DIVISION 27
Section 27 10 00

Technology Systems
Design and Installation Guidelines
for Architects and Engineers

Pinellas County
Business Technology Services

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PART 1 - GENERAL

1.1 PURPOSE OF THIS DOCUMENT

A. The purpose of this specification section is to indicate to A&E and designers of low voltage infrastructure, working in construction or renovation projects for Pinellas County Government, the design requirements by BTS when it comes to such infrastructure. This document will be a starting point for completing a set of construction documents but **SHALL NOT** be used unedited as a bid document.

1.2 SCOPE OF WORK

A. General Scope: The Project Engineer (A&E) shall provide a complete design of the Structured Cabling system (SCS) and the Contractor shall provide a complete system including all raceways, wiring, termination, testing, warranty, and as-built documents as indicated in this specification. The design and construction will have oversight from BTS, but the Project Engineer shall also provide oversight on the work done by the Contractor or Installer. All design drawings and project specifications shall be provided by the Project Engineer. Additionally, the Project Engineer shall provide BTS with a list of all wiring counts in the project, per telecom room, for BTS to estimate the amount of active equipment required to be provided for the project. This list shall be provided at all design deliverables, not just at the end of the design.

B. System Scope: Furnish, install, test, and certify complete with all accessories, an ANSI/TIA 568C SCS with a minimum 25-year performance channel warranty for the entire system from the manufacturers and a minimum one year warranty for materials and labor from the SCS Installer for all components not covered under the manufacturer's 25-year warranty. The goal of the project is to provide an enhanced SCS that shall serve as a vehicle for the transport of voice telephony, data, audio, video, security, and low voltage devices for building controls and management, throughout the building, and from building to building from designated demarcation points to outlets located at various desks, workstations, and other locations as indicated in the contract drawings.

C. Coordination with Other Trades: It is the responsibility of the Installer of the SCS to verify and advise the Installer of the raceway infrastructure (conduit, boxes, cable tray, in ground boxes, etc.) for this system, on raceway routing to minimize the wiring distances to the telecommunication room. When J-Hooks are acceptable for use in structured

cabling system, all J-Hooks and supports for these devices shall be in the scope of work of the SCS Installer.

D. Demolition and Temporary Work: During execution of the work, all required relocation, demolition, temporary connections, rerouting, etc., of existing cabling, equipment, and systems in the existing building areas where the work is required, shall be performed by the SCS Installer as indicated on the drawings, or as required by job conditions, and as determined by the Architect in the field, to facilitate the installation of the new systems. The Owner shall require continuous operation of the existing systems while demolition, relocation work, or new tie-ins are performed.

E. Additional Scope: Refer to responsibility matrix indicated in Specification Section 27 00 10 Technology General Provisions for detail on who is providing each part of the scope.

F. Cable types: For leased or lease-to-own facilities used by Pinellas County, the SCS to be used shall be Category 6 cables and single mode or multimode fiber optics, including renovations. For Pinellas County owned facilities, the SCS shall be Category 6A and single mode fiber including renovations and new construction. These specifications cover both cases. The project engineer shall select the correct paragraphs to be used on each specific project.

G. Specific Part Numbers: These specifications cover general structured cabling elements and their performance-based specifications. Please contact BTS for specific part numbers.

1.3 RELATED DOCUMENTS

A. Supplemental: Refer to the specification sections identified below for additional requirements, which are supplemented by this section:

1. 27 00 10 Technology General Provisions
2. 27 05 28 Raceways for Technology
3. 27 05 26 Grounding and Bonding for Communication Systems

B. Standards: All work related to the SCS shall adhere to the following industry codes and standards latest edition:
1. ANSI/TIA-568.0-D “Generic Telecommunications Cabling for Customer Premises” with addendums and errata
2. ANSI/TIA-568.1-D, “Commercial Building Telecommunications Cabling Standard” with addendums and errata
3. ANSI/TIA-568-C.2, “Balanced Twisted- Pair Cabling Components Standard” with addendums and errata

4. ANSI/TIA-568.3-D, “Optical Fiber Cabling Component Standard” with addendums and errata
5. ANSI/TIA-569-D, “Telecommunications Pathways and Spaces” with addendums and errata
6. ANSI/TIA-606-C, “Administration Standard for Telecommunications Infrastructure” with addendum and errata
7. ANSI/TIA-607-C, “Generic Telecommunications Bonding and Grounding (earthing) for Customer Premises” with addendum and errata
8. ANSI/NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
9. ANSI/TIA 758-B, “Customer-Owned Outside Plant Telecommunications Infrastructure Standard” with addendum and errata
10. ANSI/TIA 862-B, “Structured Cabling Infrastructure Standard for Intelligent Building Systems” with addendum and errata
11. ANSI/TIA-1152-A, “Requirements for Field Test Instruments and Measurement for Balanced Twisted Pair Cabling” with addendum and errata.
12. ANSI/TIA-526-7-A, “Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant”
13. ANSI/TIA-526-14-C, “Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant”
14. TIA-598-C, Optical Fiber Cable color coding
15. IEC/TR3 61000-5-2 - Ed. 1.0 and amendments. “Electromagnetic compatibility (EMC) - Part 5: Installation and mitigation guidelines - Section 2: Earthing and cabling”
16. ANSI/TIA-942-B, “Telecommunications Infrastructure Standard for Data Centers” with addendum and errata
17. ANSI/BICSI 002-2014, Data Center Design and Implementation Best Practices
18. ANSI/NFPA 70 “National Electrical Code”, CSA C22.1.
19. BICSI Telecommunications Distribution Methods Manual (TDMM)
20. BICSI Telecommunications Cabling Installation Manual (TCIM)
21. BICSI Customer Owned Outside Plant Manual (COOPM)
22. Local County/City Codes, Ordinances and Regulations
23. Underwriters Laboratories (UL)
24. FCC - Federal Communications Commission
25. ADA Requirements
26. Occupational Safety and Health Regulations (OSHA)
27. National Fire Protection Association (NFPA)
28. ANSI/TIA-1179, Healthcare Facility Telecommunications Infrastructure Standards
29. Florida Statutes and Administrative Rules
30. Manufacturers Product Cabling Catalogs
31. Manufacturers Training Manuals (Design and Installation)

C. General: Installation practices for SCS as describe herein take precedence over any other section in the construction documents set.

1.4 STRUCTURED CABLING SYSTEM INSTALLER QUALIFICATIONS

A. General: The Installer selected for the project must be certified by the manufacturer of the products for no less than one year, adhere to the engineering, installation, and testing procedures, and utilize the authorized manufacturers components and distribution channels in provisioning the Project.

B. General: The Installer directly responsible for this work shall be a Structured Cabling System (SCS) Installer who is, and who has been, regularly engaged in the providing and installation of commercial and industrial telecommunications wiring systems of this type and size for at least the immediate past five years. Any other company working for the SCS Installer of this system shall have the same training and certification as the SCS Installer.

C. Certification: The SCS Installer's Project Manager shall possess a current and in Good Standings BICSI Registered Communications Distribution Designer (RCDD®) certificate. All shop drawings submitted by the SCS Installer shall bear the RCDD's stamp.

D. The SCS Installer shall have a (BICSI) RCDD on Staff. Third party RCDDs will not be accepted.

E. The Installer team leader assigned for the project shall be BICSI registered Level II Installer or proven and qualified equal.

F. Experience: The SCS Installer shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The SCS Installer shall own and maintain tools and equipment necessary for successful installation and testing of SCS and have personnel who are adequately trained in the use of such tools and equipment. The Owner or Engineer may elect to request submittal of additional financial, operational, and administrative information of the SCS Installer to demonstrate the required experience.

G. Legrand/Ortronics certification for no less than one year.

H. The SCS Installer shall possess a State of Florida Low Voltage License.

I. The SCS Installer shall maintain a permanent office within 70 miles of the project site, capable of servicing low voltage installations.

1.5 MATERIALS ALTERNATES AND SUBSTITUTIONS

A. SCS Installer shall follow all requirements for material alternates and substitutions indicated in Specification Section 27 00 10 Technology General Provisions. If an alternate or substitution is submitted BTS must be notified in writing and provide approval.

1.6 SHOP DRAWINGS AND SUBMITTALS.

A. See additional requirements for shop drawings and submittals in Specification Section 27 00 10 Technology General Provisions.

B. Proposal Submittals: The SCS Installer shall submit the following information with the proposal to execute the work:

1. A list of five recently completed projects of similar type and size with contact names and telephone numbers.
2. A list of test equipment proposed for use in verifying the integrity of the installed SCS. Test equipment list shall include manufacturer part numbers, serial numbers, and a copy of the last calibration report done by the manufacturer of the equipment of the unit, indicating the date when the calibration was performed. Calibrations shall not be older than one year. Test equipment includes cable certifiers, OTDRs, fiber splicers, etc.
3. A technical resume of experience for the Installer's Engineer/RCDD and on-site foreman who will be assigned to the project, including RCDD license number and certificate.
4. Similar documentation for any company working for the SCS Installers who will assist in the performance of this work.
5. A copy of a current and valid Low voltage License for the State of Florida.
6. A copy of the certification of authorized distribution for Legrand/Ortronics.
7. Location of office from which installation and warranty work will be performed.

C. Construction Submittals: Once all proposal submittals have been received and approved by the A&E of the project, the SCS Installer shall provide all construction submittals. Construction submittals are composed of the following items.

