



# UL 1640

## STANDARD FOR SAFETY

### Portable Power-Distribution Equipment

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UL Standard for Safety for Portable Power-Distribution Equipment, UL 1640

Fourth Edition, Dated November 14, 2016

### **Summary of Topics**

***This revision of ANSI/UL 1640 dated July 14, 2021 includes the following changes in requirements:***

***– Revision of Criteria for the Use of "100 Percent Rated" Circuit Breakers; [15.2.1](#)***

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated May 7, 2021.

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**ANSI/UL 1640-2021**

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**UL 1640**

**Standard for Portable Power-Distribution Equipment**

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**Fourth Edition**

**November 14, 2016**

This ANSI/UL Standard for Safety consists of the Fourth Edition including revisions through July 14, 2021.

The most recent designation of ANSI/UL 1640 as an American National Standard (ANSI) occurred on July 14, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

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## INTRODUCTION

### 1 Scope

1.1 These requirements cover portable power-distribution equipment rated 600 volts or less and 1600 amperes maximum. They are intended for either single- or multi-phase supply and are intended to distribute power in accordance with the National Electrical Code, NFPA 70 (NEC).

1.2 These requirements cover portable power-distribution equipment intended for use in the following locations:

- a) Carnivals, circuses, fairs, and similar locations in accordance with Article 525 of the NEC;
- b) Exhibition halls in accordance with Article 518 of the NEC;
- c) Motion picture and television studios and similar locations in accordance with Article 530 of the NEC;
- d) Theaters, audience areas of motion-picture and television studios, and similar locations in accordance with Article 520 of the NEC; and
- e) Temporary installations at construction sites in accordance with Article 590 of the NEC.

1.3 These requirements do not cover portable power-distribution equipment:

- a) Intended to be mounted above or adjacent to the lighting unit it supplies. These devices are covered by the Standard for Stage and Studio Luminaires and Connector Strips, UL 1573.
- b) Intended to be connected to the load side of branch circuits, such as:
  - 1) Relocatable power taps. These devices are covered by the Standard for Relocatable Power Taps, UL 1363;
  - 2) Cord sets. These devices are covered by the Standard for Cord Sets and Power-Supply Cords, UL 817;
  - 3) Convention-center Cord Sets. These devices are covered by the Standard for Exhibition Display Units, Fabrication and Installation, UL 2305; and
  - 4) Current taps. These devices are covered by the Standard for Current Taps and Adapters, UL 498A.

### 2 Components

2.1 Except as indicated in [2.2](#), a component of a product covered by this standard shall comply with the requirements for that component. See Appendix [A](#) for a list of standards covering components used in the products covered by this standard.

2.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or
- b) Is superseded by a requirement in this standard.

2.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

### 3 Units of Measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

3.2 All applicable alternating-current electrical measurements are in root-mean-square (rms) units unless otherwise stated.

### 4 Undated References

4.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

### 5 Glossary

5.1 For the purposes of this standard the following definitions apply.

5.2 **BUS BAR CLAMP (SISTER LUG)** – A connector that terminates a single conductor cable and that is secured to a bus bar with an integral set screw. May secure the conductor by soldering, integral pressure wire connector, or by crimping of the clamp body.

5.3 **CABLE CONNECTOR** – A portable receptacle that is intended to provide power, with means for attachment of flexible cord or cable and not intended for permanent mounting.

5.4 **CABLE-SPLICING BLOCK** – Power-distribution equipment intended to provide a termination for cable assemblies. Not provided with overcurrent protection; only provide a means to extend runs of single- or multi-conductor cable.

5.5 **COVER** – An unhinged, removable covering member that is a required part of the enclosure.

Note: Some standards for products used as components on or in portable power distribution units designate “cover” as “cap” or “closure”.

5.6 **DAMP LOCATION** – Protected locations outdoors and interior locations subject to moderate degrees of moisture. This would also include areas near where artificial rain is being produced, or when effect machines that utilize water vapor to generate fog or mist effects are being used. Damp Locations are not subject to direct water spray or rain.

5.7 **DEAD-FRONT** – A panel that may or may not form a part of the enclosure and that may be used behind a door, which may have openings for the passage of cords, to cover wiring and uninsulated live parts.

5.8 **DOOR** – A hinged, sliding, or similarly attached covering member that is capable of being removed only by the use of a tool and that is a required part of the enclosure.

Note: Some standards for products used as components on or in portable power distribution units designate “door” as “cover”, “hood”, or “lid”.

