations shall be core drilled with a maximum 1/4 inch size greater than the exterior dimension of the riser conduit.
 19. Conduits entering through a wall shall be reamed and bushed and terminated as close as practicable to the terminating rack or wall.
 20. Terminating above a suspended ceiling must terminate not less 3 inches above finished ceiling and finished with bushing opening.
 21. All conduits will be labeled for easy identification.
 22. All floor penetrations shall be at columns, exterior walls or in equipment rooms.
 23. Cables shall be supported at height of bottom flange of structural beams using a rigid support method (i.e., threaded rod, beam clamps, etc.).
 24. Do not support cables from ductwork, sprinkler piping, water piping, waste piping, conduit, ceiling wire, or other system supports.
 25. The conduits or sleeve will be installed per TIA/EIA-569-B and seal all penetration with approved fire stop product.
 26. Provide independent support system for each low voltage cabling system.

B. Cable:

1. Category 6A cable will be run for data. Category 5 Gelled filled cable will be run in the backbone for all communications applications. Certain environments may require the use of different cables and/or cable jackets.
2. All Terminations will utilize T568B wiring in. Any Contractor not complying with this wiring requirement will fix the problem at no cost to USF.
3. Maximum cable lengths to be 295 feet (90 m) including service loop. Provide all necessary installation materials, tools, and equipment to perform insulation displacement type terminations at all communications outlets, patch panels.
4. All communications cabling that has become abandoned as part of new renovation projects, previous renovation projects, or temporary communication cables used during the construction process shall be completely removed.
5. Refer to detailed manufacturer's guidelines for deployment of Category 6A cable. Certain restrictions apply, and specific techniques are recommended.
6. All cabling shall be installed in accordance with manufacturers' written bend radius and pulling tensions. General industry guidelines recommend the following bend radius and pulling tensions:
 - a) Tensile loading on a single 4-pair copper UTP cable shall not exceed 25 ft-lb.
 - b) Bend radius of a single 4-pair copper UTP cable shall not exceed 4 times the diameter of the cable.
 - c) Bend radius of multi-pair copper UTP and optical fiber cable shall not exceed 10 times the diameter of the cable.
7. All conduits and conduit sleeves shall have bushings or grommets shall be installed prior to the installation of communications cables to avoid damage and abrasions to cable sheathing and insulation. If bushings have are installed by the electrical Contractor, the communications cabling contract shall furnish and install bushings prior to pulling communications cabling.
8. Horizontal cable length for 4-pair copper UTP cables shall not exceed 295 feet. Prior to bidding and installation, the contractor shall review the drawings and verify no cable run exceeds 295 feet and notify the communications designer of cable runs that may exceed 295 feet.
9. Splices are not permitted in any voice or data cable unless other specified or shown on drawings.
10. Avoid placing copper cables near sources of extreme heat (i.e., boilers, radiators, heat coils).
11. Maintain cable twists for all UTP cables. For terminations cable sheathing shall be stripping back no more than 1/2 inch back from termination point for all Category 6A cables.
12. All cables shall be supported by cable tray, cable runway, or J-hooks. When large quantities of cables leave trays or runways, cables shall be supported by drop-outs or cable support hardware manufactured specifically for the purpose of supporting cables. J-hooks shall be installed a minimum of every 5 feet and cabling shall maintain minimal deflection and strain (less than 12 inches deflection). Cables shall not be supported from ceiling grid wires. Cables shall not run above iron joists.
13. All cables shall be separated into like groups.
14. Any cabling installing in equipment rooms shall be neatly placed in cabling trays, cabling runways, or horizontal and vertical rack/cabinet cable managers.
15. Velcro cable ties may be used to secure permanently installed horizontal and backbone cabling; any Velcro installed in plenum ceiling spaces shall be rated for use in plenum spaces. Velcro shall never be secured too tight whereby potentially changing the cable geometry.
16. Velcro straps shall be utilized in the TR and inside TC enclosures for all cable bundling. Tie wraps shall be prohibited in the telecommunication rooms.
17. Separation: Maintain the following distances between cables, other system cables and other building systems:
 - a. One (1) foot from fluorescent lights.
 - b. One (1) foot from Power cable in Parallel

- c. One (1) foot from electrical conduits, other systems cables or other electrical equipment.
 - d. Four (4) feet from motors and transformers
 - e. Three (3) feet from hot water piping or other mechanical equipment.
 - f. Ten (10) feet from Bus Conductors or High-Current branch circuits
 - g. All low voltage cables shall be run parallel or at right angles to building structural framework. Do not run cables diagonally across ceiling space without written authorization by the Architect's Electrical Engineer or USF Representative.
 - h. Communications cabling that must cross power cables or conduit shall cross at a 90-degree angle and shall not make physical contact.
18. Fire seal around all cables running through rated floors and walls. Firestop all cables and pathways that penetrate fire-rated barriers using approved methods and according to local codes.
 19. Leave spare pull string with every outlet installed.
 20. Do not install cable in wet areas, or in proximity to hot water pipes or boilers.
 21. Cable ends for termination shall be clean and free from crush marks, cuts, or kinks left from pulling operations. Installed cable jackets shall have no abrasions with exposed conductor insulation or bare copper "shiners". The installer is responsible to replace damaged cables.
 22. Backbone cables shall be installed and bundled separately from horizontal distribution cables. Backbone and horizontal cable bundles shall be loose and random.
 23. Backbone cables spanning more than three floors shall be supported at the top of the cable run with a wire mesh grip and on alternating floors, unless otherwise specified by local codes or manufacturer's guidelines.
 24. Vertical runs of backbone cables entering each TR shall be securely fastened along a properly prepared wall in the TR on each floor. Use of cable ladder is recommended.
- C. Communications Infrastructure
1. Maximum cable lengths to be 295 feet (90 m) including service loop. Provide all necessary installation materials, tools, and equipment.
 2. Support and secure cables at patch panels using rear cable management bracket, spools or management devise.
 3. Install Category 3, multi-pair voice backbone cables utilizing an independent open cabling. This may require Gelled filled cable for under slab installations.
 4. For each voice cross-connect, provide the appropriate color icon at each patch panel port at the TC's and/or TR.
 5. Complete all cross-connects for analog central office facilities and alarm lines to 110-termination block.
 6. Cross-connects shall be completed as per construction schedule.
- D. Optical Fiber Cable:
1. Armored fiber of the proper rating will be run between each closet.
 2. Cables for direct burial, aerial, or other outside applications shall be designed specifically for the intended purpose.
 3. All optical fiber installations shall be installed using open cabling methods. Limit cable-bending radius to twenty (20) times the cable diameter during installation, and 10 times the diameter after installation. Provide all required tools, materials, consumables, and equipment necessary for field mounting of SC connectors.
 4. Do not exceed the maximum pull tension specified by the cable manufacturer. Use appropriate lubricants as required to reduce pulling friction. Avoid kinking and twisting of cables during installation.
 5. Label each end of each cable as to source and destination. Terminate optical fibers in consistent, consecutive manner at each end. Place all material in inner-duct between Label Optical Fiber raceway cable with yellow "Caution - Optical Fiber Cable" tags every 10 feet. Leave 10 feet of slack at each fiber termination point. Neatly coil slack optical fiber cable on top of rack above optical fiber patch panel enclosure at each rack location.
 6. Optical fiber cable terminations shall utilize enclosures and components in quantities consistent with the required fiber counts at each end of each segment.
 7. During installation of optical fiber cable do not allow pulling tension to exceed cable

manufacturer's specification for the cable being installed. Only the strength member of the cable shall be subjected to the pulling tension.

8. Clean all optical fiber connector tips prior to inserting them into matting receptacles or bulkheads. Install all dust covers.
 9. Using approved methods, pull cable into conduit, or place into raceway or cable tray as specified. A pull cord (nylon; 1/8 inch minimum) shall be co-installed with all cable installed in any conduit.
 10. Where cables are installed in air return plenum, riser rated cable shall be installed in metallic conduit.
 11. Backbone and horizontal cables shall be installed and bundled separately in any pathway.
 12. Cables above ceilings or below access floors shall be installed in cable tray or open-top cable hangers.
 13. Cable slack and service coils shall be stored properly above the ceiling or under the access floor. Pathway fill ratio in conduit, tray, raceway, etc. shall not exceed 40% of pathway cross-sectional area.
 14. A service coil of at least 1 meter is recommended within workstation outlets, and at least 2 meters is recommended for telecommunications enclosures. Main trunk and OSP cables shall also have a large diameter service coil in the specified location.
 15. Do not over-tighten tie-wraps or clamps around cable bundles.
 16. Recommended maximum spacing of cable supports above the ceiling is 60 inches.
 17. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.
 18. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other approved structure to support the weight of the cable. Do not exceed maximum cable vertical rise limits.
 19. Cables that are damaged during installation shall be replaced by the Contractor.
- E. Racks and Enclosures
1. Freestanding equipment racks and enclosures shall be protected free of all dust, debris and other environmental elements during construction until substantial completion walk-through.
 2. Each rack, enclosure shall have a dedicated #6 AWG ground wire to a grounding busbar or building ground as defined by NEC.
 3. An isolation pad will be installed prior to fastening the rack to the floor.
 4. Secure racks and enclosures to floor using rack installation kit.
- F. Category 6A Jacks
1. Refer to specific manufacturer's guidelines for termination of jacks and dressing Category 6A cables inside wall outlets and surface housings. Due to the larger size of Category 6A cable, service coils in outlet boxes and surface housings are not recommended.
 2. Terminate jacks according to manufacturer's instructions.
 3. All jack will be wired utilizing T568B.
 4. To assure 10GBase-T performance, maintain wiring pair twists as close as possible to the point of termination. Also minimize the length of exposed pairs from the jacket to the IDC termination point during installation.
 5. The length of wiring pair un-twist in each termination shall be less than 0.5 inch (13 mm).
 6. Jacks shall be properly mounted in plates, frames, or housings with dust caps fully installed over IDC contacts.
 7. Horizontal cables extending from mounted jacks shall maintain a minimum bend radius of at least four (4) times the cable diameter unless space is restricted. Note: Refer to specific manufacturer's recommendations for restricted cable bend radius.
 8. Cable terminations shall minimize tensile or bending strain on IDC contacts after assembly of faceplate or housing to the wall outlet.
- G. Category 6A patch Panels
1. Properly mount patch panels into the designated rack, cabinet, or bracket locations with the #12-24 screws provided.
 2. Terminate cables behind the patch panel according to manufacturer's instructions.
 3. To assure performance, maintain wiring pair twists as close as possible to the point of

- termination. Also minimize the length of exposed pairs to the termination point during installation.
4. The length of wiring pair un-twist in each termination shall be less than 0.5 inches (13 mm) and shall be kept to a minimum.
 5. Each terminated and dressed cable shall be maintained perpendicular to the rear cover using the recommended cable management hardware.
 6. Horizontal or backbone cables extending from the rear panel terminations shall maintain a minimum bend radius of at least four (4) times the cable diameter.
 7. Panels shall be properly labeled on the front and cables should be individually labeled on back.
- H. Optical Fiber Connectors, Horizontal and Backbone
1. Method of connector termination shall be pigtail splice.
 2. Installed fiber connectors shall have proper cable support, routing, and strain relief.
 3. Installed connectors shall be inspected 100% for polish quality, and contamination.
 4. Fibers terminated from OSP cable shall have break-out kits installed where applicable.
 5. Fusion splices for pigtail connections shall be protected in a suitable enclosure.
- I. Grounding and Bonding Systems -- Basic Guidelines
1. Telecommunications grounding and bonding system shall be installed in accordance with NEC requirements, and per the guidelines of ANSI J-STD-607-A. Installation of the system shall be by a licensed electrician.
 2. The Telecommunications Main Grounding Busbar (TMGB) shall be bonded to the building main electrical service ground (Grounding Electrode Conductor or GEC), using approved lugs or exothermic weld methods. Bonding to the GEC or TMGB with sheet metal screws is prohibited.
 3. The Telecommunications Bonding Backbone shall be a minimum 6 AWG copper wire conductor. A Telecommunications Grounding Busbar (TGB) shall be installed in the TR on each floor and shall be bonded to the TBB. All metal racks, cabinets, and enclosures shall be bonded to the TGB.
 4. Telecommunications equipment shall be grounded according to manufacturer's instructions and in accordance with applicable codes.
 5. All metallic pathways, including conduit, raceway ladder or cable trays shall be electrically continuous and shall be bonded to ground on each end.
 6. OSP cable entering the building or backbone cables having metal sheaths shall have isolation protection. Isolation protectors shall be bonded to the TMGB.
- J. Protection
1. The electrical protection is governed by the applicable electrical codes.
 2. Terminations for entrance facility copper cable shall be in accordance with the manufacturers' specifications and meet local AHJ requirements. All copper Inter-building backbone cables and antennas require protection devices.
 3. The entrance facilities include connections between cabling used in the outside environment and cabling authorized for in-building distribution.
 4. These connections may be accomplished via a splice or other means.
 5. In the Entrance facility that connects with the Access Provider, you are required to always contact Access Providers to determine the needs and policies of the installation.
- K. Fire Stop
1. Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of firestopping in accordance with manufacturer's installation instructions and technical information.
 2. Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and any other substances that may inhibit optimum adhesion.
 3. Provide masking and temporary covering to protect adjacent surfaces.
 4. Do not proceed until unsatisfactory conditions have been corrected.
 5. Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
 6. Comply with manufacturer's instructions for installation of firestopping products.

7. Keep areas of work accessible until inspection by authorities having jurisdiction. Where deficiencies are found, repair firestopping products so they comply with requirements.
8. Remove equipment, materials, and debris, leaving area in undamaged, clean condition.
9. Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

3.3 LABELING

A. General:

1. All labels shall be permanent, machine generated labels produced by a labeling machine. Labels shall be a permanent polyester material clear in color with label lettering black in color. No handwritten labels will be accepted.
2. Labeling information will be reviewed at Pre-Install Meeting, and the Owner shall approve the labeling scheme prior to the installation of any cabling.
3. Surfaces shall be cleaned before attaching labels. All labels shall be attached firmly and vertically plumb on equipment, faceplates, patch panels termination blocks, etc.
4. All labeling of cables, equipment, and components shall be included in as-built documentation, floor plan drawings, and schematic designs.

B. Cabling

1. All structured cables (horizontal and backbone) shall be labeled at both ends within 6 inches of cable termination point. Where voice backbone cables extend behind termination blocks, cable labels shall be placed at a location on the cable where the labels are visible from the front of the termination blocks.
2. Labels shall have an adhesive backing and shall wrap completely around the circumference of the cable jacket. Label and lettering sizes shall be of appropriate size in regards to cable diameter.

C. Equipment Racks, Termination Hardware, and Faceplates

1. All communications equipment racks, cabinets, fiber enclosures, and termination hardware shall be clearly labeled at the top, left-hand corner of the equipment.
2. Equipment Racks and Cabinets shall have 3/4 inch to 1 inch high lettering and shall be labeled with the telecommunications room number followed by an alphanumeric character in sequence for each rack/cabinet. (i.e., TR2-A represents the first rack/cabinet in Telecommunications room #2)
3. Fiber Enclosures shall have 3/8 inch to 1/2 inch high lettering and shall be labeled with the telecommunications room number followed by an alphanumeric character of the rack/cabinet and the enclosure number (i.e. TR1-B-1 represents the first enclosures, second rack/cabinet in Telecommunications Room #1). Additionally, each strand of fiber shall be identified with the termination location of the opposite end and the fiber position number on the outside (or inside) front cover and top, left-hand corner of the enclosure under the enclosure label.
4. Modular Patch Panels shall have 3/8 inch to 1/2 inch high lettering and shall be labeled with the telecommunications room number followed by an alphanumeric character of the rack/cabinet and the patch panel number (i.e. TR3-C-2) represents the second patch panel, third rack/cabinet in Telecommunications Room #3). Patch panels shall be labeled with sequential numbering starting with "01" for topmost patch panel and moving downward towards the bottom of the rack. Additionally, each jack position on the patch panel shall be identified with the jack position number (i.e., a 48-port patch panel shall have number 1 through 48 silk screen printed on the patch panel or shall have labeling strips with numbers 1 through 48 machine printed above/below corresponding jack position).
5. Voice Termination Blocks shall be labeled similar to patch panels and fiber enclosures when installed in equipment racks and cabinets. Voice backbone cable pairs shall be labeled starting with V001 starting at the main communications room and continuing sequentially through all communications rooms. Horizontal voice cables (station cables) terminated shall be labeled similar to data patch panels.
6. Voice and Data Outlets shall have 3/16 inch high lettering with the labeling method as indicated. Voice and data outlets shall be identified with the telecommunications room where cables are terminated, the rack/cabinet number, the patch panel number, and the

jack position number (i.e., TR3-C-2-28 represents the outlet is located on the second patch panel in the third rack/cabinet in Telecommunications Room #3 and is jack position #28). The Contractor shall terminate all cabling in a sequential method.

3.4 TESTING

A. Category 6A Cable Testing

1. Permanent Link Testing shall be completed on all horizontal (station) cables. The Contractor will be responsible to supply a Link warranty.
2. Category 6A cabling systems shall be tested as an installed horizontal permanent link configuration. Jacks and faceplates shall be assembled complete and properly mounted into outlet boxes. Panels shall be terminated complete and fully dressed in proper cable management.
3. All wiring shall be certified to meet or exceed the specifications as set forth in TIA/EIA-568B for Category 6A requirements for permanent link. All tests will be performed to 250MHz.
4. Field Testing shall include the following parameters for each pair of each cable installed:
 - a. Name of the person performing the test.
 - b. Test equipment manufacturer and model number.
 - c. Cable I.D. The test sheets will be in numerical order by cable ID.
 - d. Date of test.
 - e. Wire map (pin to pin connectivity and polarity check).
 - f. Length (in feet).
 - g. Insertion Loss.
 - h. Near End Crosstalk (NEXT).
 - i. Power Sum Near End Crosstalk (PSNEXT).
 - j. Equal-Level Far End Crosstalk (ELFEXT).
 - k. Power Sum Equal-Level Far End Crosstalk (PSELFEXT).
 - l. Return Loss.
 - m. Delay Skew.
 - n. Attenuation to Crosstalk ratio (ACR).
5. A "PASS" indication shall be obtained for each link, using at minimum a level III tester that complies with TIA/EIA-568-C.2 field test requirements.
6. Record test results for each cable and turn over to the General Contractor Upon completion of the job. Correct malfunctions when detected, and re-test to demonstrate compliance. Note: Test equipment shall be a Type III cable Tester.