1. Manufacturer cut sheets for all proposed equipment as described in Part 2 of this specification section. Cut sheets shall bear the printed logo or trademark of the manufacturer for each type of product being provided. Mark each copy of the cut sheets for the specific product being provided with an identifying mark, arrow, or highlighting.
2. Faceplate/jack color selection. Must adhere to approved material list.
3. Detail explanation of the labeling scheme to be used for all components of the system. This explanation shall include examples of all types of labels to be used, such as labels for cables, patch panels, outlet jacks, etc.
4. AutoCAD® or Revit drawings in sheets matching the size of the design documents with the following information:
    a. Floor plans with all outlets in the project. All outlets must be labeled to be used during identification and tagging process described in this specification section.

b. Enlarged telecommunication rooms with all equipment components and rack layouts for each room. All racks shall have the label to be used during identification and tagging process described in this specification section.
c. Drawings that indicate rack elevations for all cabinets or racks in the project, identifying the precise quantity of patch panels, fiber distribution centers and wire managers and accurate RU heights based on equipment selection. All equipment shall have the label to be used during the identification and tagging process described in this specification section.
d. A spreadsheet indicating all patch cords (fiber and copper) to be provided in the project. The spreadsheet shall indicate the quantity, color of the jacket, cable type, length, and connector termination on each side.

D. Construction submittals received before proposal submittals are received or approved will be rejected.

1.7 ABBREVIATIONS

A. General: The following abbreviations are used in this specification section:
1. A&E - Architect and Engineer. The Architect is the legal entity that holds a contract for the design the project. The Engineer is the consulting engineer firm or engineer of record for the project who prepared this specification.
2. APC - Angle physical contact connector. Reference to the polish style of the ferrule in fiber optic connectors.
3. Array connector - a multi-strand fiber connector user for high density applications, such as the MPO connector.
4. BICSI - Building Industry Consultant Services International
5. CCTV - Closed Circuit Television system (surveillance video system)
6. FCC - Federal Communications Commission
7. FTP - Foiled Twisted Pair. One foiled screen around each cable pair
8. IDC - Insulation Displacement Connector
9. NEC - National Electrical Code®
10. NEMA - National Electrical Manufacturers Association
11. OM1 - ISO 11801 designation for multimode 62.5/125µm glass fiber optics
12. OM2 - ISO 11801 designation for multimode 50/125µm glass fiber optics
13. OM3 - ISO 11801 designation for multimode laser optimized 50/125µm glass fiber optics
14. OM4 - TIA designation for multimode laser optimized 50/125µm glass fiber optics in compliance with TIA-492-AAAD
15. OS1 - ISO 11801 designation for single mode 9/125µm glass fiber optics.
16. OS2 - ISO 11801 designation for single mode 9/125µm glass fiber optic with performance criteria identical to ITU-T G652
17. OTDR - Optical Time Domain Reflectometer

18. RU - Rack Units. Height dimension for rack mounted equipment. 1 RU equivalent to 1.75 inches
19. SCS - Structured Cabling System
20. ScTP - Screened Twisted Pair. One foiled screen around all cable pairs
21. TIA - Telecommunications Industry Association
22. TR - Telecommunications Room
23. UPC - Ultra Physical Contact Connector. Reference to the polish style of the ferrule in fiber optic connectors.
24. UTP - Unshielded Twisted Pair
25. UV - Ultraviolet
26. VAC - Volts Alternating Current

PART 2 - PRODUCTS

2.1 MODULAR SCS JACKS

A. Structured cabling system outlets indicated in design drawings are composed of modular SCS jacks, mounted in a faceplate on an electrical box. Modular SCS jacks shall be 8-pin modules (RJ-45) that meet or exceed the following electrical and mechanical specifications:

1. Electrical Specifications:
    a. Insulation resistance: 500 MΩ minimum.
    b. Dielectrics withstand voltage 1,000 VAC RMS, 60 Hz minimum, contact-to-contact and 1,500 VAC RMS, 60 Hz minimum from any contact to exposed conductive surface
    c. Contact resistance: 20 M Ω maximum
    d. Current rating: 1.5 A at 68 º F (20 º C) per IEC publication 512-3, Test 5b
    e. ISO 9001 Certified Manufacturer
    f. UL verified for EIA/TIA electrical performance
    g. Comply with FCC Part 68
    h. Cable Termination: IDC type universal T568A or T568B.
2. Mechanical Performance:
    a. Plug Insertion Life: 750 insertions
    b. Contact Force: 3.5 oz (99.2 g) minimum using FCC-Approved modular plug
    c. Plug Retention Force: 30 lb. (133 N) minimum between modular plug and jack
    d. Temperature Range: -40º to 150ºF (-40 º to 66 º C)

B. Design selection: modular SCS jacks shall be selected according to the following criteria:

1. Performance requirement: CAT6A
2. Style: Rear loading
3. Mounting Orientation: Straight mounting
4. Color: To match faceplate
5. Dust cover required: No
6. Shielding: Use shielded modular jacks only with ScTP cable

C. Approved manufacturer: See Division 27 approved material list.

2.2 OTHER MODULAR JACKS

A. Whenever indicated in the design drawings, SCS outlets could have terminations for other media types like fiber optic cables, coaxial cables, or audio cables. Whenever those type of media are identified in the drawings, the following specifications shall be met for modular jacks mounted in SCS outlets:

1. Style, mounting orientation, and color: Match design selection for modular SCS jacks.
2. Broadband distribution system connector: Use modular jack with F connector bulkhead rated at 75Ω.
3. Fiber optic connectors: Use modular jack with adapter plate for LC.
4. For line level audio signals: Use modular jack with RCA connector bulkhead. Use different color-coded insulators for different audio channels.

B. Approved Manufacturer: See Division 27 approved material list.

2.3 FACEPLATES

A. Faceplates shall be used for all flush mounted telecommunication outlets to house modular jacks. Faceplates shall have the following specifications:

1. Construction Material: High impact thermo Plastic.
2. Size: Only use single gang faceplates unless specifically noted in the design drawings.
3. Capacity of Modular Jacks per Faceplate: Faceplate shall be selected to accommodate the number of cables in each telecommunication outlet. No less than one unused opening shall be present on each faceplate.
4. Color: Submit color to A&E and BTS for approval.
5. Labels: Faceplate shall have two recesses for labels, top and bottom, and shall have transparent label snap-on covers.
6. Faceplate Style: Direct modular plug rear loading style.

B. Approved Manufacturer: See Division 27 approved material list.

2.4 FACEPLATES WITH SUPPORT STUDS

A. Telecommunication Outlets Indicated in the Design Drawings: Wall mounted telephone outlets shall be composed of one modular SCS jack and one faceplate with support studs mounted on an electric box. Faceplates with support studs shall have the following specifications:

1. Construction Material: Stainless Steel.
2. Size: Use single gang faceplate with two support studs.
3. Capacity of Modular Jacks per Faceplate: One.
4. Faceplate style: Direct modular plug rear loading style.

B. Approved manufacturers: See Division 27 approved material list.

2.5 SURFACE MOUNTED BOXES

A. Telecommunication outlets indicated in the design drawings: Surface mounted outlets shall be composed of modular jacks mounted in a surface mounted box inside an electrical enclosure. Surface mounted boxes shall have the following specifications:

1. Construction Material: High impact thermo Plastic.
2. Capacity of Modular Jacks per Surface Mounted Box: Size of surface mounted box shall be selected as to accommodate the number of cables in the surface mounted telecommunication outlet. No more than one unused opening shall be present on each box.
3. Color: Fog White.
4. Labels: Surface mounted boxes shall have at least one recess for labels and shall have transparent label snap on covers.

B. Approved Manufacturers: See Division 27 approved material list.

2.6 MOUNTING FRAMES

A. All telecommunication outlets shall be properly mounted in the electrical raceway system provided for the outlet. The SCS Installer shall select the proper mounting frame and/or bezel to mount the modular plugs in the raceway system. Raceway systems include furniture systems, floor boxes, poke-thrus, power poles, surface raceways system, etc.

B. Whenever design drawings indicate a telecommunication outlet to be mounted in a furniture system, the SCS Installer shall select the proper mounting frame to hold the modular jacks in the furniture system selected by the Owner. Color of the mounting frames shall match the color of the furniture system.

C. If Owner provided furniture system does not have a raceway system for telecommunication, and design drawings indicate outlet to be mounted in the furniture system, SCS Installer shall provide a plastic surface mounted box that allows the mounting of the modular plugs in a standard telecommunication faceplate.

D. SCS Installer shall provide all mounting frames and bezels to mount modular jacks inside floor boxes or poke-throughs.

E. All un-used ports in mounting frames shall be covered with blank inserts.

F. Approved Manufacturers: See Division 27 approved material list.

2.7 HORIZONTAL 4-PAIR CABLE

A. General: Horizontal 4-pair cables shall be extended between the telecommunications outlet location and its associated equipment inside the TR. The cable shall consist of 4-pair cable solid copper conductors, certified to the specified performance standard. All horizontal 4-pair cables shall be terminated in modular jacks and patch panels with IDC type connectors and shall have the following specifications:

1. Cable Gauge: Minimum 23 AWG
2. Performance Standard: TIA/EIA CAT6A
3. Cable Type: UTP
4. Performance Characterized to 600 MHz
5. Time Delay Skew: Maximum 45 ns/100m
6. Input Impedance (1-100MHz): 100Ω
7. Cable Diameter: ≤ 0.295 inch

B. Cable jacket colors for 4-pair horizontal cables shall be selected according to the following preferred criteria:

1. Voice or Data Cables: Yellow and/or appropriately identified.
2. Wireless Access Points: White or Yellow, and/or appropriately labeled.
3. Security Systems and Other: Coordinate with the A&E and BTS.

C. Performance Verification: All performance of horizontal 4-pair cable shall be verified by a Nationally Recognized Testing Laboratory (NRTL) for EIA/TIA electrical performance and comply with FCC Part 68.

