

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 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 an inside plant telecommunication system. This section includes Inside Plant Communications Backbone cabling, termination, and administration equipment and installation requirements for the specified Structured Cabling System (SCS - See Definition Below).

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, NECA/NEIS and ISO/IEC compliant communications Structured Cabling System (SCS) 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 SCS.

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 GENERAL

- A. SCS components shall be manufactured by the manufacturers listed below. Components shall not be intermixed between different manufacturers unless the manufacturer of the SCS has listed (in writing) another manufacturer's component as an "Approved Alternative Product" and will warrant the "Approved Alternative Product" as part of the SCS Manufacturer Warranty (see Section 27 05 00 — "Common Works Results for Communications" PART 1 – WARRANTY).
 - 1. Bid only the following SCS Manufacturers and only bid manufacturers for which the Contractor is certified. The SCS Manufacturers shall be the following. Substitution is not acceptable:
 - a. TE, for copper-related products
 - b. Corning, for fiber optic-related products
 - 1) TE fiber optic cabling products are not acceptable.

2.2 PATCH PANELS

- A. Copper Backbone Patch Panels: Complete with incidental materials necessary for mounting. Unless otherwise indicated, copper patch panels shall be manufactured by the selected SCS Manufacturer:
 - 1. Shall exceed Category 5e (minimum) transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA 568-B and ISO/IEC 11801:
 - a. 24 Port, SL, Straight, Multimedia: TE 1375291-1 with Category 5e connectors TE 1375191-2 (Black) as required
- B. Fiber Patch Panels: Pre-assembled enclosures with connector panels, blank connector panels (for unused connector panel slots), and strain relief, complete with fiber connectors and fiber optic receptacle adapters (see CONNECTORS below), and with incidental materials necessary for mounting. Fiber patch panels shall be manufactured by the selected SCS Manufacturer:
 - 1. Backbone Distribution:
 - a. Corning:
 - 1) Rack mounted patch panels:
 - a) Corning CCH-04U (4U, 72/144 port) (black)
 - 2) Connector Panels:
 - a) Multimode: Corning (12-strand/6-connector) duplex LC, CCH-CP12-A7
 - b) Multimode: Corning (12-strand/6-connector) duplex SC, CCH-CP12-91
 - c) Singlemode: Corning (12-strand/6-connector) duplex LC, CCH-CP12-A9

- d) Singlemode: Corning (12-strand/6-connector) duplex SC, CCH-CP12-59
- e) Singlemode Pigtailed Splice Cassette (12-strand) duplex SC/APC: Corning CCH-CS12-D9-P00RE
- f) Singlemode Pigtailed Splice Cassette (24-strand) duplex LC/APC: Corning CCH-CS24-B3-P00RE

2.3 CABLE

A. General:

- 1. Cables shall be manufactured by the selected SCS Manufacturer.
- 2. Cables shall be marked with the manufacturer's label indicating plenum-rating.

B. Copper Cable:

- 1. Copper backbone cable shall be ARMM shielded, 24-AWG solid copper conductors, insulated with color-coded PVC, and UL Verified to TIA/EIA 568-B for Category 3 performance. Cable shall be manufactured by:
 - a. General Cable
 - b. Superior Essex
 - c. TE
 - d. or approved equal.

C. Fiber Cable:

- 1. Multimode 50/125 μm OM3: Shall be graded index, tight-buffered, extended/high grade with a maximum attenuation of 2.8 dB/km @ 850 nm and 1.0 dB/km @ 1300 nm and a minimum effective modal bandwidth of 4700 MHz/km @ 850 nm. Cable shall support 1GB Ethernet for lengths of up to 1000 meters, 10GB Ethernet for lengths up to 550 meters and 100GB for lengths up to 150 meters. Cable shall be manufactured by the selected SCS Manufacturer:
 - a. Corning: Corning MIC and Unitized MIC
- 2. Singlemode 8.3/125 μm : Shall be tight-buffered with a maximum attenuation of 0.4 dB/km @ 1300 nm and 0.3 dB/km @ 1550 nm. Cable shall be manufactured by the selected SCS Manufacturer and shall be:
 - a. Corning: Corning MIC and Unitized MIC
- 3. Hybrid/Composite: Multimode and singlemode characteristics and specifications shall conform to the above requirements. Cable shall be manufactured by the selected SCS Manufacturer and shall be:
 - a. Corning: Corning MIC and Unitized MIC

2.4 INNERDUCT

A. Intra-building innerduct shall be 1 inch size, orange, unsplit, corrugated, with pull tape:

- 1. Plenum-rated: Carlon Plenum-Gard CF4x1C-nnnn
- 2. Riser-rated: Carlon Riser-Gard DF4x1C-nnnn

