



UL 1786

STANDARD FOR SAFETY

Direct Plug-In Nightlights

UL Standard for Safety for Direct Plug-In Nightlights, UL 1786

Fourth Edition, Dated December 17, 2014

Summary of Topics

This revision of ANSI/UL 1786 dated February 22, 2021 includes the following changes in requirements:

– **Clarification of Test Wall Dimensions in the Blanketing Test Requirements; [11.1.1](#), [Figure 12A](#)**

– **Clarification of "glowing" in the Blanketing Test Requirements; [11.1.4](#), [11.1.7](#)**

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 new and revised requirements are substantially in accordance with Proposal(s) on this subject dated November 11, 2019 and July 10, 2020.

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ANSI/UL 1786-2021

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This ANSI/UL Standard for Safety consists of the Fourth edition including revisions through February 22, 2021. The most recent designation of ANSI/UL 1786 as an American National Standard (ANSI) occurred on February 22, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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CONTENTS

Preface	5
1 Scope	7
2 Reference Publications	7
3 Components	9
4 Units of Measurement	9
5 Application of Requirements	9
6 Definitions	10
7 Construction	11
7.1 Enclosures – General	11
7.2 Polymeric materials for enclosure and electrical insulation	12
7.3 Enclosure assembly methods	13
7.4 Corrosion protection	13
7.5 Current-carrying parts	13
7.6 Plug blades	13
7.7 Plug face dimensions	13
7.8 Polarization and identification	14
7.9 Switching mechanisms	14
7.10 Lampholder	14
7.11 Wiring and terminal connections	15
7.12 Internal wiring	15
7.13 Spacing of conductive parts	16
7.14 Grounding and bonding	17
7.15 Maximum tipping moment	17
7.16 Electroluminescent panels	17
7.17 Incandescent lamps	18
7.18 LED light sources	18
7.19 Receptacle	18
7.20 Ballasts	19
7.21 Vessels containing a liquid	19
8 General Tests	19
8.1 General	19
8.2 Accessibility of live parts	20
8.3 Dielectric voltage-withstand	20
8.4 Plug blades accessibility	20
9 Normal Operation Tests	20
9.1 Temperature	20
9.2 Lampholder and lamp base accessibility	21
10 Component Tests	22
10.1 Switch mechanism	22
10.2 Plug blade secureness test	23
10.3 Folded blade compression test	24
10.4 Mold stress-relief distortion test	24
10.5 Lamp cavity separation test	24
10.6 Pull test	24
10.7 Enclosure impact test	24
11 Abnormal Tests	25
11.1 Blanketing test	25
11.2 Overlamping test	26
11.3 Limited short-circuit test	26
11.4 Overvoltage test	26
11.5 Component breakdown test	26
11.6 Voltage surge test	26



11.7	Humidity conditioning test	28
11.8	Leakage-current test	28
11.9	Grounding continuity test	30
11.10	Crush test	30
11.11	Torque test	30
11.12	Rotational endurance test	31
12	Factory Production Tests	31
12.1	Dielectric voltage-withstand test	31
12.2	Additional factory production tests in Canada	32
13	Marking	32

Annex A (Normative) Standards for components

Annex B (CAN) (Normative) Grounding and bonding of electrical equipment

B.1	General	54
B.2	Impedance	54
B.3	Impedance Test	54

ANNEX C (CAN) (Normative) Printed circuit-board requirements

C.1	Application	55
C.2	Special Terminology	55
C.3	General	55
C.4	Printed Circuit-Board Coatings Tests	56
C.4.1	Dielectric strength	56
C.4.2	Adhesion	56
C.4.3	Abrasion resistance test apparatus	57
C.4.4	Insulation Resistance Test Voltage	58
C.4.5	Fault conditions test	58
C.5	Bond Strength of Printed-Wiring Boards	58
C.5.1	General	58
C.5.2	Test procedure	59