B. Optical Fiber Testing:

1. Test procedures shall be as described by the TIA/EIA-568-c.0: Commercial Building Telecommunications Cabling Standard, Parts 2 & 3, and TIA/EIA-526-14-A-1998 - Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant-OFSTP-14A.
2. Preinstallation Testing:
 - a. Test each conductor of every optical fiber cable on the reel with a light source and a power meter.
 - b. Obtain the cable manufacturer power meter test results for each reel used on the project. Using the attached Optical Fiber Test Form record the readings and the manufacturer's reel number. Prior to completion of project, turn over the completed optical fiber test form, optical fiber cable reel ID tags and optical fiber cable manufacturer's test results.
3. Acceptance Testing:
 - a. Each terminated fiber strand in the horizontal or backbone infrastructure shall be tested individually as a permanent link. A fiber permanent link is defined as a length of individual fiber strand with a connector terminated on each end.
 - b. Testing for multimode shall be at 850 and 1300 nanometers. Total link insertion loss (dB) shall be within the specified link loss budget.
 - c. Tier 1 testing for each installed singlemode link shall be performed as an optical power insertion loss measurement, as defined by ANSI/TIA/EIA-526-7. Testing for singlemode shall be at 1310 and 1550 nanometers. Total link insertion loss (dB) shall

- be within the specified link loss budget.
- d. Tier 2 testing, if required for each installed singlemode or multimode link, shall be performed as an OTDR measurement, as defined in [TIA-TSB-140](#). We require [Tier 2](#) testing on all fibers installed in the facility for future troubleshooting.
 - e. Multimode optical fiber attenuation shall be tested on all individual fibers of each cable segment using an LED light source and power meter to determine the actual loss. These tests shall be performed at the [850 nm](#) and [1300 nm](#) windows in both directions. Test set up and performance shall be in accordance with [ANSI/TIA/EIA-526-14A, Method B](#).
 - f. A reference power measurement shall be obtained by connecting one end of [test jumper 1](#) to the light source and the other end to the power meter. After recording the reference power measurement, [test jumper 1](#) shall be disconnected from the power meter without disturbing the light source and attached to the cable plant. The power meter shall be moved to the far end of the cable plant and attached to the cable plant with [test jumper 2](#).
 - g. Readings must not be higher than the "[Optimal Attenuation Loss](#)." The OAL will be calculated using the manufacturer's factory certified test results, (dB/km) converted to the actual installed lengths plus the manufacturer's best published attenuation losses for the connector and/or splice installed on this project. ([0.30+/-0.30](#) for Connectors and [0.10](#) for splices). The construction manager shall use the OAL for comparison with the end-to-end power loss test results prior to acceptance.
 - h. Test Results: Must be completed and turned over to the General Contractor prior to active equipment installation. Specific due dates for optical fiber will be established at pre-install meeting.

3.5 DOCUMENTATION

A. Test Results

1. All test results are to be saved electronically on CD. Test documentation submitted on disk shall be clearly marked on the cover with the words "[Project Test Documentation](#)", the project name, and the date of completion (month and year). For multiple buildings, the building name, including floor or wing I.D. should also be included on the test results disk.
2. File names of the test results recorded for each link shall match the official identification. Test results shall include a complete record for each link, including type of test, cable type, cable/port I.D., measurement direction, reference setup, date, and technician's name(s).
3. The test equipment name, manufacturer, model number, serial number, software version and last calibration date shall also be provided in the test results documentation.
4. When repairs and re-tests are performed, the problem cause and corrective action taken shall be noted, and both the failed and passed test data shall be documented.
5. The owner, engineer, lead project manager, or owner's representative reserve the right to request verification of test results with a re-test of installed cables, on a sampling basis. Re-testing shall be at the expense of the installer unless otherwise noted in the contract documents.

B. Record Drawings

1. Deviations from the approved drawings, whether a change order is submitted, shall be clearly denoted as built on the working hard copy drawing by the telecommunications Contractor. Record drawings shall be returned promptly to the owner or design agent for completion of drafting revisions to the original design. See [Subparagraph 3.5.C, Change Orders](#) below. Manufacturer's warranty registrations may also require record drawings.
2. Floor plan drawings shall at minimum include detailed cable and pathway layouts, exact locations of workstation outlets, and cable distribution hardware locations. Workstation outlets shall have alphanumeric identifiers on the drawings as specified by the end user or owner.

C. Change Orders

1. Any deviation from the approved contract drawings or specifications shall be submitted as a written change order.
2. Execution of work, to perform changes, shall not proceed without prior written approval.

Any changes done without written approval will be at no cost to USF. If the work is shown to be incorrect the Contractor will have to correct the problem at no cost to USF.

3. Significant changes may require a written quotation of additional labor and materials from the telecommunications Contractor.
 4. It is the responsibility of the owner or owner's representative to bear the added cost of any substantial cabling system design changes. The Contractor will not proceed with any change orders without written approval by the owner's representative. Any changes not approved by the owner's representative will be responsibility of the Contractor and at no cost to USF.
 5. Field changes that are completed without issuance of revised drawings shall be clearly denoted on the working record drawing. Refer to [Subparagraph 3.5.B, Record Drawings](#) above.
- D. PUNCH LISTS AND CORRECTIVE ACTION
1. As required in the contract documents, the telecommunications contractor shall correct punch-lists items determined to be in violation of drawings, specifications, codes, standards or regulations.
 2. The Contractor shall be responsible for timely re-work of faulty cabling or hardware installations.
 3. The owner reserves the right to withhold final payment until punch list items are resolved satisfactorily.

3.6 MANUFACTURER'S WARRANTY

- A. The manufacturer warrants [Category 6A](#) cabling, optical fiber cabling and connecting components free of defects in material or workmanship.
- B. [Category 6A](#) and optical fiber cabling and components are warranted to perform the intended application upon completion of proper installation and testing.
- C. Warranty coverage includes application assurance and compliance to applicable performance specifications.
- D. Installed [Category 6A](#) cabling systems may be granted a full Channel warranty under the conditions stated below.
 1. A certified installer registered who has completed a Manufacturer's training program performs the construction.
 2. Contractors performing the certified installation are properly registered in the Manufacturer's warranty program.
 3. The channel components are supplied entirely by one Manufacturer, including patch cords.
 4. Cable used in the installation is qualified and recognized by Connectivity Manufacturer.
 5. Installed link systems are properly documented and tested with a "PASS" result. The county requires a link test and the use of manufacturer patch cords to receive a channel warranty.
 6. Field test equipment used for [Category 6A](#) cabling is minimum level III classification and complies with [TIA/EIA-568-C.2](#) requirements.
 7. Required test results, stored on a CD, and project documentation including record drawings, and are submitted to the Manufacturer by the registered contractor.

3.7 MOVES, ADDS AND CHANGES

- A. Moves, adds and changes initiated by the owner, end user, project manager, or design agent, which are beyond the scope of work in the original contract, shall require a revised quotation by the telecommunications contractor.
- B. It is the responsibility of the owner or owner's representative to bear the added cost of any substantial cabling system design changes.
- C. Moves, adds and changes shall either be issued in revised drawings, or otherwise shall be clearly denoted on as-built drawings.
- D. Moves, adds and changes that affect installations covered in a manufacturer's warranty shall be performed by a certified contractor that is properly registered in the manufacturer's warranty program.

3.8 SYSTEM MAINTENANCE AND REPAIR

- A. Maintenance of the cabling infrastructure is to be done by authorized personnel only, or void of manufacturer's warranty may result. It is the responsibility of the owner or end user to utilize a certified installer to maintain warranty coverage on existing or new cabling infrastructure.
- B. The telecommunications contractor shall furnish a quotation for time and material to perform maintenance and repairs. The owner has the first right of refusal of selecting suitable contractor or qualified internal personnel to perform maintenance and repairs on structured cabling.
- C. Additions of new cabling, either horizontal or backbone, shall be completed, tested, and documented into permanent building records. New cabling installations intended to be covered by the manufacturer's warranty shall adhere to the documentation submittal and system certification provisions stated above.

3.9 CLEANUP

- A. The communications Contractor shall clean up all debris related to this work on a regular basis leaving the job site in a clean, safe condition.
- B. Protect all equipment from damage during construction. Equipment not protected shall be replaced at the Contractor's expense.

END OF SECTION 27 10 00

SECTION 27 11 00 COMMUNICATIONS EQUIPMENT ROOM FITTINGS**PART 1 - GENERAL****1.1 USF GENERAL DESIGN REQUIREMENTS**

- A. Reserved for future use.

1.2 SUMMARY

- A. Section Includes:
 - 1. Telecommunications mounting elements.
 - 2. Backboards.
 - 3. Telecommunications equipment racks and cabinets.
 - 4. Grounding.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. EIA: Energy Information Standard.
- C. LAN: Local area network.
- D. NECA: National Exchange Carrier Association, Inc.
- E. RCDD: Registered Communications Distribution Designer.
- F. TIA/EIA: Telecommunications Industry Association/Energy Information Standard

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 - 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Provide qualification data for Installer, qualified layout technician, installation supervisor, and field inspector.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of a RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of a dedicated Project Manager.
 - 3. Field Inspector: USF IT/Owner will provide Field inspection.

PART 2 - PRODUCTS**2.1 BACKBOARDS: Provided by Contractor.**

- A. Backboards: A/C Grade Plywood, fire-retardant treated, 3/4 inch x 48 inches x 96 inches.

2.2 EQUIPMENT FRAMES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product from one of the following:

1. Middle Atlantic Products, Inc.
 2. Panduit Corp.
 3. Rack Technologies.
 4. APC.
 5. Chatsworth.
- B. General Frame Requirements:
1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be fully supported.
 2. Module Dimension: Width compatible with EIA 310-D standard, 19-inch panel mounting.
 3. Finish: Manufacturer's standard, baked-polyester powder coat.
- C. Floor-Mounted Racks: Modular-type, steel or aluminum construction. Vertical and horizontal cable management channels, grounding lug, and a power strip.
1. Baked-polyester powder coat finish.
- D. Modular Freestanding Cabinets:
1. Removable and lockable side panels.
 2. Hinged and lockable front and rear doors.
 3. Adjustable feet for leveling.
 4. Screened ventilation openings in the roof and rear door.
 5. Cable access provisions in the roof and base.
 6. Grounding bus bar.
 7. Roof-mounted, 550-cfm fan with filter.
 8. Power strip.
 9. Baked-polyester powder coat finish.
 10. All cabinets keyed alike.
- E. Cable Management for Equipment Frames:
1. Integral wire retaining fingers.
 2. Baked-polyester powder coat finish.
 3. Vertical cable management panels shall have front and rear channels, with covers.
 4. Provide horizontal crossover cable manager at the top of each relay rack.

2.3 POWER STRIPS

- A. Power Strips: Comply with UL 1363.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Rack mounting.
 3. LED indicator lights for power and protection status.
 4. LED indicator lights for reverse polarity and open outlet ground.
 5. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
 6. Close-coupled, direct plug-in Cord connected with minimum 15-foot line cord.
 7. Rocker-type on-off switch illuminated when in on position.

2.4 GROUNDING

- A. Comply with requirements in [Section 26 05 26 , Grounding and Bonding for Electrical Systems](#) for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar: Contractor Provided.
1. Connectors: Mechanical type, solderless compression -two-bolt connection to ground bus bar.
 2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32 inch holes spaced 1-1/8 inches apart.
 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with ANSI Standard J-STD-607-A.

2.5 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers. Provide flexible nylon tape.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- D. Coordinate layout and installation of communications equipment with USF IT. Coordinate service entrance arrangement with USF IT.
 - 1. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
 - 2. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.2 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

Contractor Provided

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in [Section 27 05 44, Sleeves and Sleeve Seals for Communications Pathways and Cabling](#).

3.3 FIRESTOPPING

- A. Provide penetration Firestopping required at all rated assemblies.

3.4 GROUNDING

- A. Install grounding according to BICSI TDMM, Grounding, Bonding, and Electrical Protection chapter.
- B. Comply with ANSI Standard J-STD-607-A.
- C. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
 - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.
- B. Paint Fire-resistant plywood battleship gray. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A. Labels shall be preprinted or computer-printed type.

END OF SECTION 27 11 00

SECTION 27 11 10 COMMUNICATIONS ROOM BUILDING SPECIFICATIONS

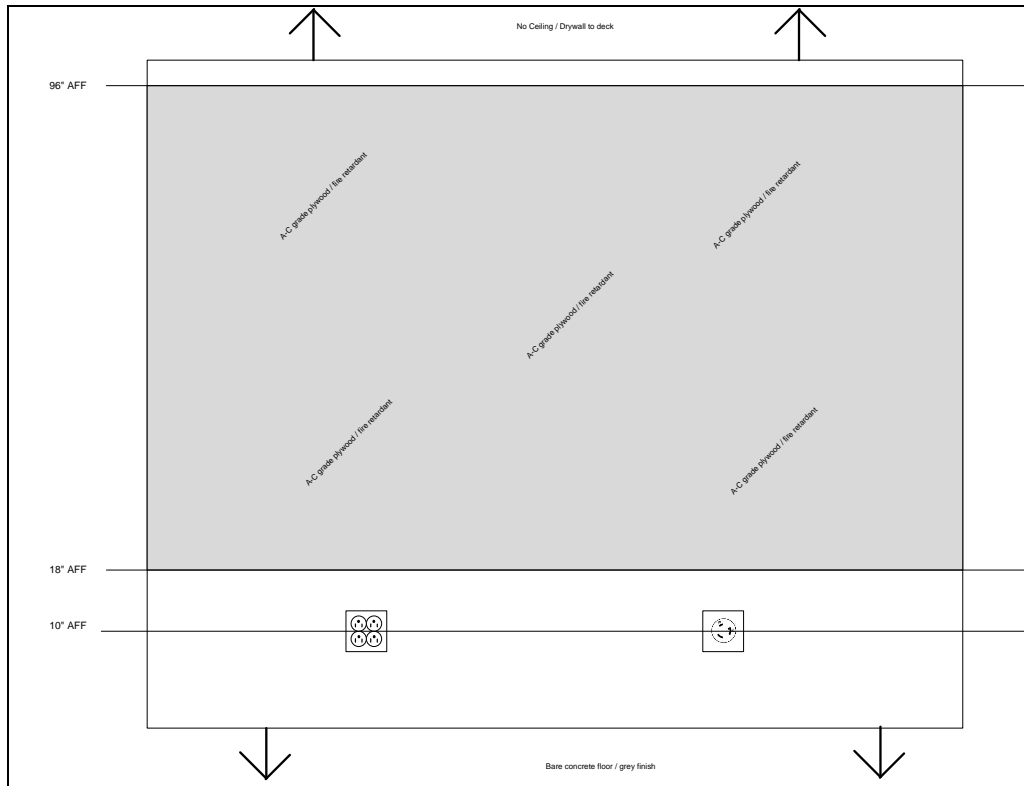
PART 1 - GENERAL

1.1 COMMUNICAITONS ROOMS

- A. Telecommunication Rooms (TRs) and Entrance Facilities (EFs)
 - 1. TRs and EFs provide voice and data services for both convenience and life safety. As a result, the USF requires that no equipment unrelated to these services be housed in this space. A/V amplifiers, fire panels, and all building control systems that may anticipate occupying any space within shall coordinate equipment footprint with IT before doing so. Pipes, conduits, cables, etc. that **MUST** pass through this space shall be coordinated with USF-IT relative to the path they follow.

1.2 INTERIOR

- A. Each TR and EF shall be fitted with plywood to wrap the entire room. Plywood specifications shall be a 3/4 inch AC grade plywood with a gray fire retardant finish.
- B. TR and EF floors shall be finished with sealed or painted concrete floors, color gray.
- C. TRs and EFs shall not be fitted with acoustical ceiling and shall contain finished walls from floor to deck above.



1.3 ENVIRONMENT

- A. Each TR and EF room shall **MAINTAIN** a maximum room temp of 74 degrees F after all equipment has been installed. Anticipated BTU's will be provided by USF IT to aid in calculating adequate cooling.
- B. TR and EF lighting shall satisfy a minimum illumination of 50 foot-candles measured 3 feet off the floor.
- C. TR and EF electrical outlets shall be included on emergency power if available.
- D. TR and EF floors shall have a distributed load rating of 250 lbs/SF.
- E. A fire extinguisher shall be in each TR and EF near the door.
- F. Water and sewer facilities shall not occupy any space within the TR and EF.

- G. Sprinkler pipes and cooling condensation installed in and through the TR and EF shall be installed with a drip pan below to funnel any leaking water or condensate away from racks and equipment.

1.4 ROOM SIZE

- A. TR and EF room sizes shall be calculated as such:
 1. Minimum size TR and EF serving a floor space up to 10,000 square feet shall be no less than 10 feet wide and have a depth no less than 10 feet with an out-swing door. (depth shall increase by 2 feet in the event the door cannot swing out due to egress requirements.)
 2. Minimum size TR and EF serving a floor space of 10,000 to 18,000 square feet shall be no less than 10 feet wide and have a depth no less than 12 feet with an out-swing door. (depth shall increase by 2 feet in the event the door cannot swing out due to egress requirements.)
 3. Minimum size TR and EF serving a floor space greater than 18,000 square feet shall be no less than 10 feet wide and have a depth no less than 14 feet with an out-swing door. (depth shall increase by 2 feet in the event the door cannot swing out due to egress requirements.)
 4. Structural building supports shall not be in the floor space of any TR or EF. If it must, minimum size measurements shall be taken from that point to the opposing wall.

1.5 CONDUITS & SLEEVES

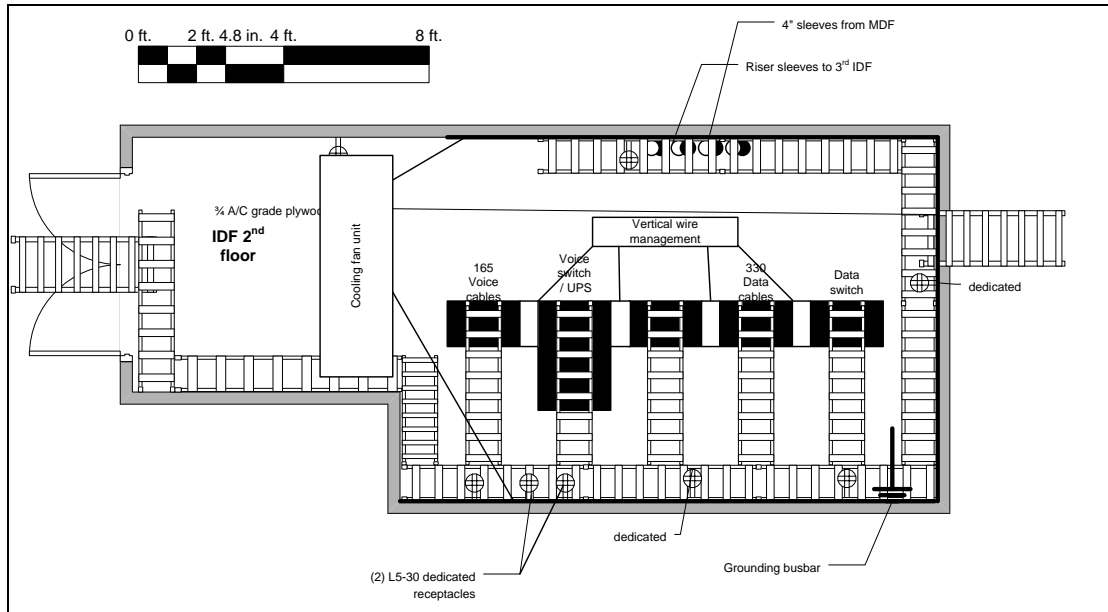
- A. EFs shall have a minimum of two (2) 4 inches conduits from nearest communications manhole. Conduits shall be fitted with plastic bushings and be clean and dry, clear of all debris, and contain a min 250 lbs test pull line.
- B. TRs and EFs shall contain a minimum of three (3) 4 inches sleeves between them. Conduits shall be fitted with plastic bushings and contain a pull string.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 DESIGN REVIEW

- A. USF IT will provide to design team room layouts for each designated TR and EF space similar to the one below.



END OF SECTION 27 11 00.10

SECTION 27 13 00 COMMUNICATIONS BACKBONE CABLING**PART 1 – GENERAL****1.1 USF General Design Requirements (reserved for future use)****1.2 SUMMARY**

- A. Section Includes:
 - 1. Pathways.
 - 2. UTP cable.
 - 3. 50/125, 62.5/125-micrometer, optical fiber cabling.
 - 4. Cable connecting hardware, patch panels, and cross-connects.
 - 5. Cabling identification products.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. BICSI ITSIM Standards: BCSI Information Transport System Installation Methods.
- C. BICSI TDMM Standards: BCSI Telecommunications Distribution Methods Manual.
- D. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- E. EIA: U.S. Energy Information Administration.
- F. EMI: Electromagnetic interference.
- G. IDC: Insulation displacement connector.
- H. LAN: Local area network.
- I. NECA: National Electrical Installation Standards.
- J. NRTL: Nationally Recognized Testing Laboratories.
- K. RCDD: Registered Communications Distribution Designer.
- L. UTP: Unshielded twisted pair.