D. Jacket: Cable jacket for inside premise cables shall comply with Article 800 NEC for correct use in the environment in which they will be used. If at time of bid the SCS Installer does not know the environment, in which cables will be used, the SCS Installer shall assume plenum rated is required for the project. At a minimum all cables shall have a flame retardant PVC jacket riser rated.

E. OSP Jackets: All horizontal 4-pair cable runs in conduits below the floor slab shall have a water-resistant flooding compound and a jacket made of UV resistant polyethylene. Cables with PVC jackets are not acceptable for this application.

F. Jacket Marking: All horizontal 4-pair cables shall have at least two types of markings imprinted in the jacket, transmission performance marking and NEC rating for environment to be used.

G. Approved Manufacturer: See Division 27 approved material list.

2.8 PATCH PANELS FOR HORIZONTAL CABLING

A. All 4-pair horizontal cables shall be terminated in rack mounted patch panels located in the telecommunication room racks. These patch panels shall have the following specifications:

1. Connector Type: 8-position modular plug (RJ-45)
2. Cable Termination: IDC type universal T568A or T568B
3. Performance Requirement: CAT6A
4. Maximum Connectors per Path Panel Allowed: 48
5. Patch Panel Type: Factory preloaded panels
6. Patch Panel Shape: Angled
7. Permanent Marking: All connectors shall be labeled in sequential numbers
8. Field Labels: Patch panels shall have a space for field labels covered with transparent protectors
9. Shielding: use shielded patch panels only with ScTP cable

B. Approved manufacturers: See Division 27 approved material list.

2.9 HORIZONTAL WIRE MANAGERS

A. Horizontal wire managers shall be mounted in racks to route cables from patch panels to vertical wire managers and to equipment. Horizontal wire managers should be used when flat patch panels are installed and have the following specifications:

1. Style: Finger duct style with hinged cover
2. Sides: Front of rack front and back of rack
3. Minimum height: Two RU

B. Approved manufacturers: See Division 27 approved material list.

2.10 CROSS OVER WIRE MANAGERS

A. Cross over wire managers shall be used to route patch cables from the right vertical wire manager to the left vertical wire manager or between racks. Cross over wire managers shall have the following specification:

1. Style: Six port finger spacing with a cover
2. Sides: Front of rack
3. Minimum Height: Four RU

B. Approved Manufacturers: See Division 27 approved material list.

2.11 FOUR PAIR PATCH CORDS

A. Four pair patch cords are required at the work area side and at the patch panel side to complete the connectivity path to the equipment. All 4-pair patch cords shall be factory tested and shall have molded boots to the cable jacket. Field made patch cords are not acceptable. Four pair patch cords shall have the following specifications:

1. Connectors: 8-pin modular plugs at both ends
2. Conductors: 4-pair stranded conductors
3. Wire gauge: For the telecom room side: AWG-28
   For the work area side: AWG23/AWG24
4. Wiring map: See section 3 of this specification
5. Performance requirement: To match horizontal 4-pair cable performance
6. Cable type: UTP

B. Approved Manufacturers: See Division 27 approved material list.

C. SINGLE STRAND FIBER OPTICS CONNECTORS

D. All fiber optic cables (horizontal or backbone cables) shall be terminated on fiber optic connectors at both ends of the cable with either single strand fiber optic connectors or array connectors. Single strand fiber optic connector shall be compliant with industry standard ANSI/TIA-568-C.3 and the applicable TIA/EIA Fiber Optic Connector Intermateability Standard (FOCIS) document, TIA/EIA 604 series. Single strand fiber optic connectors shall have the following specification:

1. Physical Contact Type: Use UPC type connector for all applications except for applications of Broadband TV distribution systems or DAS systems. For those applications use APC type connectors
2. Connector Type: LC
3. Security Level: Non-keyed connector
4. Pairing Style: Simplex
5. Acceptable Connector Attachment Types:
    a. Splice on connectors. Fusion spliced connectors with factory polished finish.
    b. Fusion-spliced pigtails with factory polished connectors
6. Fiber Type: SCS Installer shall select the connector according to the fiber type where connector will be installed. As an example, use OM1 connectors only in OM1 fiber optic cables
7. Fusion Spliced Pig Tails: When using fusion spliced pig tails the SCS Installer shall make sure the fiber type of the pig tail and the actual cable have the same optical characteristics, such as back scatter, core diameter, etc.
8. Ferrule Construction: Use ceramic ferrule connectors only, plastic ferrules are not acceptable

E. All single strand fiber optic connectors shall include boots to protect the fiber optic cable. The SCS Installer shall select the boot according to the fiber optic type selected. As an example, use 900µm boots in 900µm coated fiber, use 250µm boots on 250µm coated fiber and use 2mm boots on 2mm jacketed fiber. All boots shall be color coded to identify the type of fiber connector used. Boots shall be beige for OM1 fiber, black for OM2, aqua for OM3 and OM4. Green for APC. OM5 is lime green. OS1 is blue.

F. Single strand multimode fiber optic connectors shall have the following performance requirements:

1. The maximum insertion loss shall be 0.75 dB (maximum) when installed in accordance with the manufacturer's recommended procedure and tested in accordance with FOTP-171.
2. Connector reflectance shall be less than or equal to -26 dB when installed in accordance with the manufacturer's recommended procedure.
3. Connectors shall sustain a minimum of 500 mating cycles without violating specifications.

4. Connectors shall have an optical axial pull strength of 2.2 N (0.5lbf) at 90º angle, with a maximum 0.5dB increase in attenuation for both tests when tested in accordance with ANSI/EIA/TIA-455-6B.

G. Single strand single mode fiber optic connectors shall have the following performance requirements:

1. Maximum insertion loss shall be 0.75 dB per each mated connector pair when installed in accordance with the manufacturer's recommended procedure and tested in accordance with FOTP-171.
2. Connector reflectance shall be less than or equal to -40 dB (UPC) when installed in accordance with the manufacturer's recommended procedure.
3. Connectors shall sustain a minimum of 500 mating cycles without violating specifications.
4. Connectors shall have an optical axial pull strength of 2.2 N (0.5lbf) at 90º angle, with a maximum 0.5 dB increase in attenuation for both tests when tested in accordance with ANSI/EIA/TIA-455-6B.
5. Connectors shall meet the following performance criteria:

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

H. Approved Manufacturers: See Division 27 approved material list.

2.12 FIBER OPTICS SPLICES

A. When fiber splicing is required in the project because of the use of pigtails or field splicing, only fusion splicing will be acceptable.

B. All fiber splices shall be terminated with heat shrink sleeves and organized in splice trays. Splice tray sizes shall be selected to match the quantity of fiber strands in the cable bundles. Splice trays shall be organized in Fiber Optics Distribution Centers when inside a telecom room or in outdoor rated splice enclosures when done outdoors.

C. Fusion splice equipment to be used in this project shall have the following specifications:

1. Alignment System: Automatic Core Detection system (ACD). V-groove splicers are not allowed.
2. Typical Splice Loss for Single Mode Fibers: 0.02 dB
3. Splice Loss Result: Estimated (ACD)
4. Unit shall have a fast heat shrink oven, maintenance free electrodes, built in cleaver and graphical user interface to display alignment condition.
5. Cleaver Blade Type: Diamond.

2.13 INSIDE PREMISE FIBER OPTICS HORIZONTAL CABLES

A. Telecommunications outlets could have fiber optic terminations. Whenever design drawings indicate fiber optic terminations, inside premise fiber optic horizontal cables shall be used. The following are the specifications for fiber optic horizontal cables:

1. Strand Count: Two strands.
2. Fiber Type: OS1/OS2 as indicated in design drawings.
3. Fiber Coating: 900µm coating color coded.
4. Fiber Protection: Aramid yarn.
5. Jacket Type: 2.9mm flame-retardant PVC jacket zip-cord type.
6. Color Jacket: Jacket shall be orange for OM1 or OM2 fiber, aqua for OM3 or OM4 fiber and yellow for OS1 or OS2 fiber.

B. Jacket: Cable jackets for fiber optic cables shall comply with Article 770 NEC for correct use in the environment in which they will be used. If, at time of bid, the SCS Installer does not know the environment in which cables will be used, the SCS Installer shall assume plenum rated is required for the project. At a minimum, all cables shall have a flame retardant PVC jacket riser rated. Rating shall be printed in the cable jacket.

C. OSP Jackets: All fiber optic horizontal cables run in conduits below the floor slab shall have a water-resistant flooding compound and a jacket made of UV resistant polyethylene. Cables with PVC jackets are not acceptable with this application.

Approved Manufacturers: See Division 27 approved material list.

2.14 INSIDE PREMISE FIBER OPTICS BACKBONE CABLES

A. Whenever design drawings indicate fiber optics backbone cables to be run inside premises, the following specification shall be followed for those cables:

1. Strand Count: As indicated in design drawings
2. Fiber Type: As indicated in design drawings
3. Fiber Coating: 900µm coating color coded. 250µm coating is acceptable for loose buffer cables but they shall be protected with break-out kits with color coded 900µm buffers at both ends of the cable
4. Fiber Protection: Aramid yarn around all strands for cables under 24 strands, and aramid yarn and jacket around each subunit (6 or 12 strands) for cables above 24 strands
5. Interlock Requirement: Interlock dielectric armor is required
6. Jacket Type: Flame-retardant PVC jacket or materials with superior performance
7. Color Jacket: Jacket shall be orange for OM1 or OM2 fiber, aqua for OM3 or OM4 fiber and yellow for OS1 or OS2 fiber
8. Fiber Termination: Fibers shall be field terminated
9. Buffer Type: Tight buffer
10. Center Strength Member Material: Dielectric material

B. Jacket: Cable jackets for fiber optic cables shall comply with Article 770 NEC for correct use in the environment. If, at the time of the bid, the SCS Installer does not know the environment, in which cables will be used, the SCS Installer shall assume plenum rated is required for the project. At a minimum all cables shall have a flame retardant riser rated jacket. Rating shall be printed in the cable jacket.