Annex D (CAN) (Normative) Factory Tests for Canada

D.1	Grounding continuity	60
D.2	Separation	60
D.3	Candelabra lamp devices	60
D.4	Test records	60

Annex E (CAN) (Informative) French translations and markings

Preface

This is the harmonized CSA Group and UL Standard for *Direct Plug-In Nightlights*. It is the second edition of CSA C22.2 No. 256 and the fourth edition of UL 1786. This edition of CSA C22.2 No. 256 supersedes the previous edition published in 2005. This edition of UL 1786 supersedes the previous editions published in 1995, 1988, and 2005. This harmonized standard has been jointly revised on February 22, 2021. For this purpose, CSA Group and UL are issuing revision pages dated February 22, 2021.

This harmonized Standard was prepared by the CSA Group and Underwriters Laboratories Inc. (UL). The efforts and support of the CANENA Technical Harmonization Committee are gratefully acknowledged.

This Standard was reviewed by the CSA Subcommittee on Lighting Products, under the jurisdiction of the CSA Technical Committee on Consumer and Commercial Products and the CSA Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee.

This standard is considered suitable for use for conformity assessment within the stated scope of the standard.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is considered to be a minimum quantity.

Note: Although the intended primary application of this Standard is stated in its scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

Level of harmonization

This Standard uses the IEC format but is not based on, nor is it to be considered equivalent to, an IEC Standard. This Standard is published as an equivalent Standard for CSA Group and UL. An equivalent Standard is a Standard that is substantially the same in technical content, except as follows: Technical national differences are allowed for codes and governmental regulations as well as those recognized as being in accordance with NAFTA Article 905, for example, because of fundamental climatic, geographical, technological, or infrastructural factors, scientific justification, or the level of protection that the country considers appropriate. Presentation is word for word except for editorial changes.

Reasons for differences from IEC

There is not an IEC Standard that is equivalent to the requirements contained in this Standard.

Interpretations

The interpretation by the standards development organization of an identical or equivalent Standard is based on the literal text to determine compliance with the Standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

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1 Scope

1.1 This Standard applies to direct plug-in nightlights not exceeding 10 W input, for indoor use only, in non-hazardous locations and intended to be used in accordance with the *Canadian Electrical Code, Part I*, CSA C22.1, and the *National Electrical Code*, ANSI/NFPA 70. Light source types include incandescent candelabra base lamps, non-replaceable lamps, [fluorescent, neon, or light-emitting diode (LED) type] or electroluminescent panels.

1.2 These requirements cover direct plug in nightlights for insertion into a parallel slot receptacle rated 125 volts maximum.

1.3 These requirements do not cover:

- (a) cord-connected luminaires;
- (b) nightlights with more than one receptacle;
- (c) direct plug-in devices with other primary functions, such as room deodorizers, insect repellents, or rechargeable flashlights; or
- (d) direct plug-in devices utilizing plasma light.

2 Reference Publications

2.1 For undated references to Standards, such reference shall be considered to refer to the latest edition and all revisions to that edition up to the time when this Standard was approved. For dated references to Standards, such reference shall be considered to refer to the dated edition and all revisions published to that edition up to the time the Standard was approved.

2.2 Products covered by this Standard shall comply with the reference installation codes and Standards as appropriate for the country where the product is to be used. When the product is intended for use in more than one country, the product shall comply with the installation codes and Standards for all countries where it is intended to be used. A list of reference publications is provided below.

