This master should be used by designers working on Port of Portland construction projects. Designers working for PDX tenants should use Section 271001, Structured Cabling for Tenant Improvement Projects. Usage notes highlight a few specific editing choices, however the entire section should be evaluated and edited to fit specific project needs.

SECTION 271000 – STRUCTURED CABLING

1. GENERAL
	* + 1. DESCRIPTION
				1. This section describes copper and fiber infrastructure for the communication and data network system.
			2. RELATED WORK SPECIFIED ELSEWHERE
				1. Section 260526, Grounding and Bonding for Electrical Systems
				2. Section 260533, Raceway and Boxes for Electrical Systems
				3. Section 270553, Identification for Telecommunication Systems
				4. Section 281300, Security Access Control System
				5. Section 282300, Video Surveillance
			3. REFERENCES
				1. Install equipment and materials in accordance with the applicable standards of the following organizations:

ANSI: American National Standards Institute

ANSI/TIA: American National Standards Institute and Telecommunications Industry Association

ANSI/TIA-568-C.1: Commercial Building Telecommunications Cabling Standard

ANSI/TIA-568-C.2: Balanced Twisted-Pair Telecommunications Cabling and Components Standard

ANSI/TIA-568-C.3: Optical Fiber Cabling Components

ANSI/TIA-607-C: Generic Telecommunications Bonding and Grounding for Customer Premises

BICSI: Building Industry Consulting Service International

EIA: Electronic Industries Alliance

EIA-310: Cabinets, Racks, Panels, and Associated Equipment

IBC: International Building Code

IFC: International Fire Code

NEC: National Electrical Code

NEMA: National Electrical Manufacturers Association

UL: Underwriters Laboratories

* + - 1. SUBMITTALS
				1. Submit product data for the following:

Cable

Connectors

Cable management

Patch panels

Termination blocks

Closet connector housing (CCH)/Fiber optic distribution unit (FODU)

Modular patch cords

Faceplates

Jacks

Modular plugs

Equipment racks

Power strips

Surge protectors

* + - * 1. Submit the quantity and lengths of modular patch cords to be provided by the Contractor in accordance with project requirements.
				2. Shop Drawings: Prepare and submit coordination drawings detailing raceways and system components and materials in relation to other building systems and components. Drawings shall include, but not be limited to, the following:

Floor plans detailing raceway and cabling installations.

Enlarged network and equipment room plans showing room layouts including coordination drawings detailing all equipment to be installed by other trades within the enlarged area.

Wall-mounted facilities on terminal backboards.

Equipment rack and cabinet elevations for all termination locations.

Detail drawings shall include clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.

Cable and equipment labeling schemes and sample labels as coordinated with the Port and in accordance Section 270553.

See the drawings for completed telecommunications, backbone cabling, and horizontal cable matrix schedules. Complete these schedules upon field verification of installation locations of patch panels, racks, cabinets, etc., and submit to the Port for approval prior to commencement of work.

* + - * 1. Submit Contractor qualifications, upon request, including:

Contractor’s current certification for the manufacturer’s certified installer program.

Manufacturer’s Category 6A certifications for each technician performing installation on the project.

Manufacturer’s certificate of completion on the following course for each technician performing installation on the project:

Atlas-X1 Shielded Installation Training provided by Leviton Network Solutions.

Manufacturer’s fiber optic cable and connector certifications for each technician performing installation on the project.

* + - * 1. Submit certified equipment calibration records performed by the equipment manufacturer stating that the equipment that will be used in the testing of copper and fiber optic cables installed as part of the work was calibrated within the past 6 months.
				2. Product Data Manuals: Upon completion of the project, submit final product data manuals that include:

A complete as-installed equipment list of all components installed with manufacturers’ names and model numbers.

A complete set of product data sheets for all products installed. Product data sheets shall be clearly marked, identifying the specific items installed.

* + - * 1. Review of product data does not relieve the Contractor from responsibility for deviations from the drawings or specifications, unless the Contractor has, in writing, called attention to such deviations at the time of submission and obtained written approval from the Port.
				2. As-Constructed Documents: Maintain real-time as-constructed documentation for the installed structured cabling system.

Update and revise contract documents to record actual locations (as-installed) of all equipment, pull boxes, devices, raceways, cabling, outlets, and cable infrastructure components.

