

PART 1 GENERAL

1.01 SUMMARY

- A. Summary of Work: The Work of this section includes the construction, test, documentation, and warranty of a fiber optic cable and unshielded, twisted-pair (UTP) copper backbone cable plant for the Premises Wiring Distribution System (PWDS) in accordance with the specifications and Drawings.
- B. This Work specified in this section includes installation of backbone cabling for Port wide installations. For this Work, the Contractor shall:
 - 1. Provide optical fiber backbone cable and associated accessories.
 - 2. Provide UTP backbone cable and associated accessories.
 - 3. Termination hardware
 - 4. Conduct testing.

1.02 DEFINITIONS FOR PORT OF SEATTLE INFRASTRUCTURE

- A. Refer to Section 27 05 13 –General Communications Requirements, BACKBONE sections: 1.02.A.1.2 and 1.02.B.1.2.

1.03 RELATED WORK

- A. As related Work, the Contractor shall:
 - 1. Provide backbone pathway materials and construct pathways, as described in Section 27 05 28 - Communication Pathways; reference applicable backbone pathway options
- B. Work performed by other contracts:
 - 1. Work required to be completed by others prior to the Work in this section may include the following:
 - a. Construction of backbone cable with end and patch panel termination and placement of conduit and overhead cable trays.
 - b. Placement of open frame racks in communication rooms and equivalent locations available for backbone wiring accessories and cable termination.
 - 2. Work that will be typically performed by the Port of Seattle after the Work described in this section is substantially complete will include the following:
 - a. Installation of optical fiber and UTP jumpers and patch cords for backbone cross connects and network port connections:
 - (1) Between backbone cable patch panel ports and electronic equipment.
 - (2) Between horizontal cable patch panel ports and electronic equipment.
 - (3) Call the Port of Seattle Service Desk at 206-787-3333 to schedule Port of Seattle staff support of backbone system connections.

1.04 SCOPE OF WORK

- A. The Contractor shall provide materials and labor required to deliver a complete backbone cable system as indicated on the Contract Drawings, schedules, and these Specifications.
- B. This Work shall include, but may not be limited to, the following tasks:
 - 1. The Contractor shall provide backbone optical fiber cable that is pre-installation tested, correctly installed and terminated, and Contractor-tested prior to final acceptance by POS or testing by a systems contractor.
 - 2. The Contractor shall provide backbone copper cable that is correctly installed and terminated, and Contractor-tested prior to final acceptance by POS or testing by a systems contractor.
 - 3. The Contractor shall provide patch panels, termination blocks and end point termination devices to enable the termination and identification of the backbone cable system.
 - 4. The Contractor shall provide and install cable devices and accessories, such as patch panels, in racks installed by other contracts and in racks provided by the Contractor.
 - 5. Contractor shall fusion splice fiber optical pigtails onto ALL CIBS MDR to ER fiber optical cabling.
 - a. Fusion splice loss of single mode fiber shall be no more than 0.3 dB per fusion splice.
 - b. Port has the right to change fusion splicing requirements per application
- C. Label devices, cables, and ports per Section 27 05 53 - Identification and Labeling, and enter data in the cable management system. The Port may elect to enter data into the Port cable management system based on data from the Contractor. This does not alleviate the Contractor from their responsibility to provide personnel to manage cable management system such as maintaining Excel spreadsheets of all necessary installed cable data.
 - 1. Conduct testing on backbone cabling per Port of Seattle specifications.

1.05 REFERENCES

- A. American National Standards Institute (ANSI):
- B. Telecommunications Industry Association/Electronics Industries Alliance (TIA/EIA):
 - 1. EIA-440-A (Current Edition): Optic Fiber Terminology
 - 2. TIA/EIA 455-B, Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices and other Fiber Optic Components
 - 3. FOTP-78 (TIA/EIA-455-78A) (Current Edition): Fiber Optic Test Procedure 78 - Spectral Attenuation Cutback Measurement for Single-Mode Optical Fibers
 - 4. TIA/EIA 455-B (Current Edition): Standard Test Procedures for Fiber Optic Cable Fibers, Cables, Transducers, Connecting and Terminating Devices

5. TIA/EIA-526 (Current Edition): Standard Test Procedures for Fiber Optic Systems
 6. TIA/EIA-568 (Current Edition): Commercial Building Telecommunications Cabling Standard, with addenda
 7. ANSI/TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces
- C. National Fire Protection Association (NFPA):
1. NFPA 70 National Electrical Code (NEC)