CSA Group

C22.1-12
Canadian Electrical Code, Part I

C22.2 No. 0.4-04 (R2013)
Bonding of Electrical Equipment

CAN/CSA-C22.2 No. 0.17-00 (R2013)
Evaluation of Properties of Polymeric Materials

C22.2 No. 42-10
General Use Receptacles, Attachment Plugs, and Similar Wiring Devices

CAN/CSA C22.2 No. 60065-03 (R2012)
Audio, Video, and Similar Electronic Apparatus – Safety Requirements

UL (Underwriters Laboratories Inc)

UL 498

Attachment Plugs and Receptacles

UL 498A

Current Taps and Adapters

UL 746C

Polymeric Materials – Use in Electrical Equipment Evaluations

UL 796

Printed-Wiring Boards

UL 840

Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment

UL 1449

Surge Protective Devices

ASTM (American Society for Testing and Materials)

ASTM D 1000

Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications

ANSI/ASTM E230/E230M

Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples

IEC (International Electrotechnical Commission)

IEC 60061-1

Lamp caps and holders together with gauges for the control of interchangeability and safety Part 1: Lamp caps

IEC 60664-1

Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests

NEMA (National Electrical Manufacturers Association)

NEMA ANSLG C81.61

Electrical Lamp Bases – Specifications for Bases (Caps) for Electric Lamps

NEMA ANSLG C81.63a

Gauges for Electric Lamp Bases and Lampholders

NFPA (National Fire Protection Association)

ANSI/NFPA 70

National Electrical Code (NEC)

3 Components

3.1 Except as indicated in Clause 3.2, a component of a product covered by this Standard shall comply with the requirements for that component. See Annex A for a list of Standards covering components generally used in the products covered by this Standard. A component shall comply with the CSA or UL Standards as appropriate for the country where the product is to be used.

3.2 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. Electrical circuit components of an LED light source, including the LED itself, that are directly connected to line voltage are considered covered by the requirements of this Standard.

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

3.4 Specific components are accepted as being 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.

3.5 In Canada, a driver or part thereof providing an isolated output to an LED light source shall comply with applicable requirements of the Standard for Light Emitting Diode (LED) Equipment for Lighting Applications, CAN/CSA-C22.2 No. 250.13.

In the United States, a driver or part thereof providing an isolated output to an LED light source shall comply with applicable requirements of the Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products, UL 8750.

4 Units of Measurement

4.1 The values given in SI (metric) units shall be normative. Any other values given are for information only.

Note: Wire gauge sizes are expressed in American Wire Gauge sizes because of its widespread usage.

4.2 Temperatures are given in degrees Celsius only.

4.3 Unless indicated otherwise, all voltage and current values mentioned in this Standard are root-mean-square (rms).

5 Application of Requirements

5.1 The requirements of the national installation code and other practices of Canada and the United States have been addressed in the requirements of this Standard.

5.2 Products intended to be used in both Canada and the United States shall comply with the requirements of this Standard.

5.3 Products to be used only in Canada or only in the United States shall comply with the requirements of this Standard, but need only comply with the applicable country-specific requirement, if provided.

6 Definitions

6.1 For the purpose of these requirements, the following definitions apply:

6.2 **Accessible** – able to be contacted by the articulate probe described in Clause [8.2.2](#).

6.3 **Child-appealing feature** – A feature that provides visual appeal and attraction to children in the form of shape, decoration, bright colors, or unusual illuminations.

6.4 **Device** – the general term used to denote all direct plug-in nightlights covered by this Standard. A more specific term is used if a requirement applies only to a certain type of device.

6.5 **Direct Plug-In Nightlight** – a nightlight with an integral parallel blade plug and a 10 W maximum light source, and which may incorporate a shade. It is used not for general illumination but for illuminating obstacles. For the purpose of this Standard, a nightlight may be referred to as “a device.”

6.6 **Electroluminescent Panel** – a solid phosphor layer, contained between two electrodes, that will emit light when subjected to alternating current.

6.7 **Enclosure, Electrical** – a part of the device intended to reduce the risk of contact with parts at hazardous voltage or hazardous energy levels.

6.8 **Enclosure, Mechanical** – a part of the device intended to reduce the risk of injury due to mechanical or other physical hazards.

6.9 **Light Emitting Diode (LED)** – a solid state component embodying a p-n junction, emitting optical radiation when excited by an electric current.

6.10 **LED Light Source** – a system comprising one or more LEDs along with the necessary circuitry that supplies the proper voltage and current or that is used to switch, dim or otherwise control the electrical energy to operate the LEDs.