5.9 **ENCLOSURE** – That part of power-distribution equipment that:

- a) Renders inaccessible all or any parts of the equipment that may otherwise present a risk of electric shock and/or
  - b) Retards propagation of flame initiated by an electrical fault occurring within the equipment.
- 5.10 FORMED HINGE – A strip of metal secured to or integral with the enclosure or trim and formed so that it will cooperate with a slot in a door to form a hinge.
- 5.11 INLET ASSEMBLY, INTERLOCKED – An assembly of locking-type, single-pole pin-and-sleeve inlets. The assembly is interlocked as specified under [5.18](#).
- 5.12 INLET ASSEMBLY, SEQUENTIALLY INTERLOCKED – An assembly of locking-type, single-pole pin-and-sleeve inlets. The assembly is sequentially interlocked as specified under [5.19](#).
- 5.13 INTERLOCKED INLET – An inlet having a device, either mechanical or electrical, that is intended to reduce the risk of energizing the contacts before complete engagement with a plug, and that either is intended to reduce risk of the plug being withdrawn while its contacts are energized or de-energizes the line contacts before separation.
- 5.14 PIN-AND-SLEEVE DEVICE – A plug or receptacle utilizing contacts which generally are cylindrical or circular in shape and telescoping and are shrouded by an extension of the enclosure of the mating devices.
- 5.15 PLUG (ATTACHMENT PLUG) – A device intended to receive power when inserted in a receptacle or cable connector, which establishes connection between conductors of the attached flexible cord or cable and the conductors connected to the receptacle or cable connector.
- 5.16 POWER INLET (INLET) – A permanently mounted plug intended to receive power from a cable connector.
- 5.17 RECEPTACLE (OUTLET) – A device that is intended to provide power to an inserted plug, and that is installed as a fixed outlet on equipment.
- 5.18 RECEPTACLE ASSEMBLY, INTERLOCKED – An assembly consisting of a number of locking-type, single-pole pin-and-sleeve-type receptacles. Supply receptacles are interlocked to the source so it is not possible to connect or disconnect the plugs when the source of supply is energized.
- 5.19 RECEPTACLE ASSEMBLY, SEQUENTIALLY INTERLOCKED – An assembly consisting of a number of locking-type, single-pole receptacles that are electrically or mechanically interlocked in such a manner that plugs must be connected in the following sequence and disconnected in the reverse order:
- a) Equipment-grounding conductor connection, if provided;
  - b) Grounded circuit conductor connection, if provided; and
  - c) Ungrounded conductor connection.
- 5.20 SHIELDING – A hinged or fixed member that is attached to the enclosure but is not a required part of the enclosure, such as a rain shield.
- 5.21 TERMINAL, PRESSURE-WIRE – A terminal in which the conductor is clamped under a pressure plate or saddle by one or more screws or nuts.

5.22 TERMINAL, SET SCREW – A terminal that provides clamping by the end of the screw bearing directly on the conductor.

5.23 TERMINAL, WIRE-BINDING SCREW – A terminal having the conductor bent around the screw and clamped directly under the head of the screw when it is tightened. The conductor is intended to encircle the terminal screw at least three-fourths the circumference without overlapping.

## PART 1 – ALL EQUIPMENT

### CONSTRUCTION

#### 6 General

6.1 Portable power-distribution equipment shall be constructed and assembled so that it has the strength and rigidity necessary to resist the abuses to which it is likely to be subjected, without total or partial collapse resulting in a risk of fire, electric shock, or injury to persons due to the reduction of spacings, loosening or displacement of parts, or other serious defects.

6.2 Portable power-distribution equipment shall be constructed so as to reduce the risk of intentional contact with enclosed electrical devices and to provide internal devices with protection from specified external conditions.

6.3 Portable power-distribution equipment shall be complete when it is shipped from the factory and shall not have provisions for the mounting of additional equipment. Internal wiring and connections between components shall be completed at the factory.

#### 7 Current-Carrying Parts

##### 7.1 General

7.1.1 Current-carrying parts shall be of silver, copper, or alloys of these metals or others determined to be the equivalent. Current-carrying parts of other materials that are used in the construction of components shall comply with the appropriate requirements for that component as specified in Appendix [A](#).

7.1.2 Iron or steel shall not be used for a part that is depended upon to carry current.

##### 7.2 Bus bars

###### 7.2.1 General

7.2.1.1 The bending of a bus bar shall not result in visible cracks, but roughening or slight surface checking is not prohibited.

