

READ THIS FIRST

Notice to the Design Engineer, this document is part of Facilities and Infrastructure standards for Electrical Systems. Designers are advised to NOT use this template (*.doc) document as part of any project contract documents. Designers shall use the Port of Seattle MasterSpec specifications from the following link:

<https://www.portseattle.org/page/guide-specifications>.

Designers shall edit the corresponding Port's MasterSpec specification to meet the F&I Electrical Standard outlined in this specification. Note that Port's MasterSpec specifications contain specifications and languages for both Aviation and Maritime Divisions. F&I Standards are strictly for Aviation Division, and any Maritime related specs or languages should be removed from the project specifications.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Multimode optical-fiber cabling.
 - 2. UTP cabling.
 - 3. RS-485 cabling.
 - 4. Low-voltage control cabling.
 - 5. Control-circuit conductors.
 - 6. Identification products.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- C. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.
- D. RCDD: Registered Communications Distribution Designer.
- E. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Single-Source Responsibility: All cable of each type shall be the product of a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262 by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
 - 1. Flame Travel Distance: 60 inches or less.
 - 2. Peak Optical Smoke Density: 0.5 or less.
 - 3. Average Optical Smoke Density: 0.15 or less.
- B. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.

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- C. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

2.3 BACKBOARDS

- A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."
- B. Painting: Paint plywood on all sides and edges with flat white latex paint. Comply with requirements in Section 099123 "Interior Painting."

2.4 OPTICAL-FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (where control wiring is intended to interface with STIA telecom infrastructure, Systemax products must be used):
1. CommScope, Inc./Systemax Solutions
 2. Cooper Industries/Belden Inc.
 3. Corning Cable Systems
 4. Berk-Tek
 5. BICC Brand - Rex
- B. Description:
1. Factory-fabricated single-channel, low loss, glass type, optical fiber, multi-mode and single mode graded index cables for trunking, LAN and distribution applications as appropriate.
 2. Multimode, 62.5/125-micrometer, single fiber with 125 micron cladding diameter, 250 micron outside jacket diameter. Quantity of strands per cable as shown on drawings. Tight-buffer, optical-fiber cable.
 3. Comply with ICEA S-83-596 for mechanical properties.
 4. Comply with TIA-568-C.3 for performance specifications.
 5. Comply with TIA-492AAAA-B for detailed specifications.
 6. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262; Type OFNP in listed plenum communications raceway; or Type OFN, Type OFNG, Type OFNP, or Type OFNR in metallic conduit.
 - b. Riser Rated, Nonconductive: Type OFN, Type OFNG, Type OFNP, or Type OFNR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
 - c. General Purpose, Nonconductive: Type OFN, Type OFNG, Type OFNP, or Type OFNR in listed communications raceway or metallic conduit.
 7. Maximum Attenuation: 3.5 dB/km at 850 nm; 1.0 dB/km at 1500 nm.
 8. Minimum Modal Bandwidth: 200 MHz-km at 850 nm; 500 MHz-km at 1500 nm.
 9. Physical characteristics: 7.5kg/km, 500N maximum installation load, 150N maximum operational load, 30mm bending radius.

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10. Operating temperature: -20°C-70°C

C. Jacket:

1. Jacket Color: Orange for 62.5/125-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.
4. Provide lead-free jacketing and/or insulation where available.

2.5 OPTICAL-FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (where control wiring is intended to interface with STIA telecom infrastructure, Systimax products must be used):

1. CommScope, Inc./Systimax Solutions
2. Cooper Industries/Belden Inc.
3. Corning Cable Systems
4. Hubbell Inc.
5. ADC

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.

D. Cable Connecting Hardware:

1. Comply with Optical-Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA/EIA-604-12. Comply with TIA-568-C.3.
2. Ceramic optical fiber cable connectors capable of terminating optical fiberglass cables with diameters ranging from 62.5 to 125 microns.
3. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss of not more than 0.5 dB.
4. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.6 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (where control wiring is intended to interface with STIA telecom infrastructure, Systimax products must be used):

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1. Alpha Wire Company; a division of Belden Inc.
 2. Cooper Industries/Belden Inc.
 3. CommScope, Inc./Systemax Solutions
 4. Berk-Tek
 5. BICC Brand - Rex
- B. Description: 100-ohm, four-pair UTP. 24 AWG, solid bare copper, plenum rated FEP insulated.
1. Comply with ICEA S-90-661 for mechanical properties of Category 5e cables.
 2. Comply with ICEA S-102-700 for mechanical properties of Category 6 cables.
 3. Comply with TIA-568-C.1 for performance specifications.
 4. Comply with TIA-568-C.2, Category 5e, Category 6 and Category 6A.
 5. Comply with TIA TSB-36 with respect to attenuation, DCR unbalance and SRL.
 6. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with NFPA 70 for the following types:
 - a. Communications, Plenum Rated: Type CMP complying with UL 1685 or Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
 - b. Communications, Riser Rated: Type CMP, or Type CMR in listed plenum or riser communications raceway or metallic raceway. .
 - c. Communications, General Purpose: Type CM or Type CMG or Type CM, Type CMG, Type CMP, or Type CMR in listed communications raceways or metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

2.7 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries/Belden Inc.
 2. Hubbell Incorporated
 3. CommScope/Systemax Solutions
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 5e, 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.

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- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair UTP cable indicated, plus spares and blank positions adequate to suit specified expansion criteria.
- F. Jacks and Jack Assemblies: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-C.1.
- G. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.