6.11 **Live Part** – a metal or other conductive part that, during intended use, has an electrical potential difference with respect to earth ground or any other conductive part.

6.12 **Measurement Indication Unit (MIU)** – the output voltage across the meter, in millivolts RMS, in the measurement instrument in [Figure 1](#), divided by 500 Ω . (The instrument indication is equal to the RMS value in milliamperes when the frequency is 60 Hz (sinusoidal current). The reading may not be a direct indication of the RMS or other common amplitude quantifier of leakage-current when the leakage-current is of complex waveform or frequency other than 50 or 60 Hz.)

6.13 **Neon Lamp** – a discharge light source, also known as a “glow lamp,” that has a current limiting resistor in series with the lamp and is filled with a neon gas.

6.14 **Non-Relampable Direct Plug-In Nightlight** – a device constructed with permanent non-replaceable lamps.

6.15 Relampable Direct Plug-In Nightlight – a device constructed in such a way as to allow user replacement of the lamp.

6.16 Risk Of Electric Shock – a risk that exists between any two uninsulated conductive parts of a nightlight or between an uninsulated conductive nightlight part and earth ground, if the continuous current flow through a 1500 resistor in parallel with a 0.015 μ F capacitor connected between the two points exceeds 5 mA rms (7 mA peak) and if the open circuit voltage exceeds 30 V rms or 42.4 V peak.

6.17 Shade – a diffuser intended to reduce the glare of the lamp.

6.18 Skeleton-Type Lampholder – a screw lampholder that does not use conductive screwshell threads to make electrical contact with the lamp screw base. Electrical contact with the lamp screw base is made with one or more separate contacts in the side wall of the lamp cavity or a ring contact in the bottom of the lamp cavity.

6.19 User Maintenance – servicing operations, such as relamping and cleaning, expected to be carried out by untrained persons.

7 Construction

7.1 Enclosures – General

7.1.1 Enclosures shall have the strength and rigidity required to resist the abuses to which they are liable to be subjected, without increasing the risk of fire, electric shock, or injury to persons due to a reduction of the required spacing for live parts or the loosening or displacement of live parts.

7.1.2 The enclosure material shall be metal or a polymeric material that complies with Clause [7.2](#).

7.1.3 A device shall be constructed so that it is not necessary to open or remove the enclosure during normal use or user maintenance. Parts that can be removed during normal use or for user maintenance such as cleaning or relamping shall not be considered to be a part of the enclosure. The incorrect replacement or discarding of such parts shall not affect the intended operation of the device.

7.1.4 A live part shall be contained within an enclosure. A part that is intended to be live at any time during the normal maintenance and use of a device shall be considered to be a live part. An enclosure shall comply with Clause [8.2](#).

7.1.5 Lampholder contacts need not be enclosed if live parts are not accessible with the lamp in place as determined by the requirements of Clause [9.2](#) for lampholder and lamp base accessibility.

7.1.6 The blades of a nightlight are not required to be enclosed.

7.1.7 An enclosure shall comply with the enclosure impact test of Clause [10.7](#).

7.1.8 There shall not be any method of construction, such as sharp edges or burrs, that causes damage to electrical insulation, reduces electrical spacings, or increases the risk of personal injury to the user.

7.1.9 If knobs on switches are removable from outside the enclosure, their removal shall not expose live parts.

7.1.10 A non-relampable device shall comply with the pull test described in Clause [10.6](#).

7.1.11 Removable parts of direct plug-in nightlights with child-appealing features shall not present a risk of injury to persons from a sharp edge after being subjected to the Enclosure Impact Test, Section [10.7](#). Removable parts shall be tested both attached to the appliance and separated from the appliance.

