

Vertiv™ PowerBar HPB UL GUIDE SPECIFICATIONS

1.0 GENERAL

1.1 Related Documents

Drawings and general provisions of the contract, including general and supplementary conditions and division [01] specification sections, apply to this section.

1.2 Summary

- Feeder busway assemblies
- Plug-in busway assemblies
- Tap-off boxes (busplugs)
- Fittings including elbows, flat tees, offsets, flanges, cable end boxes (vertical), and expansion units
- Accessories including hangers, supports, fire barrier assemblies, and end caps

This specification applies to a totally enclosed, low-impedance, sandwich-type busway distribution system rated for operation up to 600 V AC in accordance with UL 857. The system is available with copper conductors rated from 1600 A to 5000 A and aluminum conductors rated from 1000 A to 4000 A. The system is for indoor use in critical power distribution applications, including data centers, industrial facilities, and commercial buildings.

1.3 Definitions

- Busway: A prefabricated electrical distribution system of busbars in a protective enclosure, per NEC Article 368.
- Tap-off Box (Busplug): A device that connects to the busway at a plug-in opening to provide a branch circuit connection, incorporating overcurrent protection.
- Feeder Busway: Busway without plug-in openings, used for point-to-point power distribution.
- Plug-in Busway: Busway with plug-in openings to accept tap-off boxes at fixed positions along its length.
- Expansion Box: A fitting designed to absorb thermal expansion in the busway system, used in straight runs and building joints (not intended to absorb building twist).

1.4 References

The busbar/busway system shall be designed, manufactured, and tested in accordance with UL 857. Additional components shall comply with the applicable standards listed below:

- UL 489: Molded-case circuit breakers, molded-case switches, and circuit breaker enclosures
- UL 98: Enclosed and dead-front switches
- UL 1479: Fire tests of penetration firestops
- UL 1008: Safety standards for transfer switch equipment
- NEMA BU 1.1: General instructions for proper handling, installation, operation, and maintenance of busway rated 600 V or less
- IEEE 693: Recommended practice for seismic design of substations
- ASTM E814: Standard test method for fire tests of penetration firestop systems
- NFPA 70E: Standard for electrical safety in the workplace (NEC)

1.5 System Description

1.5.1 Environmental Conditions

The busbar/busway shall be capable of operating continuously under the following environmental conditions without mechanical or electrical damage or degradation of performance:

- Ambient temperature limits:
 - -30 °C to +40 °C (-22 °F to +104 °F) for busway and plug-in units incorporating enclosed switches.
 - 0 °C to +40 °C (32 °F to +104 °F) for busway plug-in units incorporating molded case circuit breakers or motor controls.
- Derating shall be applied for continuous operation at ambient temperatures above 40 °C (104 °F).

NOTE: Consult the manufacturer or NEMA BU 1.1. for derating factors

- The busbar/busway shall not be operated at ambient temperatures above 70 °C (158 °F).
- Relative humidity shall be 95% or below, non-condensing.

NOTE: This product is designed for indoor use only.

1.6 Electrical Specification

The busbar/busway system shall perform as specified in this specification while supplying rated full-load current, as shown on the project drawings. The busbar/busway system shall be available in the following current ratings:

- **Aluminum:** Up to 4000 A
- **Copper:** Up to 5000 A
- **System voltage:** The busbar/busway shall be rated up to 600 V
- **Insulation voltage:** 600 V
- **Frequency:** Available in 50/60 Hz
- **Short circuit rating:** Up to 200 kA RMS symmetrical

Conductors: High-conductivity copper or aluminum. Aluminum conductors shall have a minimum conductivity of 55% IACS.

For more detailed information, refer to Chapter 2 **PRODUCT**.

1.7 Documentation/Action Submittals

1.7.1 Submittals — For Review / Approval

The following information shall be submitted to the Engineer for review and approval. Submittals shall be provided in color portable document format (PDF). Submit a combined, word-searchable PDF document (not scanned) with bookmarks matching the table of contents.

