PART 1 - GENERAL

This section of the Telecommunications Construction Guide Specification has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State University Pullman (WSUP) campus telecommunications projects. This information is provided in specification format to serve as a guide to the Designer in producing a CSI-compliant specification that will meet the unique requirements of WSUP Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Designer shall edit this section (adding and/or removing content where required) to meet the requirements of a given project.

Prior to publishing the specifications for bid or construction purposes, all edits shall be made using the MS Word Tracking Changes feature. ***When submitting the specifications for review at each progress milestone, print the specifications showing the revision markings***.

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this section that may require modification for a particular circumstance. Although this text is generally written in declarative form, the Designer shall consider it guidance only. The Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form, and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

1.1 SUMMARY

Review and edit the following list of generic type products and work for relevance to this project. This listing should not include procedures or processes, preparatory work, or final cleaning.

A. Provide all materials and labor for the installation of a customer-owned outside plant telecommunication system. This section includes Customer-Owned Outside Plant Communications cabling, termination, and administration equipment and installation requirements for the specified Outside Plant Structured Cabling System (OSP-SCS - See Definition Below).

Include this paragraph only if products will be furnished under this section but installed under other sections or by the Owner. When installations are “By Owner” consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner- Installed Items). If this paragraph is required for the project, the Engineer/Designer must take care to clearly define any product warranty issues associated with the split responsibility.

B. Products installed (but not furnished) under this section:

Include this paragraph only if products will be installed under this section but furnished under other sections or by the Owner. For example, WSUP may pre-purchase fiber, but have the Contractor install. When products are furnished “By Owner” consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner-Furnished Items). If this paragraph is required for the project, the Engineer/Designer must take care to clearly define any product warranty issues associated with the split responsibility.

Consider including paint for backboards, grounding conductors, and any other items that are installed under this section but not furnished under this section.

1. Grounding Conductor

1.2 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

A. Furnish, install, test and place into satisfactory and successful operation all equipment, materials, devices, and necessary appurtenances to provide a complete ANSI/TIA/EIA and ISO/IEC compliant communications Outside Plant Structured Cabling System as hereinafter specified and/or shown on the Contract Documents. The system is intended to be capable of integrating voice, data, and video signals onto a common media, and shall be tested for and be capable of Gigabit Ethernet operation as specified in IEEE 802.3z.

B. The work shall include all materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary to make a complete working ANSI/TIA/EIA and ISO/IEC compliant Outside Plant Structured Cabling System.

1.3 DEFINITIONS

Review and edit the following list of definitions for applicability to this project. Add and/or remove definitions for unusual terms that are not explained in the conditions of the Contract and that are used in ways not common to standard references.

NOTE: Furnish, provide and install are used repeatedly throughout this specification. The Engineer/Designer shall ensure that these terms are identified in the appropriate section of the project manual. The definitions of these terms shall be similar to the following:

Furnish - “Supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations”.

Install - “Operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations”.

Provide - “To furnish and install, complete and ready for the intended operation”.

A. “OSP-SCS” shall mean *Outside Plant - Structured Cabling System*. The OSP-SCS is defined as all required equipment and materials including, but not limited to, ANSI/TIA/EIA and ISO/IEC compliant copper and fiber optic cable (multimode and singlemode), connectors, splices, splice closures and other incidental and miscellaneous equipment and materials as required for a fully operational, tested, certified, and warranted system, compliant with all applicable codes and standards.

B. “MH” shall mean *Maintenance Holes* used for the routing of outside plant communications cables.

C. “HH” shall mean *Handholes* used for the routing of outside plant communications cables.

D. “TMGB” shall mean *Telecommunications Main Grounding Busbar.* There is typically one TMGB per building, located in the main telecommunications room. This busbar is directly bonded to the electrical service ground.

E. “TGB” shall mean *Telecommunications Grounding Busbar.* There is typically one TGB per telecommunications room. The TGB is connected both to the TMGB and to building structural steel or other permanent metallic systems.