2.8 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CMG.
 - 1. Paired, one pair or two pairs, based on system requirements twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors, color coded.
 - 2. PVC insulation.
 - 3. Overall aluminum/polyester shield and 22AWG tinned copper drain wire.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with UL 1685.
 - 6. Rated for 600V, -20°C to 80°C
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, one pair or two pairs, based on system requirements, No. 22 AWG, stranded (7x30) tinned-copper conductors, color coded.
 - 2. Teflon insulation.
 - 3. Overall aluminum/polyester shield and 22AWG tinned copper drain wire
 - 4. Teflon jacket.
 - 5. Flame Resistance: NFPA 262.
 - 6. Rated for 600V, -70°C to 2500°C, suitable for use in air-handling spaces.

2.9 LOW-VOLTAGE CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMG.
 - 1. One or Multi-pair, as required, twisted, No. 16 AWG, stranded or No. 18 AWG, stranded tinned-copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.

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5. Rated for 600V, -20°C to 80°C.
6. Flame Resistance: Comply with UL 1685.\
7. Provide plenum rated where required by code

2.10 CONTROL-CIRCUIT CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Encore Wire Corporation.p
 2. General Cable Technologies Corporation.
 3. Southwire Company.
- B. Class 1 Control Circuits: Stranded copper, Type THHN-2-THWN-2 for indoor applications, Type XHHW-2 for outdoor applications in raceway, thermoplastic complying with UL 83.
- C. Class 2 Control Circuits: Stranded copper, Type THHN-2-THWN-2, in raceway for indoor applications, Type XHHW-2, in raceway for outdoor applications, thermoplastic complying with UL 83.
- D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN-2-THWN-2, in raceway for indoor applications, Type XHHW-2, in raceway for outdoor applications, thermoplastic complying with UL 83.
- E. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.
 1. Smoke control signaling and control circuits.

2.11 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP cables according to TIA-568-C.2.
- C. Factory test optical-fiber cables according to TIA-568-C.3.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.1 EXAMINATION

- A. Test cables on receipt at Project site.
 - 1. Test optical-fiber cable to determine the continuity of the strand end to end. Optical time delay reflectometer report is required for all fiber optic systems.
 - 2. Test optical-fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
 - 3. Test each pair of UTP cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
 - 1. Outlet boxes shall be no smaller than 4 inches wide, 3 inches high and 2-1/2 inches deep.
 - 2. Outlet boxes for optical-fiber cables shall be no smaller than 4 inches square by 2-1/8 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
 - 3. Flexible metal conduit shall not be used.
- B. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Where lubrication appears necessary for installation, consider use of products with no-lube jacketing/insulation to reduce waste and labor.
- E. Raceway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard if entering the room from overhead.
 - 4. Extend conduits 3 inches above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

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3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1 and NFPA 70.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C Series of standards.
 - 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems."
 - 3. Terminate all conductors and optical fibers; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 - 4. Fiber Optic Cables: splices allowed with F&I approval only. Systimax fusion splices only.
 - 5. Copper cables: keep splices to a minimum. If splices are necessary, they shall be accessible in junction or pull boxes. Use splice and tap connectors compatible with cable material.
 - 6. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems." Install lacing bars and distribution spools.
 - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Install cables without damaging conductors, shield or jacket. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
 - 10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems." Monitor cable pull tensions. Pull tensions shall not exceed manufacturer's recommended pulling tensions.
 - 11. Support: Do not allow cables to lay on removable ceiling tiles.
 - 12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
 - 13. Provide plenum and/or tray rated cable where required by the application.
 - 14. Bond shields and drain conductors to ground at only one point in each circuit – the power supply end. Securely tape the ungrounded end of the shield. Do not ground the shield along the cable or in junction boxes. Maintain shield-to-shield isolation.
 - 15. Run low-voltage signal wiring in separate raceway from 120V power and contact status wiring.
 - 16. Provide sealant around cables penetrating fire-rated elements.
 - 17. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values or in accordance with UL 486A and UL 486B.
- C. UTP Cable Installation:
 - 1. Comply with TIA-568-C.2.

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2. Install termination hardware as specified in Section 271500 "Communications Horizontal Cabling" unless otherwise indicated.
 3. Do not untwist UTP cables more than 1/2 inch at the point of termination to maintain cable geometry.
- D. Installation of Control-Circuit Conductors:
1. Install wiring in raceways. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- E. Optical-Fiber Cable Installation:
1. Comply with TIA-568-C.3.
 2. Terminate cable on connecting hardware that is rack or cabinet mounted.
- F. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.
 3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.
- G. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-B recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
 2. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches (1200 mm).
 3. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove all abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified for future use with a tag.

3.5 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
1. Class 1 remote-control and signal circuits; No 14 AWG.
 2. Class 2 low-energy, remote-control, and signal circuits; Wire size per drawings or per system manufacturer's requirements.

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3. Class 3 low-energy, remote-control, alarm, and signal circuits; Wire size per drawings or per system manufacturer's requirements.

3.6 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.7 GROUNDING

- A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify data and communications system components, wiring, and cabling according to TIA-606-A; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Visually inspect UTP and optical-fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 3. Visually inspect cables for physical damage.
 4. Test UTP cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test cable segments for faulty connectors, splices and terminations. Test for overall integrity of the cable and the component parts. Test operation of shorting bars in connection blocks. Test cables after termination but not after cross-connection.

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- a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration. Material must be NIST traceable.
5. Optical-Fiber Cable Tests:
- a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.0. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for links shall be less than 2.0 dB, measured at either 850nm or 1300nm.
- B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Demonstration
1. Operate control/signal systems to demonstrate proper functioning. Replace malfunctioning cable with new materials and retest.

END OF SECTION 260523