As-constructed drawings shall include:

Complete site plans, floor plans, and enlarged plans and site plans indicating placement and routing of as-installed raceways, junction boxes, racks, cabinets, cables, and communications outlet locations and types with labels and cabling facilities installed. Cabling shall include callouts detailing Port cable designation.

Complete structured cabling riser diagrams showing as-installed originations, destinations, and type of pathways for all cabling. Include cabling numbers, terminal block numbers and layouts, and other designations.

Equipment rack/cabinet and wallboard elevation drawings for each network room and cable termination location.

Final, as-terminated fiber optic distribution unit (FODU) schedules and details.

* + - * 1. Test Reports: The Contractor shall be responsible for recording all test data. Submit copies of all test results to the Port for review and approval no later than one week after completion of the testing.

Prior to commencement of cable testing, submit a sample test report, with the assigned cable designation clearly indicated, of each test type to the Port for approval.

Submit final test report schedules which confirm that the cabling infrastructure has been tested, labeled, and documented.

Submit the test reports and schedules with the testing software program on CD-ROM or DVD.

* + - * 1. Submit operation and maintenance manuals. Content of each manual or chapter shall include, but not be limited to, the following:

Description of system.

Manufacturers’ brochures. Include manufacturers’ descriptive literature covering devices and equipment used in the system, together with illustrations, exploded views, and renewal parts lists. Edit the manufacturers’ standard brochures so that the information applying to the actual installed equipment is clearly defined.

* + - * 1. Submit manufacturers’ equipment guarantees or warranties for applicable systems and components.
			1. QUALITY ASSURANCE
				1. The work shall be performed by Oregon Limited Energy Journeyman licensed technician(s).
				2. The structured cabling system shall be installed by a value-added reseller for the manufacturers specified and their respective products. Each of the Contractor’s installing technicians shall have completed the manufacturer’s training for the installation of shielded cabling systems (Atlas-X1 Shielded Installation Training) and be a certified member in good standing of the manufacturer installer program before, during, and through completion of the system installation.

Edit the warranty language as applicable for HQ/P2 and other Port facilities that are not served by a Berk-Tek/Leviton system.

* + - 1. WARRANTY
				1. Provide the following:

Limited Lifetime Berk-Tek/Leviton materials warranty on parts and labor to repair/replace defective telecommunications copper station cabling materials and associated products.

Minimum 25-year Corning Cable Systems warranty on parts and labor to repair/replace defective telecommunications fiber backbone and fiber station cabling materials and associated products.

* + - * 1. Passive components and products (cables, connectors, patch panels, and/or other associated components) shall come from the manufacturers listed above to offer an extended warranty on the structured cabling system being installed. The Contractor or the Contractor’s installer shall be certified by Berk-Tek/Leviton or Corning to provide the materials warranty and shall meet all necessary requirements to make the Port eligible for the extended warranties. Upon completion, submit a certificate from the sponsoring manufacturer stating that the installed system is covered by the manufacturer’s extended warranty for the minimum period applicable.
				2. The Port shall be named the owner of the warranty and guaranteed full and complete rights under the warranty.

For HQ/P2 and other Port facilities that are not served by a Berk-Tek/Leviton system, replace “no substitutions” with “or pre-bid approved equal.” The brand name exemption for Berk-Tek/Leviton expires February 28, 2024.

The brand name exemption for Corning Fiber expires March 28, 2027.

1. PRODUCTS
	* + 1. MATERIALS
				1. Communications products installed as part of this work shall be listed by a recognized testing laboratory or approved in writing by the inspection authority as required by governing codes and ordinances.
				2. Materials shall be new and of the best quality. The materials shall be manufactured in accordance with NEMA, ANSI, UL, or other applicable standards.
				3. Equipment and materials of the same general type shall be of the same manufacturer throughout the work to provide uniform appearance, operation, and maintenance.
				4. Cable jacket shall be plenum-rated and marked with the CMP designation where appropriate and as required by code for installation in plenum-rated areas.
				5. The structured cabling system components for the horizontal cabling shall consist entirely of products from CS6700 CAT6A Shielded System by Berk-Tek/Leviton, no substitutions.
			2. FIBER OPTIC CABLE
				1. Fiber optic cables shall be single-mode, loose tube, riser/plenum rated for the environment of the installation. Corning FREEDM Cable Series, no substitutions.