C. Approved Manufacturers: See Division 27 approved material list.

2.15 FIBER OPTIC DISTRIBUTION CENTERS

A. All fiber optic cables shall be terminated in fiber optic distribution centers. Inside premises horizontal fiber optic cables shall be terminated in one side (telecommunication room side) in a fiber optics distribution center (FODC). Backbone fiber optic distribution centers shall be terminated at both ends in a FODC. FODC are composed of an enclosure and snap on adapters. These are the specifications of the enclosures for the FODC:

1. Mounting: Use rack mounted FODC enclosures in all rooms where racks are available or any type of rack rails. Use wall mounted FODC enclosures only when racks are not available like in outdoor enclosures, or other spaces different than telecom rooms.
2. Size: SCS Installer shall size the FODC based on the amount of fiber strands to be terminated in the FODC.

3. Whenever fiber splices are indicated in the design drawings next to an FODC, enclosures shall be selected by the SCS Installer to have spaces to hold splice trays. FODCs under these conditions shall be able to hold the amount of splice trays required for the fiber count indicated in the drawings.

B. These are the specifications of the snap on adapters for the FODC:

1. Style: Plate style
2. Connector type: LC to match fiber types of fiber optic cables
3. Maximum fiber strands allowed per adapter: 24
4. Security level: Non-keyed connector keyed connector
5. Pairing style: Duplex

C. Approved Manufacturers: See Division 27 approved material list.

2.16 FIBER OPTICS PATCH CORDS

A. Fiber optic patch cords shall be required for connections from active equipment to FODCs and/or to telecommunication outlets. Fiber optic patch cords shall be required at both ends of fiber optics backbone cables or horizontal fiber optic cables. Direct connection of backbone cables or horizontal fiber optic cables to active equipment shall not be allowed.

B. Fiber optic patch cords shall be all factory tested. Field made fiber optic patch cords are not acceptable. The specifications of the fiber optic patch cords shall be:

1. Strand Count: Two strands.
2. Fiber Type: Match fiber type of backbone cable or horizontal cable.
3. Fiber Connector in FODC or Outlet Side: Match connector for each adapter
4. Fiber Connector in Active Equipment Side: The SCS Installer shall coordinate with supplier of equipment the type of connector required in this side.
5. Fiber Protection: Aramid yarn
6. Jacket Type: 2.9mm flame-retardant PVC jacket zip-cord type.
7. Color Jacket: Jacket shall be orange for OM1 or OM2 fiber, aqua for OM3 or OM4 fiber and yellow for OS1 or OS2 fiber.

C. Approved Manufacturers: See Division 27 approved material list.

2.17 INSIDE PREMISE MULTIPAIR BACKBONE CABLES

A. Whenever indicated in the drawings multipair backbone cables to be run inside premises and above grade shall have the following specification:

1. Pair Count: As indicated in the design drawings.

2. Conductor: AWG 24 solid bare copper conductor.
3. Input impedance: 100 Ω.
4. Conductor Insulation: Color coded thermo plastic.
5. Performance Requirement: UL verified to ANSI/TIA-568-C Category 3 backbone cable or greater.

B. Jacket: Cable jacket for inside premise multipair backbone cables shall comply with Article 800 NEC for correct use in the environment in which they will be used. If at the time of the bid, the SCS Installer does not know the environment in which cables will be used, the SCS Installer shall assume plenum rated is required for the project. At a minimum all cables shall have a flame retardant PVC jacket riser rated.

C. Jacket Marking: All inside premise multipair backbone cables shall have at least two types of markings imprinted in the jacket, transmission performance marking and NEC rating for environment to be used.

D. Approved Manufacturers: See Division 27 approved material list.

2.18 TERMINATION OF MULTIPAIR BACKBONE CABLES

A. Backbone multipair backbone cables for inside premises or outside plant shall be terminated in termination blocks or patch panels. See design drawings for specific types on each case.

B. TSER – service provider terminations. TSER will be a hub-and-spoke design feeding each IDF/MDF.

C. Whenever indicated in the design drawings, multipair backbone cables shall be terminated in patch panels. Patch panels for this purpose shall have the following specifications:

1. Connector Type: 8-position modular plug (RJ-45).
2. Connector Wiring Map: One pair per connector pins 4 and 5 (blue pair).
3. Cable Termination Type: IDC type connector.
4. Performance Requirement: CAT3.
5. Maximum Connectors per Path Panel Allowed: 96.
6. Permanent Marking: All connectors shall be labeled in sequential numbers.
7. Field Labels: Patch panels shall have a space for field labels covered with transparent protectors.
8. Shielding: Unshielded.

D. Whenever indicated in the design drawings, multipair backbone cables shall be terminated in rack mounted termination blocks. Termination blocks for this purpose shall have the following specifications:

1. Preference is to have backbone cables terminate onto Cat 5E patch panels, one pair per port, when installing in racks.

E. Whenever indicated in the design drawings, wall-terminated multipair backbone cables shall be wall mounted termination blocks. Termination blocks for this purpose shall have the following specifications:

1. Connector Type: 66 style connectors
2. Cable Termination Type: IDC type connector
3. Performance Requirement: CAT3
4. Pair Counts: Use only 300 pair blocks in quantities as required for backbone cables.
5. Wire Managers: All termination blocks shall have a wire manager installed at both sides of the blocks and between blocks.
6. Clip Types: Use 66 style bridge clips.
7. Field Labels: Termination blocks shall have a space for field labels covered with transparent protectors.
8. Mounting: Termination block shall be mounted with legs on the wall.
9. We would prefer to use 66 blocks and backboards.

F. Approved Manufacturers: See Division 27 approved material list.

2.19 PATCH CORDS FOR MULTIPAIR BACKBONE CABLES

A. Patch cords shall be used to connect horizontal wiring to termination blocks for multipair backbone cables. Depending on the type of termination for backbone cables, the patch cord shall be selected.

B. When multipair backbone cables are terminated in patch panels, patch cords for these patch panels shall have the same specification as the 4-pair patch cord cables described above.

C. When multipair backbone cables are terminated in wall mounted or rack mounted termination blocks, patch cords shall have a patch plug connector in one end and an 8-pin modular plug (RJ-45) in the other end. The SCS Installer shall coordinate with the phone system Installer and determine if one pair or two pairs are required for each phone. Patch cords shall have one or two pairs according to the equipment selection. Patch plugs shall only be one or two pairs accordingly. Patch plug selection shall match the manufacturer and family of products of the termination blocks.

2.20 TWO POST RACKS

A. Whenever indicated in the design drawings, two post racks shall be provided as shown. Two post racks shall be made of aluminum or welded steel frames and shall have a powder coat finish. Two post racks shall have the following specifications:

1. Height: Equipment cabinet shall provide a usable height between 44 and 45 RU.
2. Channel Depth: Six inch, ten inch, 16 inch, or 24 inch – dependent on design build, use 24 inch for planning and bids.
3. Rack Rails Type: Standards EIA 19 inch located in the front and back of rack. Rack rails shall have RU marked and labeled.
4. Rack Screw Type: #12-24 threaded rack rails. Screws shall be provided for all openings in rack rails and shall be made of steel.
5. Weight Capacity: UL listed for 1000 lb. or more.

B. Two post racks shall be provided with the following accessories:

1. Cable runway mounting brackets to support cable runway installed above racks.
2. Isolation pads.
3. Grounding kit.
4. Ground bar: All cabinets shall be provided with a copper vertical ground bar covering the complete length of the rack rails. The ground bar shall be 1/8 inch thick and one inch wide with threated holes 1032 mounted to the cabinet using nylon insulation washers.
5. End panels to support vertical wire managers at both ends of each rack row.

C. Front vertical wire managers shall be provided in between all racks and at both ends of rack rows covering from top to bottom of each rack. The specifications of those wire managers shall be:

1. Style: Metal cage with dual hinged door cover.
2. Sides: Single sided wire manager.
3. Capacity: Usable cross-sectional area shall be minimum of 48 sq. inches in between racks and at the end of the racks.

4. Accessories: Whenever cable manager supports the use of spools inside the unit, spools shall be provided at all locations in the unit.
5. Generally, use ten inch vertical wire managers at the ends of rack rows and ten inch verticals between the racks, unless otherwise stipulated by BTS.

D. Approved Manufacturers: See Division 27 approved material list.

2.21 POWER DISTRIBUTION UNITS (PDU)

A. All equipment cabinets or racks in the project shall be provided with two PDUs. PDU selection shall be dictated by power requirements. The following specifications are required for all types of PDUs:

1. All units shall have monitoring through an IP Ethernet line, unless specifically indicated in the description of each PDU. The monitoring shall include the following parameters:
   a. Current and voltage for each phase available in the unit
   b. Peak Voltage, peak current, and power factor for each phase available in the unit
2. Switched capacity per each circuit or per outlet not required.
3. All units shall have an LCD display to show all monitoring settings with scrolling capabilities.
4. All PDUs and power transfer shall be the same brand and monitored with the same DCIM software.
5. No less than two ports for environmental sensors such as temperature. Two temperature sensors shall be provided with each cabinet. If the unit does not have the possibility of monitoring the temperature sensors, a separate unit just for the sensors will be acceptable.
6. Threshold remote alarms through e-mail, SNMP traps or XML.
7. No need for external software, all features shall be available through web browsing if external software monitoring is available.
8. Color coding for PDUs. Units shall be color coded. Half the PDUs on each rack shall be one color and the other half another color. There will be two types of colors used: black and blue. The color coding of the PDUs shall include the connector assembly bar and the input cord (close to the plug). Refer to design drawings for quantities of each.
9. All devices shall have a continuous operating temperature range of 50 to 113 DEGF.
10. Surge suppression is not required for any device.
11. S, M, L, XL

B. For equipment cabinets (two per cabinet):

1. Power Strip Capacity: 120/208V 30A
2. Quantity of Power Outlets: No less than 30
3. Power Outlet Configuration: Two C19 @ 208V, twelve C13 @208V and sixteen NEMA 5-20R.
4. Strip Power Cord Plug: NEMA L14-30.
5. Breaker: Built in thermal breaker with guard protection. Capacity to match power strip capacity.
6. Monitoring: digital display included with readings of amperage and voltage.
7. Surge Suppression: included and built in.
8. Listing: UL listed.
9. Mounting: Vertically mounted, not occupying any rack space, with mounting accessories. The installation of the power strip shall not prevent the removal or installation of equipment in the rack.