1.06 SUBMITTALS

- A. Submittals shall be in compliance with Section 01 33 00 - Submittals.
- B. The Contractor shall provide the following administrative submittals:
1. Certification that the cable will be installed by a Washington state Systimax Solutions-certified installation contractor.
 2. Documentation that termination crafts-people are properly trained for optical fiber termination and testing, and high-performance data cable termination and testing. Documentation shall be from a technical school, manufacturer's school, or labor union training.
 3. Discrepancy report describing existing backbone cable, equipment, and rack conditions that would affect the ability of the Contractor to successfully complete the Work.
 4. Systimax Solutions 20-year approved warranty on the completed Systimax Solutions portions of the backbone cable system.
 5. Warranty documentation on non-Systimax Solutions products.
- C. The Contractor shall provide the following technical submittals:
1. Manufacturer's complete product data and specifications, with drawings as applicable for materials furnished by the Contractor.
 2. Backbone cable testing results in hard and soft copy formats.
 - a. Test results are required to be submitted to the Port of Seattle no later than 14 days from the date of the individual test.
 3. Results of pre-installation optical fiber reel tests for Construction Manager review and approval.
 4. Conduit and cable tray fill plan indicating initial cable fill percentages and the use of innerduct. The plan may be submitted by installation area if this method is more effective.
 5. Shop drawings and single-line schematic diagrams showing final device placements, cable groups, termination details and cross-connections.
 6. Cable Pulling Plan: The Contractor shall submit a cable pulling plan, as follows:
 - a. Indicate the installed backbone conduit layout in schematic format, including junction boxes and distances between junction boxes.

- b. Indicate contents of each conduit.
- c. Indicate the cable pulling calculations, conduit fill ratios and actual cable runs and tensions.
- d. Include detail and schedule showing the construction sequence of communications rooms.
- e. Installation of cabling shall not commence prior to approval of the pulling plan and calculations by the Engineer.

- 7. Contractor's test plan for the required optical fiber and metallic (copper) cable tests.
- 8. Requests for inspections and substantial completion inspection for acceptance testing by the Port-designated test contractor.
- 9. Final as-built backbone wiring drawings and documentation.

1.07 CABLE MANAGEMENT SYSTEM DATA ENTRY

- A. Contractor to provide as-built labeling information and as-built drawings to Port of Seattle within three (3) weeks of project completion.
- B. Test results are required to be submitted to the Port of Seattle no later than 14 days from the date of the individual test.
- C. Data Entry provided to the Port of Seattle: Data shall be provided in a consistent and accurate manner in a format approved by the Engineer. Data provided shall include, but not be limited to:
 - 1. Tabular nomenclature data for spaces, pathways, cables, termination hardware, splices, ground buses, ground conductors, and ground bonds.
 - 2. Diagrammatic drawings and data for spaces, pathways, cables, termination hardware, splices, ground buses, ground conductors, and ground bonds.
 - 3. Status data for installation, tests, defects, and corrections.

1.08 PROJECT CONDITIONS

- A. Verification: Obtain specific cable lengths and location of racks and equipment by field measurement and by Contractor's shop drawings after contract award. Do not vary from the routes indicated in the drawings without prior approval from the Construction Manager.

1.09 QUALITY ASSURANCE

- A. Contractor Qualifications:
 - 1. All Systimax fiber optic communications products , including but not limited to cables, patch panels, splice panels, splices, and connectors, shall be installed, terminated, tested and documented by a Systimax Washington Business Partner. The active Business Partner list can be located at the Systimax webpage by following the link:
http://www.commscope.com/systimax/eng/partners/partner_locator/display.asp?st=wa.