F. "TBB" shall mean *Telecommunications Bonding Backbone.* The TBB is a conductor used to connect TMGBs to TGBs.

1.4 SEQUENCING

Include any requirements for coordinating work with potentially unusual or specifically required sequencing. WSUP may choose to construct a project under two bid packages - one for pathways and spaces (perhaps under a General Contract), and a second bid package for the Structured Cabling System (perhaps using the WA State DIS Master Contract). The Designer must coordinate with WSUP to determine if two bid packages will be used and include verbiage in the appropriate specification sections requiring the contractors to coordinate construction phasing and schedules.

A. Provide coordination with OSP-SCS manufacturer's representatives to ensure that the manufacturer's inspectors are available to schedule site visits, inspections, and certification of the system. Provide and coordinate any modifications required by the manufacturer and have the manufacturer re-inspect and certify the system prior to the scheduled use of the system by the Owner.

B. The Contractor is solely responsible for all costs associated with scheduling the OSP-SCS manufacturer's inspection, the inspection itself and any required re-inspections, and for any modifications to the installation as required by the OSP-SCS manufacturer.

PART 2 - PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

WSUP has standardized on certain manufacturers and certain products for all new Structured Cabling Systems in WSUP facilities. Products shall be specified accordingly. The Designer shall ensure that the latest part numbers are used for specified products. Any substitutions require WSUP pre-approval before specification.

If the Designer wishes to use products that deviate from WSUP standards, a Standards Variance Request shall be made, as described in the Technology Infrastructure Design Guide (TIDG). If the alternative product is approved, the Designer shall adapt this to reflect the approved changes.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that all required products are specified. The Designer shall also verify that the most current part number of each specified product is listed in this section.

2.1 RACEWAY

Review and edit the following products/part numbers as applicable to this project. If section numbers and titles are referenced, verify for accuracy.

A. As specified under Section 33 81 26 – "Communications Underground Ducts, Manholes and Handholes", and Section 27 05 33 – "Conduits and Backboxes for Communications Systems" except where noted below.

B. Outside plant innerduct shall be 1 ¼ inch size, orange, thin-wall, unsplit, corrugated, with pull tape:
1. Carlon Riser-Gard DG4X1C-nnnn

2.2 EQUIPMENT RACKS/ENCLOSURES

A. As specified in Section 27 11 00 – "Communications Equipment Room Fittings."

2.3 TERMINATION EQUIPMENT

A. Voice Backbone Copper Building Entrance Protectors (BEPs): Complete with lockable covers and plug-in protector modules for each pair terminated on the chassis. Protector modules shall provide over-voltage and sneak current protection. BEPs and protectors shall be manufactured by the following manufacturers:
   1. Circa Enterprises, Inc.
      a. 1880ECA1 Series
         1) Less than or equal to 6-pair to be terminated: 1880ENA1NSC-6 (for Emergency / PATS Phone)
         2) 7-pair to 25-pair to be terminated: 1880ECA1-25G
         3) 26-pair to 50-pair to be terminated: 1880ECA1-50G
         4) 51-pair to 100-pair to be terminated: 1880ECA1-100G
         5) 101-pair to 200-pair to be terminated: 1880ENA1/NSC-200
      b. Solid-state over-voltage protectors with sneak current protection. Protectors shall be:
         1) Balanced: 4B1E (PTC)

B. Fiber Optic Patch Panels: See Section 27 13 00.

2.4 CABLE

A. Outdoor Cable: Rated for outdoor use, duct installation, and/or direct burial installation as dictated by the application.
   1. Copper Cable:
      a. Backbone: Shielded, with 24-AWG solid copper conductors insulated with color coded PVC. UL Verified to ANSI/TIA/EIA 568-B for Category 3 performance. Insulated with filled foam skin-DEPIC and conform to RUS 7 CFR 1755.890 (REA PE-89). Cable shall be manufactured by or listed as an "approved alternative product" by the selected OSP-SCS Manufacturer:
         1) Essex:
            a) Inter-building Shielded Copper Cable, Outside Plant PIC: SEALPIC-FSF
         2) General Cable:
            a) Filled Foam Skin QUALPETH Cable, Spec. 2007
   2. Fiber Optic Cable: All-dielectric, meeting or exceeding ANSI/TIA/EIA and industry standards including Bellcore GR-20-CORE specifications. Cables and fan-out kits shall be manufactured by the selected OSP-SCS Manufacturer:
      a. 8.3/125 micron Singlemode: All-dielectric with a maximum attenuation of 0.4 dB/km at 1300 nm and 0.3 dB/km at 1550 nm.