C. Approved Manufacturers: See Division 27 approved material list.

2.22 RACK MOUNTED UNINTERUPTED POWER SUPPLY (UPS)

A. All equipment cabinets or racks in the project shall be provided with one uninterrupted power supply (UPS). UPS selection per rack shall be as indicated in design drawings. The following descriptions apply to each type of UPS:

B. UPS units labeled in drawings as “208V UPS” shall have the following specifications:

1. Output Power Capacity: 4200 W/6000 VA
2. Output Voltage: 120V and 208V, using a transformer.
3. Efficiency at Full Load: 95%
4. Output Voltage Distortion: Less than 5% at full load.
5. Output Frequency: (sync to mains) 57 - 63 Hz for 60 Hz nominal.
6. Topology: Double Conversion online.
7. Waveform Type: Sine wave.
8. Output Connections: (4) NEMA 5-20R, (1) NEMA L14-30R and (1) L6-30
9. Nominal Input Voltage: 120/208V
10. Input Frequency: 50/60 Hz +/- 5 Hz (auto sensing).
11. Input Connections: NEMA L14-30
12. Battery Type: Maintenance-free sealed Lead-Acid battery with suspended electrolyte, leak-proof.
13. Run Time: 9 minutes at full load.
14. Communications: RJ-45 10 Base-T Ethernet for web/ SNMP/ Telnet management included.
15. Surge Energy Rating: 1020 Joules

16. Filtering Full Time Multi-pole Noise Filtering: 0.3% IEEE surge let-through: zero clamping response time: meets UL 1449.
17. Rack Height: No bigger than 7U, including transformer.
18. Regulatory Approvals: CSA, FCC Part 15 Class A, UL 1778.

C. Approved manufacturers: See Division 27 approved material list.

2.23 MOUNTS FOR WIRELESS ACCESS POINTS.

A. General: Mounts for wireless access points shall be provided at all locations where WAP outlets are located. The A&E shall select the proper mount for each case, based on the architecture of the space and the WAP selection by BTS. Although many conditions might be possible in a building, there are 4 basic mount types:

1. Accessible ceiling mount: For areas with regular acoustic tiles (2’ x 2’ or 4’ x 2’) a WAP mount with the following specifications shall be used:
    a. Grid mount
    b. Recessed tile mount
    c. Secured tile mount
    d. The mount shall replace a complete 2’ x 2’ tile and shall have a backbox to hold the WAP
    e. The unit shall have a locking, interchangeable door specifically selected for the WAP by BTS
    f. Enclosure shall be UL listed for plenum use
    g. Unit shall have a firestop grommet for insertion into back-box, large enough for two CAT6A cables
    h. Enclosure shall be designed to hold 25 lbs. of weight
    i. Construction: 20 ga. Galvanized steel back-box, 18 ga. White, powder coated steel flange and door
    j. Enclosure shall be installed with secondary supports from structure above
    k. Approved manufacturers: See Division 27 approved material list.
2. Hard Ceilings: For areas with hard ceilings, the WAPS shall be mounted inside enclosures composed of a backbox and trim kit. The units shall have the following specifications:
    a. Basic
    b. Decorative
    c. The unit shall have a locking, interchangeable trip for the WAP selected by BTS
    d. Enclosure shall be UL listed for plenum use
    e. Unit shall have a firestop grommet for insertion into back-box, large enough for two CAT6A cables
    f. Enclosure shall be designed to hold 25 lbs. of weight

g. Construction: 20 ga. Galvanized steel back-box, 20 ga. White, powder coated steel trim. Solid backbox fills opening behind WAP, creating a fire and smoke barrier
h. Approved manufacturers: See Division 27 approved material list.

3. Wall Mounted: For open ceiling spaces or ceilings higher than 12', WAPS shall be wall mounted with an angle bracket with the following specifications:
   a. Wedge shaped right-angle mounting bracket with cover for securing WAPs on wall. The mount shall be designed to mount the AP in the horizontal orientation
   b. Unit shall have one-inch knockouts in the side for conduit connections
   c. Unit shall cover the telecommunications outlet
   d. Construction: 20 ga. Powder-coated steel
   e. Approved manufacturers: See Division 27 approved material list.
4. Outdoor Enclosures: For mounting outdoors use a mount with the following specifications:
   a. Design: Rugged polycarbonate AP enclosure designed for surface mounting AP indoors or outdoors
   b. Unit shall be capable of being wall or pole mounted
   c. Enclosure shall be design as a NEAM 4X and IP 66 with UV stabilized exposure for sun light
   d. Unit shall have a cover with screws and gasket
   e. Approved manufacturers: See Division 27 approved material list.

2.24 CABLE FASTENERS

A. Velcro must be used to provide a neat and organized installation. Use 0.75 inch width or greater.

B. To support and organize all horizontal cabling, to include inside premise backbone cables, only the following types of cable ties shall be used:

1. Hook and loop style, re-usable with Velcro no smaller than 0.5 inch width.
2. Pre-perforated rolls of re-usable ties with Velcro no smaller than 0.5 inch width.
3. Straps of other soft materials with cinch rings that allow for re-use of the cable ties in widths no smaller than 0.85 inches.

C. Nylon based cable ties (re-usable or not) can only be used to support and organize the following types of cables:

1. Outside plant fiber and copper backbone cables.
2. Inside premise fiber optic backbone cables with interlock armors.
3. Grounding conductors.

D. Nylon based cable ties shall never be used to support or organize any type of horizontal cables or inside premise fiber optic backbone cable without armor.

E. All cable ties to be used in outdoor environments shall be made of weather resistant Acetal. Outdoor cable ties used for aerial cable lacing shall follow Telcordia TR-TSY-000789 standard.

F. All cable ties shall be selected in lengths as to properly secure the bundle of cable being supported.

G. All cable ties to be used in air handling spaces, such as above ceiling and under raised floor areas, shall be UL listed for the use in those environments.

H. Approved Manufacturers: See Division 27 approved material list.

2.25 IDENTIFICATION AND LABELING TAGS

A. SCS Installer shall follow labeling materials indicated in Specification Section 27 00 10 Technology General Provisions.

PART 3 - EXECUTION

3.1 TELECOMMUNICATIONS OUTLET DESIGN

A. General: The A&E shall work with the end users in selecting the locations and cable counts for telecommunications outlets. As a starting point for conversations, the following quantities shall be followed for outlet and cable counts, for different work areas.

Standard work area, defined as an area of approximately 100 sq. ft. located in an o pen office environment with modular furniture:

- Quantity: One outlet with two cables/jacks, mounted in modular furniture, power pole or wall outlet at 18 inches AFF.
- One quad or two duplex 120 VAC power outlets by desk.

Closed office (less than 100 sq. ft.). A closed office with only one desk:

- One outlet with two cables/jacks, wall mounted at 18 inches AFF.
- One quad or two duplex 120 VAC power outlets by desk.

Closed office (greater than 100 sq. ft.) for more than one staff. Multiple desks located in the room:

- One outlet with two cables/jacks, wall mounted, by each desk at 18 inches AFF.
- One quad or two duplex 120 VAC power outlets by each desk.

Closed office (greater than 100 sq. ft.) for one staff. Large office for a single person with an auxiliary table. Director level office:

- Three outlets: one by desk, one by auxiliary table and one in an opposite wall of the desk. Outlets by the desk and auxiliary table will have 2 cables/jacks and no cables in the outlet opposite to the desk. All outlets wall mounted at 18 inches AFF.
- One quad or two duplex 120 VAC power outlets by desk and at the opposite wall of the desk. One duplex outlet by the auxiliary table.

Print area/work room. Space designated by a large printer, and other office devices:

- One outlet with two cables/jack by large printer (floor standing). 220 VAC power next to it at 18 inches AFF.
- Two outlets with two cables/jacks distributed along the working surface, 6 inches above working surface splash. One quad or two duplex 120 VAC power outlets by each telecommunications outlet.

Work area for customer service location with requirement for credit card transactions. Cashier's, Clerk's work area.

- One outlet with four cables/jacks per location wall mounted at 18 inches AFF.
- One quad and one duplex or three duplex 120 VAC power outlets by each telecommunications outlet.

Conference Rooms:

- General: At least one floor box/poke thru in the table, with a minimum of four data/cable for a conference phone system, plus the capacity to have cables for audio/visual presentation. Typically, there is no need for hard wired data connections for staff using the room. Do not locate telecommunications outlets along the walls in the room for general use, only for displays and equipment located in the perimeter of the room. (For new construction where floor boxes are to be installed) locate floor boxes close to the conference table legs, not necessarily in the center of the room. Coordinate with Owner/architect for precise location.
- Huddle Areas and Small Conference Rooms: One single data jack and one coax at TV height, dual data jack at standard height.