2. {You can also reach the same location by following the selection given below. www.Commscope.com; Brands; SYSTIMAX®; Support; Partners/Consultants/Alliances; Enterprise Locator (select Country, and State)}
 3. All Systimax® copper communications products, including but not limited to TIA-568 Category 5 or higher performance cables, patch panels, terminal blocks, and connectors, shall be installed, terminated, tested, and documented by a Systimax® Washington Business Partner. The active Business Partner list can be located at the Systimax webpage by following the link:
http://www.commscope.com/systimax/eng/partners/partner_locator/display.asp?st=wa.
 4. {You can also reach the same location by following the selection given below. www.Commscope.com; Brands; SYSTIMAX®; Support; Partners/Consultants/Alliances; Enterprise Locator (select Country, and State)}
- B. Contractor Qualifications for other manufacture sources:
1. Manufacturer shall have a certified installer program; installers shall have valid certification from specific Manufacturer.
 2. Communication material shall have the ability to physically terminate to Systimax termination hardware to maintain existing cross connect fiber patch cord usage, architectural aesthetics and end user ergonomics established in the Port of Seattle communication rooms.
 3. Installed communication infrastructure shall provide a minimum 20 year warranty.
- C. Standards:
1. Provide system components that are Underwriters Laboratories (UL) listed and labeled when applicable.
 2. UL 910 – Test Method for Fire and Smoke Characteristics of Electrical and Optical Fiber Cables Used in Air-Handling Spaces.
 3. UL 1666 – Standard Test for Flame Propagation Height of Electrical and Optical Fiber Cables Installed Vertically in Shafts.
 4. Electronics Industry Association (EIA)-455-B – Standard Test Procedures for Fiber optic Fibers, Cables, Transducers, Connecting and Terminating Devices.
 5. ANSI/TIA/EIA-568-B – Commercial Building Communications Cabling Standard, including addenda.
 6. ANSI/TIA/EIA-569-A – Commercial Building Standard for Communications Pathways and Spaces.
 7. ANSI/TIA/EIA-598-A – Optical Fiber Cable Color Coding.
 8. ANSI/TIA/EIA-606 – The Administration Standard for the Communications Infrastructure of Commercial Buildings.

9. ANSI/TIA/EIA-607 – Commercial Building Grounding and Bonding Requirements for Communications.
 10. TIA/EIA TSB-67 – Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems.
 - D. Codes and Regulations:
 1. National Electrical Code (NEC) Compliance: Comply with NEC as applicable.
 2. Local Codes: Comply with state and local codes as applicable.
 - E. Manufacturer's Recommendations: Install items per manufacturer's recommendations. Recommendations shall include, but not be limited to, cable handling, bending, and pulling requirements or limits; termination methods and materials; and use of specific tools and disposables.
 - F. Tests: Perform tests as specified in Part 3 – Execution of this section.
- 1.10 DELIVERY, HANDLING, AND STORAGE
- A. Materials shall be delivered in original packages with labels intact and identification clearly marked.
 - B. Storage temperature range: -40°F to 149°F (-40°C to 65°C).
 - C. Protect equipment and materials from foreign objects such as dirt, dust, paint, fumes, liquids, construction debris, and other contaminants. Protect from weather, humidity, temperature, and sunlight. Protect from physical damage.
 - D. Keep dust caps in place on patch panels and replace after testing. Protect 110 blocks with masking until construction is complete.
 - E. Equipment damaged prior to system acceptance shall be replaced with new at no additional cost to the Port.
 - F. Port-furnished Material: Port-furnished material will be made available to the Contractor at the airport logistics site. The Contractor shall be responsible for inspection, testing, or other verification of the condition of the materials upon receipt from the Port. By accepting materials from the Port, the Contractor warrants that said materials are free from defects. Remedy for subsequent discovery of damage or defects shall be the responsibility of the Contractor.
- 1.11 WARRANTY
- A. General: Refer to Division 1 General Requirements for general warranty requirements.
 - B. Systimax Solutions Extended Warranty: In addition to the general warranty requirements, the fiber optic cable and UTP copper cable and termination hardware shall have an overall Systimax Solutions Systimax manufacturer's warranty for a period of 20 years covering the entire system as a whole. The warranty shall cover the cost of materials and labor for repair or replacement of cables and terminations due to defects in materials or installation. The Port shall receive a Systimax Solutions certificate of warranty for the project prior to final closeout.
 - C. Other approved manufacturer's warranty shall be equal to or greater than 20 years. The warranty shall cover the cost of materials and labor for repair or

replacement of cables and terminations due to defects in materials or installation.
The Port will expect a certificate of warranty for the project prior to final closeout.