         Verify whether Outdoor or Indoor/Outdoor cable will be required for the project. Consult the WSUP ITPM as well as maintain compliance with the NEC 50-ft rule.

         1) Corning LANscape:
            a) Indoor/Outdoor rated: FREEDM
            b) Outdoor rated: ALTOS

B. Lubricant:
   1. Dyna-Blue
   2. American Polywater

C. Cable Messenger

1. Messenger Strands shall be stranded steel, not stressed beyond 60% of rated breaking strength per Rule 251 of the National Electrical Safety Code, and sized such that the cable load will not exceed 25% of its rating.
   a. 3/8 inch minimum, or larger as required, with required mounting, termination and grounding/bonding hardware.
2. Cable Lashing Supports
   a. Stainless Steel, 10 inch long: Belden PPC Diamond Construction Hardware 34-08912
   b. Or other similar part number if different length is required.

D. Pull Ropes: ¼ inch polypropylene with a minimum tensile strength of 200 pounds.

E. Muletape Pull cord with footage marks: WPxxxP

2.5 GROUNDING AND BONDING

A. As specified under Section 27 05 26 – "Grounding and Bonding for Communications Systems" and Section 33 82 43 – "Grounding and Bonding for Communications Distribution."

2.6 LABELING AND ADMINISTRATION

A. Labels
1. As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, typed, and created by a hand-carried label maker or an approved equivalent software-based label making system. Handwritten labels are not acceptable.
   a. Inside Telecommunication Rooms:
      1) Brady: Bradymaker Wire Marking Labels WML-511-292 (or approved equal)
   b. Outside Plant: Waterproof
      1) 316 grade stainless steel strap ½ inch wide, embossed with punch-pressed characters, attached to the cable sheath with stainless steel lashing wire.
         a) Panduit: METS3-X
      2) Black-on-Orange Reflective lettering
         a) 3M 5005
2. Hand-carried label maker:
   a. Panduit: MEHT187 (or approved equal).
   b. Brady: ID Pro Plus (or approved equal).

PART 3 - EXECUTION

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and described in equal or greater detail to the following paragraphs.

All installation requirements shall be consistent with the manufacturer's requirements.

3.1 GENERAL

A. Store all materials so as to be protected from the elements. Pathway materials (conduit, fittings, maintenance holes, etc.) are permitted to be stored outdoors if stacked on boards to avoid direct contact with the ground. The Contractor shall be responsible for any deteriorating effects on the materials due

to improper storage (or outdoor storage) prior to installation including damage caused by prevailing weather conditions.

3.2 DEMOLITION

The Engineer/Designer shall coordinate with local WSUP authorities to determine whether WSUP wishes to retain certain demolished material or wishes to have it hauled away. Review any demolition requirements for this project with the WSUP project manager and edit the following paragraph or create a similar paragraph as applicable.

A. Demolish existing telecommunications equipment, cable, materials, and incidentals no longer in use after installation of the new OSP-SCS.
   1. Mandrel, clean, and cap outside plant conduits left empty after demolition of outside plant cables.
      a. Clean each conduit with a wire brush, swab, and prove out with a minimum 16 inch long test mandrel that is ¼ inch smaller than the inside diameter of the duct. Clean conduit a minimum of two times in the same direction. Swab with clean rags until the rag comes out of the conduit clean and dry. Swab away from buildings for duct sections connected to buildings.
   2. Properly and legally dispose of demolished materials.

