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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Underwriters Laboratories Inc.
UL 1786
Fourth Edition

Direct Plug-In Nightlights

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Approved American National Standard

ANSI/UL 1786-2021

Commitment for Amendments

This standard is issued jointly by the Canadian Standards Association (operating as "CSA Group") and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to CSA Group or UL at any time. Revisions to this standard will be made only after processing according to the standards development procedures of CSA Group and UL. CSA Group and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue.

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This Standard is subject to review within five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquiries@csagroup. org and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

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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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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 repellers, 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 0.015µF 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.

In the United States, 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 UL 840.

7.14 Grounding and bonding

7.14.1 In Canada, the method used for the grounding continuity test shall be in accordance with Annex B (CAN).

In the United States, the method used for the grounding continuity test shall be in accordance with Clauses 11.9.3 and 11.9.4.

7.14.2 When a wiring device configuration 5-15P (3 conductor grounding type) plug is provided on a device, all non-current-carrying metal parts and metallized polymeric parts that are accessible during user maintenance or component replacement without the use of tools and that may involve the risk of shock shall be bonded to the grounding pin of the plug and comply with the grounding continuity test.

7.14.3 When a wiring device configuration 5-15 (3 conductor grounding type) plug and a convenience receptacle are provided, the convenience receptacle shall also be a grounding type. The grounding pin of the plug and the grounding contact of the receptacle shall be bonded together and comply with the grounding continuity test.

7.15 Maximum tipping moment

7.15.1 A device shall comply with the maximum tipping moment requirement specified in Clause 7.15.2, Table 4, and Figure 6.

7.15.2 The limits specified in Table 4 shall be determined as follows:

(a) a directly-mounted accessory shall be in place; and

(b) a removable part shall be in place.

7.16 Electroluminescent panels

7.16.1 The devices shall comply with Clauses 7.16.2 and 7.16.3 in addition to other applicable requirements of this Standard.

7.16.2 The device shall have a barrier in front of the electroluminescent panel to enclose parts that pose a risk of fire and shock hazard that:

(a) complies with the flame rating for the barrier in accordance with Clause 7.2 and Table 1; and

(b) provides mechanical protection. A thermoplastic barrier shall be at least 0.254 mm (0.010 in) thick and comply with other applicable requirements of this Standard.

7.16.3 The device shall comply with the:

(a) voltage surge test of Clause 11.6;

(b) humidity conditioning test of Clause 11.7; and

(c) leakage-current test of Clause 11.8.

7.17 Incandescent lamps

7.17.1 When an incandescent, candelabra-size screw-base lamp is provided with the device, it shall comply with the dimensions for candelabra screw-base lamps in accordance with NEMA ANSLG C81.61, IEC 60061-1 or comply with the lampholder and lamp-base accessibility test of Clause 9.2.

7.18 LED light sources

7.18.1 LED light sources shall be investigated as would a diode or other solid state component. See Clause 11.5.

7.19 Receptacle

7.19.1 When one, and no more than one, parallel blade receptacle is provided on a device, the receptacle shall comply with Clauses 7.19.2 and 7.19.3.

7.19.2 In Canada, a receptacle shall comply with:

(a) the tests described in this Standard; and

(b) the applicable construction details and tests in accordance with CSA C22.2 No. 42.

In the United States, a receptacle shall comply with:

(a) the tests described in this Standard; and

(b) the applicable construction details and tests in accordance with UL 498 or UL 498A.

7.19.3 The construction details referred to in Clause 7.19.2 shall include:

(a) polarization;

(b) slot dimensions; and

(c) face dimensions.

7.19.4 The receptacle tests referred to in Clause 7.19.2 shall be included but not be limited to the following tests:

(a) contact security;

(b) retention of plugs;

(c) overload;

(d) resistance to arcing;

(e) improper insertion;

(f) ground contact; and

(g) temperature test, which may be conducted as part of the temperature test of Clause 9.1 when the receptacle is loaded with a resistive load equal to the receptacle configuration.

7.20 Ballasts

7.20.1 In Canada, the ballast for a fluorescent lamp shall comply with CAN/CSA-C22.2 No. 74.

In the United States, the ballast for a fluorescent lamp shall comply with the construction requirements of UL 935.