PART 2 PRODUCTS

2.01 GENERAL

- A. Backbone cabling infrastructure shall be manufactured by Systimax Solutions, No Equal; any substitutions must be approved by Port of Seattle Sea-Tac/Seaport Telecommunications Architectural Review Team (START)
- B. New construction of a Port ER, requires a minimum of 144 (SMF) single mode fiber each, to a minimum of (2) MDRs. START committee will confirm the MDR assignments during project design review
- C. Products and materials shall be new and fit the intended purpose.
- D. Contractor is responsible to re-certify existing infrastructure when re-installed, re-located, and ALL existing infrastructure in immediate location to be operational prior to system acceptance, and at no additional cost to the Port
- E. Damaged or defective products and components shall be replaced by the Contractor at no additional cost to the Port.
- F. Cabling and termination hardware damaged prior to system acceptance shall be replaced by the Contractor at no additional cost to the Port.
- G. Miscellaneous materials required for a complete and operational cabling system shall be provided by the Contractor.
- H. All communication materials shall be subjected to final approval by the Port of Seattle START committee.

PART 3 EXECUTION

3.01 PRE-INSTALLATION TESTING

- A. General: The Contractor shall perform pre-installation tests on all fiber optic cables prior to installations. The Contractor shall accept only materials that pass the test.
- B. Testing:
 - 1. General: Test data shall include cable reel serial number and cable product number for identification. Report defective cables immediately to the Construction Manager. Repeat pre-installation tests if necessary when cable reels are stored unprotected on the job site or are mishandled. Do not install defective cables.
 - 2. Records: Cable reel serial number and cable product number shall be recorded and included in the test results for each reel. Printouts of the traces and test parameters shall be submitted to the Construction Manager within 5 working days of completing the test.
 - 3. Tests: The Contractor shall perform tests on 100% of fiber strands with an optical time-domain reflectometer (OTDR) at 1310 nanometers and 1550 nanometers for singlemode fibers. The OTDR shall have a loss resolution

of 0.01 dB or less, and a distance resolution of one (1) foot or less. Submit images of the OTDR traces for review and approval.

4. Test Criteria: A cable shall pass the test only if all strands have an attenuation no greater than the maximum attenuation stated in the manufacturer's published specifications, and if no strands have point discontinuities greater than 0.1 dB maximum for singlemode (1310 nm and 1550 nm windows).

3.02 SCHEDULING AND COORDINATION

- A. Scheduling of Work shall be coordinated with the Construction Manager and tenant representatives to minimize impact on operations and the traveling public.
- B. Scheduling of cable installation shall be coordinated with other trades within the Contract and through the Construction Manager with trades working other projects.

3.03 SURVEY AND PREPARATION

- A. The Contractor shall survey existing cable trays, conduit paths and routes, and report discrepancies and issues with the use of these for cable installation. Failure to perform this inspection and submit the report holds the Contractor at cost risk for corrective actions and schedule impacts later in the Work.
- B. Contractor shall be responsible for storage of all materials until installation.

3.04 INSTALLATION OF PULL STRINGS

- A. The conduit/pathway installing contractor shall be responsible for installing a pull cord and true tape from end to end in every conduit, cable tray, and/or innerduct.
- B. Pull strings shall be left in place.
- C. In existing conduits or cable tray with existing pull strings, the Contractor shall replace used pull strings with new pull strings.
- D. Pull strings are not required where conduit or innerduct fill is greater than 33% after installation of cable.

3.05 INSTALLATION OF PATCH PANEL AND ASSOCIATED DEVICES

- A. The Contractor shall inspect patch panels, associated devices, and materials for compliance with these Specifications and with the Contractor's orders.
- B. Patch panels and associated devices shall be installed according to manufacturer's instructions.
- C. Patch panels and termination hardware shall be installed with matching mounting screws at each location.

3.06 GENERAL CABLE INSTALLATION

- A. The system shall be installed to comply with all applicable standards, codes, and regulations. In general, where the specifications, drawings, standards, regulations, and codes conflict, the most stringent requirement shall apply; however, the Contractor shall notify the Construction Manager immediately of conflicts for determination of a resolution.
- B. Cables shall be installed in innerducts that are installed in conduits, raceways, pull boxes, cable trays, or cable runways as shown on the Drawings. No aerial or

unsupported cables are permitted unless specifically indicated on the drawings and approved by START.