B. Coordinate the demolition schedule with the Owner. Do not proceed with demolition prior to approval from the Owner.

3.3 RACEWAY

A. Provide and install as specified under Section 33 81 26 – “Communications Underground Ducts, Manholes and Handholes”, and Section 27 05 33 – “Conduits and Backboxes for Communications Systems” except where noted.

3.4 TERMINATION EQUIPMENT

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.

A. Copper Building Entrance Protectors: Provide BEPs in types, sizes and quantities as shown on the Contract Documents and as required for protection of building-to-building copper circuits. Where not shown, provide BEPs for each building-to-building copper cable.

B. Provide BEPs in sufficient quantity to protect each pair of each cable plus an additional 10% for future use. Install BEPs per manufacturer’s instructions.
   1. Bond each BEP’s protector ground lug to the nearest TGB with a #6 AWG copper grounding conductor.

3.5 GROUNDING AND BONDING

Review and edit the following installation requirements based on the products specified in PART 2 – Products above or on the products specified in another section if installed but not supplied under this section, and as applicable to this project.
Verify and edit referenced section titles.

A. Bond non-current carrying metal telecommunications equipment and materials to the nearest TGB (if within a building – as specified under Section 27 05 26 – “Grounding and Bonding for Communications Systems”) or the nearest grounding conductor if in the outside plant – as specified under Section 33 81 26 – “Grounding and Bonding for Communications Distribution.”
   1. Ensure that bonding breaks through paint to bare metallic surface of painted metallic hardware.

B. Bond both ends of each outside plant copper cable.

List additional grounding/bonding product installation requirements above as applicable to this project.

3.6 CABLE

A. General (applicable to all cable types):
1. Test Mandrels: Clean each conduit with a wire brush and swab with clean rags a minimum of two times in the same direction until the rag comes out of the conduit clean and dry. Swab away from buildings for duct sections connected to buildings. Prove out each conduit with a minimum 16 inch long test mandrel that is ¼ inch smaller than the inside diameter of the duct.
2. Install cables in compliance with ANSI/TIA/EIA requirements, BICSI practices, and manufacturers recommendations. Adhere to the requirements detailed in the manufacturer's recommendations and ANSI/TIA/EIA Standards relating to bending radius, pulling tension, other mechanical stresses, and pulling speed.
   a. Monitor pulling tension on runs of 300 feet or longer. Acceptable monitoring devices are:
      1) Winch with a calibrated maximum tension
      2) Breakaway link (swivel)
      3) In-line tensiometer
3. Set up cable reels on the same sides of maintenance holes and hand holes as the conduit sections in which cables are to be placed. Level and align reels with conduit sections to prevent twisting of cables during installation into conduits. Pull cables into conduits from tops of reels in long smooth bends. Do not pull cables into conduits from bottoms of reels. Use a cable feeder guide (shoe) of suitable dimensions between the cable reel and the face of the duct to protect the cable and to guide it into the duct. Carefully inspect the cables for sheath defects as the cables are payed off the reel. If defects are found during the pulling operation or if the cable on the reel binds, twists, or does not pay off freely, stop the pulling operation immediately and notify the Owner's representative.
4. Cables of 1-¼ inch diameter or larger shall be equipped with factory installed pulling eyes, or install a core hitch on site. Use pulling grips for cables smaller than 1-¼ inches in diameter. Do not pound grips into the cable sheath to prevent the grips from slipping. Use a ball-bearing based swivel between the pulling-eyes or grips and the pulling strand.
5. Once pulling begins, and tension is applied to the cable, continue the pull at a steady rate. If it is necessary to stop the pull at any point, the tension shall not be released unless it is necessary to do so.
6. Do not splice cables unless specifically noted on the Contract Documents, or to accomplish a transition between outdoor-rated cabling and indoor rated cabling in accordance with the 50-foot rule.
   a. Where it is possible to terminate outdoor-rated cabling within 50 feet of exposure inside a building, directly terminate the outdoor-rated cabling without a splice transition to indoor-rated cabling.
   b. Do not use tape with splices.
   c. The Contractor shall coordinate with Owner to review all splices prior to closure.
7. For new ductbank, install cables in the lowest available conduit in a duct bank, working up as additional cables are installed. For existing ductbanks, do not place cables in ducts other than those indicated on the Contract Documents.
8. Where cables are pulled through maintenance holes or handholes:
   a. Select the same duct at both sides of maintenance holes or handholes unless specifically noted on the Contract Documents.
   b. Avoid changes in duct selections, especially in elevations, to ensure that no damage occurs to the cable sheaths and that pulling tensions are kept as low as possible.
   c. Loop cable once around the perimeter of maintenance hole or handhole. Avoid blocking conduits with cable loop. Provide cable racking hardware to support cables inside maintenance holes and handholes. Maintain a sufficient length of cable in each