###### 7.2.2 Ampacity

7.2.2.1 Other than as covered in [7.2.2.4](#) and [7.2.2.5](#), the ampacity or size of a bus bar is considered sufficient if the current density is not more than as specified in [Table 7.1](#) or the size is not less than as specified in [Table 7.2](#).

*Exception: Bus bars operated at ampacities greater than as specified in [Table 7.1](#) shall be tested in accordance with and comply with the Temperature Test, Section [20](#).*

**Table 7.1  
Ampacity of single or multiple bus bars and clamped joints**

Bus bar material <sup>a</sup>	Current, amperes	Current density in amperes per square inch (6.45 square cm)	
		Bus bar cross section <sup>b</sup>	Contact area at clamped joints
Copper	0 – 600	1000 <sup>d</sup>	200
Copper	601 – 1600	1000 <sup>d,e</sup>	200 <sup>c</sup>
Brass	0 – 600	500	200

<sup>a</sup> Multiple bus bars in parallel shall be of the same material and cross section.  
<sup>b</sup> See 7.2.2.1 – 7.2.2.4 regarding the ampacity.  
<sup>c</sup> Joints bolted and plated with silver, tin, nickel, or cadmium.  
<sup>d</sup> See Table 7.2 for 800 ampere maximum single bus bars.  
<sup>e</sup> Reference the Standard for Dead-Front Switchboards, UL 891, for 100 percent rated device rated 3,000 amperes or more.

**Table 7.2  
Rating and sizes of single bus bars – 800 amperes maximum**

Current rating, amperes	Copper bus			
	Bus size <sup>a</sup> ,		Cross section,	
	inch	(mm)	inch <sup>2</sup>	(mm <sup>2</sup> )
225	0.125 by 0.875	(3.2 by 22.2)	0.109	(70.3)
400	0.250 by 1.500	(6.38 by 38.1)	0.375	(242.0)
600	0.250 by 2.000	(6.38 by 50.8)	0.500	(322.6)
800	0.250 by 3.000	(6.38 by 76.2)	0.750	(483.9)

NOTES  
 1 For multiple buses in parallel, refer to Table 7.1.  
 2 A bus connection to a fused power circuit device, to a transfer switch with Class L fuses, or to a molded case circuit breaker rated for continuous use at 100 percent of its rating shall be sized in accordance with Table 7.1 or shall be tested in accordance with the limitation on temperature rise specified in Table 20.1.  
 3 Joints bolted and plated with silver, tin, nickel, or cadmium.  
 A bus bar having other dimensions may also be used if it has not less than the cross-sectional area specified in the table and if it has been determined to have equivalent rigidity.

7.2.2.2 The material at any cross-section along the length of a bus bar shall have at least 70 percent of the required ampacity and the remaining metal in any 6 inch (152 mm) length of the bus bar shall have at least 93 percent of the metal of a bus bar having the required ampacity in accordance with Table 7.1.

*Exception: Bus bars with a larger amount of material removed shall be tested in accordance with and comply with the Temperature Test, Section 20.*

7.2.2.3 In determining the area of contact surfaces of bolted or riveted connections, no additions or subtractions for the diameters and areas of screws, bolts, or rivets shall be made.

7.2.2.4 The contact area shall not be less than the minimum 1 square inch (6.5 cm<sup>2</sup>) per 200 amperes specified in Table 7.1 and Table 7.2 unless the construction complies with one of the following:

- a) The contact area between a plated bus bar and circuit breaker or switch shall not be less than the area on the pressure wire connector that is supplied with a breaker or the full contact area on the circuit breaker, if no pressure wire connector is supplied.

b) If the full available contact area between a bus bar and pressure terminal connector is not used, the contact area shall not be less than the area that results when two of the same type connectors are bolted together back-to-back with wires leaving in opposite directions or at right angles, whichever results in the smallest area.

7.2.2.5 The limitations on current density mentioned in [Table 7.1](#) and [Table 7.2](#) do not apply to:

a) A connecting strap, bus bar, or the like, comprising all integral part of a circuit breaker, switch, or fuseholder.

b) A portion of a strap, bus bar, jumper, or the like, adjacent and connected to a terminal of a switch, circuit breaker or fuseholder [but not more than 1 inch (25.4 mm) from the terminal], when a reduced cross-section in that portion is necessary because of the recessing of the terminal or because of barriers adjacent to it.

7.2.2.6 A wire or bus bar leading to a noninterchangeable trip circuit breaker shall have an ampacity not less than the current rating of the breaker.