1. Refer to Section 27 05 28 –Communication Pathways, PART 2 section: 2.04 for approved innerduct
- C. Typically Backbone fiber and copper cable shall be installed with no splices.
1. This entry is to not be confused with the definition of fusion splicing, which is required per 27.05.13.1.05 and 27.13.00.1.04.
- D. The Contractor shall protect cables from dirt and moisture by laying cables on a clean, new ground covering.
- E. The Contractor shall inspect and clean as necessary existing and new cable trays and conduits to ensure that they are clean and free of obstructions prior to installing pull strings or pulling cable.
- F. The Contractor shall not install damaged or defective cables or components. The Contractor shall carefully inspect cable jacket for defects as cable is pulled off the reel.
- G. Cable Pulling:
1. Pull cable in accordance with manufacturer's recommendations and industry-accepted practices, and within the limits of cable bend radius and pulling tension specifications.
 2. Use of pulling lubricants is not allowed per Commscope/Systimax specifications
 3. Cables shall be hand pulled when possible or when required by manufacture. The Contractor shall use a recording tensiometer on pulls that may exceed 100 pounds pulling tension and always when a winch is used for pulling. Tensiometer printouts shall be identified by cable and submitted to the Construction Manager for each pull requiring use of a tensiometer.
 4. Pulling fixtures shall be attached to cable strength members. If indirect attachments are used, the grip diameter and length shall be matched to the cable diameter and characteristics, and the pulling forces shall be reduced to ensure that the fibers or copper pairs are not damaged from forces being transmitted to the strength member.
 5. Hand feed and guide cable through each 90-degree corner, through pull boxes, and as otherwise required for a free-flowing cable pull.
 6. Cable installation methods shall not exceed the cable manufacturer's specified pull tension for the specific cable.
 7. The mechanical stress placed upon a cable during installation shall be such that the cable is not twisted or stretched, nor shall the process kink or crush the cable.
 8. A cable feeder guide shall be used between the cable reel and the face of the cable tray or conduit to protect the cable and guide it into the cable tray or conduit as it is played off the reel.

9. The Contractor shall hand feed and guide cable through each cable tray 90-degree corner and as required for a proper, free-flowing cable pull.
 10. The Contractor shall follow the manufacturer's installation instructions and its specifications for minimum bend radius; the bend radius shall not exceed the manufacturer's minimum bend radius
 11. Cable fill shall not exceed NEC standard.
- H. Communication room entry
1. Backbone cable runs shall be routed on the upper tier of overhead ladder racking where there are multiple tiers. Contactor shall confirm these locations prior to installing cable.
 2. Optical fiber cable shall be routed from the conduit or cable tray entry point in communication rooms or equivalent spaces in the room tray system without innerduct (when transitioning into room from installed in conduit/tray), but in combed and tied bundles to the termination locations. Service loops of at least 10 meters in length. For communication rooms, provide a minimum of one lap around the upper cable tray.
 3. Copper cable shall be routed from the conduit or cable tray entry point in communication rooms or equivalent spaces in the room tray system without innerduct, but in combed and tied bundles to the termination locations. Service loops of at least 10 meters in length. For communication rooms, provide a minimum of one lap around the lower cable tray. Exception on length is the necessity to maintain Data cable limitation of 90 meters.
 4. Cable being routed through communications rooms shall be installed in innerduct or conduit.
 5. Demarcation backbone cable bundles (copper and fiber) are the exception, which are to run on lower tier. Maintain service loop rules above unless length of data backbone is in danger of exceeding cable limitation of 90 meters.
- I. Vertical Cable Runs
1. When possible, use gravity to assist in cable pulling. Pull cable from top of run to bottom of run. After installation, the vertical tension on the cable shall be relieved at maximum intervals of 20 feet using a split support grip.
 2. The Contractor shall provide sufficient tools, equipment, and manpower at required pull points to prevent damaging cables.
- J. Backbone Service loops of at least 10 meters in length shall be provided at both ends of each cable and at every Maintenance Hole (MH) in OSP applications. For communication rooms, provide a minimum of one lap around the cable tray.
- K. Cable shall not be twisted, kinked, crushed, stretched, split, scarred, or otherwise damaged. Inspect cable jacket carefully for defects as cable is played off the reel. Protect cable from contaminants and physical damage at all times.
- L. All strands of fiber optic cables shall be terminated to patch panels unless indicated otherwise in the drawings. All pairs of UTP copper cables shall be terminated to patch panels or 110 blocks.