maintenance hole or handhole to properly rack the cable. Rack cables in maintenance holes and handholes as soon as practicable, but within one week after cable installation.

d. After cabling has been installed, racked and labeled, photograph the interior of the maintenance hole or handhole, starting with the north wall. Provide photographs to the Owner as part of the As-built documentation.

9. Where cables are pulled through tunnels:
   a. Provide messenger strand through full length of route, attached to tunnel structure per manufacturer guidelines. Messenger strand shall be sized appropriately for the cable load it is intended to carry, such that its load does not exceed 25% of the strand's rating.
   b. Suspend cables from designated messenger strand using stainless steel lashings at intervals not exceeding 4 feet, with sag between suspension points not exceeding 1 inch.
   c. Provide bonding for one end of each messenger strand segment.
10. When more than one cable is being installed in a conduit, pull all cables through the conduit simultaneously.
11. Where practicable, feed cables into ducts from the end of the duct that creates the least sidewall pressure on a bend during installation (i.e. feed cable from the end closest to the bend).
12. Use pulling compound or lubricant where necessary. Use lubricants that are compatible with the cable jacket material and in accordance with the manufacturer's recommendations. Do not use soap-based lubricants. Where cable is pulled through a maintenance hole or handhole, re-lubricate the cable prior to feeding into the next duct. Immediately after cables have been installed, clean lubricant from exposed cables in maintenance holes and handholes and at termination points using dry rags.
13. Seal cable ends with end caps immediately after installation and until terminated in a termination enclosure to prevent moisture entry into the core of filled cables and to prevent damage during installation.
14. Provide a service loop in the equipment room or telecommunications room long enough to reach termination equipment if moved to the farthest side of the room in the future, but no less than a minimum of 25 feet at each end.
15. Comply with the NEC 50-ft rule when installing outdoor-rated cable (i.e. do not exceed 50 feet of exposed outdoor-rated cable length within a building).
16. Cabling in the conduits:
   a. Where multiple conduits are used to carry cabling, fill conduits completely (per fill-ratio requirements) prior to using the next adjacent available conduit. Do not partially fill multiple conduits (and thereby waste space in a conduit) when it would be possible to completely fill that conduit.
17. Cable at the backboards:
   a. Lay and dress cables to allow other cables to enter raceway (conduit or otherwise) without difficulty at a later time by maintaining a working distance from these openings.
   b. Route cable as close as possible to the ceiling, floor, sides, or corners to insure that adequate wall or backboard space is available for current and future equipment and for cable terminations.
   c. Using the most direct route, secure multi pair cable to the backboard from the cable tray to the termination source. Use of D-rings in this situation is acceptable. Route via a path that will minimize obstruction to future installation of equipment, backboards or other cables.
18. Cable in the Telecommunications Rooms:
   a. For telecommunications rooms with ladder rack, lay cable neatly in ladder rack in even bundles and loosely secure cabling to the ladder rack at regular intervals with hook-and-loop straps (similar to Velcro).
19. Building Entrances: Seal conduits (both in-use and spare) that enter the building from the outside plant to prevent intrusion of water, gases, insects and rodents.
20. Provide pull ropes as required to accomplish cable pull. At completion of cable pull, a pull rope shall remain in conduit for additional new cabling if the conduit has capacity for additional new cabling.