2.5 CONNECTORS

A. Fiber Connectors: Complete with fiber optic receptacle adapters where required for mounting.

- 1. Multimode: Duplex LC, 50/125 μm laser-optimized multimode fiber, with a ceramic ferrule:
 - a. Corning LC/APC: Unicam 95-200-94 with Duplex Clip (TRIGGER-BP-D)
- 2. Singlemode: Duplex SC, singlemode fiber with Angle Polish and rotating cam:
 - a. Corning SC/APC: Unicam 95-200-44 with Duplex Clip (95-400-03-BP)

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, and created by a hand-carried label maker or a computer/software-based label making system. Handwritten labels are not acceptable.
 - a. Backbone Cable:
 - 1) Panduit Marker Tie (or approved equal)
- B. Hand-carried label maker:
 1. 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 PATCH PANELS

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. Provide patch panels and horizontal wire management according to locations, elevations, and plan views as shown on the Contract Documents.
 1. Copper: Size and install rack-mountable patch panels as shown on the Contract Documents. Use patch panels to terminate copper backbone cables.
 - a. Termination:
 - 1) Terminate 2 pairs per jack, on pins 4 & 5 and on pins 3 & 6.
 - 2) The 25th pair of each binder group shall be preserved at the end of the patch panel for future use (replace damaged pair or support a 2-pair application).
 - 3) Maintain pair twist ratio for exposed wires at patch panel termination.
 - b. Horizontal Wire Management: Provide horizontal wire management as shown on the Contract Documents.
 2. Fiber: Size and install rack-mountable patch panels as shown on the Contract Documents. Mount intra-building fiber patch panel below outside plant fiber patch panel. Use fiber patch panels to terminate backbone and horizontal fiber optic cables.
 - a. Terminate all fiber optic cabling SC/APC-Duplex.
 - b. Where multiple cables terminate in a patch panel, terminate singlemode fiber on left side of patch panel, and multimode on the right side.

3.2 CABLE

- A. General (applicable to all cable types): Provide non-plenum (CM/CMR, OFNR) rated cable for locations where cable is to be installed in conduit. For cable not installed in conduit, provide plenum (CMP, OFNP) rated cable if cable is installed in a plenum air space environment, otherwise install non-plenum rated cabling. Cabling shall bear plenum or non-plenum markings for the environment in which it is installed.
 1. Provide intrabuilding backbone cable in types, sizes, and quantities as shown on the Contract Documents. Install intrabuilding backbone cables between telecommunications rooms within the

- same building. Provide cables of the same type in the same color – multiple colors of the same cable type are not acceptable.
2. Install cable in compliance with ANSI/TIA/EIA and ISO/IEC 11801 requirements and BICSI TCIM practices.
 3. Adhere to the bending radius and pull strength requirements as detailed in the ANSI/TIA/EIA standards and the manufacturer's installation recommendations during cable handling and installation.
 - a. Pull all cables simultaneously where more than one cable is being installed in the same raceway.
 - b. Use pulling compound or lubricant where necessary. Use compounds that will not damage conductor or insulation (Polywater, or approved equal).
 - c. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage media or raceway. Repair or replace conduit bushings that become damaged during cabling installation.
 4. Install cable in a continuous (non-spliced) manner unless otherwise indicated.
 5. Install exposed cable parallel to and perpendicular to surfaces on exposed structural members and follow surface contours where possible.
 6. Attaching cables to pipes, electrical conduit, mechanical items, existing cables, or the ceiling support system (grids, hanger wires, etc. – with the exception of ceiling support anchors) is not acceptable. Install hook-and-loop straps in conformance with the SCS manufacturer's installation recommendations. Do not cause cross-sectional deformation of cabling.
 7. 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 point. 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.
 8. Cabling in the conduits:
 - a. Where multiple conduits or sleeves 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.
 9. 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 (Velcro-type).
 10. Cable terminating on patch panels located on racks:
 - a. Route cables in telecommunications rooms to patch panels on racks by routing across ladder rack across top of rack and then down vertical ladder rack to patch panel.
- B. Copper Cable: Terminate all pairs within a cable. Un-terminated cable pairs are not acceptable.
1. Provide copper cabling in pair counts shown on Contract Documents. Where not shown, provide pair counts according to the following formula:
 - a. 1.5 times the Day 1 strand requirements, rounded up to the next commonly manufactured pair count in increments of 50.
 2. Install intrabuilding backbone cable in the locations shown on the Contract Documents. Provide a service loop long enough in the TR's to reach termination equipment if moved to the farthest side of the room in the future, but no less than a minimum length of 10 feet at each end.
 - a. Use unshielded, non-plenum multi-pair copper cable for connecting the back side of patch panels to entrance protectors.