1.4 BACKBONE CABLING DESCRIPTION

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

- A. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by USF-IT/Owner.
 - 2. Cabling administration drawings and printouts.
 - 3. Wiring diagrams to show typical wiring schematics including the following:
 - a. Cross-connects.
 - 4. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

1.7 CLOSEOUT SUBMITTALS

- A. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff. Owner may qualify installer under separate contract.
 - 1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field-testing program development by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of dedicated project manager who shall be always present when Work of this Section is performed at Project site.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- D. Grounding: Comply with ANSI-J-STD-607-A.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Advise USF-IT/Owner, minimum five working days' notice, when cables are on project site. Test cables, in the presence of USF-IT/Owner, upon receipt at Project site per BICSI ITSIM Standards.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 – PRODUCTS**2.1 PATHWAYS**

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
- C. Cable Trays: See Section 27 05 36, Cable Trays for Communications Systems.
- D. Conduit and Boxes: Comply with requirements in Section 26 05 33, Raceway and Boxes for Electrical Systems. Flexible metal conduit shall not be used.
 - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.2 BACKBOARDS

- A. Backboards: A/C Grade Plywood, fire-retardant treated, 3/4 inch x 48 inches x 96 inches.

2.3 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CommScope, Inc.

2. Mohawk; a division of Belden CDT
 3. Superior Essex Inc.
 4. OCC
 5. Hitachi
- B. Description: 100-ohm, 100 -pair UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 3. Comply with TIA/EIA-568-B.2, Category 5e, Category 6.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG, or CMP, CMR.
 - b. Communications, Plenum Rated: Type CMP complying with NFPA 262.
 - c. Communications, Riser Rated: Type CMR or CMP complying with UL 1666.

2.4 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
1. Hubbell Premise Wiring.
 2. Panduit Corp.
 3. Optical Cable Corporation, OCC
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
- D. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

2.5 OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Corning Cable Systems
 2. General Cable Technologies Corporation
 3. Hitachi
 4. Optical Cable Corporation, OCC
- B. Description: Multimode, 50/125 62.5/125-micrometer, fiber, nonconductive, tight buffer, optical fiber cable.
1. Comply with ICEA S-83-596 for mechanical properties.
 2. Comply with TIA/EIA-568-B.3 for performance specifications.
 3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. General Purpose, Nonconductive: Type OFN or OFNG, or OFNR, OFNP.
 - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - c. Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.
 - d. General Purpose, Conductive: Type OFC or OFCC; or OFNG, OFN, OFNR, OFNR, OFCP, or OFNP.
 - e. Plenum Rated, Conductive: Type OFCP or OFNP, complying with NFPA 262.
 - f. Riser Rated, Conductive: Type OFCR; or OFNR, OFCP, or OFNP, complying with UL 1666.
 4. Conductive cable shall be steel armored type.
 5. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm per link.
 6. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- C. Jacket:
1. Jacket Color: Aqua for 50/125-micrometer cable Orange for 62.5/125-micrometer cable.
 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.

3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.6 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Corning Cable Systems
 2. Hitachi
 3. OCC
 4. General Cable
- B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
- C. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.
- D. Cable Connecting Hardware:
 1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 2. Quick-connect, simplex and duplex, Type SC, Type ST, Type LC connectors. Insertion loss not more than 0.75 dB.
 3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 COAXIAL CABLE

- A. See [Section 27 41 00, Common work results for Audio-Visual Systems](#)

2.8 COAXIAL CABLE HARDWARE

- A. See [Section 27 41 00, Common work results for Audio-Visual Systems](#)

2.9 GROUNDING

- A. Comply with requirements in See [Section 26 05 26, Grounding and Bonding for Electrical Systems](#) for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.10 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.11 SOURCE QUALITY CONTROL

- A. Cable will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 2. Comply with requirements for raceways and boxes specified in [Section 26 05 33, Raceway and Boxes for Electrical Systems](#).
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.
- B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in [Section 26 05 33, Raceway and Boxes for Electrical Systems](#) for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- E. Pathway Installation within Communications Equipment Rooms may be supplied and installed by Owner provided Vendor.
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 6 inches above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.
 - 1. Installed per Owner provided layout, 27-02.

3.4 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, Cable Termination Practices.
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, Cabling Termination Practices chapter. Use lacing bars and distribution spools.
 - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - 10. In the communications equipment room, install a 10 feet long service loop on each end of cable.
 - 11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, Pulling Cable monitor cable pull tensions.
- C. UTP Cable Installation:
 - 1. Comply with TIA/EIA-568-B.2.
 - 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
 - 1. Comply with TIA/EIA-568-B.3.
 - 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

- E. Open-Cable Installation:
 - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 - 2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
 - 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Installation of Cable Routed Exposed under Raised Floors:
 - 1. Install plenum-rated cable only.
 - 2. Install cabling after the flooring system has been installed in raised floor areas.
 - 3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.
- G. Group connecting hardware for cables into separate logical fields.
- H. Separation from EMI Sources:
 - 1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 - 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 - 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 - 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
 - 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 6 inches.

3.5 FIRESTOPPING

- A. Provide penetration Firestopping through all rated assemblies.
- B. Comply with TIA/EIA-569-A, Annex A, Firestopping
- C. Comply with BICSI TDMM, Firestopping Systems article.

3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, Grounding, Bonding, and Electrical Protection chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 26 05 53, Identification for Electrical Systems.
 - 1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Paint Fire-resistant plywood battleship gray: For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A.
- D. 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.
- E. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 - 3. Supplied by Owner provided Vendor - identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
 - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

- A. By Owner.

END OF SECTION 27 13 00

SECTION 27 15 00 COMMUNICATIONS HORIZONTAL CABLING**PART 1 – GENERAL****1.1 USF GENERAL REQUIREMENTS**

(reserved for future use)

1.2 SUMMARY

- A. Section Includes:
 - 1. UTP cabling.
 - 2. 50/125 62.5/125-micrometer, optical fiber cabling.
 - 3. Multiuser telecommunications outlet assemblies.
 - 4. Cable connecting hardware, patch panels, and cross-connects.
 - 5. Telecommunications outlet/connectors.
 - 6. Cabling system identification products.
 - 7. Cable management system.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector.
- F. LAN: Local area network.
- G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- I. RCDD: Registered Communications Distribution Designer.
- J. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.5 ACTION SUBMITTALS

- A. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. Cabling administration drawings and printouts.
 - 3. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff. Owner may qualify installer under separate contract.
 - 1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field-testing program development by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of a dedicated project manager who shall be always present when Work of this Section is performed at Project site.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Advise USF-IT/Owner, minimum five working days' notice, when cables are on project site. Test cables, in the presence of USF-IT/Owner, upon receipt at Project site per BICSI ITSIM Standards.

PART 2 – PRODUCTS

2.1 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
 - 1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
 - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
 - 4. Splitters shall not be installed as part of the optical fiber cabling.
- B. A work area is approximately 100 sq ft and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Grounding: Comply with J-STD-607-A.

2.3 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 inch x 48 inches x 96 inches.

2.4 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
 - 1. Hitachi
 - 2. General
 - 3. OCC

- B. Description: 100-ohm, four-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 3. Comply with TIA/EIA-568-B.2, Category 6.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

2.5 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
1. Hitachi
 2. General
 3. OCC

2.6 OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
1. Corning Cable Systems
 2. General Cable Technologies Corporation
 3. Hitachi
 4. Optical Cable Corporation (OCC)
- B. Description: Multimode, 50/125 62.5/125-micrometer, 24-fiber, nonconductive, tight buffer, optical fiber cable.
1. Comply with ICEA S-83-596 for mechanical properties.
 2. Comply with TIA/EIA-568-B.3 for performance specifications.
 3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. General Purpose, Nonconductive: Type OFN or OFNG, or OFNR, OFNP.
 - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - c. Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.
 - d. General Purpose, Conductive: Type OFC or OFCC; or OFNG, OFN, OFCC, OFNR, OFCC, or OFNP.
 - e. Plenum Rated, Conductive: Type OFCC or OFNP, complying with NFPA 2 Riser Rated, Conductive: Type OFCC; or OFNR, OFCC, or OFNP, complying with UL 1666.
 4. Conductive cable shall be steel armored type.
 5. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
 6. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- C. Jacket:
1. Jacket Color: Aqua for 50/125-micrometer cable Orange for 62.5/125-micrometer cable.
 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.7 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
1. Corning Cable Systems
 2. General Cable Technologies Corporation
 3. Hitachi
 4. Optical Cable Corporation (OCC)
- B. Cable Connecting Hardware:
1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 2. Quick-connect, simplex and duplex, Type SC for single mode Type ST for 62.5 multi-mode Type LC for 50 multi-mode connectors. Insertion loss not more than 0.75 dB.

3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.8 COAXIAL CABLE

- A. See [Section 27 41 00, Common work results for Audio-Visual Systems](#)

2.9 COAXIAL CABLE HARDWARE

- A. See [Section 27 41 00, Common work results for Audio-Visual Systems](#)

2.10 CONSOLIDATION POINTS

- A. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
 1. [Chatsworth Products, Inc.](#)
 2. [Panduit Corp.](#)
 3. [OCC](#)
- B. Description: Consolidation points shall comply with requirements for cable connecting hardware.
 1. Mounting: Coordinate with USF IT.
 2. [NRTL](#) listed as complying with [UL 50](#) and [UL 1863](#).
 3. When installed in plenums used for environmental air, [NRTL](#) listed as complying with [UL 2043](#).

2.11 MULTIUSER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

- A. Manufacturers: Subject to compliance with requirements, product by one of the following:
 1. [Chatsworth Products, Inc.](#)
 2. [Hubbell Premise Wiring](#)
 3. [Panduit Corp.](#)
 4. [OCC](#)
- B. Description: MUTOAs shall meet the requirements for cable connecting hardware.
 1. Mounting: Coordinate with USF IT.
 2. [NRTL](#) listed as complying with [UL 50](#) and [UL 1863](#).
 3. Label shall include maximum length of work area cords, based on [TIA/EIA-568-B.1](#).
 4. When installed in plenums used for environmental air, [NRTL](#) listed as complying with [UL 2043](#).

2.12 TELECOMMUNICATIONS OUTLET/CONNECTORS JACKS: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with [TIA/EIA-568-B.1](#).

- A. Workstation Outlets: 3-port-connector assemblies mounted in single or multigang faceplate.
 1. Plastic Faceplate: High-impact plastic. Coordinate color with [Section 26 27 26, Wiring Devices](#).
 2. Metal Faceplate: Stainless steel, complying with requirements in [Section 26 27 26, Wiring Devices](#).
 3. For use with snap-in jacks accommodating, any combination of UTP, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
 4. Legend: Machine printed, in the field, using adhesive-tape label.

2.13 GROUNDING

- A. Comply with requirements in [Section 26 05 26 Grounding and Bonding for Electrical Systems](#) for grounding conductors and connectors.
- B. Comply with [J-STD-607-A](#).

2.14 IDENTIFICATION PRODUCTS

- A. Comply with [TIA/EIA-606-A](#) and [UL 969](#) for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.15 CABLE MANAGEMENT SYSTEM

- A. Manufacturers: Subject to compliance with requirements, product by one of the following:
 - 1. Panduit
 - 2. OCC
 - 3. Chatworth
- B. Description: Computer-based cable management system, with integrated database and graphic capabilities.
- C. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.
- D. System shall interface with the following testing and recording devices:
 - 1. Direct upload tests from circuit testing instrument into the personal computer.
 - 2. Direct download circuit labeling into labeling printer.

PART 3 – EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements in [Section 27 05 36, Cable Trays for Communications Systems](#).
- B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures:
 - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
 - 2. Install lacing bars and distribution spools.
 - 3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, Cable Termination Practices.
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. MUTOA shall not be used as a cross-connect point.
 - 5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for UTP at least 49 feet from communications equipment room.
 - 6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, Cabling Termination Practices chapter. Install lacing bars and distribution spools.

10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
12. In the communications equipment room, install a 10-feet long service loop on each end of cable.
13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, Pulling Cable monitor cable pull tensions.
- C. UTP Cable Installation:
 1. Comply with TIA/EIA-568-B.2.
 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
 1. Comply with TIA/EIA-568-B.3.
 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- E. Open-Cable Installation:
 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Installation of Cable Routed Exposed under Raised Floors:
 1. Install plenum-rated cable only.
 2. Install cabling after the flooring system has been installed in raised floor areas.
 3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.
- G. Outdoor Coaxial Cable Installation: (See [Section 27 41 00, Common work results for Audio-Visual Systems](#))
- H. Group connecting hardware for cables into separate logical fields.
- I. Separation from EMI Sources:
 1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 12 inches.

3.4 FIRESTOPPING

- A. Provide penetration Firestopping through all rated assemblies.

- B. Comply with TIA-569-B, Annex A, Firestopping.
- C. Comply with BICSI TDMM, Firestopping Systems article.

3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, Grounding, Bonding, and Electrical Protection chapter.
- B. Comply with J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2 inches clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 26 05 53, Identification for Electrical Systems.
 - 1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Paint Fire-resistant plywood battle ship gray: For fire-resistant plywood, do not paint over manufacturer's label.
- C. Cable Schedule: Post in 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.
- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- E. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 - 3. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 - 4. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
 - 1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

- A. By Owner.

END OF SECTION 27 15 00

SECTION 27 41 00 COMMON WORK RESULTS FOR AUDIO/VISUAL SYSTEMS
PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. General: The General Requirements, Conditions of the Contract, these sections of the USF Design & Construction Guidelines (DCG), Drawings, Addenda and Contract Modifications (the Contract Documents), and definitions of legal entity (such as Contract, Installer, Engineer, Owner, etc.) shall apply to the work described herein.
- B. Supplemental: Refer to the sections identified below for additional requirements, which are supplemented by this section.

Section	Title
27 00 10	TECHNOLOGY GENERAL PROVISIONS
27 05 28	PATHWAYS FOR COMMUNICATION SYSTEMS
27 10 00	STRUCTURED CABLING SYSTEM
27 05 26	GROUNDING & BONDING FOR COMMUNICATIONS SYSTEMS

1.2 USF POINT OF CONTACT

- A. General: All USF projects that include Audio Visual systems will have a Project Manager assigned by Information Technology - Audio Visual Engineering and Systems (AVES), who will provide detailed requirements and specifications for all phases of said systems. All information provided in this document should be considered for preliminary bid preparation and general guidelines only.

1.3 SCOPE OF WORK (SOW)

- A. General: Refer to the requirements of the related documents identified in [Subparagraph 1.1, Related Documents](#) above, for scope of work requirements, which are supplemented by this section. This shall constitute the basis for the “Scope of Work” for this section.
- B. The following are the list of standard systems considered audiovisual systems:
1. Classrooms for less than fifty (50) students.
 2. Auditoriums for more than two hundred (200) students.
 3. Conference rooms
 4. Video Teleconference Systems (VTC)
 5. Public Information Display Systems (Digital Signage).
- C. Non-standard audiovisual systems include but are not limited to:
1. Classrooms with a capacity of 51-199 students.
 2. Collaboration Rooms
- Any designers or AVS installers involved with a USF project that includes non-standard audiovisual systems are strongly encouraged to consult with AVES before starting work on these systems.
- D. For designers or consultants: The scope of work for designers or consultants shall include to a minimum the following tasks:
1. Define system functionality, configuration and features per user’s requirements.
 2. Establish preliminary project budgets based on the user requirements.
 3. Establish a responsibility matrix indicating who is providing the different components of the system.
 4. Provide architectural considerations related to AV systems for the spaces to the project architect. These recommendations shall include room layout, lighting and acoustics.
 5. Provide design drawings and specifications based on the information previously collected for the project.
 6. Assist the owner or construction manager in the bid process by checking installer’s qualifications and equipment list provided by the bidders.
 7. Establishing the scope of work for the installer and composing the complete set of bid documents (design drawings and specifications).
 8. Review shop drawings and answer RFIs
 9. Test the system with the installer after completion and verify close-out information.

- E. For installers: The scope of work for the AVS installer shall include, but not limited to the following tasks:
1. Preparation of shop drawings, submittals, training and as-built information for the system.
 2. Procurement, installation and warranty of all AVS hardware like flat panel displays, mounts for displays, signal transceivers, players, switchers, servers, etc.
 3. Procurement, installation and warranty of all AVS cabling and wiring, including support system, and fire stopping for all low voltage cabling part of the AVS.
 4. Programming labor of the AVS, including initial software set up, software registration, and initial data input, unless otherwise noted in a specific specification section.
 5. 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:

1.4 ARCHITECTURAL CONSIDERATIONS

- A. General. AVS designers shall provide architectural recommendations for this type of rooms in the project. These recommendations shall include room layout, lighting and acoustics.
- B. Program Display:
1. Screen sizing. Screen height shall be estimated as 1/6 of the distance to the least favored viewer (LFV) or the worst seat in the room. The bottom of the screen reflecting surface shall not be lower than 4 feet for non-tiered rooms. The top of the reflecting surface should be at least 2 inches below the lowest device in the ceiling structure (light fixture, sprinkler head, or diffuser). Every effort shall be made to have ceiling heights that allow the screen sizes described above. Rooms where the ratio between the screen height to the LFV is lower than 1/10 are dimmed non-usable for teaching purposes.
 2. Usable seating area per screen. Usable seating area for a screen shall be defined as the area between two 45° lines on the sides, one line parallel and close to the screen and one circular sector far from the screen. The angle is measured from a perpendicular line to the screen axis from the edge of the screen. The line parallel and close to the screen shall be separated from the screen 0.5 times the screen's reflecting surface width. The circular sector has a center in the center of the screen and a radius equal to the distance to the LFV limitation. Any room seats outside of the usable seating area shall be supported with additional display devices. All seats in the audience shall have a line of sight of a program display.
 3. Projector location. AVS designers or installer shall estimate throw distance and locate the optimal projector location that allows having the lens of the projector at midpoint in the zoom adjustment washing out completely the selected screen. The AVS designer or installer shall coordinate with other trades to avoid interference with other building systems at this location. All projectors for shall be ceiling hung where possible. In drop ceilings, a projector ceiling plate that replaces a 2 feet x 2 feet ceiling tile, installed per manufacturer's recommendation, is preferred. At all projector locations 4 electrical outlets should be provided.
 4. Screen quantity: In classrooms only one screen is required; in auditoriums two screens are preferred.
 5. In Conference Rooms, the preferred display is a single monitor no smaller than 55 inches. A front projection system shall only be used in conference rooms if the LFV rule is not being met with a large flat panel display available and project viable (budget).
- C. Lighting:
1. General. Ideally there needs to be a contrast ratio in the screen of at least 10 for good visual presentation. Contrast ratio shall be estimated as the difference between the average light hitting the screen when the projector is displaying a white screen to the average light hitting the screen when the lights in the room are in presentation mode, and the projector is off. Average light hitting the screen when the projector is displaying a white screen shall be estimated as the rated lumen output of the projector divided by the area of the screen in square ft. Architects and lighting designers shall make every effort to comply with the requirements for contrast.
 2. Classroom lighting: Dimmable lights are not required in classrooms, but two-level lighting is recommended. To obtain the two levels 1/2 or 1/3 of the lamps in each fixture shall be

- controlled separately. At a minimum there needs to be two control circuits for all the light fixtures in the room, the light fixtures closest to the screen shall be on a separate switch from the rest of the fixtures in the room, so they can be turned off during presentation mode, but the remaining lights can be left on.
3. Auditorium lighting: A software model of the lights is highly recommended for auditoriums to verify lighting levels in aisles and on projection screens. The use of a centralized dimming system and/or integration with the AV media control system is highly recommended. The light fixtures selected by designers shall address the following scenarios:
 - a. Clean-up or service lights, with 2x4 fluorescents or other high lumen output fixtures, non-dimmable.
 - b. Dimmable down lights for notes or setting different scenes.
 - c. Stage lights for presenters and performers.
 - d. Step lights, for safety purposes at all steps.
 - e. For performing theaters or large auditoriums the use of a DMX system for stage lighting is recommended.
 4. Conference Room lighting: No special considerations are required for lighting a conference room with a monitor, with the exception of avoiding locating the display devices on a wall that is subject to direct sun light. Where projectors are used, follow guidelines listed above for classroom lighting.
 5. Video Teleconference lighting: Room shall be layout with fixtures designed specifically for TVC. These fixtures are recessed fluorescent fixtures with a reflector shaped to reproduce an effect similar to studio lights. These fixtures throw light at a 45° angle, rather than straight down. It is suggested to position them so that each is mounted far enough in front of a seating position that the angled light falls on the occupant's face, and spaced so that there is a fixture at about 45° to each side of user. These fixtures are not required to be dimmable but are recommended to have 2 levels at least. No specific zoning is required also, a single zone is sufficient. For larger rooms different types of lights shall be provided depending on the room layout and size of the conference table. The designers shall indicate what other type of lights are required for these rooms. Additional lights shall have the same color temperature as the VTC lighting. For the area covering the conference table the following additional lighting requirements shall be followed: There shall be no more than a 10:1 contrast between the lightest and darkest areas in the room – and no more than a 1.5 to 1 contrast between the overall illumination on one person's face and the next. The light levels in the participant's face shall be between 30 to 50 foot-candles. Lamps on these fixtures shall have a color temperature between 3000 - 3500° K and a CRI of 80 or above.
 6. Ambient lighting. For all rooms with front projection systems, ambient light shall be able to be controlled by using black out shades. Shades can have additional fabrics (25% or 50%) to dim lights, but those fabrics are not required for the AVS. Full blackout shades are the only required fabric for the AVS. Additional fabrics shall be confirmed with the program manager. If the shades are electric, they shall be interfaced with the AVS, and all shades in one room shall be able to be controlled as a single unit.
- D. Acoustical considerations:
1. Classrooms do not require any special acoustical considerations except for the regular considerations for privacy between adjacent classrooms. Ceiling-mounted speakers for program audio only.
 2. Auditoriums require special acoustical considerations. Sound modeling is highly recommended as well as acoustic treatment for walls and ceilings. Program speakers separated from voice reinforcement speakers preferred.
 3. Conference Rooms will use only program speakers, typically built-in or as an accessory to a flat panel display.
- E. Floor boxes. Floor box location for teaching lecterns and conference tables shall be carefully selected. Architects and designers shall precisely dimension the location of the boxes to avoid misinterpretation by installers. Location of floor boxes for conference tables shall be as close as possible to one of the table's legs to conceal the cables coming up to the interface plate.