7.20.2 In addition to the tests described in this standard, the lamp ballast components shall be subjected to the component breakdown tests, Clause 11.5, and a shorted starter or deactivated lamp condition.

7.20.3 For ballast circuits that incorporate a glow-bottle, a shorted starter test shall be conducted. For ballast circuits that incorporate an electronic starter, a shorted starter or a deactivated lamp condition should be conducted – whichever is the most severe.

7.20.4 The deactivated lamp condition occurs at end of lamp life when the emissive coating on the lamp filaments is depleted and the lamp does not start. For testing purposes the condition can be created by one of the following:

(a) completely deactivated lamp (preferred), or

(b) one lamp cathode from each of two lamps arranged so that it is not possible to start either lamp.

7.20.5 For the shorted starter or deactivated lamp conditions, the test condition shall be allowed to continue for 7 h. There shall be no emission of flame or molten metal, no ignition of cotton loosely draped over or totally around the device, no emission of smoke, or discoloration or distortion of a thermoplastic enclosure as a result of the test. A 3-A fuse connected between accessible dead metal parts of the device and the neutral conductor shall not open.

7.21 Vessels containing a liquid

7.21.1 In Canada, a nightlight containing a liquid shall be subjected to the Crush Test, Clause 11.10.

In the United States, a nightlight containing a liquid shall comply with the Resistance to Liquid Damage and Portable Luminaire Containing Hazardous Substance requirements in UL 153, and the Crush Test, Clause 11.10.

Note 1: In Canada, the requirement in Clause 7.21.1 does not apply if the vessel containing the liquid is a candelabra base bubble lamp that complies with CSA C22.2 No. 37.

Note 2: In the United States, the requirement in Clause 7.21.1 does not apply if the vessel containing the liquid is a candelabra base bubble lamp that complies with UL 588.

8 General Tests

8.1 General

8.1.1 A device shall comply with the applicable tests in accordance with Table 5.

8.1.2 Unless otherwise specified, all electrical tests on a non-relampable device shall be conducted at a test voltage of 120 ± 2 V ac.

8.1.3 Unless otherwise specified, all electrical tests on a relampable device shall be conducted:

(a) using a lamp that will supply the rated lamp wattage at 120 ± 2 V ac when tested independently of the device; and

(b) at a test voltage of 120 ± 2 V ac or the closest voltage to provide rated lamp wattage.

8.2 Accessibility of live parts

8.2.1 Lamp shades and any other removable covers of a device that can be removed without the use of a tool shall be removed when the device is subjected to the requirements of Clause 8.2.2.

8.2.2 When applied in any position, the articulate probe shown in Figure 7 shall not contact live parts. Accessibility to the lampholder cavity is subject to a separate test described in lampholder and lamp base accessibility, Clause 9.2. Where necessary, an electrical indicator may be used to determine whether or not contact is made.

8.3 Dielectric voltage-withstand

8.3.1 A device shall withstand, for 1 min, without breakdown, the application of a 60 Hz essentially sinusoidal potential of 1000 V plus twice the normal voltage between live parts and non-current carrying metal parts that are likely to become energized. The test voltage of 1240 V would be applied between parts that normally had 120 V applied.

8.3.2 A device that has no metal parts accessible to the articulate probe shown in Figure 7 shall not be subjected to this test.

8.3.3 The dielectric voltage generator shall have a 500 VA or larger transformer, the output of which can be varied. The applied potential shall be increased from zero until the required test value is reached, and shall be held at that value for 1 min. The increase in the applied potential shall be at a substantially uniform rate and as rapid as consistent with its value being correctly indicated by a voltmeter. Some commercially available dielectric testers have an adjustable sensitivity control that will indicate a breakdown when the leakage-current exceeds the setting. The control should be adjusted to indicate breakdown (shorted output) and not some arbitrary value of leakage-current.

8.3.4 For the dielectric voltage-withstand test conducted after the humidity conditioning test described in Clause 11.7, a device with no metal parts accessible shall be wrapped with metal foil.

