

**PART 1 GENERAL****1.1 RELATED DOCUMENTS**

- A. The requirements of the General Conditions, Supplementary Conditions and the following specification sections apply to all Work herein:
1. Section 26 00 10 - General Requirements
  2. Section 26 00 20 - Scope of Work
  3. Section 26 05 19 - Electrical Conductors - 600 Volts
  4. Section 26 05 26 - Grounding and Bonding
  5. Section 26 08 13 - Testing
  6. Section 26 24 13 - Switchboards - 600 Volts
  7. Section 26 28 13 - Fuses

**1.2 SUMMARY**

- A. Furnish and install all busway, fittings and accessories as specified herein and as required for proper distribution of power throughout the Project as indicated on the Drawings.

**1.3 REFERENCE STANDARDS**

- A. All busway and all components shall be designed, manufactured, tested and installed in accordance with the latest applicable industry standards including the following:
1. Federal Specification W-B-811b
  2. ANSI/NEMA BU 1 - Busway
  3. NFPA 70 - National Electrical Code (NEC)
  4. UL Standard 857 - Busway
  5. ANSI/NEMA BU1.1 - General Instruction for Proper Handling, Installation of Busway
  6. ANSI/IEEE C37.23 - Metal Enclosed Bus and Calculating Losses
- B. All equipment and material to be furnished and installed on this Project shall be UL listed, in accordance with the requirements of the authorities having jurisdiction, and suitable for its intended use on this Project.

**1.4 SUBMITTALS**

- A. The following submittal data shall be furnished according to the General Conditions and Section 26 00 10 and shall include, but not be limited to:
1. Busways\* complete with capacity data, bus data, dimensional data, scaled Shop Drawings indicating bus routing, connector detail, fittings, hangars, etc.
  2. Busways scaled Shop Drawings indicating bus routing.
  3. Service busways complete with capacity data, bus data, dimensional data, connector detail, fittings, hangars, cable tap boxes, etc. Service busway Product Data and Shop Drawings shall be submitted to the utility company for approval prior to submitting to the Engineer for review.
  4. Factory Test Reports.
  5. Busway Installation Checksheet, upon completion of busway installation and testing.
  6. Busway Installation Contractor Certification, upon completion of busway installation and testing.
  7. Busway Manufacturer Certification, upon completion of busway installation and testing.
  8. Proposed test procedures, recording forms, test equipment, and list of personnel and qualifications for all tests proposed. Refer to Section 26 08 13 titled "Testing" for additional requirements.
  9. Pre-Engineering Megohm Readings, upon completion of busway installation and testing.
  10. Field Test Reports.
- B. All items or equipment listed above with asterisks (\*) shall be certified by the manufacturer using Manufacturer Certification "MCA" as set forth in Section 26 00 10. See Section 26 00 10 for certification requirements.

**1.5 WARRANTY**

- A. Comply with the requirements of the General Conditions and Section 26 00 10.

**PART 2 PRODUCTS****2.1 ACCEPTABLE MANUFACTURERS**

- A. If it complies with these Specifications, busway and accessories manufactured by one of the following manufacturers will be acceptable:
1. Cutler Hammer
  2. General Electric "Spectra Series"
  3. Siemens
  4. Square D

**2.2 RATINGS**

- A. Except as otherwise indicated on the Drawings, busways shall be three (3) phase, four (4) wires, full neutral for 480Y/277 Volts system with separate half size ground bus bar enclosed within the housing. The entire busway system shall be polarized. In lieu of a separate ground bus bar, the use of the busway housing as an equipment ground system will be acceptable where the impedance of the housing does not exceed that of a separate half size ground bus bar. If the housing is utilized as the grounding path, all system connections of the housing shall be tin plated or silver plated.
- B. Busbars and housing shall be adequately braced to provide the symmetrical short circuit withstand capability in accordance with NEMA Standard but in no case shall the short circuit withstand capability be less than the required symmetrical rms amperes of fault current indicated on the Drawings.
- C. Enclosure ratings and types shall be as follows unless otherwise indicated on the drawings:
1. Plug-in busway and plug-in units located within conditioned spaces shall have a minimum NEMA 250 enclosure rating of NEMA 1 or a minimum IEC 60529 rating of IP 40.
  2. Feeder busway located within conditioned spaces, or within covered non-conditioned spaces such as parking garages, and not in locations susceptible to windblown rain or spraying water, shall have a minimum NEMA 250 enclosure rating of NEMA 3R or a minimum IEC 60529 rating of IP 54.
  3. Feeder busway exposed to the outdoors in non-covered areas or areas exposed to windblown rain shall have a minimum NEMA 250 enclosure rating of NEMA 3R or a minimum IEC 60529 rating of IP 65.

