

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 AND NOTES TO DESIGNER

- A. Section Includes:
 - 1. Ladder cable trays.
 - 2. Trough cable trays.
- B. Deviations from cable tray types and material listed in Products section with F&I approval only.
- C. Cable tray covers are allowed with F&I approval only.
- D. Related Requirements:
 - 1. Section 270536 "Cable Trays for Communications Systems" for cable trays and accessories serving communications systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.

- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
- C. Seismic Qualification Certificates: For cable trays, accessories, and components, from manufacturer. Move this to action submittals article
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved.
 - 1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
 - 2. Vertical and horizontal offsets and transitions.
 - 3. Clearances for access above and to side of cable trays.
 - 4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.
- B. Design Calculations: Verify loading capacities for supports.
- C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."

2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
 - 1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Tray Size:
 - 1. Tray Inside Depth: 4 inches minimum and 6 inches maximum.
 - 2. Tray Width: 6 inch minimum and 24 inches maximum unless approved by F&I; tray width should reflect quantity, type and size of cables in accordance with requirements of NEC Article 392.
 - 3. Standard 12 foot lengths.
 - 4. Fitting Radius: 12 inches or 24 inches as appropriate; this represents the radius of the fitting's inner corner and is most often governed by the minimum allowable bending radius of the cables.
 - 5. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
 - 6. Concentrated Load: A load applied at midpoint of span and centerline of tray.
 - 7. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.3 LADDER CABLE TRAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Legrand/Cablofil
 - 3. MP Husky.
- B. Description:
 - 1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
 - 2. Rung Spacing: 6 inches for control cables, 12 inches for power cables on center.
 - 3. Rung cable bearing surface: $\frac{3}{4}$ inch with radiused edges.
 - 4. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
 - 5. No portion of the rungs shall protrude below the bottom plane of side rails.
 - 6. Structural Performance of Each Rung: Capable of supporting a 200-lb concentrated load, when tested according to NEMA VE 1.

2.4 TROUGH CABLE TRAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Legrand/Cablofil
3. MP Husky.

B. Description:

1. Configuration: Two longitudinal members (side rails) with a solid sheet over rungs exposed on the interior of the trough, or corrugated sheet with both edges welded to the side rails. Ventilated trough cable tray has rectangular holes punched along the width of the valleys of the corrugated bottom. Solid bottom is without holes.
2. Rung Spacing: Rungs or corrugations shall be spaced a maximum of 6 inches o.c. and have a minimum flat bearing surface of 2 inches.
3. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
4. Structural Performance: Capable of supporting a maximum cable load of 200-lb concentrated load, when tested according to NEMA VE 1.
5. Class Designation: Comply with NEMA VE 1, Class 12B OR Class 12C OR Class 20B OR Class 20C.
6. Splicing Assemblies: Bolted type using serrated flange locknuts.
7. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
8. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.

2.5 CHANNEL CABLE TRAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc
2. Legrand Cablofil
3. MP Husky

B. Description

1. Configuration: Ventilated flat bottom with holes and slots to facilitate the use of cable ties to secure cables. Minimum loading depth of 1-1/4".
2. Fitting radius – minimum of 12 inches.
3. Structural Performance: Capable of supporting a maximum cable load of 200lbs per rung or 800lbs per foot.

2.6 MATERIALS AND FINISHES

A. Steel:

1. Outdoor Installation: Steel conforming to ASTM A1011, grade 33 for 14 gauge and heavier

2. Splice Plates: High strength steel splice plates with 4 ribbed neck carriage bolts with serrated flange locknuts each.
 3. Finish: Hot-dip galvanized after fabrication, complying with ASTM A123.
 - a. Hardware: To match cable tray construction.
- B. Aluminum:
1. Indoor Applications: Alloy 6063- according to ANSI H35.1/H 35.1M for extruded components, and Alloy 5052 according to ANSI H35.1/H 35.1M for fabricated parts.
 2. Splice Plates:
 - a. Bolted type, Aluminum alloy 6063-T6 with four square neck bolts and serrated flange locknuts each.
 3. Hardware: Chromium-zinc-plated steel, ASTM F 1136.
- C. Fabricate cable tray products with rounded edges and smooth surfaces.