Note: Care should be taken to prevent the foil from shorting to the plug face or a lampholder contact during the dielectric voltage-withstand test.

8.4 Plug blades accessibility

8.4.1 A device may employ smaller plug face dimensions than shown in Figure 5, provided that the probe shown in Figure 8 does not make contact with the blades when applied around the perimeter of the plug face. The surface of the probe with the “w-z” dimension shall be applied against the external edge of the plug face, with the “y” dimension perpendicular to the blades.

9 Normal Operation Tests

9.1 Temperature

9.1.1 A device shall not attain a temperature exceeding the temperatures specified in Table 6.

9.1.2 The device shall be:

(a) installed in a position representing the most severe temperature condition;

(b) operated continuously, as intended, until temperatures become constant; and

(c) operated in a state representing the most severe condition of normal operation. For example, lamp “off” mode may result in higher temperatures of internal components.

9.1.3 Temperature measurements shall be obtained by thermocouples consisting of 28 – 32 AWG (0.08 – 0.03 mm^2) iron and constantan (Type J) wires. Thermocouples consisting of 30 AWG (0.05 mm^2) wires with a potentiometer type of indicating instrument shall be used whenever referee temperature measurements by thermocouples are necessary. The thermocouple wire shall conform with the requirements for special tolerances thermocouples as listed in the Tolerances on Initial Values of EMF versus Temperature tables in ANSI/ASTM E230/E230M.

9.1.4 The temperatures specified in Table 6 are based on an assumed test ambient temperature of 25 °C. A test may be conducted at an ambient temperature within the range of 10 – 40 °C.

9.1.5 When a test is conducted at an ambient temperature other than 25 °C, an observed temperature shall be corrected by addition if the ambient temperature is lower than 25 °C or subtraction if the ambient temperature is higher than 25 °C of the difference between 25 °C and the test ambient temperature. A corrected temperature shall not exceed the required value specified in Table 6.

9.2 Lampholder and lamp base accessibility

9.2.1 Compliance with the requirement in Clause 7.10.3 and the fit of the lampholder around a supplied lamp with a standard lamp base described in Clause 7.17 shall be determined by Clauses 9.2.2 and 9.2.3. Compliance with the requirement for a supplied lamp with a non-standard base described in Clause 7.17 shall be determined by Clause 9.2.4.

9.2.2 Lamp shades and other removable covers of a device shall be removed and the test lamp shown in Figure 9 shall be partially seated in the lampholder to provide electrical contact between the center contact of the test lamp and the center contact of the lampholder. The articulate probe shown in Figure 7 shall not contact the screwshell of the test lamp, the screwshell of the lampholder, or other parts of the lampholder that are required to be enclosed, when the probe is applied in every possible position. Where necessary, an electrical indicator may be used to determine when electrical contact has been established between the test lamp screw-shell and the articulate probe.

9.2.3 The articulate probe shown in Figure 7 shall be used as a measuring instrument to evaluate the accessibility provided by an opening, and not as a means to evaluate the strength of a material. It shall be applied with the minimum force necessary to determine accessibility.

9.2.4 When an incandescent lamp having a candelabra-sized screw base is provided with the device, and the lamp base has not been determined to be in compliance with one of the Standards described in Clause 7.17.1, the base shall be determined to be inaccessible by use of the probe in Figure 7. A sample of the lamp provided shall be partially seated in the lampholder so as to provide electrical contact between the center contact of the lamp and the center contact of the lampholder. The probe shall be applied between the lamp bulb and the lip of the lampholder. The probe shall not be able to contact the screwshell.

10 Component Tests

10.1 Switch mechanism

10.1.1 General

10.1.1.1 A device provided with a manual switching mechanism shall comply with the overload and endurance tests described in Clauses 10.1.2 and 10.1.3. The same samples shall undergo both tests. There shall be no electrical or mechanical malfunction of the mechanism nor pitting or burning of the contacts to the extent of affecting the intended switching operation.

10.1.1.2 For the overload and endurance tests, electrical supply connections shall be made to the parallel blades, and the load shall be connected by means of a plug or the equivalent to the screwshell and center contact of the lampholder.