**2.3 GENERAL**

- A. Where shown on the Drawings, furnish and install a busway system of the indicated type and ratings with all necessary fittings, hanging devices and accessories.
- B. All plug-in busway shall be provided where indicated on the Drawings in sections not less than 10'-0", with a minimum of five (5) plug-in points per section per accessible side. The plug-in sections of bus shall be located vertically to allow full use of the accessible plug-in points utilizing plug-in bus switches sized up to 600 amps. The Contractor shall provide written notice to the Engineer of any field conditions, which may prevent the plug-in bus from being installed as specified herein.
- C. Material and installation shall comply with all applicable codes, recommended practices, standards of IEEE, ANSI, NEMA and UL. All components of the busway shall be UL labeled when applicable. Arrangements, details and locations shall be as shown on the Drawings and specified herein.
- D. The busway housing shall be of fabricated sheet steel or extruded aluminum providing adequate mechanical protection for the conductors and shall include mounting rails to which hangers may be attached at any point. Hangers are specified in the paragraph titled "Busway Hangers and Supports" hereinafter. Each busway of the specified rating shall be contained in a single housing. Housing shall be finished with two coats of enamel over a rust inhibitor or using an electro deposition paint process.
- E. All busbars including neutral and ground busbars shall be ninety-eight percent (98%) conductivity copper insulated along entire length except at joints and plug outlets by two (2) layers of polyester impregnated glass cloth and two (2) layers of MYLAR to allow for movement due to the differential expansion between bars and housing. Fluid bed epoxy or electrostatically applied epoxy insulation may be used instead of polyester impregnated glass cloth providing the entire system conforms to NEMA Class B (130°C)

requirements. Busbars shall be electroplated at all contact points. Copper bus joints shall be silverplated. All bus taps shall be silver-plated or tin plated.

- F. Busbars shall be sized in accordance with NEMA Standards for nonventilated busways to limit the temperature rise to 55°C above a 40°C ambient temperature. Joints in all ratings shall be of the one (1) bolt type with through bolts, which can be checked for tightness without deenergizing the system. It shall be possible to makeup a joint from one side in event the busway is installed against a wall or ceiling. The joint shall be so designed as to allow removal of any length without disturbing adjacent lengths. Two (2) Belleville spring washers shall be provided per bolt to maintain maximum positive pressure over the complete contact area.
- G. The following table indicates the maximum acceptable voltage drop for copper busbars. The calculations are based on the rated load per 100' for the power factors listed. A horizontal flat wise position is assumed. It should be noted that the maximum voltage drop requirements listed below shall be the basis for all bus bar sizing regardless of the position of the busway shown on the Drawings or required by the service. Voltage drop listed is line-to-line Volts per 100' of bus at 100% rated load and 25°C ambient.

Type Load	4000A COPPER 90% P.F.	
	Feeder	Plug In
Distributed	2.94	1.47
Concentrated at End	2.94	2.94

**2.4 EXPANSION SECTIONS**

- A. Expansion sections shall be furnished as specified herein for all bus runs unless the manufacturer's written certification that expansion sections will not be required for this specific installation is included in the busway submittals.
  - 1. Expansion sections shall be furnished in the center of any horizontal straight run of 200' or more of copper duct. All vertical ducts shall have expansion sections at every 200' of vertical riser. Expansion section shall be used wherever a run of duct crosses an expansion joint or seismic joint in the building. At expansion sections the rigid bars shall be replaced with flexible braid surrounded with glass fiber reinforced thermosetting plastic molding material or glass polyester sheet barriers. Plastic molding material shall be diallyl phthalate, epoxy, phenolic polyester or silicone. No ebony asbestos material is permitted. All shipping bolts in expansion joints shall be removed prior to isolating the bus risers and returned to the Owner prior to energizing the bus.

