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NEMA STANDARDS PUBLICATION

NEMA BU 2

Major Requirements Related to the Application and Testing of Low Voltage Busway

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

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NEMA Standards Publication BU 2

MAJOR REQUIREMENTS RELATED TO THE APPLICATION AND TESTING OF LOW VOLTAGE BUSWAY

Published by:

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Rosslyn, Virginia 22209

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FOREWORD

In the preparation of this standards publication input of users and other interested parties has been sought and evaluated. Inquiries, comments, and proposed or recommended revisions should be submitted to the concerned NEMA product subdivision by contacting the:

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1300 North 17th Street, Suite 1847
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This Standards Publication was developed by the Busway Section. Section approval of the standard does not necessarily imply that all section members voted for its approval or participated in its development. At the time it was approved, the Busway Section was composed of the following members:

Controlled Power Ltd. Partnership—Canton, OH
Cutler-Hammer, Inc.—Pittsburgh, PA
GE—Plainville, CT
Siemens Energy & Automation, Inc.—Alpharetta, GA
Square D Company—Palatine, IL

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Section 1
GENERAL

1.1 SCOPE

This Standards Publication covers products for distribution of electric power at 600 volts or less, consisting of enclosed sectionalized prefabricated busbars rated at 100 amperes or more, and associated structures and fittings, classified as follows:

a. Feeder busways (indoor or outdoor)
b. Plug-in busways (indoor only)
c. Accessories required to complete the busway system.

It does not pertain to metal-enclosed busways as described in the ANSI/IEEE C37.23 Standard.

1.2 REFERENCED STANDARDS

Underwriters Laboratories, Inc.
333 Pfingsten Road
Northbrook, IL 60062

UL 857-1994	*Busways and Associated Fittings*

National Fire Protection Association
Batterymarch Park
Quincy, MA 02269

NFPA 70-1996	*National Electrical Code*

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AB 1-1993	*Molded Case Circuit Breakers and Molded Case Switches*
BU 1-1994	*Busways*
ICS 1-1993	*General Standards for Industrial Control and Systems*
ICS 2-1993	*Industrial Control Devices Controllers and Assemblies*
ICS 3-1993	*Industrial Systems*
KS 1-1996	*Enclosed And Miscellaneous Distribution Equipment Switches (600 Volts Maximum)*

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Section 2
UNDERWRITERS LABORATORIES REQUIREMENTS

Busway bearing the Underwriters Laboratories listing mark must pass a series of performance tests (see UL 857). Among the tests which may be required are:

2.1 Heating (Temperature Rise) Test

Busway with suitably plated joint connections must carry its rated current continuously without any part showing a temperature rise above ambient of more than 55°C. Tests are conducted on three 10-foot sections bolted together, at any convenient voltage, at design frequency, with rated current flowing.

2.2 Resistance to Impact Test

The resistance to impact test will ordinarily not be required for non-ventilated busway if its enclosure complies with UL 857. However, all other busway must be tested to ensure that no hazardous condition will exist after any side of the enclosure has been subjected to a blow from a 50-pound weight suspended from a 30-inch long pendulum arm going through a 60 degree angle from the vertical.

2.3 Dielectric Test

A busway shall withstand for 1 minute without breakdown the application of a 60 hertz essentially sinusoidal potential of 1,000 volts plus twice maximum rated voltage between (1) live parts and the enclosure and (2) between live parts of opposite polarity.

2.4 Resistance to Bending Test

Horizontal busway intended for a spacing of not more than 5 feet between mounting supports, or vertical busway intended for a spacing of not more than 10 feet between mounting supports will ordinarily be accepted without a bending test. However, to qualify for horizontal mounting up to a 10-foot support basis, or up to 16-foot centers in vertical riser support, a busway must withstand for 5 minutes without rupture of the joint, appreciable permanent distortion, or short-circuiting or grounding of the bus bars, a bending moment equivalent to:

$$(D*W)/2 + 100\ D$$

Where D is the intended spacing in integral values of feet between mounting supports, and W is the weight in pounds of a 10-foot section of the busway.