- Master drawing index
- Busway layout and installation drawings, including an isometric drawing of each busway run
- Component list
- Busway ratings, including:
 - Short-circuit withstand rating. Busway shall be marked as RMS symmetrical kA and not kAIC
 - Maximum voltage
 - Continuous current rating
 - IP rating or NEMA rating
- Major component ratings, including:
 - Maximum voltage
 - Continuous current
 - Short-circuit withstand rating
- Product data sheets, including:
 - Cable exit requirements
 - Lug type and material
 - Product data sheets
 - Short-circuit withstand ratings
- Fire barrier product data, including UL 1479 and other applicable listings
- Product certificates:

For each type of enclosed busway assembly, signed by the product manufacturer, including the following:

 - Seismic certification (Refer **Seismic Requirements**)
- Performance ratings of the busway system, as determined by the lowest performing component in the system:
 - System short-circuit withstand rating
 - System IP/NEMA rating
 - System voltage

1.7.2 Submittals — Drawings

- Shop drawings:

For each type of bus assembly and plug-in device:

- Show fabrication and installation details for enclosed bus assemblies. Include plans, elevations, and sections of components. Designate components and accessories, including brackets, connectors, straight lengths, and fittings.
- Indicate required clearances, method of field assembly, and location and size of each field connection.
- Detail connections to switchgear, switchboards, transformers, and panelboards.
- Wiring diagrams: Power, signal, and control wiring.
- Submit certification confirming that the equipment is UL listed and labeled.
- Coordination drawings:
 - All raceways and routing shown on design drawings are diagrammatic in nature to illustrate the design intent. Final design is delegated to the contractor based on coordination with all trades.
 - Floor plans and sections, drawn to scale. Include scaled bus-assembly layouts and relationships between components and adjacent structural, mechanical, and electrical elements.
 - Vertical and horizontal enclosed bus-assembly runs, offsets, and transitions.
 - Clearances for access above and to the side of enclosed bus assemblies.
 - Vertical elevation of enclosed bus assemblies above the floor or bottom of the structure.
 - Location of adjacent construction elements, including light fixtures, HVAC equipment, plumbing equipment, fire sprinklers and piping, signal and control devices, and other equipment.
- Compliance review:

Submit a compliance review of the Specifications, Drawings, and Addenda. The Compliance Review shall be a paragraph-by-paragraph review of the Specifications using the following designations:

 - “C”: Comply with no exceptions.
 - “D”: Comply with deviations. For each deviation, provide a numbered footnote with reasons for the proposed deviation and describe how the intent of the Specification will be satisfied.
 - “E”: Exception. Does not comply. For each exception, provide a numbered footnote with reasons and possible alternatives.

Submit all notes associated with “D” and “E” responses in writing for review by the Engineer and Owner.

1.7.3 Submittals — for construction

The following information shall be submitted for record purposes:

- Final as-built drawings incorporating all changes made during the manufacturing process.
- Installation information, see **SL-71268 Vertiv™ PowerBar HPB UL 857 Installer/User Guide**.
- Seismic certification. Refer **Seismic Requirements** for more details.

1.7.4 Delivery, Storage, and Handling

- Equipment shall be handled and stored in accordance with NEMA BU 1.1
- Store the busbars in a clean, dry, covered area. Protect the busbars from mechanical damage and moisture.
- Do not remove the protective wrap before installation.
- Do not expose the busbars to corrosive environments.
- One (1) copy of handling and storage instructions shall be included with the equipment at the time of shipment.

1.8 Warranty

- The busway manufacturer shall provide a minimum of 18 months of parts coverage from the date of shipment.
- Extended warranty terms beyond 18 months shall be available from the manufacturer upon request during the quoting process. Specify if an extended warranty is required.
- Coverage, including labor, shall be available from the manufacturer as an option upon request during the quoting process.