10.1.1.3 The overload and endurance tests shall be conducted with the device connected to a three-wire, 125 V dc circuit with grounded neutral; except that a device rated ac only shall be tested on a grounded neutral 60 Hz, 120 V ac source and a tungsten load. Exposed non-current-carrying metal parts, such as the cap, shell, actuator, and the like shall be grounded.

10.1.1.4 A switching mechanism under test shall not be adjusted, lubricated (other than would be provided in production), or otherwise conditioned either before or during the overload or endurance test.

10.1.1.5 Each sample shall be subjected to the specified temperature until the insulating material under consideration is thoroughly heated (1 h in a constant temperature oven usually is sufficient). The actuating member shall then be operated manually as in actual service at no electrical load (as by turning the key or by pressing the buttons of a push-type mechanism). The actuating member is not to be operated more violently than would be the case in intended service. The test shall be conducted immediately after each individual sample is removed from the oven.

10.1.2 Overload

10.1.2.1 A switching mechanism shall be subjected to the overload test of Clause 10.1.2.2 immediately following the conditioning test of Clause 10.1.1.5.

10.1.2.2 Each sample shall be mounted and connected as intended. It shall be operated manually by means of its actuating member and subjected to 50 cycles of operation, making and breaking a resistive load that results in 150 percent of rated current or wattage, at a rate of 1 s “on” and 9 s “off.” For convenience, the load may consist of two of the intended tungsten filaments connected in parallel, in which case the test cycle is to be 1 s “on” and 59 s “off.”

10.1.3 Endurance

10.1.3.1 A switching mechanism shall be subjected to the endurance test of Clause 10.1.3.2 immediately following the conditioning test of Clause 10.1.1.5.

10.1.3.2 Each sample shall be mounted and connected as described in Clause 10.1.1.3 and operated by its actuating member either manually or by a machine for 6000 cycles of operation. Each sample tested with a resistive load shall make 10 times the rated current or wattage of the device and break the rated current or wattage. Each test cycle shall be 1 s “on” and 9 s “off.” A switching mechanism may be operated faster than 6 cycles per min, if agreeable to all concerned. For convenience, a rated tungsten filament lamp load may be used, in which case the test cycle shall be 1 s “on” and 59 s “off.”

10.1.4 Actuating members

10.1.4.1 A device having an actuating member of insulating material shall be exposed to a temperature of 10 °C greater than that attained on the member during the temperature test of Clause 9.1. The actuating member shall not soften or deform to the extent that the electrical spacings are reduced below those required in Table 3. Following the exposure, the actuating member shall be made to operate the device for 25 cycles at 6 – 10 cycles per minute. The member shall not be damaged by the operations.

10.2 Plug blade secureness test

10.2.1 General

10.2.1.1 The plug blades shall withstand the following series of pull and loading tests without evidence of displacement of the plug blade or breakage of the enclosure. The blades of the device shall not have a displacement of more than 0.8 mm (0.031 in). Live parts shall remain inaccessible as determined by the accessibility of live parts test described in Clause 8.2. The spacing between live parts of opposite polarity, and between live parts and accessible non-current-carrying metal parts, shall be not less than the values shown in Table 3. External deformation of the plug blades is acceptable. A relampable device shall be subjected to the accessibility of live parts test described in Clause 8.2 with a lamp installed. The test sequence shall be as follows:

(a) The first set of six as-received samples shall be subjected in sequence to:

(1) 89 N (20 lbs) pull force on each blade; and

(2) 89 N (20 lbs) pull force on the combined blades.

If blades are enclosed in thermoplastic (not a thermoset) material, the samples shall be conditioned as specified in Clause 10.4, and the tests repeated.

(b) A second set of six as-received, previously untested samples shall be subjected to 133 N (30 lbs) loading force on each blade.

(c) A third set of six as-received, previously untested samples shall be subjected to 178 N (40 lbs) loading force on the combined blades.

Note: A single set of six samples may be used for loading tests if it is agreeable to all concerned.

10.2.2 Pull test

10.2.2.1 The device body shall be supported on a horizontal steel plate with the blades projecting downward through a single circular hole having the smallest diameter that allows them to pass through. A 89 N (20 lbs) pull force shall be applied for 2 min to each blade alone and to the two blades together. The pull force shall be gradually applied in the downward direction.