- M. Fiber optic cable and UTP copper cables shall be 100% usable after installation, termination, and testing. Replace defective or damaged cables and terminations with new at no additional cost to the Port. Repair splicing of damaged cables is not permitted.
- N. Cable Preparation and Breakout: Cables shall be dressed and routed at termination points. Cables shall be combed and each strand shall run parallel with the other strands. After combing and straightening strands, Contractor shall separate strands into bundles according to routing requirements and termination points. Bundles shall be secured with hook-and-loop cable strap material specified in Part 2 – Products of this section. Cable ties of hard polymer material shall not be used.
- O. Cables run in cable runways in communications rooms shall be fastened with nylon cable ties or Velcro at intervals of 3 feet. Do not pinch cables or use mechanical cable tie "guns".
- P. Splices and Intermediate Terminations: Cables shall be run continuous between termination points shown on the drawings and shall be spliced only where indicated. Intermediate terminations or splices for the convenience of pulling or to repair a damaged or defective cable shall not be made. Where branch cables are spliced to backbone cables, branch cables shall enter the shelf splice and backbone cables shall enter the shelf termination. The subunit(s) of the backbone cable to be spliced shall route through the shelf terminations in a manner that provides the best protection of the subunit and the least interference with access to the other fiber strands. Obtain the Construction Manager's approval of which subunit(s) to splice and of the routings through shelves prior to splicing or terminating the cable.
- Q. Routing of any metallic media cabling such as voice, data or coaxial in the same conduit as power conductors is not allowed.
- R. Cabling in ceiling interstice (i.e. - between false ceiling and structure) shall be one of the following:
 - 1. Riser or plenum rated when cable is installed in metallic conduit or fully enclosed metal tray. Plenum rating is optional in this case.
 - 2. Plenum rated when cable is installed in open tray, ventilated tray, or ladder tray, or otherwise exposed.
 - 3. Cabling in areas with open ceilings (like bagwell) shall be Plenum rated.

3.07 CABLE TERMINATION

- A. Optical fiber cable termination
 - 1. Optical fiber terminations shall be made by personnel trained and certified by the manufacturer of the fiber and connectors and shall be installed using the appropriate tool kit and equipment approved by manufacture.
 - 2. Optical fiber shall be terminated in duplex SC connectors in existing environments, and LC connectors in new environments.
 - 3. Final direction of fiber connector type will be determined by START.
 - 4. Optical fiber connectors shall not exceed manufacturer's acceptable loss budget.

5. Contractor shall fusion splice fiber optical pigtails onto ALL CIBS MDR to ER fiber optical cabling.
 - a. Fusion splice loss of single mode fiber shall be no more than 0.3 dB per fusion splice.
 - b. Port has the right to change fusion splicing requirements per application.
 - B. Category 5e and/or 6/6a cable termination
 1. Terminated cables shall meet the required performance with no degradation due to termination.
 2. Category 6/6a cables (Data backbone) shall be terminated in RJ45 female plugs or information outlets at the field ends in T568B configuration. Field termination of male ends will not be accepted, nor will it pass proper Link testing.
 3. Category 5e 25 pair cables shall be terminated 110-block units in T568B configuration.
- 3.08 SEISMIC JOINT PENETRATIONS
- A. When conduit or pathway penetrates a building expansion joint, the Contractor shall furnish and install a seismic coupling.
- 3.09 FIRE AND SMOKE PARTION PENETRATIONS
- A. The Contractor shall install cables so as to maintain the fire and smoke spread-rating of all building surfaces penetrated. Materials and methods specified under Section 07 84 00 Firestopping shall be used.
- 3.10 FIELD QUALITY ASSURANCE
- A. The Contractor shall perform inspections per Section 27 05 13 - General Communications Requirements.
 - B. The Contractor shall perform horizontal cable testing as part of the field quality assurance for this Work.
 - C. The Construction Manager may arrange for interim inspections by a manufacturer's representative as conditions deem necessary.
- 3.11 SYSTEM PERFORMANCE
- A. Fiber Optic Cable and Terminations: The maximum attenuation of each fiber strand, not including terminations, shall be no greater than the manufacturer's specified maximum attenuation for the cable. The maximum attenuation of a mated pair of connectors shall be no greater than the manufacturer's specified average attenuation of a mated pair of connectors plus 0.3 dB. The maximum attenuation of a fiber strand, terminated at both ends, shall be no greater than the actual measured attenuation of the fiber strand plus the manufacturer specified average attenuation of the mated connectors plus 0.5 dB. The average attenuation of all connectors on a fully terminated cable shall be no greater than the manufacturer's specified average attenuation of the mated connectors.
 - B. UTP Copper Cable and Terminations: The UTP copper system, including cables and terminations, shall meet the requirements of TIA-568-B, including all applicable addenda and service bulletins.