1.9 Quality Assurance

- For the equipment specified herein, the manufacturer shall be ISO 9001 certified.
- The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by UL.
- Listed by UL as compliant with UL 857, "Standard for Safety — Busways."
- Comply with NEMA BU 1, "Busways."
- Comply with NFPA 70, National Electrical Code.
- The manufacturer shall produce products in at least two ISO 9001 certified manufacturing facilities for supply chain resilience.

1.10 Seismic Requirements

When applicable, provide the latest seismic requirements per the International Building Code (IBC) and the California Building Code (CBC).

Provide seismic tested and certified equipment as follows:

- The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the following:
 - Latest International Building Code (IBC).
 - Latest California Building Code (CBC) with OSHPD amendments.
 - The equipment shall have OSHPD Special Seismic Certification (OSP) pre-approval, when required.
- The equipment manufacturer shall certify that the equipment can withstand and function following the seismic event, including both vertical and lateral required response spectra as specified in the applicable codes.
- The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualifications shall be considered achieved when the capability of the equipment meets or exceeds the specified response spectra.
- The system shall meet IEEE 693 seismic certification.

1.11 Regulatory Requirements

- The busway shall bear a UL label per UL 857.

1.12 Project Conditions

The busway system shall comply with the environmental operating requirements specified in Section **Environmental Conditions**. All temperature limits, altitude constraints, humidity conditions, and derating requirements defined therein shall be applicable.

1.13 Operation and Maintenance Manuals

- Equipment operation and maintenance manuals shall be provided with each assembly shipped. Manuals shall include instruction leaflets and bulletins for the complete assembly and each major component.
- An installation manual shall be provided with detailed procedures for handling, storage, and installation in accordance with the manufacturer's guidelines.

1.14 Coordination

- Coordinate layout and installation of enclosed bus assemblies and suspension system with other construction that penetrates ceilings or floors or is supported by them, including light fixtures, HVAC equipment, fire-suppression systems, and partition assemblies.
- The system layout shall be determined during the 3D building coordination process. Busway lengths shall be specified by the manufacturer to meet project requirements.

1.15 Extra Products

- Spare parts shall be defined on a project basis, for example, extra busplugs/tap-off boxes, joint packs, and joint covers.
- Additional accessories for installation shall be provided on a project basis.

1.16 Manufacturers

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

- Vertiv (Basis of Design)

2.0 PRODUCT

2.1 Ratings

The busway shall be Vertiv™ PowerBar HPB type with voltage and current ratings as indicated on the contract drawings.

- System Voltage: Busway shall be rated for all voltages up to 600 V AC max.
- Frequency: 50/60 Hz
- System configurations:

Note: Select one of the following configurations

- 3-phase, 3-wire + housing ground (TP)
- 3-phase, 3-wire + isolated ground (TPE)
- 3-phase, 3-wire + bonded ground (TPBE)
- 3-phase, 4-wire + housing ground (TPN)
- 3-phase, 4-wire + isolated ground (TPNE)
- 3-phase, 4-wire + bonded ground (TPNBE)
- Isolated and bonded ground and neutral conductors shall be 100% rated.
- Current ratings:
Busway shall be available in the following current ratings:
 - Copper conductors (up to 200 kA at 600 V AC): 1600 A, 2000 A, 2500 A, 3000 A, 3200 A, 4000 A, and 5000 A
 - Aluminum conductors (up to 200 kA at 600 V AC): 1000 A, 1200 A, 1600 A, 2000 A, 2500 A, 3000 A, and 4000 A
- Short-circuit ratings
 - The busway system is designed to comply with short-circuit ratings up to 200 kA RMS symmetrical. Actual short-circuit ratings vary by ampere size and shall be verified based on the specific ampacity selected.
 - Ingress Protection (IP Rating): IP55 minimum for bus duct. Accessories with reduced IP ratings shall be communicated by the manufacturer.
 - Joint connections with installation tolerances of 0.5 inch (12.7 mm) or greater shall be investigated by the manufacturer's certification agency. Certificates showing this tolerance shall be available on request.