10.2.2.2 A device with an enclosure that is constructed of thermoplastic material shall be conditioned in accordance with Clause 10.4.1 and then shall be tested again in accordance with Clause 10.2.2.1.

10.2.3 Loading test

10.2.3.1 The device body shall be rigidly supported in the blade-up position. The device shall be positioned so as not to restrict possible displacement of the plug blades or breakage of the enclosure. Each blade, in turn, shall be individually subjected to a force of 133 N (30 lbs) applied gradually along the longitudinal axis of the blade in a direction towards the plug face. The 133 N (30 lbs) force shall be maintained for a period of 1 min.

10.2.3.2 Each device shall be subjected to the loading test described in Clause 10.2.3.1, except that a single force of 178 N (40 lbs) shall be applied to both blades in combination for a period of 1 min.

10.3 Folded blade compression test

10.3.1 Embossed folded blades made from unformed metal stock thickness of less than 0.699 mm (0.0275 in) shall withstand a 22.2 N (5 lbs) compressive force applied for a period of 1 min to the center of the blade by means of a 3.18 mm (0.125 in) diameter circular rod. The formed blade shall not be compressed to a thickness less than 1.39 mm (0.055 in). This test shall be performed on loose, individual blades.

10.4 Mold stress-relief distortion test

10.4.1 A device shall be placed in a circulating-air oven for 7 h at a uniform temperature of 10 °C higher than the maximum temperature measured on the enclosure material during the temperature test of Clause 9.1, but not less than 70 °C.

10.4.2 After returning to room temperature, a device material shall not be cracked, warped, or distorted as a result of conditioning, and there shall be no:

(a) reduction of clearances and creepage distances below the values shown in Table 3;

(b) accessibility of live parts as specified in Clause 8.2; or

(c) interference with the normal operation or relamping.

10.5 Lamp cavity separation test

10.5.1 A relampable device shall withstand a pull force of 89 N (20 lbs) for a period of 1 min without coming apart.

10.5.2 The device shall be supported by rigidly securing the blades to a rigid structure by any convenient means that does not distort the blades or body. The body shall not be restricted or supported to reduce the likelihood of an unhinging separation of the halves. The pull of 89 N (20 lbs) shall be gradually applied in a direction tending to separate the assembly means. The force shall be applied to the body half that does not support the blades, at a point between the two outermost threads of the lamp cavity.

10.6 Pull test

10.6.1 The body of a nightlight not employing a replaceable lamp shall withstand a pull force of 89 N (20 lbs) for 1 min without coming apart or separating from the blades.

10.6.2 The nightlight, complete with any face plates or decorative accessories, shall be rigidly supported by the blades. A pull force of 89 N (20 lbs) shall be applied to the front half of the assembly or enclosure or to the faceplate or accessory, as far from the blades as possible, such that the most adverse condition is tested. The force shall be applied for 1 min in a direction most likely to result in a separation of the two halves of the enclosure, or a separation of the face plate or accessory from the base unit, as shown in Figure 10.

10.7 Enclosure impact test

10.7.1 A device, with lamp, shall be installed as intended and subjected to a single impact in accordance with Figure 11, produced by allowing a solid, smooth, steel sphere 51 mm (2 in) in diameter and weighing

0.5 kg (1.1 lb) to strike the enclosure of the device with a single impact of 3.4 J (2.5 ft-lb) from a height determined by the following equation in a direction perpendicular to the enclosure surface.

Drop distance (free fall or pendulum) = Impact energy / Mass (weight)

10.7.2 There shall be no reduction in the spacing between live parts of opposite polarity, and between live parts and accessible non-current-carrying metal parts, below the values shown in Table 3, or no live parts shall become accessible as determined by the accessibility of live parts test described in Clause 8.2.

10.7.3 Breakage of the lamp is acceptable.

10.7.4 In accordance with Clause 7.1.11, removable parts of direct plug-in nightlights with child-appealing features shall be additionally and separately subject to the impact test of Clause 10.7.1. The "free fall" method shall be used, with the removable part placed on a hardwood floor in an orientation considered to represent the most severe position to receive the impact. Three separate samples shall be tested with each sample receiving 1 impact. The samples are permitted to break as a result of the impact but shall not produce any edges or points that are sharp to the touch under casual handling conditions.