- F. Furniture:
1. Lecterns. Lecterns intended to have AV equipment installed inside shall allow for at least 14 RU of rack space. Lecterns shall be no less than 24 inches deep clear inside. Lecterns shall have rear access panels no smaller than the full width and height of the rack rails inside, front doors, side flip-up ADA shelf, casters, front and rear rack rails. Doors and panels shall be lockable. Lecterns shall have ventilation panels to avoid equipment overheating.
 2. AV Racks. In any space that does not contain a lectern, it is preferred to mount AV equipment in a regular freestanding rack (wall mounted rack or an AV designed credenza with rack rails). USF IT department does not recommend mounting equipment inside casework, but if absolutely required by the program of the project, casework shall be able to hold no less than 14 RU of equipment, be 24 inches deep inside clear and designed to avoid overheating of equipment by providing ventilation with fans and feature a slide-out rack for maintaining equipment.
 3. Tables. For conference rooms, it is highly recommended to use table shapes suitable for videoconference systems. Those table shapes include “V” shapes or “C” shapes. These shapes improve visibility of all participants in the video conference system. Avoid as much as possible tables with rectangular form. Tables should be able to support the installation of media control panels and interface plates.
- G. AV rooms/booths are preferred for Auditoriums only. Preferably located in the back of the room and with a view of the stage or front of room. When the program requires the use of a green room, communication between the AV room and the green room shall be installed as well as an audio and video feed from the stage or front of the room.
- H. Tiered Floor Seating. Tier seating is highly recommended in Auditoriums. Classrooms and Conference Rooms do not require tiered seating.

1.5 DESIGNER QUALIFICATIONS

- A. General. At a minimum the designer or consultants responsible for the audiovisual design shall be company regularly engaged in the design of audiovisual system for at least the past five (5) years. Designer or consultants working on USF projects shall have as a minimum a Certified Technology Specialist (CTS) designation by AVIXA. It is highly recommended the designer or consultants also have a CTS-D certification by AVIXA. Proof of current certification shall be provided to USF IT department for confirmation.

1.6 INSTALLER QUALIFICATIONS

- A. Installer Qualifications: The Installer or Installers directly responsible for the work associated with any of the audiovisual systems (also references hereinafter as AVS) shall be a licensed and registered contractor who is, and who has been, regularly engaged in providing the installation of audiovisual systems of similar size and complexity for at least the immediate past five (5) years.
- B. Project manager requirements: The project manager for each company participating in the installation of the AVS shall be a Certified Technology Specialist (CTS) by AVIXA. Proof of current certification shall be provided with the submittal.
- C. Programmer-Installer: The AVS installers shall have a factory-trained programmer/installer, for the provided Project products, in full-time employment, as part of the Installer's staff. AVS installers shall provide certificates of completion of training for the staff that will be taking part in the execution of this project.
- D. Qualification Documentation: The Installer shall provide the following documentation with their bid package, as evidence that the requirements for the Installer qualifications have been satisfied:
1. A list of not less than five (5) references for jobs of similar size and complexity including:
 - a. Project Names
 - b. Locations
 - c. Contact Names
 - d. Contact Telephone Numbers

2. Location (specific street address) of the office from which this installation and warranty work will be performed. It is preferred that the Installer has established and maintains a permanent office within 150 miles of the project site.
3. Copies of Manufacturer certification certificates. It is required that the Installer possess the following certifications, at a minimum:
 - a. Crestron certified installer
 - b. Crestron DM-E
 - c. Extron certified installer
 - d. Symetrix certified programmer
 - e. Clearone certified installer.
 - f. Cisco certified installer
4. Copies of Licensure certificates.
5. Copies of Insurance and Bonding certificates.

1.7 SUBMITTALS

- A. General: The AVS installers shall prepare submittals during different stages of the construction process. This is the list of required documentation for each stage:
- B. START OF PROJECT SUBMITTALS: A maximum of 60 days after the AVS installers receives a notice to proceed on the project, but no sooner than a year before substantial completion, the following information needs to be submitted:
 1. Cut sheets with all specifications of all cables and connectors to be used in the project.
 2. One-line diagrams with all devices included in the systems separating power, video, audio and control. Each system in a different sheet.
 3. User interface and faceplate color submittal. The AVS installers shall prepare a separate submittal with the shape and color of all user interface plates to be approved by the Architect of the project or the Owner.
 4. Proposed construction details for any custom fabricated items or finishes, including speaker rigging, large display mounting, etc. These details shall include dimensions, materials, finishes and colors.
 5. List of all IP addresses needed for the AVS.
 6. Rack elevations of all AV equipment for all rooms in the project.
 7. Conduit rough-in requirements of all wall and ceiling mounted devices for all equipment part of the PS system.
 8. Standard service agreement contractor provided by the AVS installer including yearly cost.
- C. CONSTRUCTION SUBMITTALS: During the construction process the AVS installers shall submit different information to get approval on continuing with the installation process. The AVS installer shall submittal the following information:
 1. Before starting the programming process the AVS installers need to provide the following information:
 - a. A schematic presentation of the layout of all the user interfaces in the project and screen shoots. The AVS installers need to get approval of this submittal before starting any programming.
 - b. Meeting minutes from all project plans between the Owner and the AVS installers.
 2. Any design changes whether originated by the Owner, Designer or by the AVS installers as a VE suggestions need to follow the same submittal process described in the previous paragraph for all equipment involved on the change.
 3. Thirty (30) days before starting the training sessions the AVS installers need to provide the following information:
 - a. A detailed training chronogram indicating all training sessions requested in this section.
 - b. An outline of the training sessions.
 - c. Samples of the training manuals for each session.
- D. NO SUBMITTAL: Failure to comply with all the submittals listed above and getting the proper approval from the Owner and the Design Engineer for each submittal will cause the AVS installers to replace installed unapproved equipment at no additional cost to the Owner.

1.8 PROJECT SPECIFIC SOURCE CODE OWNERSHIP

- A. Definition of project specific source code: Project specific source code includes all source code created to generate an executable file to be intended to run in any equipment used in the installation of the AVS. Examples of project specific source code include source code used to generate executable files for control processors, DSP processors and touch panels. Project specific source code does not include source code used to create programming tools and compilers or source code used to generate operating systems or application programs running in PC based workstations.
- B. Ownership: Any project specific source code used in this project shall remain the exclusive property of the USF. By accepting the contract to perform the work included in this project, the AVS installer or designer (and any other companies working creating project specific code during this project) relinquish the right of ownership of this source code and waive any licensing fees or royalties for the use of source code by USF (or any company authorized by the owner to perform changes in the source code after the project is substantially completed).

PART 2 – EQUIPMENT

2.1 EQUIPMENT SPECIFIED

- A. Specific equipment: Where design drawings indicate a specific manufacturer and model number for a piece of audiovisual equipment, the AVS installers shall provide the same device as indicated. Substitutions for this type of equipment are not acceptable.
- B. Non-specific equipment: When the design drawings do not indicate a specific manufacturer and model number, the AVS installers are free select any equipment that meets the minimum specifications indicated in this section. However, AVS installers must submit the manufacturer and model selected as part of the submittal process, and USF retains the right to approve all selections.
- C. Note to designer or consultants: USF maintains a specific list of equipment that is required for AV projects. Since this list changes frequently as technology advances, designers should check with USF IT AVES for the current list of equipment.

2.2 SYSTEM FUNCTIONS

- A. SYSTEM SIGNALS FOR ALL SYSTEMS
 - 1. General: The completed systems shall be capable of receiving, processing, routing and distributing the associated signals, as indicated in the functionality description for each system.
 - 2. Audio systems will have full range frequency response 100 Hz to 18 kHz at a level of at least 60 dB above the ambient noise floor with a Total Harmonic Distortion (THD) of less than .5%.
 - 3. Analog video signals through the system shall be maintained to the minimum quality requirements as follows:
 - a. The system shall provide a signal response of 0.7 Vpp (nominal) @ 300 Mhz RGB, throughout the system channel, for all visual content.
 - 4. Digital video signals through the system shall be capable of delivering 1920 x 1080 resolutions at 24 fps from end to end.
 - 5. Control signals through the system shall be maintained to the minimum level established by the control equipment manufacturer for the control protocol utilized. This level shall be correct at all connection points in the system.
- B. REMOTE ASSET MANAGEMENT SOFTWARE
 - 1. General: The Remote Asset Management Software selected by USF for all projects is Crestron Fusion. When referenced in the contract documents within the room functionality, Fusion shall be able to provide the functionality described in these paragraphs.
 - 2. Programmers of Crestron system using Crestron SIMPL Windows shall follow the IDs referenced herein for programming:
 - a. Touchpanel IP ID = 03
 - b. Xpanel control = 04
 - c. Fusion ID = 06
 - d. Cresnet Occupancy Sensor = 10

3. At a minimum all AVS with control processors shall have the following monitoring features through Fusion:
 - a. Laptop connection plate video source usage: start time, stop time and cumulative use.
 - b. Document camera usage: start time, stop time and cumulative use.
 - c. Projector lamp usage hours.
 - d. UPS monitoring, including automatic start, battery test and status, and internal temperature.
 4. At a minimum all AVS with control processors shall provide the following alarms:
 - a. Projector in video mute for more than 1 hour.
 - b. Projector turned off (not on stand-by).
 - c. Projector lamp approaching 85% of estimated lifetime.
 - d. Projector lamp bad (if reported by projector)
 5. Additional software customization: The AVS installers shall customize the user interface of Fusion according to the project specific requirements. The AVS installers shall meet with the Owner and Design engineer during the construction process and agree on the additional features that will be used by the owner on the project. Once this step is completed, the AVS installers shall program the Fusion interface based on the conclusions of that meeting.
 6. Training: The AVS installers shall provide administration level training for specific Fusion features programmed during a project.
 7. Delivery: The AVS installers shall provide USF electronic copies of all programs in executable and source code format. Each file shall be properly labeled with the room description and the room number.
- C. OWNER FURNISHED EQUIPMENT (OFE)
1. General: When indicated in the drawings the AVS installers shall interface with equipment provided by the owner or by third parties. Refer to the design drawings for audio, video and control lines required for OFE.
 2. Scope of work: It is in the scope of work of the AVS installers to run, terminate and connect the audio, video and control lines to OFE as shown in the design drawings. When control lines are indicated in the design drawings, the AVS installers shall program all control features described in each system functions per controllable room, including all features related to owner provided equipment or third-party equipment.

2.3 WIRE, CABLE, CONNECTORS, AND ACCESSORIES

- A. General: The AVS installers shall provide the system components and materials necessary to properly install, support, and terminate all audiovisual cabling. The AVS installers shall coordinate with the installer of the raceway system final locations of all outlet boxes. The AVS installers shall also provide and attach all required cable connectors. Label all cable with source and destination.
- B. Cable: The AVS installers shall provide all cabling associated with, and required to, provide a complete, operable system in accordance with the Contract Documents. All cable provided by the AVS installers shall be of a manufacture and quality consistent with the design intent, and shall be reviewed by the Engineer prior to installation.
- C. Cabling in air handling spaces. The AVS installers shall provide cables with plenum rated jackets (CMP) for all cables run above ceiling spaces. For all cables run in vertical shafts or conduits, the AVS shall provide riser rated cables (CL2).
- D. Cabling below grade: When cable part of the AVS have to be run in conduits below slab and grade level, the AVS installers shall use only cables with water-blocking jackets.
- E. Cable signals: The following is a list of signal types and the cables to be used for those signals:
 1. Line level audio signal cable: Provide one (1) twisted pair cable for mono signals and two (2) 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.
 2. Microphone level audio signal cable: Provide one (1) twisted pair cable, 22 AWG stranded (7x28) tinned copper conductors, overall foil shield (100% coverage) with a 22 AWG stranded tinned copper drain wire.

3. Serial Digital video cable: Provide one (1) RG-6 coaxial cable, 18 AWG solid. Characteristic impedance 75Ω.
 4. Control cable (i.e. Crestron CRESNET): Provide one (1) cable with one (1) twisted pair 22 AWG stranded copper conductors with overall aluminum foil (100% coverage) and a 24 AWG tinned copper drain wire, and one (1) unshielded twisted pair, 18 AWG stranded bare copper conductors.
 5. Control cable (i.e. RS-232, RS-485 Signal, IR or Contact Closure): Provide one (1) 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. Digital video, audio and control over twisted pair. Provide one or two cables UTP or STP as required by transceiver equipment manufacturer to ensure the digital signal is transported properly up to 328 feet, at maximum resolution indicated in [Subparagraph 2.01, System Functions](#) above. If equipment manufacturer supports the use of UTP Category (5e, 6 or 6A) for this application, the AVS installers shall provide cables in compliance with [Section 27 10 00, Structured Cabling System](#) and all cables part of the AVS. Color jacket for these cables shall be blue.
 7. UTP Category cables. Provide UTP Category cables for all Ethernet connection part of the AVS as indicated in [Section 27 10 00](#), including horizontal cables, patch cords and station cables. All cables part of the AVS shall be included in the same warranty as all cables provided under [Section 27 10 00](#). Color jacket for these cables shall be blue.
 8. Speaker Cable: Provide two (2) 16 AWG stranded conductors, with overall jacket.
 9. HDMI Cables. HDMI cables may be no longer than 10 meters (32.8 feet) and meet attached equipment manufacturer's specifications.
- F. Connectors and plates: The AVS installers shall provide connectors and plates to terminate all wiring part of the AVS, regardless of if indicated on the design drawings. As a general guideline, the AVS installers shall follow these recommendations:
1. Compression type connectors on BNC cables.
 2. When custom panels or plates are required in the project, the AVS installers shall submit detail drawings of all plates for approval by the Design Engineer.
 3. All termination of UTP Category (5e, 6 or 6A) cables shall be done in accordance to [Section 27 10 00](#).

2.4 DEDICATED COMPUTERS FOR AV SYSTEMS

- A. General: All computers will be provided by USF, except where a computer is built-in to a device (such as an annotation-capable monitor). In that instance, full computer specifications shall be submitted to USF Information Technology for vetting. A demo computer may be required before USF IT provides approval.

2.5 BLU-RAY PLAYERS

- A. General: The Blu-ray player shall have the following specifications:
1. Capable of up-scaling DVDs to 1080P format
 2. DVD formats accepted: DVD+R/+RW/-R/-RW
 3. Blu-ray disk reading compatibility: BD-ROM, BD-R, BD-RE
 4. Control: RS-232 preferred, IR acceptable.
 5. Outputs: one (1) HDM1 1.3, analog audio (L/R)
 6. HDCP Keys supported: No less than 16 keys for HDCP protected content.
- B. HDCP Keys: Since the number of HDCP keys varies from model number to model and are often not disclosed in equipment spec sheets, it is the AVS installer's responsibility to check that the number of keys supported by the unit submitted complies with this section. Approval by the A/E of a specific non-compliant unit during the shop drawing review process does not relieve the AVS installers of the responsibility of providing a compliant unit at no additional cost to the project.
- C. Accepted manufacturers: Sony, Panasonic, Samsung, Philips or similar.

2.6 NETWORKING EQUIPMENT

- A. General: All networking equipment required for the AVS shall be provided by USF unless otherwise noted in the design documents.
- B. Interfacing: When connecting computers and AV components to the USF network, the following order should be employed (jacks are numbered left to right then top to bottom):
 - 1. Computer
 - 2. Media Control Processor
 - 3. User Interface (touch panel)
 - 4. Accessory 1 (i.e. wireless connection device).
 - 5. Accessory 2
 - 6. Accessory 3
- C. Cabling: Use yellow CAT6 patch cables for computers, blue CAT6 patch cables for media control devices.

2.7 CLASSROOM CAPTURE SYSTEMS

- A. General: Currently USF used the software Panopto for classroom capture. The software is currently set up with two channels, one for a camera inside the classroom, and one for content from any source in the podium. Selection of different sources by the presenter shall follow the channel being recorded by the capture PC.
- B. NOTE TO DESIGNERS OR CONSULTANTS: During the program phase of the project the designer or consultant shall clarify with the USF project manager the scope of work for classroom capture. Clear direction shall be established for the following elements:
 - 1. Which items of the system are OFE and which items will be provided by installer. This clarification shall address at a minimum, the workstations, capture card, software licenses, cameras, and control system for the cameras.
 - 2. Quality of the recording (type of capture card to be used)
 - 3. Location of capture workstation
 - 4. Location and type of capture cameras.

2.8 VIDEOTELECONFERENCE

- A. General: Currently USF has standardized in the use of Cisco video conference systems. All network interfaces for VTC codecs shall be IP interface.
- B. Cameras. High-definition cameras are highly recommended for VTC. A two-camera set up is ideal, having one camera looking at the presenter and one camera looking at the audience.
- C. Microphones. When audience participation is required during VTC, it is highly recommended to have fixed installed microphones. The use of a wireless microphones for audience participation is recommended. Acoustic Echo cancellation (AEC) shall be provided in the DSP processor for all microphones being use for VTC.
- D. Control system. Control to the VTC shall be via the media control user interface. The user interface shall be programmed to allow all features of the VTC system to be available.