**2.5 BUS SWITCHES**

- A. On vertical risers, provide plug-in fusible quick make, quick break interrupter switches as indicated on the Drawings. Switches shall be externally operated 600 Volt units equipped with appropriate fuse clips. Refer to Section 26 28 13 titled "Fuses" for additional requirements.
- B. A metal housing shall completely enclose the bus switch device. Provide stab shields on plug-in switches, which protect stabs and ground the plug body to the busway housing before stabs make power contact. Provide a grounding terminal inside each switch body and adequate shielding to prevent access to live parts when the switch cover is open. Provide means for padlocking cover and operating handle in "OFF" position. By removal of one screw the operating handle shall be easily removed from end to side or vice versa so that it will be in the correct position to operate from the floor. All current carrying parts shall be tin plated or silver plated.

Note: All vertical mounted switching devices shall be mounted so that "Up" is "On" and "Down" is "Off". A means shall be provided to operate switches from the floor when installed more than six foot six inches (6'-6") above the floor.

- C. All plug-in units shall be arranged so that no more than one (1) plug-in point is utilized for any switch-up through 400 amperes in size. All adjacent plug-in points must be available for additional switches.

**2.6 FLEXIBLE BUS CONNECTIONS**

- A. All busbar connections to equipment mounted on vibration isolation shall be made using flexible braid surrounded with glass fiber reinforced thermosetting plastic molding material. Plastic molding material shall be diallyl phthalate, epoxy, phenolic polyester or silicone. No ebony asbestos insulating material shall be allowed. Bus duct housing shall also have a means of flexible connection.
- B. Flexible braid shall be copper with same capacity requirements as rigid bars with silver plated joints.

**2.7 BUSWAY END TAP BOX FITTINGS (Alternate E-9)**

- A. In addition to furnishing and installing the busway system specified hereinbefore and indicated on the drawings, furnish to the Owner two (2) busway end tap boxes for each size feeder or plug-in busway size indicated by the Drawings and as specified hereinbefore. One set of two (2) busway end tap boxes may be provided for multiple busway runs of the same size that have the same physical and electrical characteristics.
- B. The Electrical Subcontractor shall demonstrate to the Owner that the end tap box is compatible with the busway by temporarily installing the fitting on an end of the appropriate busway. Upon completion of the demonstration, the Electrical Subcontractor shall repackage the fittings in a suitable storage container to prevent physical or moisture damage to the fittings. The fittings storage container shall be clearly and permanently marked: "4000 Amperes End Tap Box", as is appropriate for the fitting enclosed.
- C. Upon completion of the Project, the properly packed end tap box fittings shall be delivered to the Owner.
- D. The busway end tap box fittings shall be manufactured by the same manufacturer furnishing the feeder and plug-in busway.

**PART 3 EXECUTION****3.1 INSTALLATION**

- A. Provide floor or wall flanges at all fire separations as required, as specified in Section 26 00 10 and as indicated on the Drawings. Coordinate installation of floor flanges and firestop systems with waterproof curbs provided under another division.
- B. All busway joints shall be torqued as recommended by the manufacturer. A recheck of torque setting shall be made by the Electrical Subcontractor after the busway has been in service and subjected to varying load conditions. The Electrical Subcontractor shall submit a report of this recheck to the Owner upon completion.
- C. Inspection and testing shall be performed during installation in compliance with paragraph 3.04 titled "Field Testing and Busway Installation Checksheet" located hereinafter.

**3.2 BUSWAY HANGERS AND SUPPORTS**

- A. All horizontal busways throughout the building shall be thoroughly and substantially supported in accordance with the National Electrical Code. Busways may be supported individually with approved hangers or in groups using Unistrut and hangers. Hangers shall not be spaced more than ten feet (10') apart. Additional hangers shall be provided where required by the manufacturer or the local authorities having jurisdiction. Busway shall be attached to the hanger supports. Perforated extension hangers will not be accepted in any part of the Work.
- B. All vertical busways shall be substantially supported at each floor line to carry the weight of the busway in a satisfactory manner, with allowance for expansion and contraction. Installation shall comply with the manufacturer's requirements including maximum and minimum spring hangar deflection, expansion section tolerances and torque settings. Coordinate installation of hangers and supports with waterproof curbs provided under another division.

- C. Special hangers and supports shall be provided where they may be required because of any peculiarities of construction. Adequate space shall be provided between adjacent busways to provide for maintenance of joints.
- D. Hanger rod sizes shall be recommended by the hanger and/or busway manufacturer for the service intended.

