

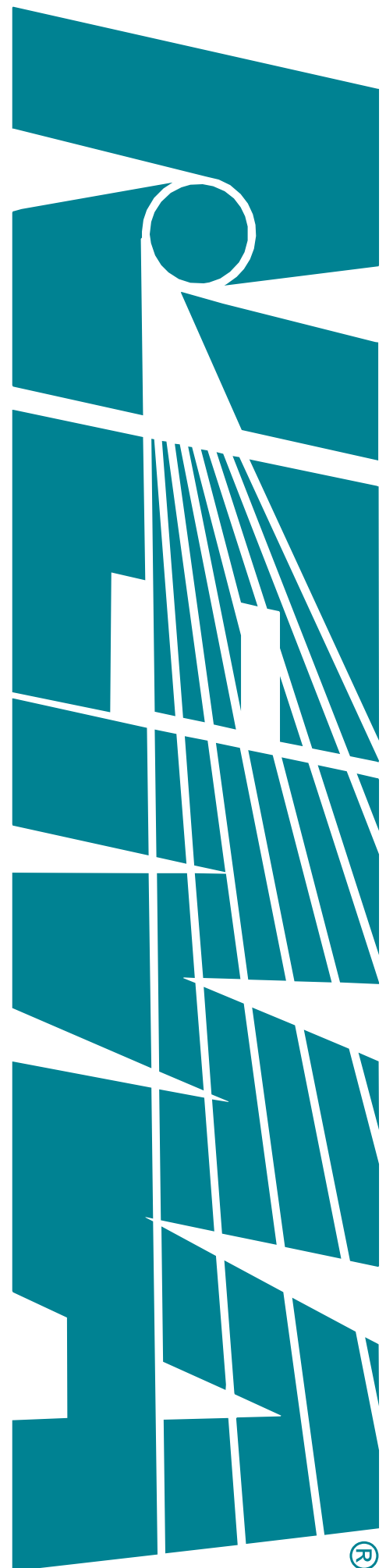
NEMA Standards Publication

NEMA PB 1-2011

---

# Panelboards

National Electrical Manufacturers Association



**NEMA Standards Publication PB 1-2011**  
(Incorporates March 2008 Errata)

*Panelboards*

*Published by:*

**National Electrical Manufacturers Association**  
1300 North 17th Street, Suite 1752  
Rosslyn, Virginia 22209

[www.nema.org](http://www.nema.org)

© Copyright 2011 by the National Electrical Manufacturers Association. All rights including translation into other languages, reserved under the Universal Copyright Convention, the Berne Convention for the Protection of Literary and Artistic Works, and the International and Pan American Copyright Conventions.

## **NOTICE AND DISCLAIMER**

The information in this publication was considered technically sound by the consensus of persons engaged in the development and approval of the document at the time it was developed. Consensus does not necessarily mean that there is unanimous agreement among every person participating in the development of this document.

The National Electrical Manufacturers Association (NEMA) standards and guideline publications, of which the document contained herein is one, are developed through a voluntary consensus standards development process. This process brings together volunteers and/or seeks out the views of persons who have an interest in the topic covered by this publication. While NEMA administers the process and establishes rules to promote fairness in the development of consensus, it does not write the document and it does not independently test, evaluate, or verify the accuracy or completeness of any information or the soundness of any judgments contained in its standards and guideline publications.

NEMA disclaims liability for any personal injury, property, or other damages of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, application, or reliance on this document. NEMA disclaims and makes no guaranty or warranty, express or implied, as to the accuracy or completeness of any information published herein, and disclaims and makes no warranty that the information in this document will fulfill any of your particular purposes or needs. NEMA does not undertake to guarantee the performance of any individual manufacturer or seller's products or services by virtue of this standard or guide.

In publishing and making this document available, NEMA is not undertaking to render professional or other services for or on behalf of any person or entity, nor is NEMA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances. Information and other standards on the topic covered by this publication may be available from other sources, which the user may wish to consult for additional views or information not covered by this publication.

NEMA has no power, nor does it undertake to police or enforce compliance with the contents of this document. NEMA does not certify, test, or inspect products, designs, or installations for safety or health purposes. Any certification or other statement of compliance with any health or safety-related information in this document shall not be attributable to NEMA and is solely the responsibility of the certifier or maker of the statement.