2.7 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Barrier Strips: Same materials and finishes as for cable tray.
- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.8 WARNING SIGNS

- A. Lettering: 3/4 inch high, black letters on yellow laminated plastic nameplate, engraved with "WARNING! DO NOT SUE AS A WALKWAY, LADDER OR SUPPORT FOR LADDERS OR PERSONNEL – CABLES ADDED AFTER INITIAL INSTALLATION REQUIRE POS/F&I APPROVAL".

2.9 FIRESTOPPING

- A. Flame Safe compound capable of passing a one-hour or two-hour fire test per UL requirements.
- B. Use Halon-free material that does not generate hydrogen gas while curing as manufactured by 3M Corporation or F&I approved equal.

2.10 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect cable trays according to NEMA VE 1.

3.1 CABLE TRAY INSTALLATION

- A. Install cable trays according to NEMA VE 2.
- B. Install cable tray level and plumb.
- C. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- D. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- E. Remove burrs and sharp edges from cable trays.
- F. Join aluminum cable tray with splice plates; use four square-neck carriage bolts and locknuts.
- G. Fasten cable tray supports to building structure and install seismic restraints.
- H. Support cable tray according to manufacturer's instructions, original design and rough-in drawings. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems." Comply with seismic-restraint details according to Section 260548.16 "Seismic Controls for Electrical Systems."
- I. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- J. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- K. Support bus assembly to prevent twisting from eccentric loading.
- L. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.
- M. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.
- N. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

- O. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed 100 feet. Space connectors and set gaps according to applicable standard.
- P. Make changes in direction and elevation using manufacturer's recommended fittings.
- Q. Make cable tray connections using manufacturer's recommended fittings.
- R. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."
- S. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- T. Install cable trays with enough workspace to permit access for installing cables.
- U. Install barriers to separate cables of different systems, such as power, communications, and data processing.
- V. Install barriers to separate normal and emergency cables.
- W. Provide separate trays for cables of different insulation levels such as 600V, 4.16kV and 12.47kV.
- X. Identify medium voltage conduits or raceways with labels reading "HIGH VOLTAGE – 12.5KV", "HIGH VOLTAGE – 4.16KV", or "HIGH VOLTAGE – 4.16KV (EMERGENCY)"
- Y. When terminating a conduit to a cable tray, use appropriate ground bushing to bond the conduit to tray.
- Z. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.
- AA. Clamp covers on cable trays installed outdoors with heavy-duty clamps.
- BB. Install warning signs in visible locations at 25 foot intervals on cable trays after cable tray installation. Provide warning signs on both sides of tray if both sides are visible.

3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 and as instructed by manufacturer. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Cable trays shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque tightening values.

- D. Cable trays shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72-inch intervals with F&I approved grounding clamps designed for cable trays. The grounding conductor shall be minimum #2 AWG bare copper stranded cable or larger, sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."
- E. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding-bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
- F. When steel or aluminum tray is used as equipment grounding conductor, cable tray sections and fittings shall be marked to show minimum cross-sectional area in accordance with Article 392 of the NFPA 70.
- G. Connections to aluminum cable tray shall be made using an anti-oxidant compound.
- H. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."
- I. Connect cable tray ground conductor to building steel or ground grid.

3.3 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 18 inches.
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 48 inches.
- E. Tie MI cables down every 36 inches where required to provide a 2-hour fire rating and every 72 inches elsewhere. MI cable not allowed in Port standard, but if provided in OEM equipment.
- F. In existing construction, remove inactive or dead cables from cable trays.

3.4 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect raceways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
 - 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
 - 4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
 - 5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
 - 6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and re-torque in suspect areas.
 - 7. Check for improperly sized or installed bonding jumpers.
 - 8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 - 9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.
- B. Prepare test and inspection reports.

3.6 PROTECTION

- A. Protect installed cable trays and cables.
 - 1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
 - 2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.

3. Remove dirt and construction debris and repair damage to paint finishes including chips, scratches and abrasions with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 260536