- b. For shielded cable, bond one end of the metallic shield (or metallic strength) member to the nearest TGB (as furnished under Section 27 05 26 — “Grounding and Bonding for Communications Systems”).
- C. Fiber Cable: Terminate all fiber strands within a fiber cable. The installation of unterminated fiber is not acceptable.
1. Provide fiber optic cabling in strand counts shown on Contract Documents. Where not shown, provide strand counts according to the following formula:
 - a. 1.5 times the Day 1 strand requirements, rounded up to the next commonly manufactured strand count in increments of 12.
 2. Secure fiber optic cable with hook-and-loop straps (similar to Velcro).
 3. Innerduct
 - a. **The Designer shall indicate in the Contract Documents where innerduct is required, consistent with the requirements described below.**
 - b. Innerduct is required for routing inside plant fiber optic backbone cabling through all vertical riser pathways (conduits and sleeves) that exceed 4 feet in length.
 - c. Innerduct is also required for routing inside plant fiber optic backbone cabling through cable trays where larger outside plant cable shares the cable tray.
 - d. Otherwise, innerduct is not required for routing inside plant fiber optic backbone cabling.
 - e. 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.
 - f. See Sections 27 15 00 and 27 15 23 for innerduct requirements related to fiber optic cabling in horizontal and GPON applications, respectively.
 4. 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. Test shall conform to the procedures as outlined in the paragraph entitled TESTING at the end of this specification section.
 - b. Demonstrate that the test results are in harmony with the factory test results as shipped with the reel.
 5. For shielded cable, bond both ends of the metallic shield (or metallic strength) member to the nearest TGB (as furnished under Section 27 05 26 — “Grounding and Bonding for Communications Systems”).
 6. Provide a service loops as follows:
 - a. Inside the patch panel, store approximately 60 inches of unsheathed fiber prior to termination.
 - b. Attached to the wall, store approximately 20 feet (in innerduct).

3.3 CONNECTORS

- A. Fiber Connectors: Provide connectors and adapters per manufacturer recommendations and install into Connector Panels.

3.4 LABELING AND ADMINISTRATION

- A. Color Coding: Apply industry standard color coding to cable terminations. Always apply the same color at both ends of any given cable. Cross-connections are generally made between terminations 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. Brown: Identification of inter-building backbone cables.
6. Yellow: Identification of auxiliary circuits, alarms, maintenance, security, and other miscellaneous circuits.
7. Red: Identification of key telephone systems.

B. Cables:

1. Label Locations:
 - a. Affix at each end of the cable, within 24 inches of telecommunications room entrance and again within 24 inches of termination point.
 - b. Inside each tunnel entrance point, exit point and intersection.
 - c. Twice inside each maintenance hole and handhole, at the entrance conduit and exit conduit.
2. Label Colors:
 - a. Brown at source end and green at destination end of cable.
 - b. Stainless steel straps along length of cable.
3. 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† b†	c c c c c*	- d* 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".

4. Use cable numbering shown on the drawings. For cable numbering that is not shown on the drawings, request numbering assignments from the Owner.
5. Provide labels in the following locations:

- a. In the MDF, on the cable, approximately 12 inches from the protector and from the patch panel.
- b. On the fiber optic patch panel in the MDF and IDFs.
- c. Within 36 inches of the entrance and exit conduits and riser sleeves on the cable sheath.
- d. 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.

C. Termination Hardware:

- 1. Copper Backbone Building Entrance Protectors:
 - a. General: Label BEPs with a printed adhesive label, as shown on the Contract Documents, matching the cable label content described above.
 - 1) MDF: Use blue label stock.
 - 2) IDFs: Use green label stock.
- 2. Copper Backbone Patch Panels:
 - a. No labeling required.
- 3. Fiber Optic 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 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. 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.

3.5 TESTING

- A. Provide test records on a form approved by the Owner and 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 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 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. Intrabuilding Backbone Copper: 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.

- a. Test copper cable on the reel upon delivery to the job site, again prior to installation, and again after installation.
 - b. Test entire channel, from entrance protection to patch panel.
 - c. Use a TIA/EIA Level III testing instrument, re-calibrated within the manufacturer's recommended calibration period, 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, or approved equal.
2. Fiber: Test fiber optic cable on the reel upon delivery to the job site 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) Horizontal Distribution:
 - a) Max Loss = 2.0db (per ANSI/TIA/EIA 568-B)
 - 2) Backbone Distribution:
 - a) Max Loss = [(allowable loss/km) * (km of fiber)] + [(0.3db) * (# 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 (such as an 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. Test the polarity of each pair of strands. Record the following measurements: length and attenuation.
 - 1) Calculate attenuation 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-568B.
 - 2) The Contractor's calculated loss budget above.
 - 3) The criteria specified in IEEE 802.3ae-2002 (10GBase-X 10 Gigabit Ethernet).
 - a) In addition to the above, perform tests both recommended and mandated by Corning. Tests shall confirm/guarantee compliance to Corning's performance standards and also IEEE 802.3ae-2002 for a maximum end-to-end dB loss of 2.5 dB.
 - 4) The criteria specified in IEEE 802.3ae-2002 (10GBase-X 10 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.

3.6 CLOSE-OUT

- A. Furnish uninstalled fiber optic cable reel remnants to the Owner.

END OF SECTION