Singlemode fiber shall be 8.3um/125um.

Where installed in cable tray, cable shall be armored.

* + - * 1. Cable strand size as indicated on the drawings.
			1. RISER COPPER CABLE
				1. Riser cable shall be copper, 24-gauge, paired dual, semi rigid PVC skin over foamed PE. The core shall be overlaid with a corrugated aluminum sheath bonded to an outer PVC plastic jacket to form an alvyn sheath. Cable shall be UL verified to TIA/EIA 568-B for Category 3 performance.
				2. Acceptable manufactures are General Cable, Berk-Tek, Superior Essex, CommScope Systimax, or pre-bid approved equal. Cable designation shall be ARMM series.
				3. Cable pair size shall be as indicated on the drawings.
			2. OUTSIDE PLANT (OSP) TELEPHONE CABLE
				1. Telephone cable shall be copper, 24-gauge, paired, dual insulated with foam skin and gel filling compound. Cable shall be plastic core wrapped, and shall have an aluminum steel polyethylene (ASP) sheath.
				2. Acceptable manufacturers are General Cable, Superior Essex, CommScope SYSTIMAX, or pre-bid approved equal. Cable designation shall be ANMW series.
				3. Cable size shall be as indicated on the drawings.
			3. SHIELD BOND CONNECTORS
				1. 3M Scotchlok Bonding Connectors, 3M Part No. Series 4460, or pre-bid approved equal, shall be used to bond multi-pair copper cable jackets to appropriate ground at building entrance terminal locations.
			4. BUILDING ENTRANCE TERMINALS (BET) FOR OSP CABLES
				1. For Interior Wall Mount Installations:

Building entrance terminals shall be Porta Systems Series 24 with110 connector block input and 110 connector block output, Part No. 24xxx-110-M110C, or pre-bid approved equal.

Pair size as indicated on the drawings.

* + - * 1. For Rack/Enclosure Installations:

Rackmount protector panels shall be Porta Systems 50 pair with 110 connector block input and 110 connector block output, Part No. 19050-110-110, or pre-bid approved equal.

* + - 1. BET PROTECTOR MODULES
				1. Five pin, three-element gas, 350v module, black in color. Circa Telecom No. 3B1E, or pre-bid approved equal.
				2. Provide protector modules to fully populate each pair listed on the BET’s protector module panel.
			2. CAT6A BUILDING ENTRANCE PROTECTORS
				1. CAT6A building entrance protectors shall be Transtector DPR-F140, or pre-bid approved equal.
				2. Rack Mount Chassis: Transtector 10000-1206 DPR Rack Mount Chassis, or pre-bid approved equal.
			3. HORIZONTAL CABLE – INTERIOR
				1. Horizontal cables shall be four-pair, shielded, twisted pair (F-UTP), #23 AWG solid copper conductors, paired, flame-retardant PVC jacket.
				2. Cable shall be pliant with no memory.
				3. Manufacturer: Berk-Tek LANmark-10G FTP Plenum cable (Part No. 10189548), no substitutions.
				4. Cable jacket shall be violet in color.
			4. HORIZONTAL CABLE – INTERIOR/EXTERIOR
				1. Horizontal cables shall be four-pair, shielded, twisted pair (F-UTP), #23 AWG solid copper conductors, paired, and PVC jacket. Cable shall be rated CMR and CMX Outdoor.
				2. Manufacturer: Berk-Tek LANmark-B751 CAT6A FTP Outdoor cable (Part No. 11101959), no substitutions.
				3. Cable jacket shall be black in color.
			5. HORIZONTAL CABLE - EXTERIOR
				1. Horizontal cables shall be four-pair, unshielded, twisted pair (UTP), #23 AWG solid copper conductors, paired, polyethylene insulated.
				2. Manufacturer: Berk-Tek LANmark-10G CAT6A OSP cable (Part No. 11094458), no substitutions.
				3. Cable fill shall contain a water-resistant flooding compound.
				4. Cable jacket shall be black in color.
			6. CABLE MANAGEMENT COMPONENTS
				1. Vertical Cable Management: Chatsworth Evolution G3 combination vertical cable manager or pre-bid approved equal, clear in color, sized as indicated below:

In existing network rooms: 6" W x 20.2" D x 7' H, Part No. TS1037525.