2.5 Resistance to Crushing Test

Busway intended to employ a spacing of not more than 5 feet between mounting supports and whose enclosure thickness is no less than the values shown in UL 857 will ordinarily be accepted without a crushing test. However, if the busway does not meet these requirements, it shall be tested to ensure that it will be able to withstand a crushing force of 200 pounds plus three times the weight of a 10-foot section.

2.6 Bus Bar Pullout Test

Busway intended for mounting in a vertical run shall be capable of supporting a downward force equal to five times the weight of each bus bar in a 10-foot section applied simultaneously to each of the bus bars, without rupture or permanent distortion of bus bar supports.

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2.7 Insulation Resistance and Dielectric Strength Test After Exposure to Rain

Outdoor busway must withstand a simulated rain for 8 hours per day for 5 successive days without dielectric breakdown and the insulation resistance can not be reduced below 1 megohm per 10 feet of length.

2.8 Short Circuit Test

Busway with a 5,000 ampere short circuit current rating need not be tested. Additionally, busway rated over 100 amperes with a 7,00 or 10,000 ampere short circuit current rating need not be tested. All other busway and fittings shall be tested and marked with their respective rating(s). In order to verify these rating(s), representative samples of the busway shall be subjected to phase-to-phase, phase-to-enclosure, and phase-to-ground conductor (when applicable) short circuit tests. Tests may be conducted either with or without fuse or circuit breaker protection ahead of the busway being tested, and the ratings and markings will so indicate.

2.9 Electric Conductivity Test

The resistance between two adjacent busway sections shall be no more than 0.005 ohm. Additionally, if the method of attaching a plug-in device, or if the method of attaching any metal part required to be grounded does not result in positive metal to metal contact, the resistance between the parts shall be no more than 0.06 ohm. These resistances are to be computed from measurements taken when passing a direct current of 30 amperes between the parts.

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Section 3
NEMA STANDARDS

3.1 Short Circuit Current Ratings

There are no minimum or maximum standards on short-circuit current ratings specified by Underwriters Laboratories. The minimum rating depends upon the maximum short-circuit current available at the line end of the installed busway run. However, NEMA recommends the minimum ratings listed in Table 3-1.

Table 3-1
RECOMMENDED MINIMUM RATINGS

Continuous Current Rating of Busway (Amperes)	Short circuit (Symmetrical Amperes)	
	Plug-In Busway	Feeder Busway
100	10,000	----
225	14,000	----
400	22,000	----
600	22,000	42,000
800	22,000	42,000
1,000	42,000	75,000
1,200	42,000	75,000
1,350	42,000	75,000
1,600	65,000	100,000
2,000	65,000	100,000
2,500	65,000	150,000
3,000	85,000	150,000
4,000	85,000	200,000
5,000	----	200,000

3.2 Voltage Drop

There are no minimum or maximum standards on voltage drop since these values may vary considerably depending upon several factors including:

a. Design
b. Conductor material
c. Continuous current design
d. Current load
e. Power factor of the load
f. Operating temperatures
g. Length of the run
h. Distribution of the load

Actual values of voltage drop in given situations can best be determined by obtaining the necessary data from a busway manufacturer and applying it to the specific situation. In general, the line-to-line voltage drop of fully loaded, three-phase busway will usually be less than 6 volts per hundred feet. Voltage drops for plug-in busway are based upon an evenly distributed load along the run and are one-half that of a load concentrated at one end.

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3.3 Resistance, Reactance, and Impedance

There are no minimum or maximum values of resistance, reactance, or impedance since these values vary considerably with different ratings and busway constructions. Busway manufacturers can supply these data for their particular products. These data are used for calculating the voltage drop for a specific application.

3.4 Unusual Service Conditions

For applications where the ambient temperature is higher than 40°C, the busway current rating should be derated in accordance with the manufacturer's recommendations, if furnished, or the temperature listed in Table 3-2.

Table 3-2
AMBIENT TEMPERATURE

Ambient Temperature (°C)	Multiplier
40	1.00
45	0.95
50	0.90
55	0.85
60	0.80
65	0.74
70	0.67

For applications where the ambient temperature is lower than the ambient temperature limits shown in Table 3-3 or at altitudes greater than 6,600 feet (2,000 meters), consult the manufacturer.