2.2 Busway Construction

Housing:

- The busway housing shall be fabricated from extruded aluminum for maximum protection against corrosion from water and other contaminants normally encountered during construction.
- Housing shall be totally enclosed with an up to IP55 rating for protection against mechanical damage, dust, and water ingress.
- Housing shall be lightweight and corrosion-resistant. All hardware shall be coated to prevent corrosion.

Busbars:***Note:** Select one conductor material*

- High-conductivity copper conductors
- Aluminum with a minimum 55% IACS conductivity
- Busbars shall be insulated over their entire length, except at joints and contact surfaces, with electrostatically sprayed or dipped epoxy insulation. Insulation material shall be NEMA Class B 130 °C (266 °F).
- Insulation shall be UL rated as self-extinguishing and resistant to acids, alkalis, acetones, machine oils, and lubricants commonly found in industrial environments.
- Conductor insulation shall be chemical-resistant and moisture-resistant. The uniform coating shall be applied by either the electrostatic spray process or the fluidized bed process for consistent coverage.
- Current-carrying conductors shall be fully covered with Class B insulation except at joints and where design constraints prohibit insulation. In these cases, provisions for phase isolation compliant with UL 857 shall be implemented. Plated surfaces at joints shall be silver or tin.
- Conductors shall be rated for 100% of the busway rating under continuous operation up to the maximum ambient temperature of 40 °C (104 °F).
- The busway shall be capable of carrying rated current continuously without exceeding temperature-rise limits listed in UL 857.
- Current-carrying conductors shall be electrically isolated from the housing.

Grounding:

- The busway grounding system shall be available in the following configurations:
 - Case (housing/enclosure) ground
 - Isolated, epoxy-coated dedicated ground bar
 - Bare or uncoated internal ground bonded to the housing throughout the system

Bus joints:

- Each busway section shall be furnished complete with joint hardware and covers.
- Joint pack construction shall use joint bolts with primary and secondary nuts (lock nuts) for reliable performance.
- Manufacturers shall provide recommended procedures to verify joint pack bolt torque during commissioning.
- Joint covers and gaskets shall be sealed to maintain an up to IP55 rating.

Mounting:

- The busway shall be capable of being mounted flat-wise (horizontal), edgewise (horizontal), or vertically (riser) without derating.
- Busway lengths shall be available from 24 inches (2 feet) to 144 inches (12 feet) for aluminum conductors, or 24 inches (2 feet) to 120 inches (10 feet) for copper conductors. The manufacturer shall verify busway length availability up to 4 meters upon request. System layout shall be determined during the 3D building coordination process.
- Horizontal busway runs shall be UL listed to hang on up to 10 feet support spacings with the manufacturer's approval.
- Mounting hardware shall be available to support horizontal, edgewise horizontal, and vertical installations.
- Fixing brackets provided with the system shall not interfere with tap-off box installation.
- Fixing brackets shall be supplied by the busway manufacturer. All-thread rod, Unistrut, and hardware shall be supplied by the installation contractor.

Fire Barriers:

- Fire barrier provisions compliant with UL 1479 shall be available on request with two-hour fire-rating options.
- Depending on the system number, either factory-installed fire barriers or site-installed fire barrier systems may be deployed with guidance from the busway and fire barrier manufacturer.
 - Factory-installed fire barriers shall be positioned based on the 3D building coordination and enclosed within the profile of the busway.
 - Fire barrier systems shall be installed per the manufacturer's instructions.
- Final sealing at penetrations shall be by others per NEC and local fire codes.
- Fire barrier sealing at penetrations is by others and is not within the busway manufacturer's scope of supply.

Traceability:

- Components shall be marked with unique identification for full traceability.
- Copper purity and material traceability reports shall be available on request when specified at the quoting stage.

2.3 Plug-in Busway

- Where required, the busway shall be of the plug-in type.
- Up to twelve (12) tap-off points for double or triple body systems per standard 12 feet length.
- Up to six (6) tap-off points for single body systems per standard 12 feet length.