7.1.12 In the United States, an accessible liquid coating material (such as paint, enamel, lacquer, ink, and the like) applied to direct plug-in nightlights with child-appealing features shall not contain compounds of lead, antimony, arsenic, barium, cadmium, chromium, mercury, or selenium exceeding amounts specified in ASTM F963. A liquid coating material is considered to be accessible if it can be contacted by persons before or after compliance with the performance requirements described in the Mold Stress-Relief Distortion Test, Clause [10.4](#), and the Enclosure Impact Test, Clause [10.7](#).

Note 1: In Canada, various requirements in jurisdictions such as federal, provincial, or municipal may apply.

Note 2: The requirements for a liquid coating material do not apply to ink applied to a packing material.

7.2 Polymeric materials for enclosure and electrical insulation

7.2.1 An enclosure of polymeric material (thermoplastic or thermoset) that encloses a live part shall:

- (a) have a flammability rating of V-0, V-1, or V-2 in accordance with CAN/CSA-C22.2 No. 0.17 or UL 746C;
- (b) comply with the appropriate lamp cavity separation test of Clause [10.5](#) or the pull test of Clause [10.6](#);
- (c) comply with the enclosure impact test of Clause [10.7](#); and
- (d) if thermoplastic, comply with the mold stress-relief distortion test of Clause [10.4](#).

7.2.2 A polymeric material, thermoplastic or thermoset, used as electrical insulation shall comply with the requirements of Clauses [7.2.3](#) and [7.2.4](#) when the polymeric part is:

- (a) in direct contact with a live part;
- (b) used to enclose a live part and is within 0.8 mm (0.032 in) of a live part; or
- (c) used to enclose arcing parts and within 13 mm (0.50 in) of such live parts. The high current arc ignition (HAI) shown in [Table 1](#) only applies in this application.

7.2.3 A polymeric material (thermoplastic or thermoset) used as electrical insulation shall have a flammability rating in accordance with [Table 1](#).

7.2.4 A polymeric material used as electrical insulation or enclosure, as defined in Clause [7.2.2](#), shall be able to withstand the hot wire ignition (HWI), the comparative tracking index test (CTI), and the high current arc ignition (HAI) to a level not exceeding the values in accordance with [Table 1](#).

7.2.5 A polymeric material used as an enclosure or electrical insulation shall have a relative thermal index (RTI) equal to or exceeding the values as determined by the temperature test of Clause [9.1](#) and, as a minimum, specified in [Table 2](#).

7.3 Enclosure assembly methods

7.3.1 Mechanical fastenings

7.3.1.1 Construction of mechanical joints or fastening of parts shall prevent turning if turning can result in movement of internal wiring or components. Frictional contact alone between parts shall not be used to prevent turning. Parts in a brush and slip-ring arrangement, such as the front of a device intended to be rotated regardless of the orientation of the supply receptacle, shall not involve the movement of internal wiring or components.

7.3.1.2 Screws used to mount components shall be provided with a means to reduce the likelihood of loosening.

7.3.2 Adhesives

7.3.2.1 An adhesive, glue, or ultrasonic or chemical bonding that is relied upon to hold together parts of an enclosure shall be evaluated by the mechanical tests of this Standard.

7.4 Corrosion protection

7.4.1 Iron or steel, other than stainless steel, shall be protected from corrosion by painting, coating, or plating. Non-plated iron or steel alloys may be used for lead wires that are part of a neon lamp.

7.5 Current-carrying parts

7.5.1 Current-carrying parts shall be copper, copper alloy, or aluminum unless otherwise specified in this Standard.

7.5.2 Stainless steel is acceptable for current-carrying parts not subject to arcing.

7.5.3 Iron or steel, other than stainless steel, may be used for lead wires that are part of a neon lamp.

7.6 Plug blades

7.6.1 Current-carrying parts shall be copper or copper alloy unless otherwise specified in this Standard.

7.6.2 Plug blade shall conform to the dimensional requirements as specified in [Figure 2](#). If the plug blades employ a folded blade construction, the blades shall also conform to [Figure 3](#).