3.12 GENERAL REQUIREMENTS FOR BACKBONE CABLING TESTING

- A. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform specified testing.
- B. Prior to testing the cable, the Contractor shall verify that the components and systems being tested have been installed in accordance with the Contract Documents.
- C. Test results are required to be submitted to the Port of Seattle no later than 14 days from the date of the individual test
- D. Test results are required to be submitted to the Port of Seattle before any network switch or network device activation will occur. This to ensure the entire cable channel meets all industry and manufacturer requirements.
- E. Cable testing shall be completed by the Contractor and accepted by the Construction Manager as a condition of Substantial Completion.

3.13 BACKBONE CABLE TEST PLAN

- A. The Contractor shall submit a general backbone cable test plan to the Construction Manager for review and approval 20 working days prior to the start of on-site cable installation Work, and 20 working days prior to pre-installation optical fiber reel testing.
- B. Contractor is responsible to re-certify existing infrastructure when re-installed, re-located, and ALL existing infrastructure in immediate location to be operational prior to system acceptance, and at no additional cost to the Port
- C. The test plan shall include:
 - 1. Schedules for the following:
 - a. Optical fiber pre-installation reel testing by the Contractor
 - b. Optical fiber terminated cable testing by the Contractor, by area
 - c. Copper cable terminated cable testing by the Contractor, by area
 - d. Release of optical fiber and copper cables for acceptance testing by the systems contractor or POS.
 - 2. The test plan shall include a list of the test equipment to be used by the Contractor, including model number of sample test reports and wave forms, manufacturer training certificates for technicians operating test equipment and calibration certificates, for approval by the Construction Manager prior to the start of testing. Test equipment shall have the latest firmware upgrades installed prior to testing. Port-specified test equipment shall be as follows:
 - a. Recommended tester is Fluke DTX or approved Level 5 test meter equivalent.
 - b. A Tier 1 Optical Loss Tester (OLT) shall be used to produce test results. The OLT is used to certify the fiber optical terminations as warrantable.

- (1) An OTDR shall not be used to record link loss and shall only be used as a troubleshooting tool.
 - (2) Recommended tester is Fluke DTX or approved Level 5 test meter equivalent.
 - c. Optical Loss Tester (OLT). The Contractor shall submit the OLT model number and calibration certificates to Construction Manager for approval prior to testing.
 - d. Unshielded twisted pair (UTP) cable tester. The Contractor shall submit UTP cable tester model number and calibration certificates to Construction Manager for approval prior to testing.
 - (1) Recommended tester is Fluke DTX or approved Level 5 test meter equivalent.
- 3. Summary of the tests that are to be performed by the Contractor, and the test results that are to be submitted.
- D. Backbone cable test results - submittals
 - 1. The Contractor shall provide test results in hard copy and soft copy format. The format, content, and graphic scales shall be submitted to the Construction Manager for approval prior to performing tests.
 - 2. Contractor shall furnish to the Construction Manager the licensed software required to view electronic copies of test results.
 - 3. Final testing shall use Port of Seattle cable naming convention in all test records.
 - 4. Test results are required to be submitted to the Port of Seattle no later than 14 days from the date of the individual test.
 - 5. Test results are required to be submitted to the Port of Seattle before any network switch or network device activation will occur. This to ensure the entire cable channel meets all industry and manufacturer requirements.

3.14 OPTICAL FIBER PRE-INSTALLATION REEL TESTING

- A. The Contractor shall compare factory test data with data obtained by conducting a pre-installation reel test as follows.
- B. The Contractor shall pre-test single mode fiber at 1310/1550 nm.
- C. Dual-pulse Function. A fiber shall be tested at a single wavelength with two pulse widths.
- D. Two traces shall be displayed, one for each pulse width. (The short pulse provides optimal event resolution, while the longer pulse provides excellent distant measurements.)