- Medium Conference Room: One floor box with two data jacks and power, ceiling projector, one data jack, and duplex power, TV one single data jack and one coax at TV height.
- Large Conference Rooms (≥12 seats): No less than two floor boxes at opposite end of the table. Provide 120 VAC duplex power outlets with USB charges in all walls in conference rooms and at each floor box. Additional power and telecommunications might be required for Audio/visual equipment in the room. Example: podiums, AV cabinets. See Specification Section 27 41 00 Audio/Visual Systems.

Break Rooms:

- One wall mounted telephone outlet (48" AFF) close to the door. Separated at least 12" from any other outlets/switches.
- One telecommunications outlet by each group of vending machines. One cable/jack per vending machine.
- Power outlet, as required by breakroom/kitchen equipment. Also provide power outlets with USB chargers in the wall, close to break room tables.

Wireless Access Points

- Wireless access shall be provided to cover the complete building.
- Each WAP location shall have a telecommunications outlet surface mounted with two cables/jacks in a biscuit style box, mounted above the ceiling close to the WAP mounting enclosure.
- Cable terminations in plugs for direct attach connections to devices are not acceptable.
- For areas with ceiling higher than 12', WAPs shall be wall mounted in a 45-degree mounting bracket. In such case, use a biscuit style box inside the outlet box or the wall mounted enclosure.
- There is no need for power outlets for WAPs in building indoors. They might be required for outdoor WAPs when located far away from telecom rooms.

Mechanical/Electrical/Telecom rooms:

- There is no need for wall mounted phones inside these rooms. Only telecommunications outlets for equipment that requires such lines, like Building Automation Head end, Fire Alarms panels and Lighting control panels. Quantity of cables/jacks shall be no less than two per outlet but needs to be coordinated with MEP designers.
- Outlet termination shall be a surface mounted biscuit box inside a 6" X6"X4' electrical box.
- Power outlets as dictated by Electrical Engineer.

Elevators, Escalators, and Moving Walkways:

- One outlet with two cables/jacks for elevators, one cable/jack for other devices.

Access Control Panels Outside of Telecom Rooms:

- Outlet termination shall be a surface mounted biscuit box inside a 6" X6"X4' electrical box. Location shall be carefully coordinated with equipment vendor
- Power outlets as dictated by Electrical Engineer.

Flat Panel Displays or Individual Offices. Displays to be used for Commercial TV, *not part of an AV System*:

- One outlet box with a flush mounted faceplate with one cable/jacks for future IPTV and one coaxial (F type) jack.
- One duplex 120 VAC power outlets by each telecommunications outlet.
- Outlet locations shall be coordinated with architect and display mount selection. In many cases mounting the outlets at the centerline of the display will conflict with display mount.

Flat Panel Displays Part of an Audio/Visual system. Like Conference Rooms, Training Rooms, Combinable Rooms, and Other Assembly Type of Rooms:

- A larger box for power and low voltage terminations, like the Wiremold Evolution Wall backbox.
- Two duplex 120 VAC power outlets inside outlet box.
- Outlet location shall be coordinated with architect and display mount selection. In many cases mounting the outlet displays in the middle will conflict with display mount.

Ceiling Mounted Projectors:

- Cables/jacks and termination style shall be dictated by Audio/visual designer. Do not locate a ceiling mounted telecommunications outlet unless is requested by Audio/visual designer.

Surveillance Cameras:

- Each camera shall be provided with one telecommunications outlet with one cable/jack for each camera. Mount outlet in a surface mounted biscuit jack. Install outlet above the ceiling or inside outlet box for wall mounted applications. Do not use standard flush mounted faceplates for data terminations for cameras.
- Cable terminations in plugs for direct attach connections to devices are not acceptable

- There is no need for power outlets for cameras in building indoors. They might be required for outdoor cameras when located far away from telecom rooms.

3.2 INSTALLATION PRACTICES

A. General: All installation requirements indicated in Specification Section 27 00 10 Technology General Provisions shall be followed.

B. Workmanship: All work shall be completed by the SCS Installer in a neat and professional manner. The use of all BICSI standards and recommendations for installation shall be followed as the benchmark for workmanship.

C. Cable Lengths: It is the SCS Installer's responsibility to plan the cable routing in the cable tray and other raceways to minimize all cable runs to stay under the 90-meter length limitation for Horizontal Cabling except for UTP cables to outlets for Wireless Access Points for which the distance limitation is 80 meters. All Horizontal cable shall be placed without diagonal runs. (i.e., parallel to walls and ceiling grid) unless otherwise specifically indicated on the drawings.

D. Wire Mapping: All terminations of 4-pair horizontal cabling in this project and terminations of all 4-pair patch cords shall be per T568B standard.

E. Fiber Optics Termination Polarity: All fiber optic cables (horizontal or backbone) terminated in duplex style adapter panels shall be connected in a cross-over polarity configuration. As an example, if fibers one and two are terminated in one end in positions A and B respectively in one side of the cable, the same strands shall be terminated in B and A positions in the other side of the cable.

F. Location of Horizontal Terminations: In a multi-story facility with telecommunication rooms on every floor, all horizontal drops, whether terminated in the wall or in floor boxes shall be terminated in the same floor telecommunications room as the location of the final outlet.

G. Cable Bundles: In suspended ceilings and raised floor areas, if cable trays or conduits are shown on the contract drawings, the SCS Installer shall bundle, in bundles of 40 or less, horizontal wiring with Velcro. The cable bundling shall be supported via "CLIC" fasteners in TR's and non-plenum areas and J-Hooks in ceiling spaces. The SCS Installer shall adhere to the manufacturers' requirements for bending radius and pulling tension of all cables.

H. CLIC Fasteners: Horizontal cables shall be suspended by "CLIC" fasteners with cable inserts in TRs on the plywood area where ladder tray or rack management is not available per the design documents. Listings: "CLIC" fasteners shall be in accordance with NEC and BICSI standards. Above the plywood area J-Hooks or D-rings should be used.

I. Fire Stop Protection: Sealing of openings between floors, through rated fire and smoke walls, existing or created by the SCS Installer for cable pass through shall be the responsibility of the SCS Installer. Sealing material and application of this material shall be accomplished in such a manner, which is acceptable to the local fire and building authorities having jurisdiction over this work. Creation of such openings as are necessary for cable passage between locations as shown on the drawings shall be the responsibility of the SCS Installer's work. Any openings created by or for the SCS Installer and left unused shall also be sealed as part of this work. Penetration rating shall equal structure rating.

J. New Materials: All components, wiring and materials to be used for the installation of the SCS shall be new and free of defects. Used components, wiring and materials shall only be used when specifically indicated in the design drawings.

K. Damage: The SCS Installer shall be responsible for any damage to any surfaces or work disrupted because of their work. Repair of surfaces including painting and ceiling tile replacement shall be included as part of this contract.

L. Avoiding EMI: To avoid EMI, all pathways shall provide clearances of at least four feet from motors or transformers; one foot from conduit and cables used for electrical-power distribution; and five inches from fluorescent lighting. Pathways shall cross perpendicular to fluorescent lighting and electrical-power cables and conduits. The SCS Installer shall not place any distribution cabling alongside power lines, or share the same conduit, channel, or sleeve with electrical apparatus.

M. Work External to the Building: Any work external to the confines of this building as shown on the drawings shall be governed by the provisions of this specification.

N. Demolition: Any task part of the installation of the SCS requiring relocation, rerouting and/or demolition shall be done according to the following requirements:

1. Coordination: Prior to any deactivation and relocation or demolition work, arrange a conference with the Architect and the Owner's representative in the field to inspect each of the items to be deactivated, removed, or relocated. Care shall be taken to protect all equipment designated to be relocated and reused or to remain in operation and be integrated with the new systems.

2. Provisions: All deactivation, relocation, and temporary tie-ins shall be provided by the SCS Installer. All demolition, removal, and the legal disposal of demolished materials of system designated to be demolished shall be provided by the SCS Installer.
3. All Existing Voice/Data cables and connecting hardware not to be used after the new installation is complete and within the areas where work is required as part of this project shall be removed by the SCS Installer. All existing cables to be left for future use if indicated by the Owner shall be tagged for that purpose.
4. Owners Salvage: The Owner reserves the right to inspect the material scheduled for removal and salvage any items he deems usable as spare parts.
5. Phasing: The SCS Installer shall perform all work in phases as directed by the Architect to suit the project progress schedule, as well as the completion date of the project.

O. Blank Inserts and Panels: All telecommunications outlets with faceplates or mounting frames with unused terminations shall be plugged with blank inserts or panels. Blank inserts shall match the color of the faceplate or mounting frame. No more than one blank module shall be required for each faceplate. All unused ports in the FODC enclosures for adapter panels shall be filled with blank adapter panels.

P. Patch Panel and FODC Separation: Horizontal cables shall be terminated in separate patch panels according to the use of the cable. Each series of patch panels or FODC for a specific use shall have at least 20% spare capacity of ports. Patch panels of the same use shall be mounted consecutive in the equipment cabinets or racks. The following separation for patch panels and FODCs shall be provided:

1. Cables for any other specialty systems like security systems or others shall all be terminated in separate patch panels from any other cables.
2. Horizontal fiber optic cables shall be terminated in separate FODC from fiber optics backbone cables.
3. Single mode fiber optic backbone cables shall be terminated in separate FODC from multimode fiber optic backbone cables.

Q. Supports for Rear of Patch Panels: All patch panels for horizontal cables shall be provided with a rear support bar to hold the cable and to provide strain relief. At a minimum one rear support bars shall be provided for each two rows of 24 connectors.