Table 3-3
TEMPERATURE LIMITS

	Ambient Temperature Limits (°C)	NEMA Standards Publication No.
Busway lengths and fittings	-30 through 40	BU 1
Molded case circuit breakers	0 through 40	AB 1
Enclosed switches	-30 through 40	KS 1
Low voltage cartridge fuses	See applicable UL standards	
Electromagnetic and manual motor controls at 6000 feet and less	0 through 40 maximum	ICS1, ICS 2, ICS 3

There are other service conditions which may require further consideration. Where such conditions exist, it is recommended that they be brought to the manufacturer's attention.

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Section 4
NATIONAL ELECTRICAL CODE REQUIREMENTS

The *National Electrical Code* (NEC), which is sponsored by the National Fire Protection Association, outlines the general guidelines which are necessary for safe application of electrical equipment. Article 364 of the Code specifically applies to busways, although other articles in the Code are applicable in certain situations. Thorough familiarization with the NEC requirements of busway is recommended before attempting to apply busways to specific applications.

Some of the major requirements for safe application of busways, as outlined in the 1996 NEC are as follows:

364-4. **Use.**

(a) **Use Permitted.** Busways shall be installed only where they are located in the open and are visible.

Exception: Totally enclosed, non-ventilating-type busway, installed so that the joints between sections and at fittings are accessible for maintenance purposes, shall be permitted to be installed behind panels where means of access are provided, and

a) the space behind the access panels is not used for air-handling purposes; or
b) the space behind the access panels is used for environmental air, other than ducts and plenums, in which case there shall be no provisions for plug-in connections, and the conductors shall be insulated.

(b) Use Not Permitted. Busways shall not be installed (1) where subject to severe physical damage or corrosive vapors; (2) in hoistways; (3) in any hazardous (classified) location, unless specifically approved for such use [see Section 501-4(b)]; nor (4) outdoors or in wet or damp locations unless identified for such use.

Lighting busway and trolley busway shall not be installed less than 8 feet (2.44 m) above the floor or working platform unless provided with a cover identified for the purpose.

364-5. **Support.** Busways shall be securely supported at intervals not exceeding 5 feet (1.52 m) unless otherwise designed and marked.

364-6. **Through Walls and Floors.** It shall be permissible to extend unbroken lengths of busway through dry walls. It shall be permissible to extend busways vertically through dry floors if totally enclosed (unventilated) where passing through and for a minimum distance of 6 feet (1.83 m) above the floor to provide adequate protection from physical damage.

300-21. **Spread of Fire or Products of Combustion.** Electrical installations in hollow spaces, vertical shafts, and ventilation or air-handling ducts shall be so made that the possible spread of fire or products of combustion will not be substantially increased. Openings around electrical penetrations through fire-resistance rated walls, partitions, floors, or ceilings shall be fire-stopped using approved methods to maintain the fire-resistance rating.

(FPN): Firestops may require decreasing the allowable load on the conductors.

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364-11. **Reduction in Ampacity Size of Busway.**
Overcurrent protection shall be required where busways are reduced in ampacity.

Exception: For industrial establishments only, omission of overcurrent protection shall be permitted at points where busways are reduced in ampacity, provided that the length of the busway having the smaller ampacity does not exceed 50 feet (15.2 m) and has an ampacity at least equal to 1/3 the rating or setting of the overcurrent device next back on the line, and provided further that such busway is free from contact with combustible material.

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Section 5
STATE AND LOCAL CODES

Many states and cities have electrical codes which supplement the *National Electrical Code*. Before attempting to apply or install busway, as well as any other type of electrical equipment, contact your local electrical inspection authority for a copy of the latest requirements applicable to the location of the installation.

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Section 6
ELECTRIC POWER COMPANY REQUIREMENTS

Busways are commonly used for the main services of buildings in which they are usually connected to one or more distribution transformers owned by the local electric power company. This connection may be made by either cable or bus bars, depending upon local practices. Since the various electric power companies throughout the United States often prefer different methods of connection to busway services, it is recommended that the local power company supplying the power be contacted before applying or installing a service entrance busway run.

6.1 Contacting Busway Manufacturers

Since the practical applications and uses of busway are nearly unlimited, it is not possible to outline in this publication all of the technical information available pertaining to busway. For this reason, it is advisable to contact one or more of the manufacturers of busway for more specific information.

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