### 3.3 BUSWAY PLUG-IN SWITCH INSTALLATION AND SUPPORT

- A. Busway plug-in switch units shall be supported from the busway with manufacturer supplied hangers and clamps. Install additional weight barring drop rods and spring hangers to support all bus plugs 600 amp and larger and 400 amp bus plugs where specifically required by the manufacturer. The additional supports shall be spring isolated to allow for building movement and expansion and contraction of the busway. Spring supports shall be provided by the busway manufacturer.
- B. Busway shall be installed specific to its orientation, either vertically or horizontally as indicated on the drawings. The manufactured unit shall be designed for its final installed orientation, either vertical or horizontal. Units designed for horizontal installation only shall not be installed on vertical busway and units designed for vertical installation only shall not be installed on horizontal busway.
- C. All vertical and horizontally mounted switching devices shall be mounted so that "Up" is "On" and "Down" is "Off". Where unit handles are designed to be interchangeable between vertical and horizontal mounting positions, they shall be arranged to match their final installed orientation.
- D. All connections to busway plug-in units shall be made with a minimum 24 inches of flexible steel conduit to allow busway movement consistent with the movement allowed by the busway spring supports and expansion fittings. Flexible steel conduit shall be installed in accordance with the requirement in Section 26 05 33 titled "Raceways and Boxes". No "hard pipe" connections to plug-in units are allowed. All plug-in unit connections shall be in place prior to final adjustment and isolation of all vertical bus risers. Conduit shall not be supported from the busway or from the plug-in unit.

### 3.4 FACTORY TESTING

- A. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL Standards.
- B. The manufacturer shall provide three (3) certified copies of factory test reports as part of the required submittals.

### 3.5 FIELD TESTING AND BUSWAY INSTALLATION CHECKSHEET

- A. The Electrical Subcontractor shall complete the Electrical Subcontractor portion of the "Busway Installation Checksheet", "Busway Installation Contractor Certification", and "Pre-Energizing Megohm Readings" as provided hereinafter for each busway run upon completion of busway installation and testing.
- B. The Busway Manufacturer or a manufacturer authorized service and testing organization shall field verify the busway is installed in accordance with the manufacturer's instructions, review the "Pre-Energizing Megohm Readings", and complete the Manufacturers portion of the "Busway Installation Checksheet" and the "Busway Manufacturer Certification" as provided hereinafter for each busway run upon completion of busway installation and testing.
- C. At completion of Manufacturers field review submit six (6) certified copies of the completed "Busway Installation Checksheet", "Busway Installation Contractor Certification", "Busway Manufacturer Certification", and "Pre-Energizing Megohm Readings" to the Engineer for review and two (2) copies of each to the Owner.
- D. Both the "Busway Installation Checksheet" and the "Pre-Energizing Megohm Readings" shall be included in the busway "Operation and Maintenance Manuals" specified in 26 00 10.

- E. The “Busway Installation Checksheet” is not intended to cover all items related to the busway installation and startup and in no way relieves the contractor of his obligation to follow manufacturer’s instructions or meet specifications and code requirements.
- F. Refer to Section 26 08 13 for additional testing requirements for Busways.

<b>Busway Installation Checksheet</b>			
Project Name:		Busway ID:	
Amp Rating:		Copper/Aluminum:	
Item	Question	Response/Comment	
		Sub-Contractor	Manufacturer
1.	Did you read the manufacturers busway installation manuals prior to installation and follow all installation instructions?		
2.	Has all busway damaged during shipping been replaced so that no damaged busway has been installed on the project?		
3.	Has all busway with mechanical damage due to handling been replaced so that no damaged busway has been installed on the project?		
4.	Were busway components kept clean and dry prior to installation?		
5.	Has the busway been kept free from exposure to any corrosive materials such as fumes, liquids, salts, or concrete material?		
6.	Have expansion fittings been installed in accordance with the specifications and manufacturers recommendations to allow for busway expansion and contraction from fixed busway ends and on long busway runs?		
7.	Have expansion fittings been installed across all building structural expansion joints to allow for busway movement across the expansion joint?		
8.	Have all shipping bolts/screws been removed from expansion fittings and returned to the Owner to allow proper movement of the expansion fitting?		
9.	Is the busway support spacing in accordance with the specifications and manufacturer’s instructions? (both horizontal and vertical supports)		
10.	Have non-rigid busway supports been installed to allow for expansion and contraction of the busway per the specifications and manufacturer recommendations?		
11.	Have vertical spring supports been adjusted properly per manufacturer recommendations during initial installation of vertical busway?		
12.	Have vertical spring supports been properly adjusted from top to bottom after the vertical runs where in place to allow the bus to be supported by the springs to allow movement with no spring fully compressed?		
13.	Are all supports installed so not to interfere with busway joints?		
14.	Are busway terminations to other equipment installed so that the equipment is in no way used to support the busway? (Busway weight should not bear on equipment such as switchgear, switchboards, or transformers.)		
15.	Are busway connections to equipment supported by vibration isolation made with flexible connections per the specifications?		
16.	Are all busway joints properly tightened per manufacturer instructions?		