R. Horizontal Wire Managers: Horizontal wire managers shall be provided typically on retro fit projects following these criteria:

1. At least one above and below each straight (flat) patch panel.
2. At least one above and below any network switches.
3. At least one below any rack mounted termination block.

S. Cross Over Wire Managers: Cross over wire managers shall always be used with angled or curved patch panels. One cross over wire manager shall always be installed in the middle of each rack at the same height on every rack.

T. Patch Cord Quantity, Color and Lengths: Copper and fiber optics patch cords shall be provided per following chart. All percentage calculations shall be rounded off to the nearest integer number.

TYPE	QUANTITY	COLOR JACKET	LENGTH
4-pair at work area outlet	One for 90% of all 4-pair horizontal cables in the project	Match horizontal cable color jacket	30% 7', 50% 10' and 20% 14'. SCS Installer shall field verify these percentages to provide more accuracy.
4-pair at WAP location	One for 100% of all 4-pair horizontal cables for WAPS in the project + 10% spare	Match horizontal cable color jacket	The SCS Installer shall field verify all lengths to match location of WAPS selected by Owner or wireless survey.
4-pair at Surveillance camera	One for 100% of all 4-pair horizontal cables for cameras in the project +10%	Match horizontal cable color jacket	The SCS Installer shall field verify all lengths to match location of cameras.
4-pair at patch panel side (excluding surveillance cameras and WAPs)	One for 90% of all 4-pair horizontal cables in the project	Match horizontal cable color jacket	40% 7', 40% 10', 20% 14'. SCS Installer shall field verify these percentages to provide more accuracy.
4-pair at patch panel side (surveillance cameras and WAPs)	One for 100% of all 4-pair horizontal cables in the project +10%	Match horizontal cable color jacket	For pricing purposes use: 40% 7', 40% 10', 20% 14'. SCS Installer shall field verify these percentages to provide more accuracy.

(Patch Cord Table continued on next page)

TYPE	QTY	COLOR JACKET	LENGTH
2-strand fiber optics at work area outlet	One for 100% of all 2-strand horizontal fiber cables in the project + 10% spare	Per fiber type	50% 8’ and 50% 10’
2-strand fiber optics at FODC.	One for 100% of all horizontal 2-strand fiber cables and one for 83% of all fiber strands of backbone cables in the project. For example, a 24-strand cable shall require 20-2-strand patch cords or 10 for each side of the cable	Per fiber type	20% 6’, 60% 10’, 20% 14’ SCS Installer shall field verify these percentages to provide more accuracy.
One or two pair for copper backbone cross connects	One for 90% of all backbone copper pairs installed in the project.	Gray	For pricing purposes use: 80% 2M, 20% 3M. SCS Installer shall field verify these percentages to provide more accuracy.

U. Cable Slack: Cable slack shall be provided for all cables in the project following this guideline:

1. At each work area outlets, all horizontal cables shall have 3’ of slack above ceiling.
2. At the telecom room side all horizontal cables shall have at least 6’ neatly organized on the wall using a figure 8 configuration or a non-loop shaped arrangement with Velcro straps.
3. Backbone cables at termination points shall have at least 15’ of slack neatly organized on the wall using a standard loop and Velcro straps.
4. Outside plant backbone cables run through in-ground pull boxes greater than 24 inches X 24 inch shall include one service loop inside the box.

V. Bend Radius: Installation of Fiber Optic Cables shall be in accordance with ANSI/TIA-568C guidelines and cable manufacturer specifications. Bend radius parameters shall be followed for load and no-load conditions. Cable installation and terminations that do not comply shall be replaced by the SCS Installer. If no recommendation is specified by cable manufacturer, at least the following criteria shall be met:

1. The bend radius for intrabuilding 2 and 4-fiber horizontal optical fiber cable shall not be less than one in under no-load conditions. When under a maximum tensile load of 222 N (50lbf), the bend radius shall not be less than two inches.
2. The bend radius for intrabuilding optical fiber backbone with fiber counts above four shall not be less than ten times the cable outside diameter under no-load conditions and no less than 15 times the cable outside diameter when the cable is under tensile load.
3. The bend radius for interbuilding optical fiber backbone shall not be less than ten times the cable outside diameter under no-load conditions and no less than 20 times the cable outside diameter when the cable is under tensile load up to the rating of the cable, usually 2670 N (600lbf).

W. Innerduct: Innerduct shall be provided from end to end of a raceway system under the following conditions:

1. Inside underground conduits as indicated in design drawings.
2. For horizontal fiber optic cable or inside premise fiber optics backbone cables without interlocking armor when routed through cable trays, ladder trays or vertical conduit sleeves. This requirement is usually not indicated in the drawings but indicated only in this specification.
3. For backbone fiber optic cable in vertical risers.

X. SCS Protection During Construction: The SCS Installer shall protect all SCS materials from damage during construction. Racks shall be covered with fabric or plastic after mounting to prevent dust, debris and other foreign materials having contact with SCS devices. The SCS Installer shall protect, at all times, all fiber optic and copper cables from damage during installation. All cables shall maintain the physical integrity as manufactured for testing and delivery to the Owner. All damaged cables shall be replaced at no additional cost to the Owner.

Y. Cable Bonding: Shielded cables or cables with metal strength or protection members (like interlocking armor) shall be bonded to the telecommunications grounding system as indicated in Specification Section 27 05 26 Grounding and Bonding for Communication Systems.

Z. Rack Installation: All racks shall be installed leveled and plumbed. Four post racks and two post racks shall be anchored to the floor and shall be installed with isolation pads. Equipment cabinets shall be leveled using the leveling feet unless design drawings specifically indicate to leave them on the casters.

AA. Rack Bonding: All equipment cabinets and racks shall be bonded to the telecommunication grounding system as indicated in Specification Section 27 05 26 Grounding and Bonding for Communication Systems.

3.3 IDENTIFICATION AND TAGGING

A. General: Identification and tagging of SCS components shall be executed by the SCS Installer. At a minimum, identification and tagging shall be provided for the following components of the system:

1. All horizontal and backbone cables at both ends of the cable in the cable jacket. Labels on each side shall be different indicating the location of the other side of the cable.
2. All faceplates indicating all jacks terminated in the faceplate.
3. All patch panels.
4. All racks.
5. All termination blocks.
6. All telecommunication rooms and outdoor enclosures.
7. All interbuilding backbone cables inside in ground pull boxes outside of the building shall have a visible label in each box they pass through.

B. The SCS Installer shall follow the Owner provided identification system. If Owner does not have any preference or standard the SCS Installer shall provide a system for approval of the A&E and the Owner as indicated in the submittal paragraph of this specification. The identification system shall follow the TIA/EIA 606-B standard.

3.4 TESTING OF COPPER CABLING

A. General: Horizontal and backbone cabling shall be verified in accordance with ANSI/TIA/EIA-568-C, Cabling Transmission Performance and Test Requirements.

B. For all 4-pair copper cabling terminated for the use of building systems or systems provided under the contract, such as surveillance cameras, emergency phones, elevator phones, WAPs, Access control panels, and building automation equipment the required test shall be a permanent link style test. A permanent link test is defined as a test that does not include the patch cords to be used in the project.

C. For all 4-pair copper terminated for the use in work areas such as computers and phones, the test method selected for all 4-pair copper cabling is a permanent link style test. Permanent link test is defined as a test that does not include the patch cords to be used in the project.

D. General: In the event the A&E elects to be present during the tests, provide notification to the Engineer two weeks prior to testing.

E. General: The Installer's RCDD shall sign off on all copper and fiber optic cable test results, indicating that he/she was responsible for all cable testing procedures and that all cables

were tested in compliance with the contract documents and met or exceeded the requirements stated herein.

F. Testing Equipment: Tester shall be as manufactured by Agilent, Fluke, IDEAL or Wavetek. Tester shall be 100% Level III(e) compliant with ANSI/EIA/TIA 568C specifications for testing of the CAT6A cabling. No tester will be approved without meeting these requirements.

G. Each jack in each outlet shall be tested at a minimum to the manufacturer's performance of the cable to verify the integrity of all conductors and the correctness of the termination sequence. Testing shall be performed between work-areas and the equipment rack patch panel. Prior to testing UTP runs, the tester shall be calibrated per manufacturer guidelines. The correct cable Nominal Velocity of Propagation (NVP) shall be entered into tester to assure proper length and attenuation readings.

H. Documentation of cable testing shall be required. The SCS Installer shall provide the results of all cable tests in electronic format (final results in PDF format and raw data). Each test page shall be separated by standard page break (one test per page). The test results shall include sweep tests, continuity, polarity checks, wire map, Attenuation, NEXT, PSNEXT, FEXT, PSFEXT, ELFEXT, PSELFEXT, ACR, Return Loss, Delay Skew, and the installed length. Cables not complying with the EIA/TIA 568C tests results shall be identified to the A&E for corrective action which may include replacement at no additional expense to the Owner. All identification names of the cables used in the test shall match the labeling system approved for the project and the corresponding shop drawings.

I. Any Fail, Fail*, Pass* or WARNING test result yields a Fail for the channel or permanent link under test. To achieve an overall Pass condition, the result for each individual test parameter must be passed. All test results shall come from a tester with the permanently enabled marginal reporting feature.

J. Test results shall show and comply with the margin claimed by the manufacturers over CAT6A permanent link specifications on all transmission parameters across the entire frequency range as shown on the manufacturer's cut sheets.

K. General: Copper multipair backbone cabling shall be tested for length, continuity, polarity checks, and wire map. The SCS Installer shall provide the results of all Copper Riser cable tests in electronic format. The use of pigtails or special harness could be required to properly test these cables.

L. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests.