## CONTENTS

	<b>Page</b>
<b>Section 1 GENERAL .....</b>	<b>1</b>
1.1 Scope.....	1
1.2 Referenced standards .....	1
1.3 Definitions .....	2
<b>Section 2 PANELBOARDS.....</b>	<b>10</b>
2.1 Types of Panelboards.....	10
2.2 Lighting and Appliance Branch-Circuit Panelboards.....	10
2.3 Distribution Panelboards .....	11
2.4 Panelboard Circuit Protective Devices, NEMA Standards.....	12
2.5 UL Requirements.....	12
2.6 Usual Service Conditions .....	12
2.7 Unusual Service Conditions .....	12
2.8 Suitability for Use as Service Equipment .....	12
2.8.1 Ground-Fault Protection .....	13
2.9 Lighting and Appliance Branch-Circuit Panelboard Mains.....	13
2.10 Standard Main Bus, Switch, and Breaker Ratings .....	13
2.11 Product Safety Labels .....	13
<b>Section 3 RATING STANDARDS .....</b>	<b>15</b>
3.1 Standard Voltage Rating .....	15
3.2 Current Rating .....	15
3.2.1 Panelboards Using a Snap Switch .....	15
3.3 Frequency Rating .....	15
3.4 Basis of Short-Circuit Current Rating of Panelboards.....	16
3.5 Standard Short-Circuit Current Ratings of Panelboard Devices.....	16
3.5.1 Circuit Breakers.....	16
3.5.2 Fusible Switches.....	16
3.5.3 Other Devices .....	16
<b>Section 4 INSTALLATION, MAINTENANCE, AND STORAGE.....</b>	<b>17</b>
<b>Section 5 CONSTRUCTION.....</b>	<b>18</b>
5.1 General.....	18
5.1.1 Marking Information.....	18
5.1.2 Other Markings .....	18
5.2 Uninsulated Live Metal Parts.....	18
5.3 Wiring Terminations.....	18
5.3.1 Conductor Terminals .....	18
5.3.2 Main Terminals Kits .....	18
5.3.3 Main and Branch-Circuit Terminals .....	19
5.3.4 Connectors .....	19
5.4 Spacings.....	19
5.4.1 Minimum Panelboard Spacings.....	19
5.4.2 Insulating Material Other than Air.....	20
5.4.3 Screw Shells .....	20
5.4.4 Wire Connectors (Lugs) .....	20
5.5 Grounding and Insulating .....	20
5.5.1 Operating Handle .....	20
5.5.2 Grounding and Bonding .....	20
5.5.3 Size of Grounding Conductors .....	20
5.5.4 Equipment Grounding Terminals.....	21
5.5.5 Size of Grounding Electrode Conductors and Main Bonding Jumper .....	21
5.5.6 Grounding of Three-Phase Delta Systems .....	21
5.6 Cabinets, Gutters and Wiring Space .....	22

5.6.1	Cabinet .....	22
5.6.2	Distance between End of Wiring Lugs and Opposite Wall.....	22
5.6.3	Enclosed Panelboard .....	22
5.6.4	Knockouts.....	22
5.6.5	Wiring Gutters and Terminal Compartments.....	22
5.6.6	Wiring Space .....	22
5.7	Fuse and Circuit Breaker Location .....	22
5.7.1	Fuse.....	22
5.7.2	Circuit Breakers with Interchangeable Trip Units.....	22
5.8	Enclosures.....	22
5.8.1	Types of Enclosures .....	23
<b>Section 6</b>	<b>TEST STANDARDS.....</b>	<b>24</b>
6.1	Classification of Tests.....	24
6.1.1	Design Tests (Type Test).....	24
6.1.2	Production Tests (Routine Test).....	24
6.2	Design Tests (Type Test).....	24
6.2.1	Temperature Rise Tests.....	24
6.2.2	Dielectric Tests.....	24
6.2.3	Short-Circuit Tests.....	25
6.2.4	Environmental Tests.....	25
6.2.5	Strength of Insulating Base and Support Test .....	25
6.3	Production Tests (Routine Test).....	25
6.3.1	Ground-Fault-Sensing Test.....	25
<b>Section 7</b>	<b>APPLICATION STANDARDS .....</b>	<b>26</b>
7.1	Selection of Apparatus .....	26
7.2	Voltage Ratings .....	26
7.3	Continuous-Current-Carrying Ratings.....	26
7.3.1	Panelboard without Main Overcurrent Protective Devices (Main Lug Panelboard)....	26
7.3.2	Panelboard Having One or More Main Overcurrent Protective Devices .....	26
7.3.3	Branch-Circuit Devices.....	26
7.3.4	Panelboards with Feed-Through or Sub-Feed Lugs.....	26
7.4	Calculation of Available Short-Circuit Current.....	26
7.5	Short-Circuit Current Ratings .....	26
7.5.1	Panelboard Short-Circuit Current Rating .....	26
7.5.2	Examples for Application.....	26
7.6	Field-Installed Conductors.....	28
7.7	Corner-Grounded (Grounded B Phase) Three-Phase Delta Applications.....	28
7.8	Mounting of Enclosure.....	28