Busway Installation Checksheet			
Project Name:		Busway ID:	
Amp Rating:		Copper/Aluminum:	
Item	Question	Response/Comment	
		Sub-Contractor	Manufacturer
17.	Has the busway been inspected for proper phasing? (A-B-C-N Left to right on vertical plug-in busway sections when facing the plug-in unit unless busway is indicated on the drawings to have plug-in units located on both sides).		
18.	Are all vertically installed plug-in units mounted so that the switching handle orientation is such that "Up" is "ON" and "Down" is "OFF" (unless busway is indicated on the drawings to have plug-in units located on both sides)?		
19.	Are connections to plug-in units made with flexible metal conduit in accordance with the specifications?		
20.	Is the bus installed level and plumb?		
21.	Does the busway maintain proper clearances from walls, floors, ceilings, other bus, and structures or equipment?		
22.	Do all busway floor penetrations have curbs installed per the specifications?		
23.	Are all plug-in units inserted completely to the fully engaged position and all unit supporting clamps tightened per the manufacturer's instructions?		
24.	Did each busway section ("joint") get a pre-installation megohm test?		
25.	Was a periodic megohm test performed as the run was installed? (After every two or three items or as critical items are installed. Joints should be tightened for all megohm testing.)		
26.	Was a final megohm test performed when all bus was installed and verified to be within acceptable readings in accordance with the busway manufacturer's written recommendations? (Record and attach "Pre-Energizing Megohm Readings" tables).		
<b>NEMA 3R, IP 54, IP 65 Busway</b>			
27.	Is the orientation of busway per manufacturer's instructions and weep holes proper oriented to prevent standing water?		
28.	Are all drain holes clear from obstruction?		
29.	Are joints assembled per manufacturer's instructions including gasketing and caulking where required?		
30.	Are joint caps installed and properly tightened in accordance with manufacturer's instructions?		

List any exceptions made to this checklist and any other comments related to the installation of the busway for this project. Where exceptions are made, attach a letter from the manufacturer addressing each exception with their recommendations. Submit any exceptions to the Engineer and Owner immediately.

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This checklist is not intended to cover all items related to the busway installation, and startup and in no way relieves the contractor of his obligation to meet specification and code requirements.

Busway Installation Contractor Certification		
The Electrical Subcontractor named below hereby certifies that the installation of the busway is in accordance with the manufacturer's written instructions and the Contract Documents.		
Company (please print):		
First Name:	Last Name:	Position:
Signed:		Date:

Busway Manufacturer Certification		
The Busway Manufacturer Authorized Representative named below hereby certifies that the installation of the busway is in accordance with the manufacturer's written instructions.		
Company (please print):		
First Name:	Last Name:	Position:
Signed:		Date:

**Pre-Energizing Megohm Readings**

Date:	
Run ID:	
Run Length (ft):	
Phase	Megohms
A-G	
B-G	
C-G	
N-G	
A-B	
A-C	
B-C	
A-N	
B-N	
C-N	

Date:	
Run ID:	
Run Length (ft):	
Phase	Megohms
A-G	
B-G	
C-G	
N-G	
A-B	
A-C	
B-C	
A-N	
B-N	
C-N	

Date:	
Run ID:	
Run Length (ft):	
Phase	Megohms
A-G	
B-G	
C-G	
N-G	
A-B	
A-C	
B-C	
A-N	
B-N	
C-N	

**END OF SECTION**