B. Copper Cable:
   1. Provide copper cable in quantities and pair counts as shown on the Contract Documents.
   2. Test copper cable on the reel upon delivery to the job site prior to installation. Permanently affix test results to the reel and provide a copy to the Owner prior to installation. Do not install cables that fail. Replace failing cables at no additional expense to the Owner.
      a. Conform to the test procedures as outlined in the paragraph entitled TESTING at the end of this specification.
      b. Demonstrate that the test results are similar to the factory test results as shipped with the reel.
   3. Route outside plant copper cables to the BEP, enter the top-left side, and terminate cable in BEP.
   4. Terminate all pairs within a cable. Un-terminated cable pairs are not acceptable.
   5. For shielded cable, bond the shield at both ends to the ground lug on the Building Entrance Protector.

C. Fiber Cable:
   1. Test fiber optic cable on the reel upon delivery to the job site, and again prior to installation. Permanently affix the test results to the reel and submit a copy to the Owner prior to installation. Do not install cables that fail the on-reel test. Replace any cables that fail the on-reel test at no additional expense to the Owner.
      a. Conform to the test procedures as outlined in the paragraph entitled TESTING at the end of this specification.
      b. Demonstrate that the test results are similar to the factory test results as shipped with the reel.
   2. Provide fiber optic cable in quantities, strand counts, and types, as shown on the Contract Documents. Provide cable with fan-out kits for both ends.
   3. Secure fiber optic cable with hook-and-loop straps (similar to Velcro).
   4. Terminate all fiber strands within a fiber cable.
   5. For shielded cable, bond the shield at both ends to the TGB.

D. Innerduct:
   1. Innerduct

      The Designer shall indicate in the Contract Documents where innerduct is required, consistent with the requirements described below.

      a. Innerduct is required for routing outside plant fiber optic backbone cabling through all ductbank, conduit and sleeve pathways that exceed 4 feet in length.
      b. Otherwise, innerduct is not required for routing outside plant fiber optic backbone cabling.
      c. Do not provide innerduct through underground tunnels.
      d. Where innerduct is required, install fiber optic cable in innerduct per manufacturer's instructions. Innerduct shall terminate within 6 inches of top of each patch panel where fiber optic cable terminates. Secure innerduct with zip-ties at intervals not exceeding 24 inches. Do not use wire or tape.
      e. See Sections 27 15 00 – Communications Horizontal Cabling and 27 15 23 – Communications Optical Fiber Horizontal Cabling for innerduct requirements related to fiber optic cabling in horizontal and GPON applications, respectively.
   2. Provide innerduct for all interbuilding fiber optic cable runs through ductbanks, maintenance holes and handhole application.

3.7 LABELING AND ADMINISTRATION

A. Color Coding: Apply industry standard color coding to cable termination fields. Always apply the same color to both ends of any given cable. Cross-connections are generally made between termination fields of different colors. The color may be applied to the backboard behind the termination equipment, may be the color of a cover on the termination equipment, or may be the actual color of the insert label on the termination equipment. Use the following color code:

1. Orange: Identification of the telecommunication service (telephone company) demarcation point.
2. Green: Identification of network connections on the customer side of the demarcation point.
3. White: Identification of first-level backbone in the building containing the main cross-connect, or may be used to identify the second-level backbone in buildings not containing the main cross-connect.
4. Gray: Identification of the second-level backbone in the building containing the main cross-connect.
5. Blue: Identification of the horizontal distribution (station) cables. A blue color coding is only required at the telecommunications room end of the cable, not at the station end of the cable.
6. Brown: Identification of inter-building backbone cables.
7. Yellow: Identification of auxiliary circuits, alarms, maintenance, security, and other miscellaneous circuits.
8. Red: Identification of key telephone systems.