2.9 MEDIA CONTROL SYSTEMS

- A. USF has standardized on Crestron media control systems exclusively for the Tampa and Health campuses. Integration with Creston Fusion is required. Please consult with the AVES project manager for systems on other USF campuses or affiliated sites.
- B. User interfaces shall be a touchscreen no smaller than 8 inches. In classrooms and auditoriums, the user interface should be on the lectern. For conference rooms, on top of the table is preferred.
- C. An occupancy sensor is required in all classrooms and auditoriums.

2.10 MICROPHONES

- A. All wireless microphones must be in the frequency range of 516-558 MHz.
- B. Classrooms require one wireless lavalier microphone for instructor use with classroom capture.
- C. Auditoriums require one wireless lavalier microphone for instructor use with classroom capture and voice reinforcement. One wireless handheld microphone is also required.
- D. Conference rooms require at least one tabletop or ceiling-mounted microphone for web-based video conferencing.

- E. VTC rooms: Boundary microphones in the tables or choir microphones for the audience could be required. The intent is that in these types of rooms all participants (presenter and audience) have means to collaborate during the video conference.
- F. When several microphones are in any room, the use of a separate DSP processor is required.

2.11 POWER

- A. A power conditioner is required in all classroom lecterns and/or racks.
- B. An uninterruptible power supply (UPS) is required in all auditorium lecterns and/or racks. UPS units should be able to interface with Crestron Fusion.
- C. For each lectern and/or rack in any AVS, designers must provide load calculations to USF for distribution to project electricians.

2.12 ASSISTED LISTENING DEVICES

- A. Portable units are acceptable for Classrooms. Designers should include a method for interfacing assisted listening transmitters on all drawings and leave space in lecterns and/or racks for a portable unit when required.
- B. Auditoriums require permanently installed assisted listening transmitters.
- C. For all other types of spaces, please consult with the AVES project manager.

2.13 PROGRAM MONITORS

- A. All monitors should be professional-grade only and include HDMI inputs.
- B. Monitors for use in digital signage applications must be 24/7 rated.
- C. Monitors for use in conference rooms must include speakers.
- D. Monitors for use in with media control systems must include RS-232 connections.

2.14 COMPUTER MONITORS

- A. Classrooms and auditoriums require a touch screen monitor with at least 20 inches diagonal display area and work natively with the current standard USF operating system.

PART 3 – EXECUTION

3.1 EXECUTION OF THE WORK

- A. General: Refer to the requirements of the related documents identified in [Subparagraph 1.1](#) above, for execution of work requirements supplemented by this section.
- B. WORKMANSHIP: The AVS 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. Any equipment packaged by the manufacturer without mounting accessories: The AVS installer shall provide all required accessories necessary to mount the equipment within the designated cabinets and/or rack locations. These accessories may include (but not limited to) rack ears, brackets, shelves, and security mounts.
 - 2. Provide appropriate ventilation panels, vents, and/or fans to assure sufficient ventilation for adequate cooling of all equipment. The AVS installer shall provide solutions to avoid overheating when equipment is to be installed in casework or closed lecterns.
 - 3. Confirm the polarity and phasing of system components before installation. Connect to maintain uniform polarity and phasing.
 - 4. Insulate all non-insulated, stranded conductors before making termination when connecting to equipment terminals.
 - 5. All wiring is to be free from grounds loops, shorts, opens, and reversals.
 - 6. Neatly tie all cabling within equipment cabinets, housings, and terminal cabinets with nylon cable ties or 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. Cut any plastic cable ties flush to the head so no sharp edges are present. Architect & Engineer approved wiring trough may be used in lieu of tie-wraps. Cable routing shall not braid or cross with other wires in parallel more than once.

7. 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.
8. Connect all equipment power to power conditioner or UPS
- C. RACEWAYS. All raceways for audiovisual devices shall have the following specifications:
 1. Refer to Section 27 05 28, Pathways for Communication System for all raceways specification.
 2. All cables for speaker level signals, regardless of their level shall be run separate from other low voltage cables.
 3. All cables for microphone level signals, regardless of their level shall be run separate from other low voltage cables.
 4. Separation of Raceways: USF does not allow the use of raceways or cable trays design for structured cabling systems to be used for AVS cables except for fiber optic cables. Raceways for CATV system can be used for AVS distribution cables when required. Cable tray supports can be used as supports for hangers for AVS distribution cables.
 5. Raceways for AV outlets: Outlets for AV cables shall be composed of electrical boxes (sized for the number of connectors) and a conduit(s) to the nearest accessible ceiling space. All AV outlet boxes shall be at least 2.5 inches deep.
 6. All indoor rated cables can be supported with j-hooks or cable hangers above accessible ceiling spaces. J-hooks shall be spaced no longer than 6 feet.
- D. LABELING. Any type of write-on labels, handwriting on cable jackets or directly on equipment, labels made with masking tape or any other type of non-approved tape are not acceptable and shall be corrected with approved labeling methods at no additional cost to the owner. The only approved types of labels for cables and devices part of the broadband distribution system are:
 1. Non-laminated thermal transfer labels printed with a high-quality thermal transfer printer.
 2. Laminated thermal transfer labels printed with a high-quality thermal transfer printer.
 3. Thermal transfer polyolefin tape printed with a high-quality thermal transfer printer.
 4. Self-laminated dot-matrix labels printed with a high-quality dot matrix printer.
 5. Non-laminated dot-matrix labels printed with a high-quality dot matrix printer.
- E. ENGRAVING: All push buttons in user interfaces part of the AVS shall be engraved with descriptive wording of the use of the button. The AVS installers shall submit and receive approval for the proposed wording in each button before doing the engraving. Failure to follow this step might cause the AVS installers to replace the buttons in interfaces where the Owner is not satisfied with the wording of the label at no additional cost to the Owner. The color of the wording in the engraving shall have high contrast with the background color of the button.
- F. PROJECTOR INSTALLATION: The Installer shall adhere to, at a minimum, the following installation practices for projectors:
 1. Projector shall be provided with corresponding mounting brackets depending on the projector selected.
 2. All anchors and supports whether prefabricated or customs, required to mount the projector where indicated in the design drawings are in the scope of work of the AVS installers
- G. FLAT PANEL DISPLAY INSTALLATION: The AVS installers shall adhere to, at a minimum, the following installation practices for flat panel displays:
 1. All anchors and supports whether prefabricated or customs, required to mount the displays where indicated in the design drawings are in the scope of work of the AVS installers.
 2. All walls where flat panel displays will be installed shall be re-enforced with sheet metal behind the drywall. The extent of the re-enforcing shall be the contour of the flat panel display to be installed and no less than twice the distance between 2 drywall stud frames.
 3. When flat panel displays are installed inside a wall niche, the AVS shall provide a wall mount with adjustable depth that allows the flat panel display to be installed flush with the exterior wall.
 4. Power and AV outlets to be installed behind flat panel displays shall use an ARLINGTON TVB613 or approved equal box.
- H. SPEAKER INSTALLATION: The Installer shall adhere to, at a minimum, the following installation practices for speakers:

1. All ceiling mounted speakers shall have a support wire tie to the building structure, and shall not be supported exclusively from the ceiling grid.
 2. All ceiling mounted speakers shall be plenum rated.
 3. All in-wall speakers shall be installed with pre-construction brackets.
- I. EQUIPMENT RIGGING: When speaker assemblies or arrays weight more than 100 lbs, the AVS installers shall follow all rigging instructions from the manufacturer and shall be done by an experienced rigger. The AVS installers shall also adhere to the following practices:
1. Only the rigging equipment and method listed by the manufacturer of the equipment are approved for the installation No substitutions are accepted.
 2. Only the rigging points available in the speaker assembly are accepted as means of support.
 3. All anchors and supports whether prefabricated or customs, required to mount the displays where indicated in the design drawings are in the scope of work of the AVS installers.
 4. Shop drawings for rigging methods shall be signed and sealed by a licensed structural engineer.
- J. MILLWORK OPENINGS: When AV equipment like flip tops and plates will be mounted in millwork provided by the owner or third parties, the AVS installers shall provide cut out dimensions for all the AVS equipment listing location in the millwork where the cuttings need to be done. It is the AVS installer's responsibility to install those devices in the millwork, once the openings have been done. All millwork opening shall be done by the furniture manufacturer.
- K. FLOOR BOXES. Floor boxes used for connection to teaching lecterns shall have at least the following minimum requirements:
1. Floor boxes shall be large enough to have at least 3 different compartments, one for power one for voice/data cables and one for AV cabling.
 2. Each low voltage compartment shall have a separate raceway back to the accessible ceiling space. If speaker wires are run from the lectern, the AV compartment shall have at least one 1 inch conduit from the AV compartment to the accessible ceiling. Additional conduits might be required depending on the application.
 3. Floor boxes shall have a recessed compartment to hold connectors. Floor boxes that leave AV connectors flushed with the floor are not desirable since they become tripping hazards and could be easy broken with the lectern when moved.
 4. AV compartments shall have termination plates and connectors for all cables coming from the accessible ceiling space. All connectors shall be properly secured to the plates in the floor box. All unused compartments shall have blank plates.
- L. STRUCTURED CABLING INFRASTRUCTURE: The AVS installers shall adhere to [Section 27 10 00](#) for all requirements of structured cabling components to be used as part of the AV system. The structured cabling components include but are not limited to:
1. All unshielded twisted pair Category cables and fiber optic cables
 2. Termination devices like termination jacks, patch panels and faceplates.
 3. All UTP and fiber optics patch cords.
 4. All testing procedures for Category and fiber optic cables.
- M. IP/MAC ADRESSES. All IP addresses will be provided by USF unless IT AVES specifically pre-approves the use of a separate network for the AVS. Reprogramming of AVS due to un-approved IP address use by the AVS installer shall be at the installer's expense. The AVS installer shall provide a list of all equipment requiring IP addresses to USF Information Technology AVES in advance of installation. This list shall include:
1. Device manufacturer and model number.
 2. Device MAC address
 3. Device serial number
 3. Installation location of Device.
- N. DSP PROCESSORS. AVS installer shall program all audio and/or video DSP processors unless specifically noted by owner during the program phase of the project.

3.2 SOFTWARE PROGRAMMING AND TESTING

- A. The software programming and testing of the AVS system will be a multi-step process. The AVS installers shall provision in the proposal for the time indicated in each of the steps:

- B. BRIEFING STEP: After receiving the notice to proceed, the AVS installer shall request 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. Some important notes about this step are:
1. The AVS installers shall have software programming submittals approved as described in [Section 27 41 00, Part 1](#) above.
 2. The AVS installers shall prepare meeting minutes of the key decisions made during these meetings. The approval of these meeting minutes by the Owner and Design Engineer will be accepted as approval notice of this step.
- C. SHOP PROGRAMMING STEP: Once the briefing step has been completed and approved, the AVS installers shall allocate off-site programming time to accomplish all the requirements listed in this section and the clarifications done in the previous step. It is the sole responsibility of the AVS installers to estimate how many man hours are required for this step. This step does not require approval by the Owner and/or design Engineer.
- D. FIELD VERIFICATION STEP: After all AVS equipment has been installed on site and the system has been programmed, the AVS installers shall request one or more working sessions with the Owner and/or design engineer to verify in the field the functionality of the AVS system. Some important notes about this step are:
3. The AVS installers shall have different AV media and sources to test all features in the AVS system.
 5. Physical installation of all devices will be checked by the Owner and/or the Design Engineer. Any deviations in the installation of the equipment part of the AVS 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 AVS installers within the next 5 days of the working session for immediate corrective action. One punch list will be prepared for each room with AVS.
 6. The AVS installers shall prepare meeting minutes of the key decisions made during these meetings that affect the programming sequence. The approval of these meeting minutes by the Owner and Design Engineer will be accepted as approval notice of this step.
- E. FINAL ADJUSTMENT STEP: Once the previous step has been approved, the AVS installers shall allocate time to make any corrections to the AVS system on site based on the conclusions of the punch list. It is the sole responsibility of the AVS installers to estimate how many man hours are required for this step. This step does not require approval by the Owner and/or design Engineer.
- F. FINAL ACCEPTANCE STEP: Once the AVS installers has completed the previous step the AVS installers shall allocate time to review the complete AVS system with the Owner and/or design engineer, for compliance with this section, previous punch list and conclusions in previous meetings and working sessions. Some important notes about this step are:
1. It is the sole responsibility of the AVS system installer to estimate the time allocated for this step. It is assume that at this point in time all the features of the AVS system are clear to the Owner and the AVS installers so this step is just to make sure that all the features are working properly as agreed.
 2. The AVS installers shall have different AV media and sources to test all features in the AVS system.
 4. Physical installation of all devices will be checked again by the Owner and/or the Design Engineer. All previously noted punch list items shall have been corrected by the AVS installers.
 5. Failure to complete one or more of the previously issued punch list items or failure to correct any programming changes previously noted will revoke acceptance of the room or system being tested.
 6. Final acceptance will be granted on a room-by-room basis.
- G. DATA WIRING AND FIBER OPTIC TESTING: Testing of UTP data wiring, copper patch cords, fiber optic cables and fiber optic patch cords shall be done as indicated in [Section 27 10 00](#). Testing results shall be submitted as indicated in the same section.
- H. TEST EQUIPMENT: The AVS installers shall supply all testing instruments required for the equipment programming and system tests. The AVS installers shall use test equipment meeting the minimum specifications, identified herein, to perform system calibrations and

adjustments. The AVS installers shall make available the same test equipment available, for inspection by the Engineer, during Final Acceptance step.

1. Audio Impedance Meter.
 2. Digital Multimeter.
 3. Sound Level Meter – ANSI & IEC Type 2.
 4. Digital Video Signal Test pattern generator.
 5. CAT6 cable tester
- I. SIGNAL ADJUSTMENT: The AVS installers shall ensure that the following adjustments, tests and measurements, at a minimum, have been completed:
1. The system shall be measured and adjusted for optimum signal quality and minimum signal loss, to all audio and video signals, through the system channel, using appropriate test equipment and standardized testing procedures.
 2. The system shall be measured and adjusted for optimum signal-to-noise ratio and maximum headroom in the system electronics.
 3. The system shall be measured and adjusted to eliminate distortions or degradation of signal resulting from, but not limited to, clipping, hum, noise, and RFI interference.
 4. The Installer shall check the quality of each signal, at its source, and compare it against the quality of the signal at various points of its transmission through the system

3.3 TRAINING

- A. The AVS installers shall provide the owner with different types of training as described herein.
- B. SYSTEM ADMINISTRATION TRAINING. The AVS installers shall provide system administration training at the job site as described below:
1. Duration of system administration training will be indicated for each AVS in the corresponding section.
 2. Travel time will not be counted as part of the training sessions.
 3. Training will be broken down to several sessions in different days. Each session shall be no longer than 6 hours. The number of sessions will be indicated for each AVS in the corresponding section.
 4. The objective of the system administration training will be to properly operate, trouble shoot, calibration and perform specific field repairs to AVS equipment.
 5. Field repair and calibration training will be limited to those repairs notes by the manufacturer of the equipment as field repairs done by non-factory trained personnel.
 6. Training shall be done at the job site with all the equipment operational after final acceptance.
 7. Training will be limited to a maximum of 5 attendees per session.
 8. Operation and Maintenance manuals shall be delivered at the beginning of these sessions.
- C. USER TRAINING. The AVS installers shall provide user training at the Job site as described below:
1. Duration of user training will be indicated for each AVS in the corresponding section.
 2. Travel time will not be counted as part of the training sessions.
 3. Training will be broken down to several sessions in different days. Each session shall be no longer than 6 hours. The number of sessions will be indicated for each AVS in the corresponding section.
 4. The objective of the user training will be to properly operate the AVS.
 5. Training will be limited to a maximum of twenty (20) attendees per session.
 6. User short form guides shall be provided to all attendees of the sessions.
 7. Short form guides shall provide the users with quick finding ways to operate the system. If AVS operation is different from one room to the other, one separate short form guide shall be provided for each room.
- D. OTHER TRAINING REQUIREMENTS: The AVS installers shall also comply with the following training requirements:
1. At least one of each type of training sessions may be recorded by USF Information Technology AVES for review on a later date.

3.4 COMISSIONING

- A. NOTE TO DESIGNERS OR CONSULTANTS: USF might choose to have third party commissioning of audiovisual system. Designers shall confirm with the USF AV Project Manager if this is a project requirement. If so, designers shall include a description in this section of the commissioning process so the AVS installer can factor the required commissioning time in their bid.

3.5 EQUIPMENT WARRANTY

- A. All manufacturer's warranties for equipment included in the project shall be transferred to USF upon completion. The AVS installer shall provide a list with all equipment in the project and duration of the warranty as issued by the manufacturer. AVES installer shall aid in the event manufacturer's warranty requires AVES installer to facilitate repair and/or service instead of USF.

3.6 INSTALLATION AND PROGRAMMING WARRANTY

- A. The overall AVS installation and software shall be warrant for at least one (1) year. The warranty shall start from the day the AVS installers receives the approval of the Final Acceptance Step.
- B. During the warranty period the AVS installers shall visit the site as many times as required to fix any issues in the system.

3.7 SERVICE LEVEL AGREEMENTS

- A. USF may require service level agreements (SLA) on a project-by-project basis to be negotiated with AVS installer during the bid process.

3.8 CLOSE-OUT DOCUMENTATION

- A. General: Refer to the requirements of the related documents identified in [Section 27 41 00, 1.01, Related Documents](#) above, for close-out documentation requirements supplemented by this section. The following is a list of required close-out documentation:
1. Drawings indicating final floor plan locations of all AV devices in full-size paper and digital formats.
 2. One line diagrams with all devices connected in the system in full-size paper and digital formats.
 3. All programming source code done by the AVS for this project for all pieces of equipment in digital format (no printed copies accepted).
 4. Compiled executable files as requested for Computer based user interface.
 5. All Operations and Maintenance Manuals (digital format preferred).
 6. All printed test results.
 7. Inventory of all equipment used in the project (digital copy only, in spreadsheet or csv format) containing the following information:
 - a. Manufacturer
 - b. Model
 - c. Description
 - d. Serial Number
 - e. MAC address (where appropriate)
 - f. Installation Location (building and room).
 - g. Duration of warranty.

END OF SECTION 27 41 00

SECTION 27 41 10 SMALL CLASSROOM AUDIO/VISUAL SYSTEMS
PART 1 – GENERAL**1.1 RELATED DOCUMENTS**

- A. General: The General Requirements, Conditions of the Contract, these sections of the USF Design & Construction Guidelines (DCG), Drawings, Addenda and Contract Modifications (the Contract Documents), and definitions of legal entity (such as Contract, Installer, Engineer, Owner, etc. shall apply to the work of this specification section.
- B. Supplemental: Refer to [Section 27 41 00, Common Work Results for Audio/Visual Systems, Part 1](#) for additional requirements, which are supplemented by this section.

1.2 SCOPE OF WORK (SOW)

- A. General: A small classroom is considered an open use environment classroom used for less than sixty (60) students.
- B. General: The scope of work for the installer of these rooms is to provide and install all equipment and wiring for the small classrooms. Programming for these rooms is provided by USF IT department unless the program requirements for the classrooms indicate particular features not available in standard USF small classrooms.
- C. The following is a list of small classrooms where Audio Visual system shall be provided in this project:
1. List all rooms.
- D. Consumables: The Audio-Visual System (AVS) Installer shall provide as part of the scope the following consumable devices:
1. 10% of lamps for each type of projector used the projects.

1.3 ARCHITECTURAL CONSIDERATIONS

- A. General: AVS designers shall provide architectural recommendations for this type of rooms in the project. These recommendations shall include room layout, lighting and acoustics.
- C. Tier seating: unless the program requires it, this type of room does not require tier seating.
- D. Screen quantity. This type of rooms only requires one screen unless the specific program request more than one.
- E. Dimming lights are not required in this type of classroom, but two-level lighting is recommended. To obtain the two levels 1/2 or 1/3 of the lamps in each fixture shall be controlled separately. At a minimum there needs to be two control circuits for all the light fixtures in the room, the light fixtures closest to the screen shall be on a separate switch from the rest of the fixtures in the room, so they can be turned off during presentation mode, but the remaining lights can be left on.
- E. Acoustical considerations. This type of room does not require any special acoustical considerations except for the regular considerations for privacy between adjacent classrooms.