11 Abnormal Tests

11.1 Blanketing test

11.1.1 A relampable device shall be installed on a duplex receptacle of 5-15R configuration mounted in the vertical test wall, illustrated in Figure 12A. A polymeric cover plate shall be fitted on the receptacle. The receptacle slots shall be either horizontal or vertical so that the device is oriented with the lamp axis closest to vertical while the lamp base is downward. A shade on the device that is removable without the use of tools or equivalent means shall be removed. The device shall be in the "on" condition.

11.1.2 A vertical, rectangular wood surface covered with two layers of tissue paper shall be positioned parallel to the wall in front of the device. The surface shall contact the part of the device that extends farthest from the wall (such as the lamp, the switch actuator, a non-removable shade). The dimensions of the surface shall be a width of 305 mm (12 in) by a height extending from the floor to at least 150 mm (6 in) above the installed device.

11.1.3 A piece of cotton flannel blanket or terry cloth material shall be folded so that four layers are draped over (on two sides of the lamp) and in contact with the device as shown in Figure 12. The material shall be sized so that at least 305 mm (12 in) of the material extends downward along each side of the device.

11.1.4 The device shall be operated continuously for 7 h or until combustion of the blanket or tissue paper occurs.

11.1.5 The test shall be repeated, except the lamp axis shall be as close to horizontal as the two receptacle positions allow.

11.1.6 The blanket material for this test shall be 100 percent unbleached cotton flannelette sheet blanket and is generally available in the 2 x 2.7 m (80 x 108 in) size, or 100 percent cotton terry cloth having a density of at least 310 g/m^2 (9 oz/yd^2). The unfolded material shall be approximately 0.4 x 0.9 m (16 x 36 in). The material is to be folded in half 2 times in succession at lines A-A, and B-B, and bent over at C-C as shown in Figure 12. The resulting folded material shall be 4 layers of the material on each side of the lamp, and shall measure approximately 0.1 x 0.45 m (4 x 18 in). The folded portion shall be tacked together at D-D to form a pocket over the device.

11.1.7 A relampable device shall not cause:

(a) glowing, flaming or charring of the blanket material or tissue paper;

(b) a reduction of electrical spacings as specified in Clause 7.13;

(c) accessibility of live parts as specified in Clause 8.2; or

(d) interference with the normal operation or relamping when the device is tested in an ambient temperature of 25 ± 5 °C.

Note: Glowing or charring of cheesecloth is to be determined by visual examination for broken fibres after removing the cheesecloth from the test surface. Charring is more than discolouration; it is the condition in which the surface or test material is rendered black.

11.2 Overlamping test

11.2.1 A relampable device intended for use with a lamp rated less than 10 W shall not emit flame or molten metal or cause risk of fire or electric shock when operated continuously with a 10 W type C7 lamp until ultimate results are observed. In most cases, continuous operation for 7 h is necessary to determine the ultimate results. Live parts shall remain inaccessible in accordance with Clause 8.2 and clearances and creepage distances shall be maintained in accordance with Clause 7.13.

11.3 Limited short-circuit test

11.3.1 A relampable device incorporating an electronic switching circuit shall be subjected to the 1000 A limited-short-circuit test of Clauses 11.3.2 to 11.3.4 without producing a fire or shock hazard.

11.3.2 Six samples of the device shall be individually tested. Three samples shall be energized by a circuit switch, such as a wall switch, with the photocell covered, and three by causing the photocell to operate by turning off the room lights.

11.3.3 Each device shall be fitted with a shorted lamp (glass broken and filaments twisted together), covered with untreated surgical cotton, and connected to a 120 V ac circuit capable of delivering 1000 A. The lamp filaments shall be isolated from the cotton. A Class H, 30 A non-renewable cartridge fuse shall be wired in series with the input. Any accessible non-current-carrying metal shall be wired through a 3 A fuse to ground.