3.15 OPTICAL FIBER TERMINATED CABLE

- A. The Contractor shall test fiber with launch and receive cables in both ways and record measurements for the following:
 - 1. Link loss. The one-way backbone link loss shall be less than 2.0 dB, measured at either 1310nm or 1550nm.

2. Fiber attenuation (dB/km)
 3. Splice and connector loss
 4. Reflectance and optical return loss
 5. Length
- B. Optical fiber cable shall comply with the following singlemode standards:
1. ANSI 2136.2
 2. EIA-440-A
 3. Fiber optic test procedure (FOTP) FOTP-8 (TIA/EIA-455-8)
 4. FOTP-61 (TIA/EIA-455-61-A)
 5. FOTP-77 (TIA/EIA-455-77)
 6. FOTP-78 (TIA/EIA-455-78A)
 7. FOTP-95 (TIA/EIA-455-95)
 8. FOTP-171 (TIA/EIA-455-171)
 9. TIA/EIA-455-B
 10. TIA/EIA-526
- 3.16 CATEGORY 5 AND/OR 6/6a TERMINATED CABLE TESTING
- A. The Contractor shall test and record measurements for the following:
1. TIA Category 6/6a per TIA addendum #1 to TIA/EIA-568B
 2. IEEE 802.3 1000 Base-T
- B. Category 6 terminated cable shall comply with the following standards:
1. Category 6/6a per Addendum #1 to TIA/EIA-568-B
 2. ISO/IEC 11801, Class C and D
 3. ANSI INCITS 263 (TP-PMD)
 4. IEEE 802.3 (for 10BASE-T, 100BASE-TX, and 1000BASE-T)
 5. IEEE 802.5
- C. The Contractor shall use Level 5 permanent link adapters on test equipment.
1. Recommended test unit:
 - a. Fluke DTX
 - b. Approved Level 5 test unit
- D. The following Category 6/6a test results shall be submitted
1. Line Map
 2. Cable Length
 3. Attenuation
 4. Cross Talk
 5. Return Loss

6. Propagation Delay
7. Delay Skew
- E. Refer to POS “Communications System Standards Design Principles” for Acceptance Testing.

3.17 POST-INSTALLATION TESTING

- A. General: Perform post-installation tests on fiber optic cables and terminations, and on UTP copper cables and terminations as required by the Systimax Solutions Systimax or others extended warranty programs.
- B. Final testing shall use Port of Seattle cable naming convention in all test records.
- C. Third Party Testing: The Port may use an Independent Cable Test contractor for independent testing of the fiber optic cable and UTP copper system in addition to the testing required by the installation Contractor. This independent testing is not included in the Work of this contract. Coordination with the Port and the Independent Cable Test contractor is required as Work of this contract and shall be required as follows:
 1. The Contractor shall notify the Construction Manager when terminated cables have passed the tests necessary to satisfy the requirements of the Systimax Solutions extended warranty program.
 2. The Port will schedule an Independent Cable Test contractor thereafter. It is anticipated that testing by this contractor will closely follow the progress by the Contractor. The Contractor shall coordinate with and assist the independent Cable Test contractor to the maximum extent possible.
 3. Cables and terminations found by the Independent Cable Test contractor to be damaged, defective, improperly installed, or that fail to meet performance requirements shall be remedied by the Contractor to the satisfaction of the Construction Manager, and shall be retested by the Contractor to meet the Systimax Solutions extended warranty program requirements, at no additional cost to the Port.

3.18 LABELING AND COLOR CODES

- A. Identification, labeling, and product color selection shall comply with Section 27 05 53 - Identification and Labeling, Section 27 05 53.13 – Communications Standard for Labeling and Nomenclature, and Section 27 05 53.23 - Port of Seattle Color Code Requirements.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

- A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the [Schedule of Unit Prices] [Lump Sum price bid for the Project].

End of Section

Revision History:

05/01/2014 Conversion to 2004 CSI Numbering System

10/15/2014 Added Sole Source and Salient Characteristics Note to Part 2 and revisions

01/29/2015 Revised Sole Source

01/23/2017 Incorporated ICT specifications

01/01/2022 Added fusion splice requirements; added test report timeline; clarified pull requirements, testing requirements and timeline, ER room requirements.