In new network rooms: 8" W x 20.2" D x 7' H, Part No. TS1037513.

* + - * 1. Horizontal Cable Management:

Rack Mount FODUs:

1RU: 19-inch horizontal cable manager. CPI Evolution G3 1RU (Part No. 35441-701), or pre-bid approved equal.

2RU: 19-inch horizontal cable manager. CPI Evolution G3 2RU (Part No. 35441-702), or pre-bid approved equal.

Wall Mount R66 and 110 Termination Blocks: Siemon S110A2RMS, or pre-bid approved equal.

* + - * 1. Filler Patch Panels:

Top Patch Panel in a Rack: 1RU blank angled plate with transitional cover. Leviton 49254-BC1, no substitutions.

Subsequent Patch Panels in a Rack: 1RU blank angled plate. Leviton 49254-BA1, no substitutions.

* + - 1. HORIZONTAL CABLE PATCH PANELS
				1. Design patch panels for installation on standard NEMA 19-inch equipment racks.
				2. Patch panels shall be certified by the manufacturer to ensure optimal channel performance of the structured cable system. Leviton Atlas-X1 Angled Shielded QuickPort 24 Port Patch Panel+ (Part No. 4S256-S24), no substitutions.
			2. BACKBONE CABLE TERMINATION BLOCKS
				1. Wall Mount 110 Termination Block:

Provide termination blocks with legs for installation on 3/4-inch plywood backboards.

Termination blocks shall be 110 termination with tin lead-plated insulation displacement connector (IDC). Siemon S110 wiring blocks or S110 field terminated block kit, Part No. S110A52-100FT/300FT, or pre-bid approved equal, quantity and size as indicated on the drawings.

* + - * 1. Rack Mount Termination Block:

Design termination blocks for installation on standard NEMA 19-inch equipment racks.

Termination blocks shall be 110 termination with tin lead-plated insulation displacement connector (IDC). Siemon field terminated panels with cable managers, Part No. S110D52-200RWM, or pre-bid approved equal, quantity as indicated on the drawings.

* + - 1. FIBER CONNECTORS
				1. In Existing FODUs with Fan-Out Kits:

Terminate singlemode fiber ends with LC ceramic ferrule connectors. Corning FuseLite splice on connector, no substitutions.

Bare fibers shall be protected using buffer tube fan-out kits prior to termination. Corning Cable Systems Part No. FAN-BT25-1, no substitutions.

* + - * 1. Wall Mount FODUs:

Terminate singlemode fiber ends with LC ceramic ferrule connectors. Corning FuseLite splice on connector, Part No. SOC-LCU-900-SM, no substitutions.

* + - * 1. New 2 or 4 RU FODUs:

Rack mountable CCH splice cassette loaded with LC connectors, CCH panel and factory-terminated pigtails. Corning Cabling Systems, Part Nos. CCH-CS12-A9-P00RE and CCH-CS24-A9-P00RE, no substitutions.

* + - 1. CLOSET CONNECTOR HOUSING (CCH)/FIBER OPTIC DISTRIBUTION UNIT (FODU)
				1. Network, Equipment Rooms:

CCH with LC bulkheads, connector panels, and associated hardware.

Closet connector housings shall be black in color.

CCH housing size as indicated on the drawings.

* + - * 1. Wall Mount FODUs:

Surface mountable CCH with LC bulkheads, connector panels, splice trays, and associated hardware. Corning Cabling Systems, Part No. ICH-02P, no substitutions.

Closet connector housings shall be black in color.

CCH housing size as indicated on the drawings.

* + - 1. CATEGORY 6A MODULAR PATCH CORDS
				1. Provide Leviton CAT6A high-flex copper patch cords, Part No. H6A10-xxS, no substitutions.

For field devices installed such as, but not limited to, interface terminal box (ITB) edge controllers, video surveillance cameras, flight information displays, gate operators, and biometric readers.

Provide one patch cord (installed by the Contractor) at the device end, length as required.

For the total number of horizontal cables installed (including for field devices):

Provide one patch cord, 7 feet in length, for 60 percent of total horizontal cables installed.

Provide one patch cord, 10 feet in length, for 60 percent of total horizontal cables installed.