#### LIST OF TABLES

<b>Table 2-1</b>	Standard Lighting and Appliance Branch-Circuit Panelboard Voltage Systems.....	10
<b>Table 2-2</b>	Standard Distribution Panelboard Voltage Systems .....	11
<b>Table 2-3</b>	Usual Ambient Limits of Devices Commonly Mounted in Panelboards .....	12
<b>Table 3-1</b>	Standard Panelboard Voltage Ratings .....	15
<b>Table 5-1</b>	Minimum Panelboard Spacing, Inch (mm).....	20
<b>Table 5-2</b>	Size of Grounding Electrode Conductors and Main Bonding Jumper.....	21

## LIST OF FIGURES

<b>Figure 1-1</b> Double-Lugs or Sub-feed Lugs Connected to Main Incoming Line Terminals.....	4
<b>Figure 1-2</b> Sub-feed Lugs Connected to Bus Bars Protected by an Overcurrent Protective Device in the Panelboard.....	5
<b>Figure 1-3</b> Feed-Through Lugs for a Separate Circuit External to the Panelboard .....	5
<b>Figure 1-4</b> Gutter Tap Lugs Connected to Panelboard Mains .....	7
<b>Figure 1-5</b> Gutter Tap Lugs Connected to a Branch Circuit .....	7
<b>Figure 2-1</b> Product Safety Label .....	14
<b>Figure 7-1</b> Typical Panelboard Schematic.....	27

## FOREWORD

This standards publication is intended to provide a basis of common understanding within the electrical community by aiding the user and specifier in properly selecting panelboards for specific applications by stating:

- a. The general standards for panelboards including the types, insulating requirements, unusual service conditions, service equipment requirements, ampacity, and markings
- b. Standard panelboard ratings including short circuit current ratings
- c. Test procedures and tests for panelboard design and production
- d. Manufacturing standards for panelboards
- e. Panelboard application standards to provide proper selection of a panelboard and its components to ensure satisfactory service

PB 1-2011 completely revises and supersedes PB 1- 2006.

These standards are periodically reviewed by the Panelboard and Distribution Board Section of NEMA for any revisions necessary to keep them up-to-date with advancing technology. User needs have been considered throughout the development of this publication. Proposed or recommended revisions should be submitted to:

Vice President, Technical Services  
National Electrical Manufacturers Association  
1300 North 17th Street, Suite 1752  
Rosslyn, Virginia 22209

This standards publication was developed by the Panelboard and Distribution Board Section. At the time it was approved, the section was composed of the following members:

ABB, Inc.—New Berlin, WI  
Cooper Bussmann—St. Louis, MO  
Eaton Corporation—Pittsburgh, PA  
The Durham Company—Lebanon, MO  
GE Industrial Solutions—Plainville, CT  
Hubbell, Inc.—Bridgeport, CT  
Penn Panel & Box Company—Collingdale, PA  
Reliance Controls Corporation—Racine, WI  
Schneider Electric—Palatine, IL  
Siemens Industry Inc.—Norcross, GA

The standards or guidelines presented in a NEMA standards publication are considered technically sound at the time they are approved for publication. They are not a substitute for a product seller's or user's own judgment with respect to the particular product referenced in the standard or guideline, and NEMA does not undertake to guarantee the performance of any individual manufacturer's products by virtue of this standard or guide. Thus, NEMA expressly disclaims any responsibility for damages arising from the use, application, or reliance by others on the information contained in these standards or guidelines.

## Section 1 GENERAL

### 1.1 SCOPE

This standards publication covers single panelboards or groups of panel units suitable for assembly in the form of single panelboards, including buses, and with or without switches or automatic overload protective devices (fuses or circuit breakers), or both. These units are used in the distribution of electricity for light, heat, and power at 600 volts and less with:

- a. 1600-ampere mains and less
- b. 1200-ampere branch circuits and less

Specifically excluded are live-front panelboards, panelboards employing cast enclosures for special service conditions, and panelboards designed primarily for residential and light commercial service equipment.

### 1.2 REFERENCED STANDARDS

**American National Standards Institute**  
11 West 42nd Street  
New York, NY 10036

ANSI Z535.4      *Product Safety Signs and Labels*

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

ANSI/UL 67      *Panelboards*

**Institute of Electrical and Electronics Engineers, Inc. (IEEE)**  
445 Hoes Lane, P.O. Box 1331  
Piscataway, NJ 08855-1331

IEEE 141      *Electric Power Distributions for Industrial Plants*

**National Electrical Manufacturers Association**  
1300 North 17th Street, Suite 1752  
Rosslyn, VA 22209

NEMA 250      *Enclosures for Electrical Equipment (1000 Volts Maximum)*

NEMA AB 1      *Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures (UL 489)*

NEMA FU 1      *Low-Voltage Cartridge Fuses*

NEMA KS 1      *Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)*