B. Cable:
1. Cables shall be labeled according to the following scheme:

Source Building	Telecom Room at Source	Destination Building	Telecom Room at Destination	Cable Number
a a a a a -	b* b b b b† b†	c c c c c* -	d* d d d d† d†	e† e e e e†

When building identifiers, room identifiers, and cable numbers lack a character in a given position, an asterisk shall be used as a placeholder or that position deleted, as follows:

- * This character position should be replaced by an asterisk if the number doesn't include an alpha character in that position.
- † This character position should be deleted if not necessary.

The Source Building is typically the MCF. The Destination Building is the customer/outlet-end of the cable.

Three or four-position sequentially numbered Cable Numbers are structured as follows:

- 001-999 for UTP cables
- FM01-FM99 for Multimode Fiber cables
- FS01-FS99 for Singlemode Fiber cables
- X01-X99 for Coax cables
- Z01-Z99 for Composite cables

There is one special case for a prefix character on a cable number: cables that are owned by a third party (not WSU). For example, cables owned by Housing and Dining are labeled with a prefix of "H".

2. Use cable numbering shown on the drawings. For cable numbering that is not shown on the drawings, request numbering assignments from the Owner.
3. Provide labels in the following locations:
   a. In the MCF and MDF, approximately 12 inches above the protector: metallic strap label on the cable sheath.
   b. On the fiber optic patch panel in the MCF and MDF: Black-on-orange adhesive label and printed adhesive label.
   c. Twice in each maintenance hole and handhole within 36 inches of the entrance and exit conduits: metallic strap label on the cable sheath.
   d. At each tunnel intersection and entry/exit point: metallic strap label on the cable sheath.

e. On the cable sheath adjacent to all splice closures, and at any other location where the cable enters or exits conduits, innerduct, or other wall penetration: metallic strap label on the cable sheath.

C. Termination Equipment:
1. Copper Building Entrance Protectors:
a. Outside the BEP: Label each BEP (in the MCF and MDF) with black-on-orange adhesive label matching the cable label content described above.
b. Inside the BEP: Label each BEP (in the MCF and MDF) with a printed adhesive label matching the cable label content described above.
2. Fiber Patch Panels:
a. Outside the panel: Label fiber patch panels with a black-on-orange adhesive label and printed adhesive label matching the cable label content described above.
b. Inside the Panel (Connector Panels): Label each connector panel with the opposite end termination point and type of the cable terminated at that location, in the form below, referencing the cable numbering discussed above.

Far End Building	Telecom Room at Far End	Cable Number
a a a a a*	- b*b b b b b†b†	- c†c c c c†

When building identifiers, room identifiers, and cable numbers lack a character in a given position, an asterisk shall be used as a placeholder or that position deleted, as follows:

- * This character position should be replaced by an asterisk if the number doesn't include an alpha character in that position.
- † This character position should be deleted if not necessary.

c. Inside the Panel (pull-out labeling plate): Each fiber patch panel includes a pull-out labeling plate with space to document the purpose of each fiber optic cable. Apply self-adhesive labels to the plate to matching the cable label content described above.

D. Grounding/Bonding Conductors: Label bonding conductors "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.8 TESTING

A. Provide test records on a form approved by the Owner and Engineer/Designer. Include the test results for each cable in the system. Submit the test results for each cable tested with identification as discussed under LABELING AND ADMINISTRATION above. Include the cable identifier, outcome of test, indication of errors found, cable length, retest results, and name and signature of technician completing the tests. Provide test results to the Owner and Engineer/Designer for review and acceptance within two weeks of Substantial Completion.
1. Print test records for each cable within the system directly from the tester and submit in paper form (in a binder) and in electronic PDF format (on flash drive or CDROM) to the Owner and Engineer/Designer for review. Handwritten test results will not be accepted.

B. Test the SCS after installation for compliance to all applicable standards as follows:
1. Copper Backbone Distribution: Test copper cable on the reel upon delivery to the job site, again prior to installation, and again after installation.

a. Test all cable pairs for length, shorts, opens, grounds, continuity, polarity reversals, termination order, transposition (wire map), attenuation, and the presence of AC voltage. All pairs shall demonstrate compliance to TIA/EIA 568-B Category 3 standards.
b. Test entire channel, from termination block to termination block.
c. Use a TIA/EIA Level III testing instrument (or higher accuracy level), re-calibrated within the manufacturer's recommended calibration period or within one year (whichever is more recent), with the most current software revision based upon the most current TIA/EIA testing guidelines, capable of storing and printing test records for each cable within the system.
    1) Fluke DSP-4000 with latest software and hardware releases, or approved equal.