1.4 ROOM AUDIO/VISUAL FUNCTIONALITY

- A. General: Room Audio/visual functionality shall be as described in the current standard program for the control processor installed in most classrooms of this type. It is the intent of the USF IT department to keep this functionality as uniform as possible to reduce training time for teachers and support staff.

PART 2 - PRODUCTS**2.1 APPROVED PRODUCTS**

- A. General: The following is the list of equipment currently approved by USF for this type of classroom:

Component	Manufacturer	Model
Display		
Projector	PANASONIC	PT-FW300NTU
Projector Ceiling Plate	CHIEF	CMS0445
Projector Security Mount	BMS	LCD LOC II DD
Projection Screen	DA LITE	HDTV HEAVY DUTY MODEL C 79882

Wall Mount Brackets	DA LITE	40932 #6 White
Presentation Resources		
Document Camera	ELMO	P100
DVD/VHS Combo Player	SONY	RDRVX560
Desktop PC	DELL	Optiplex 760 SFF
Interactive Pen Display/Annotation	Smart Technologies	SYMPODIUM ID370
Laptop and USB Connections		
Audio		
Pair Audio Speakers	EXTRON	SI 26CT
Media Control		
Media Control Link	CRESTRON	MPS 100
Media Control user interface	CRESTRON	C2N-FT-TPS4-B
QuickMedia Receiver	CRESTRON	QM-RX
IR Emitter Probe	CRESTRON	IRP2
Media Control Cable	CRESTRON	CrestCat-QM-P
Accessories		
Lock	Kensington	K64189USL
Wiring, Accessories		
Surge Protector	Tripp-Lite	Super7Tel15
Rack Shelving	RAXXESS	UTS-2
Hardware security mount	PEERLESS	LDM 233K

- B. Variations from this list of equipment shall be pre-approved by USF IT department.

PART 3 - EXECUTION

3.1 EXECUTION OF THE WORK

- A. General: See [Section 27 41 00, Part 3](#), for execution of work requirements supplemented by this specification section.
- B. Programming. Programming for the control system for this type of room will be provided by the owner unless specifically requested by the program of the project.
- C. All equipment in this type of classroom shall be in the teaching lectern.
- E. Projectors shall be installed using a projector ceiling plate that replaces a 2 feet x 2 feet ceiling tile. Ceiling plates shall be installed per manufacturer's recommendation.
- F. Sound-reinforcement for this type of room is not required, neither the use of a microphone for the teacher.
- G. In this type of room assisted listening devices does not need to be permanently installed in the classroom. Portable units are acceptable.
- G. Computers for teaching lecterns will be provided by the owner in this type of classrooms.
- H. UPS is not required for this type of classrooms.
- I. Integration between the lighting system and the audio-visual system is not required, but wall switches shall be located close to the lectern location.

3.2 TESTING

- A. General: Because in this type of rooms the programming of the system is done by the owner, the AVS installer does not need to test all the systems, but the installer of these rooms shall be available during the testing done by the owner to solve any problems associated with the installation of the equipment encountered by the owner during the testing process.

3.3 TRAINING

- A. SYSTEM ADMINISTRATION TRAINING. The installer of the systems part of this specification section shall provide four (4) hours of system administration training.
- B. USER TRAINING. The installer of the systems part of this specification does not need to provide user training

END OF SECTION 27 41 10

SECTION 27 41 15 LARGE CLASSROOM AUDIO/VISUAL SYSTEMS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. General: The General Requirements, Conditions of the Contract, these sections of the USF Design & Construction Guidelines (DCG), Drawings, Addenda and Contract Modifications (the Contract Documents), and definitions of legal entity (such as Contract, Installer, Engineer, Owner, etc.) shall apply to the work of this specification section.
- B. Supplemental: Refer to [Section 27 41 00, Common Work Results for Audio/Visual Systems, Part 1](#) for additional requirements, which are supplemented by this section.

1.2 SCOPE OF WORK (SOW)

- A. General: A large classroom is considered an open use environment classroom used for more than sixty (60) students.
- B. General: The scope of work for the installer of these rooms is to provide and install all equipment and wiring for the large classrooms. Programming for these rooms is provided by the installer.
- C. The following is a list of large classrooms where Audio Visual system shall be provided in this project:
 1. List all rooms.
- D. Consumables: The Audio-Visual System (AVS) Installer shall provide as part of the scope the following consumable devices:
 1. 10% of lamps for each type of projector used the projects.

1.3 ARCHITECTURAL CONSIDERATIONS

- A. General: AVS designers shall provide architectural recommendations for this type of rooms in the project. These recommendations shall include room layout, lighting and acoustics.
- B. Tier seating. Tier seating is not required but highly recommended specially in room with over 100 seats.
- C. Projection system. The preferred projection system for this type of rooms is front projection
- D. Screen quantity. This type of rooms only requires one screen but double screens are highly recommended.
- E. Three point lighting is recommended for this type of rooms. The intent of the 3 point is to achieve a good audio/visual experience during presentation mode. The types of lights are:
 1. Regular fluorescent lights with wide dispersion (direct recessed or indirect pendants). These fixtures are intended to be used during test, classes that don't require the use of the projector or for clean-up/repairs mode for staff. These lights do not require two levels unless for some reason the down lights are not possible in the classroom. There is no need to zone these lights because during presentation mode all these fixtures will be turned off.
 2. Dimmable down lights. These fixtures are intended to be used during presentation mode. The purpose of these fixtures is to provide a minimum level of lighting for the students to take notes and to provide a safe way to egress the room. The dimmable feature will allow for adjustment of the light levels to an acceptable level. The dimmers on this system shall be controllable dimmers so they can be integrated to the AV system.
 3. Presenter lighting. When this type of room has classroom capture cameras (CC) or video teleconference cameras (VTC), it is recommended to provide a directional light at the presenter to improve the quality of the recording. This type of light should be aimed at 45° angle to the presenter to avoid blinding the presenter and also to avoid hitting the projection screen with direct light from this source. These fixtures do not need to be dimmable but should be controllable from a control system integrated also to the AVS. All different types of lamps should have the same or very similar color temperature to have a uniform look and feel. This type of light should be aimed not only at the podium location but also along the front of the classroom, to keep the effectiveness when the presenter decides to move away from the podium.
- F. Acoustical considerations. This type of rooms will use program speakers separated from sound

reinforcement speakers, but because of the volume level of main program speakers it is recommended to use some form of acoustical treatment on the walls to avoid undesirable sound reflections. Sound modeling for this type of rooms is a nice to have but not a requirement.

1.4 ROOM AUDIO/VISUAL FUNCTIONALITY

- A. General: Room Audio/visual functionality shall be as described in the current standard program for the control processor installed in most classrooms of this type. It is the intent of the USF IT department to keep this functionality as uniform as possible to reduce training time for teachers and support staff.

PART 2 - PRODUCTS

2.1 APPROVED PRODUCTS

- A. General: The following is the list of equipment currently approved by USF for this type of classroom:

Component	Manufacturer	Model
Display		
Projector	PANASONIC	PT-D4000U
Lens	PANASONIC	ET-DLE350
Projector Ceiling Plate	CHIEF	CMS0445
Projector Security Mount	BMS	LCD LOC II DD
Projection Screen	DA LITE	HDTV HEAVY DUTY MODEL C (Size depending on room size)
Wall Mount Brackets	DA LITE	40932 #6 White
Presentation Resources		
Document Camera	ELMO	P100
DVD/VHS Combo Player	SONY	RDRVX560
Desktop PC	DELL	Optiplex 760 SFF
Interactive Pen Display/Annotation Laptop and USB Connections	Smart Technologies	SYMPODIUM ID370
Audio		
Pair Audio Speakers	EXTRON	SI 26CT
Pair Audio Speakers	EXTRON	42-072-03
Wireless Mic System	Sennheiser	levelier type
Audio Amplifier	Crown or TOA	3 channel amp.
Media Control		
Media Control Link	CRESTRON	MPS 200
Media Control user interface	CRESTRON	C2N-FT-TPS4-B
QuickMedia Reciever	CRESTRON	QM-RX
IR Emitter Probe	CRESTRON	IRP2
Media Control Cable	CRESTRON	CrestCat-QM-P
Accessories		
Lock	Kensington	K64189USL
Wiring, accessories		
Surge Protector	Tripp-Lite	Super7Tel15
Rack Shelving	RAXXESS	UTS-2
Hardware security mount	PEERLESS	LDM 233K

- B. Variations from this list of equipment shall be pre-approved by USF IT department.

PART 3 - EXECUTION

3.1 EXECUTION OF THE WORK

- A. General: See specification [Section 27 41 00, Part 3](#), for execution of work requirements supplemented by this specification section.
- B. Programming. Programming for the control system for this type of room will be done by the installer but USF IT will provide a base code to be used as a starting point to program these rooms. Additional features requested by the specific room program will have to be programmed by the installer.
- C. All equipment in this type of classroom should be in the teaching lectern, but additional racks

with equipment could be required for some rooms. If additional racks are required, it is recommended these racks be located outside of the classrooms to be able to service them without disrupting the class.

- D. Projectors shall be installed using a projector ceiling plate that replaces a 2 feet x 2 feet ceiling tile. Ceiling plates shall be installed per manufacturer's recommendation.
- E. Sound-reinforcement speakers and program speakers are required for this type of room. These speakers shall be wired through an external amplifier. Program speakers shall only play program audio, sound reinforcement speaker shall play a mix of program audio and microphone outputs.
- F. Microphones. At a minimum one wireless microphone is required for the presenter but depending on the program additional microphones could be required like choir microphones or array microphones (acoustic magic) for audience participation during VTC. If more than one microphone is required in these rooms, it is highly recommended to have a DSP processor to provide mixing and filters to enhance the quality of the audio.
- G. In this type of room assisted listening devices shall be permanently installed in the classroom.
- H. Computers for teaching lecterns will be provided by the owner in this type of classrooms.
- I. UPS is required for this type of classrooms with monitoring capabilities through the RAMS.

3.2 TESTING

- A. General: Testing for this type of room shall be done by the installer and reviewed by the owner and design engineer. For this type of rooms all testing requirements described in [Section 27 41 00](#) shall be followed.

3.3 TRAINING

- A. SYSTEM ADMINISTRATION TRAINING. The installer of the systems part of this section shall provide four (4) hours of system administration training.
- B. USER TRAINING. The installer of the systems part of this section shall provide at least six (6) hours of user training in two (2) different sessions.

END OF SECTION 27 41 15

SECTION 27 41 20 CONFERENCE ROOM AUDIO/VISUAL SYSTEMS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. General: The General Requirements, Conditions of the Contract, these sections of the USF Design & Construction Guidelines (DCG), Drawings, Addenda and Contract Modifications (the Contract Documents), and definitions of legal entity (such as Contract, Installer, Engineer, Owner, etc.) shall apply to the work of this specification section.
- B. Supplemental: Refer to specification Section 27 41 00, Common Work results for Audio/Visual Systems, Part 1 for additional requirements, which are supplemented by this section.

1.2 SCOPE OF WORK (SOW)

- A. General: This specification applies to conference rooms or collaboration rooms smaller than 400 square feet.
- B. General: The scope of work for the installer of these rooms is to provide and install all equipment and wiring for the conference rooms. Programming for these rooms is provided by the installer.
- C. The following is a list of conference rooms where Audio Visual system shall be provided in this project:
 1. List all rooms.
- D. Consumables: The Audio-Visual System (AVS) Installer shall provide as part of the scope the following consumable devices:
 1. 10% of lamps for each type of projector used the projects.

1.3 ARCHITECTURAL CONSIDERATIONS

- A. General: AVS designers shall provide architectural recommendations for this type of rooms in the project. These recommendations shall include room layout, lighting and acoustics.
- B. Tier seating. Tier seating is not recommended.
- C. Projection system: The preferred projection system for this type of room is a flat panel displays with speakers and tuner, not smaller than 55 inches. A front projection system shall only be used in this type of rooms if the LFV rule is not being met with a large flat panel display commercially available and project viable (budget).
- D. Flat panel display quantity. This type of rooms only requires one flat panel displays. Dual displays are not required unless the specific program request this functionality.
- E. Lighting. If flat panel display will be used in this type of rooms, no special considerations are required for lighting except for avoiding locating the display devices on a wall that is subject to direct sun light. If the room will have a front projection system a two-point lighting system is recommended for this type of rooms. The intent of the 2 point to achieve a good audio/visual experience during presentation mode. The types of lights are:
 1. Regular fluorescent lights with wide dispersion (direct recessed or indirect pendants). These fixtures are intended to be used during test, classes that don't require the use of the projector or for clean-up/repairs mode for staff. These lights do not require two levels unless for some reason the down lights are not possible in the classroom. There is no need to zone these lights because during presentation mode all these fixtures will be turned off.
 2. Dimmable down lights. These fixtures are intended to be used during presentation mode. The purpose of these fixtures is to provide a minimum level of lighting for the students to take notes and to provide a safe way to egress the room. The dimmable feature will allow for adjustment of the light levels to an acceptable level. The dimmers on this system shall be controllable dimmers so they can be integrated to the AV system.
- F. Acoustical considerations. This type of rooms will use only program speakers. Program speakers are recommended to be built-in or an accessory to the flat panel displays. Sound modeling for this type of rooms is not required.
- G. Equipment racks. It is very likely the AVS in this type of rooms requires the use of rack mounted AV equipment. The preferred location for this equipment is inside the room in a small rack. See specification Section 27 41 00 for additional information on racks inside rooms, casework,

or credenzas.

- H. Flip top devices: As a preference user interface plates shall be located in the table and not in the wall. Interface plates in the table are preferred to be installed in a flip top device. The interface plate shall have as a minimum the following connections:
1. One (1) HDMI
 2. One (1) Composite video connector and stereo audio in RCA connectors
 3. One (1) VGA connector and stereo audio. VGA connector in a HD15 connector and audio in a 3.5 mm stereo connector.

1.4 ROOM AUDIO/VISUAL FUNCTIONALITY

- A. General: Room Audio/visual functionality for this type of rooms varies depending on the final use of the room. This functionality needs to be defined with the users and needs to be indicated in the specifications. As a minimum the following features shall be available in the control system:
1. System On-Off with status indication.
 2. Individual display device on/off control with status indication.
 3. Select and route any audio and video source to any of the available audio and video output devices. Each output device shall provide indication in the user interface of the current source selected for that output.
 4. Playback control of any recorded media capable of operating in the available input sources. Status indication for playback control include end of tape indication, selected function and invalid action. The playback control shall at least provide the following functions:
 - a. Play
 - b. Stop
 - c. Rewind
 - d. Forward
 - e. Fast Rewind
 - f. Fast Forward
 - g. Pause
 - h. Frame-by-frame controlled playback
 - i. Digital media Menu navigation controls.
 5. TV channels selection. TV channel selection shall be provided by the following methods:
 - a. Manual entering channel number
 - b. Pick from a list of ten (10) favorite channels. Favorite channels shall be labeled by the name of the network and the channel number. The owner will provide list of favorite channels for this room.
 - c. Channel up and down, by moving up or down in the list of available channels.
 6. Selected audio output device(s) volume control. Volume level should always be set to an acceptable user level during power up. Status indication of volume level shall be provided for each controllable output device.
 7. Selected audio output device(s) volume mute. Mute status indication shall be provided at user interfaces.
 8. Audio settings control including equalization control
 9. Individual control and status indication of all features for all controllable devices
 10. Video mute for display output devices.
 11. Display automation. Motorized Screen shall follow the operation status of the projector, regardless of if the manual switch to the screen has been used to operate the screen. When the projector is on the screen shall be down and when the projector is off the screen shall be pulled up.
- B. Additional functionality shall be identified with the users and the USF project manager.

PART 2 – PRODUCTS

2.1 APPROVED PRODUCTS

- A. General: There is no specific list of equipment to be used in this room. Designer shall recommend equipment for this type of room.

PART 3 - EXECUTION**3.1 EXECUTION OF THE WORK**

- A. General: See specification [Section 27 41 00, Part 3](#), for execution of work requirements supplemented by this specification section.
- B. Programming. Programming for the control system for this type of room will be done by the installer.
- C. Projectors shall be installed using a projector ceiling plate that replaces a 2 feet x 2 feet ceiling tile. Ceiling plates shall be installed per manufacturer's recommendation.
- D. Program speakers are required for this type of room. These speakers shall be powered from the flat panel display.
- E. In this type of room assisted listening devices are not required permanently installed in the room.
- F. UPS is not required for this type of room but power strips are required with surge suppression.

3.2 TESTING

- A. General: Testing for this type of room shall be done by the installer and reviewed by the owner and design engineer. For this type of rooms all testing requirements described in [Section 27 41 00](#) shall be followed.

3.3 TRAINING

- A. SYSTEM ADMINISTRATION TRAINING. The installer of the systems part of this specification section shall provide four (4) hours of system administration training.
- B. USER TRAINING. The installer of the systems part of this specification shall provide at least six (6) hours of user training in two (2) different sessions.

END OF SECTION 27 41 20

SECTION 27 41 25 CONFERENCE ROOM WITH VTC AUDIO/VISUAL SYSTEMS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. General: The General Requirements, Conditions of the Contract, these sections of the USF Design & Construction Guidelines (DCG), Drawings, Addenda and Contract Modifications (the Contract Documents), and definitions of legal entity (such as Contract, Installer, Engineer, Owner, etc.) shall apply to the work of this specification section.
- B. Supplemental: Refer to specification Section 27 41 00, Common Work Results for Audio/Visual Systems, Part 1 for additional requirements, which are supplemented by this section.

1.2 SCOPE OF WORK (SOW)

- A. General: A conference room with VTC is a regular conference room where video conference equipment will be installed on a permanent basis. There is no specific size for this type of room, the only criteria are that it is a meeting room (or small classroom) and it has videoconference permanently installed.
- B. General: The scope of work for the installer of these rooms is to provide and install all equipment and wiring for the conference room with VTC. Programming for these rooms is provided by the installer.
- C. The following is a list of conference rooms with VTC where Audio Visual system shall be provided in this project:
 - 1. List all rooms.
- D. Consumables: The Audio-Visual System (AVS) Installer shall provide as part of the scope the following consumable devices:
 - 1. 10% of lamps for each type of projector used the projects.