7.2.2.7 A wire or bus bar leading to a circuit breaker frame constructed for use with interchangeable trip equipment shall have an ampacity not less than the maximum current rating of the frame.

### 7.2.3 Bolted construction

7.2.3.1 A spring washer shall be used at one end of a bolt that secures current-carrying parts together.

*Exception No. 1: A spring washer is not required in a construction that has been tested in accordance with and complies with the Clamped Joint Temperature Test, Section [21](#).*

*Exception No. 2: A spring washer shall not be replaced with a split-ring lockwasher and a flat washer unless all the current-carrying parts in the joint, including the tang of a pressure terminal connector, are copper.*

*Exception No. 3: A flat washer, a split-ring lockwasher, or a bolthead that has an outer diameter of at least 150 percent of the bolt shaft shall not be used in place of a spring washer unless the only aluminum in the joint is the tang of a pressure terminal connector.*

7.2.3.2 Unless investigated for such use, a bolted connection between two bus bars or between a bus bar and another current-carrying part shall not depend upon any polymeric insulation to maintain the clamping force and shall not depend on thermoplastic material in any case.

7.2.3.3 A bolted joint in a bus bar shall be accessible for tightening without removing insulating tape or any other part.

### 7.2.4 Riveted construction

7.2.4.1 Each riveted connection involving current-carrying parts shall have a spring washer at one end and either a spring washer or a flat washer at the other end.

*Exception No. 1: The washers are not required in a construction that has been tested in accordance with and complies with the Clamped Joint Temperature Test, Section [21](#).*

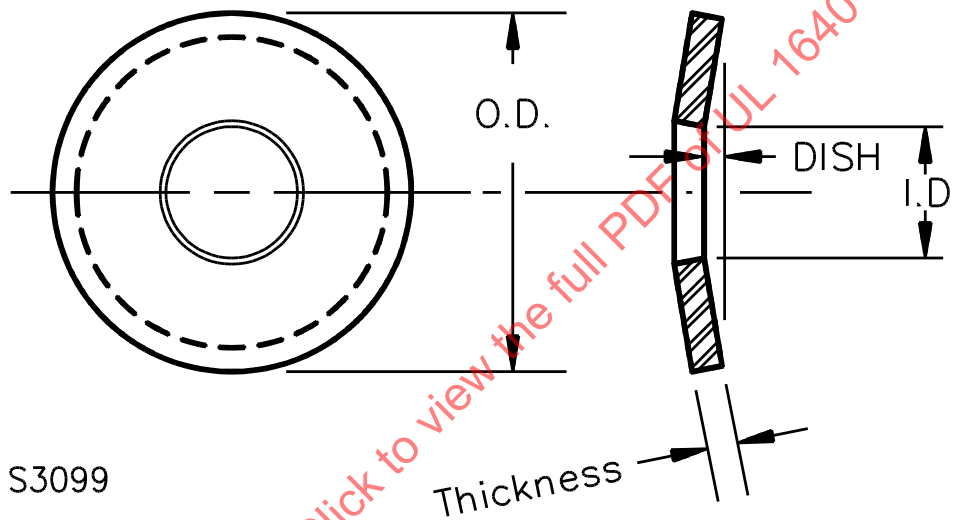
*Exception No. 2: The washers are not required in a connection rated 220 amperes or less having copper bus bars only.*

**7.2.5 Washers**

7.2.5.1 The flat washer as specified in 7.2.3.1 shall have a thickness of at least 1/6 of the diameter of the rivet shank or bolt and shall have an outer diameter of at least 150 percent of the rivet shank or bolt but not less than the outer diameter of the spring washer.

7.2.5.2 A spring washer as specified in 7.2.3.1 is a dished washer of stainless or hardened or tempered steel having an outer diameter of not less than 150 percent of the bolt diameter, having a thickness not less than 1/8 of the bolt diameter, and dished not less than 3-1/2 percent of the bolt diameter. A typical spring washer is shown in Figure 7.1. The intended orientation of the spring washer is shown in Figure 7.2.

**Figure 7.1  
Spring washer**



**NOTES**

1 The spring washer shall comply with the following:

$OD \geq 1.5 D$

$T \geq 0.125 D$

$H \geq 0.035 D$

in which:

*OD is the outer diameter of washer,*

*D is the diameter of bolt or rivet shank,*

*T is the thickness of washer, and*

*H is the depth of "dish" of spring washer.*

2 Spring washers are also referred to as Belleville and ramp-conical washers.