* + - * 1. Modular patch cords shall be certified by the manufacturer to ensure optimum channel performance for the structured cabling system. Leviton, no substitutions.
				2. Modular patch cords shall be grey in color.
			1. BACKBOARDS
				1. AC grade plywood, 3/4" by 48" by 96", or to size, as indicated on the drawings, mounted vertically with C side against building structure (unless the FR-S rating stamp is on the C side).

Fasten plywood to studs at 16"” to 24" using #12 flat head sheet metal screws (nail guns and explosive discharge devices shall not be used to secure plywood to studs).

Backboards shall be free of surface defects such as knots and cracks.

Plywood shall have a FR-S flame spread rating.

Paint plywood with two coats of light gray low gloss paint. Leave FR-S rating stamp unpainted.

Coordinate with electrical power and other trades for light switch, power outlet, and other fixture locations prior to placement of backboards.

* + - 1. FACEPLATES
				1. Faceplates shall have a minimum of four communication ports that may be configured for either copper or fiber installations on a per-port basis and shall be flush-mount unless otherwise specified.
				2. Provide angled single gang configuration.
				3. Faceplates shall be stainless steel.
				4. Unused faceplate ports shall have black blank inserts (Part No. 41084-BW).
				5. Leviton, Part No. 43081-1L4, no substitutions.
			2. JACKS
				1. Shielded jacks shall be purple, Leviton Atlas-X1 CAT6A Shielded QuickPort Connector Part No. 6ASJK-RP6, no substitutions.
				2. Unshielded jacks shall be purple, Leviton Atlas-X1 CAT6A UTP QuickPort Connector Part No. 6AUJK-RP6, no substitutions.
				3. Wall mount jacks (for wall phones) shall be stainless steel Leviton Recessed Wallplate Part No. 4108W-1SP, no substitutions.
			3. MODULUAR PLUGS
				1. Modular plugs shall be shielded CAT6A, tool-free, Part No. Leviton CAT6APLG-S6A, no substitutions.
			4. OUTLETS
				1. One Port: Leviton, Part No. 41089-1IP, no substitutions, shall be used at Port-approved locations.
				2. Two Port: Leviton, Part No. 4S089-2IP, no substitutions.
				3. DIN Rail Mount: Signamax Keystone Industrial DIN Rail module, with side lids on the end units. Part Nos. KI-DIN-RMM and KI-DIN-RMM-SL, or pre-bid approved equal.
			5. EQUIPMENT RACKS
				1. Standard two-post 19-inch equipment racks shall have the following minimum requirements:

45 rack mounting spaces.

Adjustable equipment mounting rails drilled and tapped to EIA-310 standards.

Clear in color with alphabetical RMU labeling from “A” to “SS.”