Note: Double-sided plug-in openings are available only for double and triple stack busway configurations. Consult the manufacturer for the minimum ampere rating where a double-sided tap-off is achievable for copper and aluminum.

- Plug-in openings shall pass the UL finger probe test.
- Busplug outlets shall be configurable as needed to meet project requirements.

2.4 Tap-off Boxes (Busplugs)

The busway manufacturer shall advise customers if alternative options are available that meet their requirements and are not listed below.

The busway manufacturer shall provide details regarding cable entry, size, and connection type (if applicable), and dimensions upon request.

Nominal Ratings:

Plug-in tap-off boxes shall be available at nominal ratings as follows:

- Molded case circuit breaker tap-off boxes:
 - 100 A, 65 kA at 480 V AC, 100% rated
 - 200 A, 65 kA at 480 V AC, 100% rated
 - 250 A, 65 kA at 480 V AC, 100% rated
 - 400 A, 150 kA at 480 V AC
 - 600 A, 65 kA at 480 V AC
 - 800 A, 65 kA at 480 V AC, 100% rated
- Fused tap-off boxes:
 - 30 A J-Type or Cubefuse, up to four circuits, 100 kA at 480 V AC
 - 60 A J-Type or Cubefuse, up to two circuits, 100 kA at 480 V AC
 - 100 A J-Type, single circuit, 200 kA at 600 V AC
 - 200 A J-Type, single circuit, 100 kA at 600 V AC
 - 300 A J-Type, single circuit, 100 kA at 600 V AC
- Performance and Safety
 - Tap-off boxes shall be listed and labeled for use with the specified busway system.
 - Tap-off boxes shall comply with the applicable requirements of UL and NEC.
 - Tap-off boxes shall be suitable for installation at any approved plug-in location along the busway.
- Identification
 - Each tap-off box shall be provided with nameplate identification.
 - Identification shall include device rating, voltage, and short-circuit rating.

Miniature Circuit Breakers:

- 30 A J-Type or Cubefuse, up to two circuits, 14 kA at 415 V AC

Note: Select required busplug options and delete options that are not required. Define trip-unit type if a specific type is required.

- Busway shall be designed to prevent incorrect installation.
- All busplugs shall have mechanical and electrical interlocks with an earth-first, break-last safety feature. The busplug shall include an extended earth contact bracket to ensure the earth ground is the first point of contact with the busway system during installation.
- Busway shall use stamped (pressed-out) conductor tabs for busplug connections.
- The busplug shall include an interlock that prevents the tap-off door from fully opening while the tap-off unit is in the ON position.
- Busplugs shall use either a circuit breaker or a fused switch for branch-circuit protection, as indicated on the project drawings.

Molded-Case Circuit Breaker Busplugs:

- Thermal-magnetic circuit breakers shall provide inverse time-current characteristics for low-level overloads and instantaneous magnetic trip for short circuits. Adjustable magnetic trip settings shall be provided for frame sizes 250 A and larger, as indicated on the drawings.
- Electronic trip-unit circuit breakers shall be provided where indicated on the drawings. Electronic trip units shall include RMS sensing, a field-replaceable rating plug, and the following adjustable settings.
- Instantaneous trip with a minimum adjustment ranges up to 12x.
- Long- and short-time pickup levels.
- Long- and short-time adjustments.
- Molded-case circuit breaker busplug features and accessories:
 - Direct connections to circuit breakers shall use mechanical lugs for 400 A and larger frame sizes when type-tested and approved for use by the manufacturer on the specific breaker. Manufacturer's standard mechanical lugs shall be used where compression lugs are not an approved option. For circuit breakers smaller than 400 A frame size, manufacturer's standard mechanical lugs shall be used.
 - UL-listed shunt trips shall be available and compatible with the circuit breaker upon request.
 - Compatible cable materials, sizes, and quantities for each busplug shall be provided upon request.
 - The busway manufacturer shall provide guidance and details regarding 100%-rated molded-case circuit breakers in the busplug.
 - Locking provision in the OFF position.