M. All 4-pair patch cords shall be factory tested only.

3.5 TESTING OF FIBER OPTICS CABLING

A. General: Horizontal and backbone cabling shall be verified in accordance with ANSI/TIA/EIA-568-C and the addendum for fiber optic testing.

B. General: In the event the Engineer elects to be present during the tests, provide notification to the engineer two weeks prior to testing.

C. Cleanliness: All fiber optic connectors shall be cleaned properly before any testing and after testing. Proof of cleanliness shall be required during the acceptance test for the SCS by the A&E. SCS Installer shall have available during this test a 200X microscope or a video probe to demonstrate the cleanliness of the randomly selected connectors by the A&E.

D. End to End Attenuation Test: The SCS Installer shall perform end-to-end attenuation testing for each multimode fiber at 850 nm and 1300 nm from both directions for each terminated fiber span in accordance with EIA/TIA-526-14A (OFSTP 14) and single-mode fibers at 1310 nm and 1550 nm from both directions for each terminated fiber span in accordance with TIA/EIA-526-7 (OFSTP 7). A one jumper reference shall be used for all testing. For spans greater than 90 meters, each tested span must test to a value less than or equal to the value determined by calculating a link loss budget. For horizontal spans less than or equal to 90 meters, each tested span must be < 2.0 dB. When calculating the link loss budget for spans greater than 90 meters use the values listed below. End to end attenuation shall be done with a Level II meter using a meter and light source equipment (also known as main and remote unit)

ATTENUATION DUE TO	FIBER TYPE	MAX. ATTENUATION
Terminating connectors. Field terminated options	All fiber types	0.75 dB per connector
Terminating connectors. Field terminated options	All fiber types	No more than 0.2 dB additional to total dB loss measured at the factory in report sent by cable manufacturer.
Splices	All fiber types	0.3 dB per splice
Distances	OM1 (850nm/1300)	3.4 dB /1.0 dB per Km.
Distance	OM2, OM3 and OM4 (850nm/1300)	3.0 dB /1.0 dB per Km.
Distance	OS1 and OS2 (1310 nm/1383 nm/1550 nm)	0.65 dB /0.65 dB/ 0.5 dB per Km.

E. OTDR Test: Additional end to end attenuation test, all fiber optic cables shall be tested with Level III OTDR equipment for the following conditions:

1. Each known event (connector/splice) insertion loss at both windows for each fiber type (850/1300 nm for multimode and 1310/1550 nm for single mode). All events shall pass maximum allowed insertion loss for the event type as indicated in table above.
2. Reflective events (connections) shall not exceed:
    a. 0.75 dB in optical loss when bi-directionally averaged
    b. -35 dB Reflectance for multi-mode connections
    c. -40 dB reflectance for UPC single-mode connections
    d. -55 dB reflectance for APC single-mode connections
3. Non-reflective events (splices) shall not exceed 0.3 dB.
4. Estimated distance for multiple strands of the same cable shall not vary more than 1% between strands.
5. Cable signatures in the form of traces along the complete distance of the cable. Unexplained cable reflections shown in the OTDR shall require the Installer to submit a letter explaining such events and pictures of cable conditions in the locations where the unexplained events are located to demonstrate cable has not been kinked or damaged during installation.

F. OTDR Test conditions: All OTDR testing shall be performed with the following conditions:

1. Use a launch cable and a tail cable in accordance with fiber type being tested and requirements indicated by OTDR equipment manufacturer.
2. Launch and tail cables shall be products sold by testing equipment manufacturer and not field made cables.
3. Launch and tail cables shall be selected according to the type of connector being tested such as APC or UPC type connectors.
4. Use launch compensation mode during the test to subtract the effects of the launch and tail cables.
5. Test from one direction unless the presence of “gainers” are spotted during the test. In such case the Installer shall test in both directions and adjust the test equipment to average measurements from both directions.
6. The SCS Installer shall verify the backscatter coefficient used in the test to make sure it matches the coefficient of the cable being tested.

G. OTDR Testing Equipment used on this project shall have the specifications indicated in this following table:

SPECIFICATION	MULTIMODE	SINGLE MODE
Wavelengths	850 nm ±10 nm. 1300 nm +35 / -15 nm.	1310 nm ±25 nm. 1550 nm ±30 nm.
Event Dead Zone. Measured at 1.5 dB below non-saturating reflection peak with the shortest pulse width. Reflection peak < -40 dB for mm and < -50 dB for sm.	850 nm: 0.5m typical 1300 nm: 0.7m typical	1310 nm: 0.6m typical 1550 nm: 0.6m typical
Attenuation Dead Zone. Measured at ± 0.5 dB deviation from backscatter with the shortest pulse width. Reflection peak < -40 dB for mm. and < -50 dB for sm.	850 nm: 2.2 m typical 1300 nm: 4.5m typical	1310 nm: 3.6m typical 1550 nm: 3.7m typical
Pulse Widths (nominal)	850 nm: 3, 5, 20, 40, 200 ns. 1300 nm: 3, 5, 20, 40, 200, 1000 ns.	3, 10, 30, 100, 300, 1000, 3000, 10000, 20000 ns
Loss Threshold Setting	0.01 dB to 1.5 dB Adjustable in 0.01 dB increments	0.01 dB to 1.5 dB Adjustable in 0.01 dB increments

H. The Test Report for each fiber strand shall include the following information:

1. Calculated Loss Budget for each optical fiber link (see attenuation table above).
2. Cable/strand ID matching shop drawings labeling system.
3. Name of technicians who performed the test.
4. Date and time the test was performed.
5. Measurement direction (from/to).
6. Jumper reference set up date/time and attenuation value.
7. Equipment model and serial number used and calibration date.
8. End to End Attenuation Loss Data for each optical fiber link.
9. OTDR Traces, one page per strand. Expand chart to cover most of the page.
10. Each event loss data and test limits used, including test limit file date used.

I. For fiber optic cables with factory terminated connectors or pre-terminated pigtails, the SCS Installer shall also provide the test results performed at the factory for fiber optic cables with factory terminated connectors to compare with the field test done by the SCS Installer. No significant variation between the factory test results and the field test results shall be encountered.

3.6 SYSTEMS WARRANTY AND SERVICE

A. SCS Installer shall follow all warranty and service requirements indicated in Specification Section 27 00 10 Technology General Provisions.

B. Warranty: The SCS shall be required to be under the manufacturer's warranty program for a complete channel configuration including cable, jacks, patch cords, and patch panels and include cabling specifically approved for the channel configuration with the manufacturer's components. Manufactures shall provide the warranty worst-case performance data for the installed cabling system, and the performance data indicated in the warranty documents/certificate.

C. A 25-year warranty available for the Structured Cabling System (fiber optics and copper infrastructure) shall be provided for an end-to-end channel model installation which covers applications assurance, cable, connecting hardware, and the labor cost for the repair or replacement thereof.

D. Additional features of the warranty shall include:

1. That the SCS installed system complies with the margin claimed by the manufacturer above the category 6A channel specifications on all transmission parameters across the entire frequency range of 1-600 MHz as shown on the manufacturers catalogs and literature.

3.7 ENGINEER'S FINAL ACCEPTANCE TEST

A. SCS Installer shall follow all requirements for final acceptance indicated in Specification Section 27 00 10 Technology General Provisions to be approved by both BTS and/or the Project Architect.

B. The Engineer's final acceptance test will not include testing of structured cabling components but could include verification of cleanliness of fiber optic connectors.

3.8 TRAINING AND INSTRUCTION

A. Training shall only be done after all testing, and identification processes have been completed and passed as indicated in this specification. Any training done prior to final acceptance will not be accounted for the formal training requested and the SCS Installer shall re-do all training after the final acceptance test is passed, at no additional cost to the Owner.

B. SCS Installer shall follow all training requirements indicated in Specification Section 27 00 10 Technology General Provisions.

C. The training for the SCS shall include the following topics:

1. Detail explanation of the identification system.
2. A walkthrough of all spaces and locations where terminations have been done in the project.

3.9 AS-BUILT DOCUMENTS AND PROJECT CLOSEOUT

A. The SCS shall follow all requirements for as-built and closeout documents indicated in Specification Section 27 00 10 Technology General Provisions.

B. The following are additional requirements supplementing the information provided in Specification Section 27 00 10 Technology General Provisions:

1. Provide the Warranty certificate issued by the manufacturer of the SCS infrastructure.
2. The Installer's RCDD shall affix his/her stamp to the as-built drawings, indicating that he/she has reviewed and approved the drawings as being complete, accurate, and representative of the system as actually installed.

3. As-built drawings inside each telecom room. The SCS Installer shall plot all as-built drawings and locate them inside each of the telecom rooms in the project. Each telecom room shall have the as-built drawings of the areas being served from that room. Each drawing shall be placed inside a clear vinyl document protector the size of the actual design drawing and affixed to a wall/plywood in the telecom room. The document protector shall be re-usable and shall allow the Owner to replace the drawings as changes are done to the SCS infrastructure in the future. Without this information, substantial use of the system will not be provided to the Installer.
4. The SCS Installer shall provide an Excel software spreadsheet that defines the telecommunications outlet number, location, number of voices, data, and special jacks. This database shall also provide the outlet patch panel connection to the riser/inter-floor cable, equipment, and telephone company demarcation circuit pairs as part of the as-built documentation.
5. Electronic copies of all test results (copper and fiber). Electronic copies shall include raw data files and PDF files with results. PDF files shall be organized the following way:
    a. All copper cables for cables terminating in one telecom room in a single PDF file with the name equal to the label used in the shop drawings for the telecom room where the cables are terminated.
    b. All attenuation and OTDR test for all strands of a single cable shall be in one PDF file with the name corresponding to the Cable ID used in the shop drawings.

END OF SECTION 27 10 00