1.3 ARCHITECTURAL CONSIDERATIONS

- A. General: AVS designers shall provide architectural recommendations for this type of rooms in the project. These recommendations shall include room layout, lighting and acoustics.
- B. Table. For conference room, it is highly recommended to use table shapes suitable for videoconference systems. Those table shapes include "V" shapes or "C" shapes. These shapes improve visibility of all participants in the video conference system. Avoid as much as possible tables with rectangular form.
- C. Projection system. The preferred projection system for conference rooms is dual flat panel displays no smaller than 65 inches diagonal, installed side by side. These displays shall not be mounted higher than 6 inches from the top of the table to the bottom of the displays. For classrooms, dual front projection system and a rear flat panel display for the presenter to see the far side.
- D. VTC Camera installation: For meeting rooms, the recommended location for the VTC camera as in between the flat panel displays, above the unit. For classrooms, two cameras are recommended, one for the audience and one for the presenter, installed one in the front and one in the back of the room.
- E. Depending on the room size, different types of lights are recommended. For small conference rooms (less than 250 square feet) one type of lighting is recommended. For larger rooms or classrooms (greater than 250 square feet) additional lighting types might be required. As a minimum all conference rooms shall have:
 - 1. VTC lighting. Room shall be layout with fixtures designed specifically for Video Tele Conference. These fixtures are recessed fluorescent fixtures with a reflector shaped to reproduce an effect similar to studio lights. These fixtures throw light at a 45° angle, rather than straight down. It is suggested to position them so that each is mounted far enough in front of a seating position that the angled light falls on the occupant's face and spaced so that there is a fixture at about 45° to each side of user. These fixtures are not required to be dimmable but are recommended to have 2 levels at least. No specific zoning is required also, a single zone is sufficient.
- F. For larger rooms different types of lights shall be provided depending on the room layout and size of the conference table. The designers shall indicate what other type of lights are required

- for these rooms. Additional lights shall have the same color temperature as the VTC lighting.
- G. For the area covering the conference table the following additional lighting requirements shall be followed:
 - 1. There shall be no more than a 10:1 contrast between the lightest and darkest areas in the room – and no more than a 1.5 to 1 contrast between the overall illumination on one person's face and the next. The light levels in the participant's face shall be between 30 to 50 foot-candles.
 - 2. Lamps on these fixtures shall have a color temperature between 3000 - 3500° K and a CRI of 80 or above.
 - H. Window shades. This type of rooms shall have black out window shades to control ambient lighting in the room. When the specific program requires electric shades, those shades shall be interface and controlled through the AVS.
 - I. Acoustical considerations. This type of rooms will use program speakers separated from sound reinforcement speakers, but because of the volume level of main program speakers it is recommended to use some form of acoustical treatment on the walls to avoid undesirable sound reflections. Sound modeling for this type of rooms is a nice to have but not a requirement.

1.4 ROOM AUDIO/VISUAL FUNCTIONALITY

- A. General: The features for this type of rooms shall be identified and approved with the project manager for USF. There is no specific list of equipment required for these rooms, but there are certain guidelines that shall be followed.
- B. Microphones: For small rooms voice tracker array microphones (by Acoustic Magic) are recommended. For larger rooms boundary microphones in the tables or choir microphones for the audience could be required. The intent is that in these types of rooms all participants (presenter and audience) have means to collaborate during the video conference.
- C. When several microphones are in the room, the use of a separate DSP processor is required. DSP filters shall be set for optimum use during VTC, including acoustic echo cancellation.
- D. User interfaces shall be a touchscreen no smaller than 8 inches. For meeting rooms, a wireless or wired touchscreen on top of the table is preferred. For classrooms, a wired touchscreen in the podium is preferred.
- E. When front projection is used for this type of rooms, designer or consultant shall try to use as much as possible the same type of equipment used in the small classrooms or large classrooms, to minimize the spare part inventory for the owner. In particular, the projectors shall be the same unless there are specific reasons why this can be achieved.
- F. It is common to see in this type of rooms annotation devices. For small rooms or meeting rooms a smart board or an overlay on one of the flat panel displays is acceptable. For larger rooms or classrooms, a presenter-based system is acceptable, like a touchscreen device or an interactive pen displays (i.e. Sympodium®). Interactive pen displays shall be specified capable of handling HD signals.
- G. Signal types. Because of the high proliferation of high-definition system, it is highly recommended that the systems specified for this type of room be capable of managing high definition digital signals, including DVI, HDMI and Display Port.

PART 2 - PRODUCTS

2.1 APPROVED PRODUCTS

- A. General: See specification [Section 27 41 00, Part 2](#).
- B. A detailed list of equipment shall be presented to the owner for approval.

PART 3 – EXECUTION

3.1 EXECUTION OF THE WORK

- A. General: See specification [Section 27 41 00, Part 3](#), for execution of work requirements supplemented by this specification section.
- B. Programming. Programming for the control system for this type of room will be done by the installer.
- C. When this type of room is a classroom all equipment in this type of classroom should be located

- in the teaching lectern, but additional racks with equipment could be required for some rooms. If additional racks are required, it is recommended these racks be located outside of the classrooms to be able to service them without disrupting the class. For meeting rooms,
- D. Projectors shall be installed using a projector ceiling plate that replaces a 2 feet x 2 feet ceiling tile. Ceiling plates shall be installed per manufacturer's recommendation.
 - E. Sound-reinforcement speakers and program speakers are required for this type of room. These speakers shall be wired through an external amplifier, or for smaller rooms they could be part of the flat panel displays. Program speakers shall only play program audio, sound reinforcement speaker shall play a mix of program audio and microphone outputs.
 - F. For conference room set up mix-minus systems are highly recommended.
 - G. For classrooms with capacity larger than fifty (50) students assisted listening devices shall be permanently installed in the classroom.
 - H. Computers for teaching lecterns will be provided by the owner in this type of classrooms.
 - I. UPS is required for this type of classrooms with monitoring capabilities through the RAMS.

3.2 TESTING

- A. General: Testing for this type of room shall be done by the installer and reviewed by the owner and design engineer. For this type of rooms all testing requirements described in [Section 27 41 00](#) shall be followed.

3.3 TRAINING

- A. SYSTEM ADMINISTRATION TRAINING. The installer of the systems part of this specification section shall provide twelve (12) hours of system administration training.
- B. USER TRAINING. The installer of the systems part of this specification shall provide at least six (6) hours of user training in two (2) different sessions.

END OF SECTION 27 41 25

SECTION 27 41 34 BROADBAND DISTRIBUTION SYSTEM
PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and [Division 1, General Requirements](#), apply to work of this section.
- B. Supplemental: Refer to the specification sections identified below for additional requirements, which are supplemented by this section.

Section	Title
27 00 10	TECHNOLOGY GENERAL PROVISIONS
27 05 28	PATHWAYS FOR COMMUNICATION SYSTEMS
27 05 26	GROUNDING & BONDING FOR COMMUNICATIONS SYSTEMS

1.2 SCOPE OF WORK (SOW)

- A. **For designers or consultants:** The scope of work for designers or consultants shall include to a minimum the following tasks:
1. Define system topology, including routing of backbone cables, cable types and location of all active and passive components of the system.
 2. Defining the interface to the existing head end system.
 3. Prepare initial calculations for the complete system to accomplish the required output at all outlets. These calculations shall produce as a conclusion tap values, equalizer values and location of amplifiers in the system.
 4. Establishing the scope of work for the installer and composing the complete set of bid documents (design drawings and specifications).
 5. Review shop drawings and answer RFIs
 6. Test the system with the installer after completion and verify close-out information.
- B. **For installers:** The scope of work for the CATV installers shall include to a minimum the following tasks:
1. Produce shop drawings
 2. Provide and install all cabling passive and equipment (active and passive) per designer's specifications.
 3. Adjust and test the system.
 4. Provide training and close out information as indicated in the specifications.

1.3 DEFINITIONS

- A. Agile Receiver: A broadband receiver that can be tuned to any desired channel.
- B. Broadband: For the purposes of this Section, wide bandwidth equipment or systems that can carry signals occupying in the frequency range of 54 to 1002 MHz. A broadband communication system can simultaneously accommodate television, voice, data, and many other services.
- C. Carrier: A pure-frequency signal that is modulated to carry information. In the process of modulation, it is spread out over a wider band. The carrier frequency is the center frequency on any television channel.
- D. CATV: Community antenna television; a communication system that simultaneously distributes several different channels of broadcast programs and other information to customers via a coaxial cable.
- E. CEA: Consumer Electronics Association.
- F. dBmV: Decibels relative to 1 mV across 75 ohms. Zero dBmV is defined as 1 mV across 75 ohms. $\text{dBmV} = 20 \log_{10}(V1/V2)$ where V1 is the measurement of voltage at a point having identical impedance to V2 (0.001 V across 75 ohms).
- G. Headend: The control center of the master antenna television system, where incoming signals are amplified, converted, processed, and combined into a common cable along with any locally originated television signals, for transmission to user-interface points. It is also called the "Central Retransmission Facility."
- H. RF: Radio frequency.

1.4 DESCRIPTION

- A. Broadband Distribution Systems shall provide distribution of video, television signals to all selected spaces in the buildings. The system design anticipates increasing demands for expanded channel capacity. The system shall include, but not be limited to passive and active infrastructure like distribution amplifiers, directional couplers, taps and splitters as required to achieve a fully functional system.
- B. Topology at USF. Currently USF has a CATV headend system located in in the ITS building on the main campus. This headend system is operated by Apogee Telecom Inc. It is the intent of USF of distribute CATV signals from this location to new and renovated buildings on main campus. A signal feed will be provided from the ITS building to the new project. It is the responsibility to each project to select, specify and install the required fiber optic equipment to get the signal to the new project. Requirements for connection to external service providers shall be discussed in every project.
- C. Standards: Distribution system components and overall system performance shall meet or exceed requirements set forth in Federal Communications Commission Technical Specifications Title 47, Part 76 as applied to cable television systems.
- D. RFI: Special emphasis shall be placed on radio frequency interference (RFI) integrity as licensed radio services outside the cable system share the same frequencies designated for use within.
- E. Distribution of direct broadcast satellite service signals. Whenever a project requires the use of satellite distribution signals, the designer of the system shall coordinate with the owner the location of satellite dishes and the architecture for this system.

1.5 SERVICES SUPPORTED

- A. The system configuration will allow the forward distribution of digital channels available in the existing headend.
- B. The system bandpass shall allow for the following channel loading and forward distribution:
 - 1. One hundred and twenty nine (129) channels from 47 MHz to 860 MHz.
- C. Locally originated programs must be sent to the headend via the fiber backbone.

1.6 INSTALLER QUALIFICATIONS

- A. Qualifications: The CATV installer installing this system shall be experienced in the design, installation, proof-of-performance testing and maintenance of broadband cable television systems comparable or larger in size and complexity to the system required on this project. Such experience shall be indicated in a list of successfully completed systems with the submittal for this system. Contact names and addresses for all references shall be provided.
- B. Equipment: The CATV installer executing this work shall own and maintain at least the following equipment for execution and maintenance of this system:
 - 1. A CATV signal level meter capable of measuring levels between 5 and 1000 megahertz. For example, Blonder Tongue BTPDA-2
 - 2. A flat noise generator or sweep/marker generator capable of providing a calibrated output between 5 and 1000 megahertz.
 - 3. An oscilloscope with a suitable RF detector for use in sweep testing system response.
 - 4. A return loss bridge and variable termination for on-site cable sweep testing prior to installation.
 - 5. A time domain reflectometer designed for operation into 75-ohm polyethylene dielectric cable for verification of installed cable.
 - 6. Composite test sets, simul-sweep equipment, and other test systems capable of providing the required functions shall be considered equivalent to the equipment specified.
 - 7. A stripping/coring tool appropriate for 0.500 inch hardline cable or larger cables.
- C. Resume: A resume of personal cable television experience shall be submitted for the cable foreman, each splicer, each technician, and the system design engineer.

1.7 SUBMITTALS

- A. The CATV installer shall submit the following information as part of the shop drawing submittal process:

1. Cut sheet of all devices to be provided as part of this systems. When multiple devices are in the same cut sheet, the installer shall highlight the specific part number to be used.
 2. Resumes of installer that will perform the job, with their experience in this type of systems.
 3. Cut sheet of labels to be used in the system and a labeling scheme.
 4. A list of all testing equipment owned by the installer as requested in this specification. The list shall include all make and model number of all devices and the last time they were calibrated.
 5. Drawings indicating all outlets in the project, with cable distances included types of cables and how they are connected to the backbone system. The drawings shall include all pad and equalization calculations to the input of all amplifiers in the system.
- B. For quantities of submittal see [Division 1, General Requirements](#). In all cases no less than four (4) copies shall be submitted for approval.

1.8 GENERAL SYSTEM PARAMETERS

- A. Devices and products described below may or may not be required for the overall design. If such devices are required in the course of this project to achieve the design distribution parameter, the installer shall provide such devices as a part of their design solution and said devices shall be included as part of the installers package in the bid. These items would include those listed below as well as splitters, taps, couplers and pads.
- B. The CATV installer shall be familiar with the [ANSI/SCTE](#) standards and shall follow those standards during the installation process.
- C. Amplifiers: In most cases, the output from the amplifier shall be adequate for building distribution. However in larger building distribution systems, additional amplifiers will possibly be required. If such is the case, Input pad and equalizers shall be provided to compensate for short spacing and cable slope, respectively. Outputs shall be adjusted to the rated sloped output of the amplifier selection (typically 36 dBmV to 44 dBmV or rated output by equipment manufacturer) at the selected frequency range indicated in this specification section.
- D. Output: All outlets shall provide a minimum output of between +3 dBmV and +10dBmV for the complete frequency range specified in this section.
- E. Minimum acceptable distribution system performance at all outlets shall be as follows:
1. RF Video Carrier Level: Between 3 and 12 dBmV.
 2. Relative Video Carrier Level: Within 3 dB to adjacent channel.
 3. Carrier Level Stability, Short Term: Level shall not change more than 0.5 dB during a 60-minute period.
 4. Carrier Level Stability, Long Term: Level shall not change more than 2 dB during a 24-hour period.
 5. Channel Frequency Response: Across any 6-MHz channel in 54 to 220-MHz frequency range, referenced to video, signal amplitude shall be plus or minus 1 dB, maximum.
 6. Carrier-to-Noise Ratio: 45 dB or more.
 7. RF Visual Signal-to-Noise Ratio: 43 dB or more.
 8. Cross Modulation: Less than minus 50 dB.
 9. Carrier-to-Echo Ratio: More than 40 dB.
 10. Composite Triple Beat: Less than minus 53 dB.
 11. Second Order Beat: Less than minus 60 dB.
 12. Terminal Isolation from Television to Television: 25 dB, minimum.
 13. Terminal Isolation between Television and FM: 35 dB, minimum.
 14. Hum Modulation: 2 percent, maximum.
 15. RF FM Carrier Level: 13 to 17 dB below video carrier level.
 16. FM Frequency Response: More than the 88 to 108-MHz frequency range, signal amplitude is plus or minus 0.75 dB, maximum.
 17. FM Carrier-to-Noise Ratio: More than 24 dB.
- F. RF Leakage: Radio frequency leakage into the system shall be in compliance of all FCC rulings and regulations.
- G. Delay: Combined reverse and forward path chroma delay, as measured at the most distant bridged port, to the headend and or main distribution point in the building and back, shall not exceed 28 nanoseconds.

PART 2 - PRODUCTS**2.1 DISTRIBUTION AMPLIFIERS (NOT AT HEAD END)**

- A. This amplifier shall be used only in the distribution system and shall have the following specifications:
1. Frequency Range: As stated in [Section 27 41 34, Broadband Distribution System, Subparagraph 1.5. B.](#)
 2. Forward gain: 43 dB
 3. Gain Control Range: Greater or equal to 10 dB
 4. Slope Control Range: Greater or equal to 8 dB
 5. Input Return Loss: Greater or equal to 16 dB
 6. Noise Figure: Greater or equal to 7 dB
 7. Required output Level: 36/44 dBmV
 8. Hybrid technology: Power doubling
 9. Input/Output Test Point Level: -30 dB
- B. Design Selection: Blonder Tongue BIDA 5900 series, or approved equal with required pads and equalizers.

2.2 PASSIVE DEVICES

- A. All passive devices shall have a minimum bandwidth of 5 to 1000 MHz.
- B. Splitters for drops or backbones designed with RG-6 or RG-11 lines: Splitters shall be Blonder Tongue SXRS-2, 3, 4 & 8 as required by the system configuration.
- C. Directional Couplers for drops or backbones designed with RG-6 or RG-11 lines: shall be Blonder Tongue SRT series, with dB TAP setting as required by the system configuration.
- D. Splitters for backbones designed with PIII-500 or bigger diameter cable: shall be Toner TGSP series as required by the system configuration.
- E. Directional couplers for backbones designed with PIII-500 or bigger diameter cable: Shall be Toner TGDC series as required for the system configuration
- F. Multi-taps shall be Toner Total tap with 3 or 6 tap housings as indicated by the system configuration. Tap values and quantity of tap ports as indicated in system configuration.
- G. Equalizer. Equalizer shall be mounted in the tap housings and shall be a Toner TXMT plate. Equalizers could be mounted also inside distribution amplifiers. The value to equalize shall be as indicated in system configuration.

2.3 OUTLETS

- A. The television outlet shall provide one (1) "F" type barrel connector mounted alone or with other audio/visual system connectors on a common face plate. Outlets shall be mounted as indicated on the documents, or as otherwise indicated and directly in line with the proposed television location. Coordinate final location based upon provided drawings and coordination with the Owner. A three-wire grounded, 120 VAC power outlet shall be located adjacent to the television outlet and be provided by owner selected [Division 26, Electrical](#) Installer. Coaxial cable shall be provided by the CATV installer to each outlet location indicated on the drawings. Conduit and boxes shall also be provided according to specifications [Section 27 05 28, Pathways for Communication Systems](#). Coordinate location with electrical installer if not already provided at time of installation of this work.
- B. Design selection: F- connector with a single barrel connector to match (faceplate style and color) de design selection of the structured wiring system as described in specification [Section 27 10 00, Structured Cabling System](#).

2.4 VIDEO DISTRIBUTION CABLE

- A. Structural Return Loss Testing: All cable shall be 100% swept tested. Return loss shall not be less than 23 dB at any given frequency between 5MHz and 1000MHz.
- B. Construction: Cable shall be constructed of a copper clad steel or solid copper center conductor, gas expanded cellular polyethylene dielectric, multiple aluminum braided shields, and an overall jacket. All cables shall have characteristic impedance of 75 ohms.
- C. Attenuation: Attenuation characteristics in decibels per 100 feet at 20 °C shall not deviate more

than 10% from the following values:

FREQUENCY (MHz)	RG-6	RG-11	PIII-500
5	0.57	0.36	0.16
55	1.5	0.95	0.54
211	2.87	1.81	1.09
300	3.43	2.17	1.31
400	4.0	2.53	1.53
450	4.28	2.69	1.63
550	4.76	3.01	1.82
750	5.62	3.58	2.16
870	6.09	3.9	2.35
1000	6.54	4.23	2.53

- D. **RG-6 Cable:** No 18 AWG solid bare copper conductor. Four layers of shield, two aluminum foil-polyester tape aluminum foil, one 60% aluminum braid and one 40% aluminum braid. NEC article 820. Jacket shall be suitable for the environment being installed.
- E. **RG-11 Cable:** No 14 AWG solid bare copper center conductor. Two layers of shield, one aluminum foil-polyester tape aluminum foil and one 60% aluminum braid. NEC article 820. Jacket shall be suitable for the environment being installed.
- F. **PIII-500:** 0.109 inch diameter copper clad center conductor. Solid aluminum tube swaged onto a high compression micro-cellular foam dielectric core. NEC article 820. Jacket shall be suitable for the environment being installed.
- G. **Indoor Cables:** The following table indicates the design selection for all CATV cables. Cables shall be selected according to the environment in which they will be installed

CABLE TYPE	GENERAL (CM)	RISER RATED	PLENUM RATED
RG-6	Belden 5339Q5	Use plenum rated cable	Belden 6339Q8
RG-11	Belden 1617A	Use plenum rated cable	Belden 1153A
PIII-500	Use riser rated cable	Commscope P3 500 JCAR	

- H. **Outdoor Cables:** When coaxial cables are to be installed outdoors or underground in conduit, they need to have a jacket with a water blocking compound.
- I. **RG-59** cable shall never be used for the distribution system.
- J. For all fiber optic cables and connector for broadband distribution see specification [Section 27 10 00, Structured Cabling System](#). All connector for fiber optic cables shall be APC (Angled polished connectors) type connectors

2.5 CONNECTORS AND ADAPTER

- A. **Site Cable Connectors:** All connectors shall be as recommended by the Cable manufacturer for the cable size and jacket of the cable.
- B. **Connectors for RG-6 cables.** All connectors for RG-6 cable shall be one piece compression connectors with color coded sleeve. Design selection: Thomas & Betts, part number SNS1P6QS or equivalent.
- C. **Connectors for RG-11 cables.** All connectors for RG-11 cable shall be one piece compression connectors with color coded sleeve. Design selection: Stirling, part number SPL-11 or equivalent.
- D. **Connectors for PIII-500 cables.** All connectors for PIII-500 cable shall use a 5/8 inch 3 pin type connector. Design selection: Amphenol ACC-500-CHT10 or equivalent.
- E. **Adapters.** The installer shall provide all adapters to connect all different cables listed above to an F type connector or a to a 5/8 inch 3 pin connector, as required in the design to make complete connections. Design selection: Amphenol ACC series or equivalent.
- F. **Crimping:** All connectors shall be installed using the connector manufacturer's recommended cutting, coring and pin crimping tools.