UL98 Fusible Disconnect Switch Busducts:

- Fused disconnect switch busplugs shall be available at amperages up to 300 A.
- Fused solutions shall be available to supply short-circuit ratings up to 200 kA at 600 V AC max.
- UL-listed shunt trips shall be available and compatible upon request.
- Compatible cable materials, sizes, and quantities for each busplug shall be provided upon request.
- Locking provision in the OFF position.

Inline Disconnect

Non-plug-in inline disconnect devices shall be available at nominal ratings up to 1200 A with 100% utilization. The manufacturer shall advise on application limits.

Accessories

- Furnish nameplates for each device as indicated on the drawings.
- Expansion units:
 - Straight busway runs over 132 feet shall include provisions to mitigate thermal expansion of the busway system.
- Provide expansion fittings when the busway run crosses a building expansion joint.
- End caps: Exposed conductors at the end of the busway run shall be terminated with an end cap.
- Cable end feed or panel flange: The busway shall be powered by either a cable end feed or a panel flange, for switchgear applications.
 - Infrared windows:
 - Infrared windows shall be installed by the manufacturer in cable end boxes upon request. Locations shall allow unobstructed and safe infrared scanning of feeder termination points.
 - The manufacturer shall advise on infrared window availability and type for the selected busway system.
- Furnish spring hangers as required for vertical risers at each floor penetration and supplementary support locations.
- Furnish cable end boxes or tap-off boxes as required.

Fittings

Busway system shall be available with fittings to meet project requirements, including:

- Elbows, offsets, combinations
- Flanges and end feeds
- Flat tees
- Non-UL listed load banks

3.0 EXECUTION

3.1 Installation

- The contractor shall install all equipment in accordance with the manufacturer's recommendations and the contract drawings.
- An end cap shall be installed at each end of the busway run.
- Maintain minimum clearances and workspace at equipment in accordance with the manufacturer's written instructions. Refer to the **SL-71268 Vertiv™ PowerBar HPB UL 857 Installer/User Guide** for additional details.
- Maintain manufacturer's minimum support spacing in accordance with the installation manual.

3.2 Connections

- Ground equipment in accordance with NEC Article 250.
- Connect wiring in accordance with NEC 310-16.
- The contractor shall make connections to supply circuits in accordance with the manufacturer's instructions and the project drawings.

3.3 Factory Testing

- Standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest applicable ANSI and NEMA standards.

3.4 Field Quality Control

- Testing agency: Engage a qualified testing agency to perform tests and inspections and to prepare test reports.
- Manufacturer's field service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- Tests and inspections:
 - Perform visual and mechanical inspections and electrical testing in accordance with the NETA Acceptance Testing Specification.
 - Inspect joints and housing visually.
 - Verify case earth and ground continuity.
 - Remove and replace units that do not pass tests and inspections and perform re-testing.
- Test labeling: Upon completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to the tested component.

3.5 Pre-energization

- Verify that all busplug boxes are correctly installed in accordance with the manufacturer's instructions and are in the OFF position for insulation resistance testing to ensure that no field wiring is tested as part of the initial busway testing.
- Verify that all joints have been torqued in accordance with the recommended settings and have not been subsequently loosened. Ensure all joint covers are firmly secured.
- Perform and document the testing procedure in accordance with Vertiv™ PowerBar HPB UL 857 standard testing. Refer to NEMA BU 1.1-2010, Section 7.

3.6 Pre-energization Testing

- Perform a continuity test to verify continuity and polarity of the entire busway run.
- Verify that joint packs are torqued to the manufacturer's specification.
- Confirm that all joint covers and gaskets are properly sealed.
- Verify case earth and ground continuity.

3.7 Adjusting

Set field-adjustable circuit-breaker trip ranges and overload relay trip settings as required in accordance with the manufacturer's instructions.

3.8 Cleaning

Remove dirt and debris by vacuuming. Do not use compressed air to assist in cleaning.