7.6.3 Plug blades shall comply with the plug blade secureness test of Clause [10.2](#) and, if applicable, with the folded blade compression test of Clause [10.3](#).

7.7 Plug face dimensions

7.7.1 The minimum plug face dimensions shall be in accordance with [Figure 5](#) or with the plug blade accessibility test of Clause [8.4](#).

7.7.2 A nightlight shall be of such dimensions that, when plugged into an outlet of a duplex receptacle, it shall either:

- (a) sufficiently cover the remaining outlet of the duplex receptacle to render it unusable, or
- (b) leave the remaining outlet completely open such that an attachment plug can be fully inserted.

Unless otherwise restricted by instructions on the packaging, any orientation of the nightlight that allows for compliance with (a) or (b) shall be considered when determining compliance with this clause. The dimensions for a duplex receptacle are shown in [Figure 4](#) and those for an attachment plug in [Figure 5](#).

7.7.3 A device shall not be provided with a means for being permanently mounted to a duplex receptacle face.

7.7.4 A plug face provided with a rotational mechanism to permit adjustable positioning of the device after insertion into the duplex receptacle shall comply with the torque test of Clause [11.11](#) and the rotational endurance test of Clause [11.12](#).

7.8 Polarization and identification

7.8.1 A device provided with a relampable candelabra screwshell lampholder shall be polarized. The plug blades shall comply with the dimensions of either [Figure 2](#) or [Figure 3](#). The lampholder screw-shell shall be connected to the grounded supply conductor (such as the wide blade of the attachment plug).

7.8.2 A device that includes live parts that may become accessible during normal operation or user maintenance and is provided with a switch shall be polarized. The plug blades shall comply with the dimensions of either [Figure 2](#) or [Figure 3](#), and the switch shall interrupt the ungrounded supply conductor (the narrow blade of the attachment plug).

7.9 Switching mechanisms

7.9.1 A switching mechanism shall comply with the switching mechanism tests of Clause [10.1](#). A component switch with a load rating that is equal to or greater than the load intended in this application is not required to be tested.

7.9.2 When a manual switching mechanism is operated as in actual service, the rate of motion of the contactor shall not be subject to control by the operator at the point of break.

7.9.3 A removable switch knob shall not expose live parts when removed in accordance with Clause [8.2](#).

7.10 Lampholder

7.10.1 A device intended for use with screw-base lamps shall be the E-12 candelabra size only.

7.10.2 A screwshell shall be tested with GO and NOT GO gauges made in accordance with NEMA ANSLG C81.63a. A skeleton-type lampholder shall provide an equivalent mechanical engagement. A skeleton-type of construction shall make electrical contact with at least two threads of the threaded lamp base. An equivalent mechanical construction generally consists of one or more narrow strips of metal secured to a molded, threaded body of insulating material. The strip generally extends the length, and conforms to the shape, of the molded threads.

7.10.3 A device incorporating a replaceable lamp shall comply with the lampholder and lamp base accessibility tests of Clause [9.2](#).

7.10.4 A device using a replaceable lamp shall comply with the lamp cavity separation test specified in Clause [10.5](#).

7.10.5 The minimum thickness of the candelabra base screw shell shall be:

- (a) 0.25 mm (0.010 in) for copper-alloy; or

(b) 0.33 mm (0.013 in) for aluminum.

7.11 Wiring and terminal connections

7.11.1 A soldered connection shall be made mechanically secure before soldering by one of the following acceptable methods:

- (a) twisting of conductors together;
- (b) insertion of a bare conductor through a hole in a flat terminal;
- (c) insertion of a bare conductor straight into a terminal sleeve; and
- (d) wrapping at least halfway (180 degrees) around a terminal.

7.11.2 A printed-wiring board connection need not be mechanically secure if an automatic soldering operation is employed.

7.11.3 A live part shall be secured by means other than friction alone so that it cannot be turned relative to the surface on which it is mounted in a way that can reduce the spacing of the live part to another part.