2.6 SURGE SUPPRESSION

- A. All coaxial cables entering or exiting a building (above or below ground) shall be surge protected as required by NEC article 820.
- B. All surge suppression devices shall be grounded with an AWG-12 isolated wire to the closest electrical ground.
- C. All surge suppression devices shall be UL 497 listed, gas tube suppression, power passing and

specifically designed for broadband network applications.

- D. Design selection: TII in-line coaxial lighting surge protector 212FF757225-31

2.7 FIBER OPTIC BROADBAND TRANSMITTER

- A. The fiber optic broadband transmitter (FOBT) shall be able to transmit broadband signals over a single mode fiber optic link and shall be able to accommodate a variety of different modulation formats such as AM/VSB, 8VSB, QAM, QPSK, etc. The FOBT shall use a high- power, low noise 1310 nm distributed feedback (DFB) laser diodes to transmit the signals.
- B. The specifications of the FOBT shall be:
1. Channel loading: Same bandwidth as requested in [Section 27 41 34, Subparagraph 1.5.B](#) of this specification section.
 2. Operating Wavelength: 1310 nm
 3. Required Fiber Bandwidth: 1,000 min. MHz
 4. Input Return Loss: =/>>16 dB @ 75 Ohm
 5. Back Reflection: -50 min. dB
 6. Optical Output Power: as indicated in design documents.
 7. RF Input Level (110 Ch. Load): + 18 dBmV/Ch
 8. CNR (-1 dBm Input, 77 Ch. Load) + QAM 550-860 MHz @ -6dB Ref. Analog): ≥ 52 dB
 9. CTB: ≥ 69 dB
 10. CSO: ≥ -63 dB
 11. Side Mode Suppression Ratio (SMSR): 30 dB
 12. Fiber optic connector type: FC (APC)
 13. Mounting: rack mounted with built in power supply.
- C. Design selection: Blonder Tongue FIBT series or equivalent.

2.8 FIBER OPTIC BROADBAND RECEIVER AND AMPLIFIER

- A. The fiber optic broadband receiver (FOBR) shall be able to receive broadband signals over a single mode fiber optic link and shall be able to accommodate a variety of different modulation formats such as AM/VSB, 8VSB, QAM, QPSK, etc. The FOBR shall have an included distribution amplifier built in.
- B. The optical specifications of the FOBR shall be:
1. Channel loading: Same bandwidth as the FOBT.
 2. Bandpass Flatness: 1.0 dB P/V
 3. Operating Wavelength: 1310/1550 nm
 4. Optical Input Range: -6.0 to +3.0 dBm
 5. Output Impedance: 75 Ω
 6. CNR -1 dBm Input, 40 Ch. Load: 56 dB
 7. CNR -1 dBm Input, 79 Ch.+ Data: 55 dB
 8. CNR -1 dBm Input, 110 Ch. Load: 54 dB
 9. Input Connector: FC/APC
- C. The specifications of the distribution amplifier part of the FOBR shall be:
1. Channel loading: Same bandwidth as the FOBT.
 2. Impedance - All Ports: 75 Ohm
 3. Return Loss Output: 16 dB
 4. RF Gain: 43 dB
 5. Test Port: -30, ± 2 dB
 6. Gain Control Range: 10 dB
 7. Slope Control Range: 8 dB
 8. Number Of Hybrids: 2
 9. Hybrid Technology: Power Doubling
 10. Channel Loading: same as described in [Section 27 41 25, Subparagraph 1.4.B.](#)
 11. Flatness: ± 0.75 dB
 12. Output Level (Low/High): 34/42 dBmV
 13. Composite Triple Beat (CTB): -60 dB
 14. Composite Second Order (CSO): -58 dB
 15. Hum Modulation: -70

- D. Design selection: Blonder Tongue FRDA series.

2.9 FIBER OPTIC BROADBAND COUPLER

- A. The fiber optic broadband coupler (FOBC) shall be a passive device capable of splitting a broadband signal modulates in a fiber optic signal to multiple outputs.
- B. The specifications of the FOBC are:
 1. Number of Inputs: 1
 2. Wavelength: 1310 & 1550 nm
 3. Number of Outputs: As indicated in design drawings
 4. Connectors: FC/APC

Number of Outputs	2	3	4	6	8
Insertion Loss (Individual Port):	≤3.6 dB	6.0 dB	7.3 dB	9.7 dB	10.8 dB
Uniformity:	≤0.6 dB	1.0 dB	1.0 dB	1.0 dB	1.9 dB
Directivity:	≥ 50 dB	≥ 50 dB	≥ 50 dB	≥ 50 dB	≥ 50 dB

- B. Design selection: Blonder Tongue FOC-22 series

PART 3 - EXECUTION

3.1 INSTALLATION PRACTICES

- A. In Raceway: All cables shall be installed in raceways without kinks, dents, or abrasions. Specified pulling strength of cable shall not be exceeded.
- B. Separation of Raceways: USF does not allow the use of raceways or cable trays design for structured cabling systems to be used for CATV distribution cables with the exception of fiber optic cables. Raceways for audio/visual system can be used for CATV distribution cables when required. Cable tray supports can be used as supports for hangers for CATV distribution cables.
- C. Raceways for CATV outlets: Outlets for CATV cables shall be composed of a 4-inch square box with a single gang device adapter and a 1 inch conduit to the nearest accessible ceiling space.
- D. All indoor rated cables can be supported with j-hooks or cable hangers above accessible ceiling spaces. J-hooks shall be spaced no longer than 4 feet.
- E. All indoor cables shall have no splices at any points.
- F. Terminal Locations: Cables at terminal locations shall be neatly formed using a bending form to prevent kinks or other discontinuities. Cables showing evidence of abuse or physical damage shall be replaced at the installer's expense.
- G. It is envisioned that television service will migrate into the overall telecommunications scheme for a given facility, therefore television distribution shall be accomplished via the following methods. In general, television distribution points shall be located throughout the facility such and all wiring shall be run back to the Telecommunication room where the connection to the Broadband distribution backbone will take place.
- H. Location of CATV distribution equipment inside telecommunication rooms shall be closely coordinated with structured cabling system components.
- I. All unused outputs of splitters, directional couples or distribution taps shall have a 75 ohm termination installed.
- J. All unused cavities of the Toner Total Tap housing shall be filled with blank plates
- K. All equipment with a grounding lug shall be grounded as recommended by the equipment manufacturer to an acceptable grounding point as described by the NEC.
- L. All amplifiers shall be used at the rated output. The installer shall provide the required equalization and attenuation pads for all amplifiers to operate at the rated output at only 80% of the maximum gain control of the unit.
- M. Cable and equipment identifiers shall be provided and shall follow a standard labeling system like TIA/EIA-606. The identification system chosen by the CATV installer shall be submitted for approval.
- N. The only approved types of labels for cables and devices part of the broadband distribution system are:
 1. Non-laminated thermal transfer labels printed with a high quality thermal transfer printer.
 2. Laminated thermal transfer labels printed with a high-quality thermal transfer printer.

3. Thermal transfer polyolefin tape printed with a high-quality thermal transfer printer.
 4. Self-laminated dot-matrix labels printed with a high-quality dot-matrix printer.
 5. Non-laminated dot-matrix labels printed with a high-quality dot-matrix printer.
 6. Preprinted labels from marker books.
- O. Any type of write-on labels, handwriting on cable jackets or directly on equipment, labels made with masking tape or any other type of tape not listed in previous paragraph are not acceptable and shall be corrected with approved labeling methods at no additional cost to the owner.
- P. The installer shall use attenuator or adjustment for fiber optic equipment to ensure proper budget levels are getting to each receiver.

3.2 INSTALLATION OF CONNECTORS

- A. Provisions: All connectors shall be installed in strict accordance with the manufacturers' instructions.
- B. Residue Removal: All dielectric residues shall be removed from surfaces of center conductors to insure proper electrical contact.
- C. Preparation: Semi-rigid cables shall have jacket removed to a length of 2 inches from the cable end to allow proper seating of connectors without scoring of the aluminum sheath. A tubing cutter shall not be used for this purpose. All flooding compounds shall be removed from the connector location with a suitable solvent.
- D. Connections: All connections including terminations and connections on flexible cables shall be wrench tightened to insure RFI integrity.
- E. Tooling: Cables shall be prepared to accept connectors using the manufacturer's recommended tooling.
- F. Heat Shrink Boot: All cables containing flooding compound shall be provided with a heat shrink boot at all termination points which covers the housing connector boss, body of the connector and extends not less than 12 inches along the cable jacket. Heat shrink boot shall be of the filled type.
- G. Splices: Cable splices below grade or in other locations shall be made according to manufacturers' recommendations, tested, and covered with a filled heat shrink boot approximately 30 inches in length. Boot shall contain a resilient compound which melts as heat is applied and fills all voids between the shrink tube and cable jacket. Resin casts shall not be acceptable.

3.3 EQUIPMENT MOUNTING

- A. Mounting: All remote terminal equipment (amplifiers, taps, couplers etc.) shall be neatly arranged and securely mounted. When installed above the ceiling all devices need to be in accessible places.
- B. Integrity: All equipment housing hardware including amplifiers shall be wrench tightened to insure full RFI integrity.

3.4 SYSTEM ADJUSTMENTS

- A. Installation: System design drawings are based on estimated distances between devices. The installer shall measure the exact cable footages between equipment locations and submit a revised drawing to the engineer for review containing the following:
1. Exact footage of each cable
 2. Revised coupler and tap values
 3. Revised equalizer and pad values

3.5 SYSTEM PERFORMANCE

- A. General: Upon completion the system shall be adjusted, tested, and left in perfect operating condition.
- B. Provisions: The system shall not exhibit any audible or visible components of hum, noise, or distortion.
- C. Before the system acceptance test, the installer shall test all outlets in the system and document the result in a spreadsheet, called TEST RESULT REPORT (TRR). The TTR spreadsheets shall include the following information:

1. Project name and location
2. Day test was done (if done in different days, the report shall be broken in sections by days the tests were done).
3. Name of the installer that performed the test
4. Serial number of the tester used.
5. For each outlet in the project the report shall include:
 - a. Room number:
 - b. Room name:
 - c. Outlet number (with permanent label matching as-built drawings)
 - d. Lowest channel - signal level (in dBmV)
 - e. Mid bandwidth channel – signal level (in dBmV)
 - f. Highest channel (as identified in part 1 of this specification) – signal level (in dBmV)
6. For each amplifier in the system the report shall include:
 - a. Room number:
 - b. Room name:
 - c. Lowest channel - signal level (in dBmV, measured @ test port)
 - d. Mid bandwidth channel – signal level (in dBmV, measured @ test port)
 - e. Highest channel (as identified in [Section 27 41 34, Part 1](#) of this specification) – signal level (in dBmV, measured @ test port)

3.6 SYSTEM ACCEPTANCE TEST

- A. General: The Installer shall demonstrate the operation of the system to the Architect & Engineer (A/E) during the final inspection in the following manner:
 1. Measure signal levels with a calibrated field strength meter at outlets and or amplifiers selected by the A/E. At a minimum 5% of all outlets will be tested. The readings of the meter shall be between 1.5 dBmV of the value documented in the TRR
 2. Observe picture quality at outlets selected by the Engineer using a television receiver.
- B. If at least one measurement fails, the A/E can request to the installer to test more outlets (beyond the 5% indicated previously) until the A/E is satisfied with the results. Any failures shall be corrected by the installer at no additional cost to the owner.

3.7 TEST EQUIPMENT REQUIRED

- A. At a minimum during the acceptance test to the A/E the installer shall have the following equipment:
 1. TV Receiver: 17 inches minimum diagonal screen size color receiver in good working order.
 2. Signal Meter: Signal level meter capable of measuring peak carrier levels within the 5 MHZ to 1000 MHZ spectrum. The signal meter shall be capable of downloading test results to a computer system or directly to a printer. Example: Sadelco DisplayMax 500 or similar. This signal meter needs to be the same tester used during the TRR.
- B. Age and Calibration: Test equipment used in demonstrating system performance shall be less than 6 months old or bear the calibration seal of a recognized lab which is dated within 6 months of the date of acceptance test.

3.8 TRAINING

- A. The CATV installer shall provide training to the owner of the project.
- B. Training shall only be done after the final acceptance test has been completed and passed as indicated in this specification. Any test done prior to final acceptance will not be accounted for the formal training requested and the installer shall re-do all training after the final acceptance test is passed, at no additional cost to the Owner.
- C. The training shall include the following topics:
 1. How to make connectors part of this system with the provided tools.
 2. A walk-through of the facility pointing out the location of all active and passive equipment part of this system and showing to the owner the as-built drawings with matching labels for those pieces of equipment.
 3. A complete training on the use of the test tool provided.

3.9 SPARE PARTS AND TOOLS

- A. As part of this contract the installer of this system shall provide the following materials and tools:
1. Twenty (20) RG-6 connectors same make and model as the units used in this project.
 2. Five (5) 75 Ohm terminators (f connector)
 3. One (1) 5/8 inch 75 ohms terminator.
 4. Two (2) surge protectors.

3.10 AS BUILT DRAWINGS AND CLOSE-OUT DOCUMENTATION

- A. General: Complete system of as-built drawings shall be provided in AutoCAD (version as indicated in [Division 1, General Requirements](#) and include the following information:
1. A block diagram of the entire system indicating all cable routing and lengths
 2. Revised coupler and tap values for each cable drop
 3. All cable types, active components, and passive components.
 4. All equalizing and attenuating pads used for each amplifier.
 5. All system settings.
 6. All brands and part number of all devices shall be indicated in the drawings.
 7. Location of each outlet and the unique label identifier of each outlet.
 8. High/low signal level measured at each amplifier test port.
- B. The CATV installer shall also provide as part of the close out information the following information:
1. A copy of the TRR signed approved by the A/E.
 2. A copy of receipt of all spare parts and tools signed by the owner of the project.
 3. A copy of the training attendance list indicating the names of all attendees.
 4. A copy of all manufacturers' warranties.

END OF SECTION 27 41 34

SECTION 27 41 35 LARGE VENUE AUDIO/VISUAL SYSTEMS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. General: The General Requirements, Conditions of the Contract, these sections of the USF Design & Construction Guidelines (DCG), Drawings, Addenda and Contract Modifications (the Contract Documents), and definitions of legal entity (such as Contract, Installer, Engineer, Owner, etc.) shall apply to the work of this specification section.
- B. Supplemental: Refer to specification [Section 27 41 00, Common Work Results for Audio/Visual Systems, Part 1](#) for additional requirements, which are supplemented by this section.

1.2 SCOPE OF WORK (SOW)

- A. General: A large venue audio/visual system shall consist of any space with an occupancy above two-hundred (200) people. Among this type of rooms are Auditoriums, Theaters, large classrooms, multipurpose rooms, ballrooms, etc. This specification applies to all those rooms when audio/visual systems are required in those rooms.
- B. Program: It is required for the designer or consultant for the project to establish a specific audio/visual program for all large venue spaces, in conjunction with the owner and the users. The intent of the program is to indicate exactly all uses of the room and all types of activities that can be done by the users with the room.
- C. General: The scope of work for the installer of these rooms is to provide and install all equipment and wiring for the large venue rooms. Programming for these rooms is provided by the installer.
- D. The following is a list of large venue rooms where Audio Visual system shall be provided in this project:
 1. List all rooms.
- E. Consumables: The Audio-Visual System (AVS) Installer shall provide as part of the scope the following consumable devices:
 1. 10% of lamps for each type of projector used the projects.

1.3 ARCHITECTURAL CONSIDERATIONS

- A. General: AVS designers shall provide architectural recommendations for this type of rooms in the project. These recommendations shall include room layout, lighting and acoustics.
- B. Line of sight. All rooms in the audience shall have a line of sight of the projection screens. See screen sizing considerations in specification [Section 27 41 00](#).
- C. Tier seating is highly recommended in this type of rooms.
- D. Projection system. The preferred projection system for this type of room has to be determined with the owner and the users during the program phase. Single screen front projection systems are recommended for Auditoriums and Theaters.
- E. Lighting for this type of spaces shall be planned carefully. A software model of the lights is highly recommended for this type of room, to verify lighting levels in aisles, and projections screens. The use of a centralized dimming system for these rooms is highly recommended. The light fixtures selected by designers shall address the following scenarios:
 1. Clean-up or service lights, with 2x4 fluorescents or other high lumen output fixtures, non-dimmable.
 2. Dimmable down lights for notes or setting different scenes.
 3. Stage lights for presenters and performers.
 4. Step lights, for safety purposes at all steps.
 5. Decorative sconces or wall washers.
 6. For performing theaters or large auditoriums the use of a DMX system for stage lighting is recommended.
- F. Window shades. This type of rooms shall have black out window shades to control ambient lighting in the room. When the specific program requires electric shades, those shades shall be interface and controlled through the AVS.
- G. Acoustical considerations. Sound modeling for this type of room is highly recommended. Speaker shall be selected by designers with extreme care and balancing aesthetics and

performance. Walls and ceilings are recommended to have acoustic treatment.

- H. An AV room shall be considered for this type of spaces. Preferable located in the back of the rooms and with a view of the stage or the front of the room. When the program requires the use of a green room, communication between the AV room and the green room shall be installed as well as an audio and video feed from the stage or front of the room.

1.4 ROOM AUDIO/VISUAL FUNCTIONALITY

- A. General: The features for this type of rooms shall be identified and approved with the project manager for USF. There is no specific list of equipment required for these rooms, but there are certain guidelines that shall be followed.
- B. Microphones: Microphone connections from the stage shall be available in the AV room but also in the back of the room for a possible in audience console. Wiring for microphones shall be planned to be as flexible as possible, allowing for different microphone lay outs, and console locations.
- C. User interfaces shall be a touchscreen no smaller than 8 inches. Wireless touchscreen are highly recommended for this type of rooms.
- D. Signal types. Because of the high proliferation of high-definition system, it is highly recommended that the systems specified for this type of room be capable of managing high definition digital signals, including DVI, HDMI and Display Port.

PART 2 - PRODUCTS

2.1 APPROVED PRODUCTS

- A. General: See specification [Section 27 41 00, Part 2](#).
- B. A detailed list of equipment shall be presented to the owner for approval

PART 3 - EXECUTION

3.1 EXECUTION OF THE WORK

- A. General: See specification [Section 27 41 00, Part 3](#), for execution of work requirements supplemented by this specification section.
- B. Programming. Programming for the control system for this type of room will be done by the installer.
- C. UPS is required for this type of rooms for all control processors with monitoring capabilities through the RAMS.

3.2 TESTING

- A. General: Testing for this type of room shall be done by the installer and reviewed by the owner and design engineer. For this type of rooms all testing requirements described in [Section 27 41 00](#) shall be followed.
- B. Additional testing for this type of rooms is recommended like acoustic test.

3.3 TRAINING

- A. SYSTEM ADMINISTRATION TRAINING. The installer of the systems part of this specification section shall provide 12 hours of system administration training.
- B. USER TRAINING. The installer of the systems part of this specification shall provide at least 6 hours of user training in two (2) different sessions.

END OF SECTION 27 41 35