* + - * 1. CPI Universal (Part No. TS1039550), or pre-bid approved equal.
			1. VERTICAL RACK BUSBAR KIT
				1. Provide a copper vertical rack busbar kit for each two-post 19-inch rack, 5/8"(H) x 1/4" (W) x 72" (D), CPI 40161-072, or pre-bid approved equal.
				2. Vertical rack busbar kits shall be listed as a ground bond pathway.
			2. POWER STRIPS FOR RACKS
				1. Two Post Racks with 120vac Power Receptacles: Provide a vertical power strip within each rack, 120 VAC, 20 amp, with 20 NEMA 5-20R receptacles, CPI 12851-705, or pre-bid approved equal.
			3. CABLE RUNWAYS
				1. Cable runways shall be clear, Telco-style, classified as equipment grounding, and sized according to the drawings. Chatsworth Part No. 11275-0xx, or pre-bid approved equal.
				2. Effectively bond all metal runway.
				3. Cable runway and manufacturers’ hardware shall be UL-listed as a ground bond pathway.
			4. CABLE PROTECTION COMPONENTS
				1. Spiral cable wrap, flame retardant polyethylene (UL94V-0), 0.25 OD, wraps cable bundles from 3/16 inch to 2 inch, color shall be black. Panduit Part No. T25FR-C, or pre-bid approved equal.
1. EXECUTION
	* + 1. GENERAL
				1. Provide services, labor, material, and components necessary for a complete and finished installation.
				2. Install equipment, patch panels, and termination blocks between 1 foot 6 inches AFF and 6 feet 6 inches AFF on equipment racks or backboards as appropriate.
				3. Install firestops and seals at penetrations through building floors, walls, or where required by fire codes.
				4. Field test cables prior to installation. Replace damaged cables.
				5. Inspect cable for sheath defects or other irregularities as it is pulled out. Upon detection of defects, stop pulling and repair or replace the cable section.
				6. Install cables continuously with no splices.
				7. Provide bonding for all equipment within telecom rooms in accordance with manufacturer’s requirements.
				8. Provide rack anchor bolts and attachments, installation of cable runway, and anchoring of equipment in accordance with the manufacturer’s recommendations. Provide engineered/stamped seismic calculation where required by code.
				9. Provide vertical and horizontal cable management troughs as appropriate for the installation and as indicated on the drawings.
			2. GROUNDING
				1. Comply with grounding specifications of EIA/TIA-607-C: Generic Telecommunications Bonding and Grounding for Customer Premises.
			3. EQUIPMENT SUPPORT
				1. Each fastening device and support for communications equipment and racks shall be capable of supporting not less than four times the ultimate weight of the object or objects fastened to or suspended from the building structure and shall be installed to resist seismic forces as specified in the IBC for the ground motion accelerations corresponding to the project location.
				2. Powder-actuated or similar shot-in fastening devices will not be permitted for any communications work except when approved by the Port.
			4. ALIGNMENT
				1. Install racks and equipment level and plumb, parallel with structural building lines. Communications enclosures shall fit neatly without gaps, openings, or distortion. Properly and neatly close unused openings with approved devices.
				2. Fit outlets with neat, appropriate trims, plates, or covers, without overhanging edges, protruding corners, or raw edges, to leave a finished appearance.
			5. CUTTING AND PATCHING
				1. Include cutting, patching, and restoration of finishes. Surfaces damaged by this work shall be neatly patched and finished to match the adjacent construction, including paint or other finishes. Clean up and remove dirt and debris.
				2. Where equipment installations or connections require the installation of an access panel, provide a properly sized and installed access panel similar to those used for mechanical equipment access.
				3. Conduit fill shall not exceed NEC fill requirements.
			6. PROTECTION OF WORK
				1. Protect communications work and equipment installed against damage by other trades, weather conditions, or any other causes. Equipment found damaged or in other than new condition will be rejected as defective.
				2. Communications equipment shall be kept covered or closed to exclude dust, dirt and splashes of plaster, cement, or paint, and shall be free of all such contamination on exterior and interior before acceptance. Enclosures and trims shall be in new condition, free of rust, scratches, and other finish defects. Properly refinish to new condition if damaged.
			7. MAINTENANCE OF SERVICE
				1. Communication systems and equipment shall be maintained to functioning portions of the building throughout construction, during normal working hours of the building occupants. Outages to occupied areas shall be kept to a minimum and require pre-approval from the Port. The Contractor will be liable for any damages resulting from unscheduled outages or for outages not confined to the prearranged times.
			8. FIBER OPTIC CABLE
				1. Install fiber optic cable in inner duct, either existing corrugated or new flexible fabric, when using underground conduits. Use no inner duct in cable trays if armored fiber cable is used. Stop inner duct before entering a network room or computer room. Leave 10 feet of maintenance loop at both ends. Coordinate with the Port for location.
				2. For installation of fiber optic cabling in the outside plant raceway system, provide a 15 maintenance loop in every third manhole, vault, or pull box in addition to the maintenance loop indicated above.
				3. Fan-Out of Fiber Optic Cable: Prior to termination, fiber optic cable strands shall be furcated (fanned out) using the specified buffer tube fan-out kits and using the procedure specified by the manufacturer.
			9. CAT6A BUILDING ENTRANCE PROTECTORS
				1. Install CAT6A building entrance protectors for exterior CAT6A cables on a rack mount chassis or wall-mounted DIN rail as indicated on the drawings.
				2. Terminate exterior CAT6A cables with a modular plug to the building entrance protector. Provide a patch cord at the other end of the building entrance protector. Terminate patch cord to location as indicated on the drawings.
				3. Provide a continuous No. 6 ground wire to bond the rack mount chassis or DIN rail to the building ground bar with bolted lug connections. Do not splice or connect ground wires in a daisy chain arrangement.
			10. HORIZONTAL CABLE
				1. Install cables in cable tray or conduit. Install conduit in accordance with Section 260533.
				2. Dress cables neatly in cable trays and tie down at corners and changes in cable tray elevation using hook and loop fastener, strap or wrap. Install cables in center spine cable tray so that the cable tray is balanced.
				3. Verify cable lengths prior to installation. Provide notification of cables exceeding 290 feet, do not install cables that exceed 290 feet without prior Port approval.
				4. Install pull string in all conduits.
			11. TERMINATIONS
				1. Terminate horizontal cables on modular jacks inserted in patch panels, faceplates, or surface mount boxes.
				2. Terminate backbone cables on 110 field termination blocks as specified and as shown on the drawings. Wrap each binder group with the appropriate color to indicate proper binder group identity. When installing in center hung cable tray, install on the higher side of the tray to keep the cable tray balanced.
				3. All four pairs of each horizontal cable shall be terminated in T568B pinout standard order on the jack.
				4. Lay out cables on the patch panel as indicated on the cable matrix drawings.
				5. Terminate fiber optic cables in FODUs as indicated on the drawings.
			12. TESTING
				1. Upon completion, test systems to show that equipment installed operates as designed and specified. Submit testing plans for review prior to testing. Plan system tests for as many at one time as possible to work into construction phasing. The Port may witness tests at its option and if so, schedule tests 48 hours in advance.
				2. A written record of performance tests shall be compiled, dated, witnessed, and submitted along with operating and maintenance data, prior to substantial completion.
				3. Test reports shall certify that wiring is complete, passes all test criteria, is fully operational, and that the work has been completed as specified.
				4. Provide all forms, instrumentation and test equipment, loads, and other consumables required.
				5. Copper CAT6A Horizontal Cable Testing:

Test after jacks are inserted and faceplates correctly mounted and labeled.

Following the final inspection tests and certification by the Contractor, post-certification may be performed through an independent field verification program or testing service. The Port, at its discretion, may require the Contractor to return to the site, at no additional cost to the Port, to assist with the determination of any certification discrepancies. If such a determination finds the materials, installation procedures, or final testing procedures to be out of compliance with this contract, the Contractor shall remedy the cause and re-test, at no additional cost to the Port.

Test copper cables with test equipment designed to substantiate compliance with ANSI/TIA568-C.2. If the test equipment permits, program into the tester “Port of Portland” as the name of “Owner” and the correct cable number under “Circuit ID” appearing on each cable report page. Retain test results and submit.

Perform channel tests on horizontal cables and provide test results on the following electrical signal characteristics:

Wire Map

Length

Resistance

Propagation Delay

Delay Skew

Insertion Loss

Return Loss

Near-End Crosstalk (NEXT)

Powersum Near-end Crosstalk (PSNEXT)

Attenuation to Crosstalk Ratio Near-End (ACRN)

Powersum Attenuation to Crosstalk Ratio Near-End (PSACRN)

Attenuation to Crosstalk Ratio Far-End (ACRF)

Powersum Attenuation to Crosstalk Ratio Far-End (PSACRF)

Test cables to meet ANSI/TIA-568-C.2 standards on the permanent link, equipment outlet to patch panel. The cable installation and products will be deemed acceptable if the Contractor provides documentation substantiating compliance with the electrical signal characteristics of the ANSI/TIA-568-C.2 specifications for horizontal cables.

Approved CAT6A tester is Fluke Versiv with DSX5000 module, or equal.

Correct or replace copper cables and related hardware that fail the acceptance test. Re-test, as outlined in the testing procedures, cables requiring corrective action to meet compliance.

Submit cable test equipment reports on a compact disc using the latest version of the test equipment manufacturer’s software, as well as a printed paper copy, for approval. Provide a copy of the test equipment manufacturer’s most current release of the test equipment software to allow reading of the test data.

* + - * 1. Riser and Backbone/OSP Copper Cable Acceptance Testing:

Perform testing of copper cabling prior to system use. Test 100 percent of the cable pairs.

Test 100 percent of the wiring pairs and cross-connections for opens, shorts, polarity reversals, transposition, and presence of AC voltage.

Individually test 100 percent of the cable pairs for continuity, power faults, polarity reversals, transposition, and ground faults. Correct all shorts, opens, crosses, bad termination, foreign voltages, grounding problems, sheath continuity problems, etc.