2. Fiber: Test fiber cable on the reel upon delivery to the job site, again prior to installation, and again after installation.
    a. Prior to testing, calculate the cable loss budget for each fiber optic cable and clearly show the result on the test documentation. Calculate maximum loss using the following formula, assuming no splices:
        1) Backbone Distribution:
            a) Max Loss = [(allowable loss/km) * (km of fiber)] + [(.3db) * (# of connectors)]
            b) A mated connector to connector interface is defined as a single connector for the purposes of the above formula.
            c) A given fiber strand shall not exceed its calculated maximum loss (per the above formula).
    b. Test all strands using a bi-directional end-to-end Optical Transmission Loss Test Instrument (OTDR) trace performed per ANSI/TIA/EIA 455-61 or a bi-directional end-to-end power meter test performed per ANSI/TIA/EIA 455-53A, and ANSI/TIA/EIA 568-B, and the Corning LANscape field testing guidelines (latest edition). Test the polarity of each pair of strands. Record the following measurements: length and attenuation.
        1) Calculate loss numbers by taking the sum of the two bi-directional measurements and dividing that sum by two.
        2) Provide test measurements as follows:
            a) Multimode Cable: Test at both 850 and 1300nm.
            b) Singlemode Cable: Test at both 1310 and 1550nm.
    c. Test results shall conform to:
        1) The criteria specified in ANSI/TIA/EIA-568-B
        2) The Contractor's calculated loss budget above
        3) The criteria specified in IEEE 802.3z (1000Base-X Gigabit Ethernet)
            a) In addition to the above, perform tests both recommended and mandated by Corning LANscape. Tests shall confirm/guarantee compliance to Corning LANscape Ethernet 1000B-X performance, and IEEE 802.3z for a maximum end-to-end dB loss of 2.5 dB.
        4) The criteria specified in IEEE 802.3z (1000Base-X Gigabit Ethernet)

C. Identify cables and equipment that do not pass to the Owner and Designer. Determine the source of the non-compliance and replace or correct the cable or the connection materials. Retest the cable or connection materials at no additional expense to the Owner. Provide a complete revised set of all test results to the Owner and Designer, in the same manner as above. Remove original individual cable test reports that are unacceptable and insert the new corrected cable test reports. Do not simply resubmit the test reports for the corrected cabling only.
    1. In addition to the above, if it is determined that the cable is faulty, remove the damaged cable and replace it with a new cable. Cable repairs are not acceptable. The procedure for removing the cable shall be as follows:
        a. Prior to removal of damaged cable and installation of new cable:
            1) Inform the Owner and Designer of the schedule for the removal and installation.
            2) Test the new cable on the reel per paragraph B, above.

3) Test cables that occupy the same innerduct or conduit (if not in innerduct) as the damaged cable per paragraph B, above, regardless of whether or not they are new cables installed as part of this project or existing cables installed prior to this project.

b. Remove the damaged cable and provide new cable.

c. After the removal of the damaged cable and installation of the new cable:
   1) Test the new cable per the paragraph titled TESTING.
   2) Test cables that occupy the same innerduct or conduit (if not in innerduct) as the damaged cable per paragraph B, above, regardless of whether they are new cables installed as part of this project or existing cables installed prior to this project.
      a) If any of the cables requiring testing are in use, coordinate with the Owner to schedule an outage opportunity during which the testing can be performed.

d. If a cable which occupies the same innerduct or conduit (if not in innerduct) as a damaged cable is damaged by the extraction and installation process, replace the cable at no additional expense to the Owner.
   1) Damaged cables which are replaced shall be subject to the testing procedures of the paragraph titled TESTING.

END OF SECTION