7.11.4 Two live parts shall be joined by brazing, soldering, or crimping. Two parts may be held together by a fit where the parts are wedged into a molded slot of the enclosure. The pad contact of an electroluminescent panel may be joined to another live part by a fit where the two parts are held together by the enclosure.

7.12 Internal wiring

7.12.1 Insulated wire shall be suitable for the temperature and voltage encountered.

7.12.2 Conductors shall be not smaller than 18 AWG. However, conductors as small as 24 AWG may be used where the wire is selected in relation to the maximum current during normal operating conditions, and the time and level of the current flowing during fault conditions do not result in a risk of fire, in conjunction with the following conditions:

- (a) The wire is completely enclosed and not used in a swivel joint.
- (b) The length of the wire is not more than 152 mm (6 in).
- (c) Wiring is connected to the supply via an internal current-limiting device (e.g., lamp current control device, circuit cutouts, energy limited or isolated transformers).

7.12.3 In Canada, a printed-wiring board shall be suitable for the application. The criteria shall include and comply with:

- (a) the bonding of the foil to the substrate for the minimum conductor width and maximum unpierced area in accordance with Annex C.
- (b) the temperatures measured during the temperature test of Clause 9.1 shall be less than the relative thermal index (RTI) rating of the substrate in accordance with CAN/CSA-C22.2 No 0.17.
- (c) the printed-wiring board substrate shall:
 - (1) have a flammability rating of no less than V-2; and
 - (2) be suitable for direct support, in accordance with CAN/CSA-C22.2 No. 0.17.

In the United States, a printed-wiring board shall be suitable for the application. The criteria shall include and comply with:

- (a) the bonding of the foil to the substrate for the minimum conductor width and maximum unpierced area in accordance with UL 796;
- (b) the temperatures measured in the temperature test of Clause [9.1](#) shall be less than the relative thermal index (RTI) rating of the substrate in accordance with UL 746C;
- (c) the printed-wiring board substrate shall:
 - (1) have a flammability rating of no less than V-2; and
 - (2) be suitable for direct support in accordance with UL 746C.

7.13 Spacing of conductive parts

7.13.1 Spacing of conductive parts through air and over surface of insulating materials shall comply with the minimum spacing requirements in [Table 3](#) for:

- (a) uninsulated live parts of opposite polarity; and
- (b) an uninsulated live part and a non-current-carrying metal part that may be grounded or a metal part exposed to contact by persons.

7.13.2 With reference to Clause [7.13.1](#), the requirement does not apply when an insulating barrier or liner is used. In lieu of the spacing required, it shall be:

- (a) of electrical grade paper not less than 0.3 mm (0.011 in) thick;
- (b) of polyester film not less than 0.25 mm (0.01 in) thick; or
- (c) capable of withstanding the dielectric voltage-withstand test of Clause [8.3](#).

7.13.3 A complete device shall comply with the dielectric voltage-withstand test of Clause [8.3](#).

7.13.4 With reference to Clause [7.13.1](#), the requirement does not apply at the body of a neon light if, when the lead wires are short-circuited at the base of the light, the series resistor does not operate in excess of its nominal rating.

7.13.5 In Canada, the spacing between uninsulated live parts of opposite polarity on a printed-wiring board may be less than specified in [Table 3](#) when a printed wiring board is conformally coated with material that complies with the conformal-coating requirements specified in Annex [C](#).

In United States, the spacing between uninsulated live parts of opposite polarity on a printed-wiring board may be less than specified in [Table 3](#) when a printed wiring board is conformally coated with material that complies with the conformal-coating requirements specified in UL 746C.

7.13.6 In Canada, the spacing between uninsulated live parts of opposite polarity on a printed-wiring board may be less than as specified in [Table 3](#) when a printed wiring board complies with clearances and creepage specified in IEC 60664-1 for overvoltage category 2 and:

- (a) for pollution degree 1 for conformally coated printed-wiring boards; or
- (b) for pollution degree 2 for uncoated printed-wiring boards.