Notify the Port at least 24 hours prior to testing to allow observation. If the Port confirms its intention to observe, a reasonable starting time shall be agreed upon.

Record and submit all test results to the Port for verification. Record test results using the forms provided at the end of this section.

Following the final inspection tests and certification by the Contractor, post-certification may be performed through an independent field verification program or testing service. The Port, at its discretion, may require the Contractor to return to the site, at no additional cost to the Port, to assist with the determination of any certification discrepancies. If such a determination finds the materials, installation procedures, or final testing procedures to be out of compliance with the contract documents, the Contractor shall remedy the cause and re-test, at no additional cost to the Port.

Correct or replace copper cables and related hardware that fail the acceptance test. Re-test, as outlined in the testing procedures, cables requiring corrective action to meet compliance.

* + - * 1. Fiber Optic Cable Testing:

Tier 1 Testing:

Test all fiber strands via the one-jumper reference method.

Fiber test reference cords shall meet ISO/IEC 14763-3 maximum dB loss limits with verifiable maximum loss limits of no more than 0.20dB.

Fiber test reference cords shall be between 2m and 5m in length.

Perform end-to-end, one-directional attenuation test for each fiber strand (connector-to-connector) at 1310 and 1550 wavelengths.

Approved Tier 1 tester is Fluke Versiv with CertiFiber Pro OLTS module, or equal.

Tier 2 Testing:

Install a launch cable between the OTDR and the first link connection.

Install a tail cable after the last link connection.

The launch and tail cables shall remain in place for the measurement in the opposite direction.

Launch and tail cable connectors shall not have more than 0.20dB maximum loss.

Launch and tail cables shall have a minimum length of 130m.

Perform end-to-end, bi-directional attenuation test for each fiber strand (connector-to-connector) at 1310 and 1550 wavelengths.

Approved Tier 2 tester is Fluke Versiv with OptiFiber Pro OTDR module, or equal.

Fluke field-test instrument shall be within the calibration period recommended by the manufacturer and a copy of the calibration certificate shall be made available.

Calculate the fiber optic attenuation loss budget using the manufacturer’s specified attenuation per linear foot of fiber. Calculate singlemode connectors using the manufacturer’s published values of 0.30 dB per connector for the maximum loss.

No singlemode mated pair connector will be accepted if field test result loss is greater than 0.50 dB.

Place terminated fiber connectors in duplex fiber bulkheads and panels sequentially per the fiber color code. Polarity shall be straight through.

Submit a copy of the OLTS and OTDR test reports on a compact disc using the latest version of the test equipment manufacturer’s software, as well as a printed paper copy, for approval. Include a copy of the test equipment manufacturer’s most current release of the test equipment software.

Following the final inspection tests and certification by the Contractor, post-certification may be performed through an independent field verification program or testing service. The Port, at its discretion, may require the Contractor to return to the site, at no additional cost to the Port, to assist with the determination of any certification discrepancies. If such a determination finds the materials, installation procedures, or final testing procedures to be out of compliance with the contract documents, the Contractor shall remedy the cause and re-test, at no additional cost to the Port.

Fiber strands not in compliance with manufacturer’s performance specifications shall be removed, replaced, and re-tested as outlined in the testing procedures.

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| BACKBONE COPPER CABLE TEST RESULTS |
| CONTRACTOR: | DATE: |
| PROJECT: |
| TEST EQUIPMENT: |
| CABLE LABEL: |
| CABLE COUNT: |
| PAIR | CONTINUITY | OPEN | SHORT | CROSSED | COMMENTS |
| 1 |   |   |   |   |   |
| 2 |   |   |   |   |   |
| 3 |   |   |   |   |   |
| 4 |   |   |   |   |   |
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| BACKBONE COPPER CABLE TEST RESULTS |
| CONTRACTOR: | DATE: |
| TEST EQUIPMENT |
| PROJECT: |
|   |   |   | MEASURED | CALCULATED |
| TEST LOCATION NAME | CABLE COUNT/CABLE NAME | BAD PAIRS | COPPER CABLE CUMULATIVE FOOTAGE | LOOP RESISTANCE MEASURED IN OHMS | dB LOSS @ 1Khz | dB LOSS @ 1Khz | dB LOSS @ 1Khz |
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END OF SECTION 271000