11.3.4 There shall be no glowing or flaming or fire of the cotton wrapped around the device. The 3 A fuse shall not open. The neutral conductor shall not open. Opening of the 30 A fuse as a result of this test is acceptable.

11.4 Overvoltage test

11.4.1 A relampable device provided with an electronic switching circuit shall withstand 110 percent of the rated voltage without exhibiting a risk of fire or electric shock.

11.4.2 The device shall be enclosed in a single layer of tissue paper and connected and operated as intended until ultimate results are achieved or for 7 h, whichever is less.

11.4.3 There shall be no glowing, charring, or ignition of the tissue paper; live parts shall remain inaccessible in accordance with Clause 8.2 and spacings of Clause 7.13.

11.5 Component breakdown test

11.5.1 A device incorporating components such as an electrolytic capacitor, a diode, a photocell, or other solid-state parts shall be subjected to the component breakdown test described in Clause 11.5.2.

11.5.2 The components shall be short- or open-circuited, as applicable, representing the failure of the component. The component failure, as well as any other associated fault conditions that may arise as logical consequences, shall be applied in turn to the device. Only one component at a time shall be subjected to the applicable short- or open-circuiting.

11.5.3 There shall be no emission of flame or molten metal, nor ignition of cotton loosely draped over or totally around the device. A 3 A fuse connected between accessible non-current-carrying metal parts of the device and the neutral conductor shall not open.

11.6 Voltage surge test

11.6.1 A device containing an electroluminescent panel shall comply with the voltage surge test of Clauses 11.6.2 – 11.6.6.

11.6.2 In Canada, a device is not required to comply with this test if it is provided with a surge protective component that is in accordance with CAN/CSA C22.2 No. 60065-03 and that protects the circuit containing solid-state components, and has a suppression voltage rating not lower than the voltage rating of the solid-state components.

In the United States, a device is not required to comply with this test if it is provided with a surge protective component that is in accordance with UL 1449, and that protects the circuit containing solid-state components, and has a suppression voltage rating not lower than the voltage rating of the solid-state components.

11.6.3 The surge generator and control relay shall be as shown in Figure 13 and Figure 14 with a surge impedance of 50 Ω. With no load on the generator, the wave form of the surge shall be essentially as follows:

(a) initial rise time, 0.5 ms between 10 percent and 90 percent of peak amplitude;

(b) the period of the following oscillatory wave, 10 ms; and

(c) each successive peak, 60 percent of the preceding peak.

11.6.4 Three samples shall be subjected to ten applications of a surge consisting of an initial peak amplitude of 3 KV applied to the 60 Hz supply to the unit with the samples:

(a) placed on a white-tissue-paper-covered softwood surface, and covered with a single layer of cheese cloth;

(b) connected to a supply of rated voltage, with the grounding terminals of each sample, if provided, connected to the supply conductor serving as a neutral;

(c) in the “on” position; and

(d) for each of the ten applications placed randomly with respect to the phase of the 60 Hz supply voltage.

11.6.5 Compliance with Clause 11.3 shall be determined when:

(a) there is no glowing, charring, or ignition of the cheese cloth or tissue paper; and

(b) the insulation between the electroluminescent panel’s live parts and non-current-carrying metal parts complies with the dielectric-voltage withstand test of Clause 8.3.

11.6.6 It is acceptable that as a result of the test, the samples are no longer operable.

11.7 Humidity conditioning test

11.7.1 Two sample devices containing electroluminescent panels shall be conditioned for 168 h at 85 – 90 percent relative humidity at 30.0 ± 2 °C under the following conditions:

(a) one sample unenergized; and

(b) one sample energized at rated voltage.

Following conditioning, the unenergized sample shall be operated at rated voltage for up to 2 min or until any of the conditions in Clause 11.7.2(a) is identified.

11.7.2 Compliance with Clause 11.7.1 with regards to risk of fire, electrical shock, or injury to persons shall be determined by:

(a) visual examination to determine that there is no physical damage to the insulation system or the enclosure of the devices after both sample devices are energized as described in Clause 11.7.1 and that there is no:

(1) smoking, burning, or melting of insulation;

(2) burn marks as a result of insulation breakdown between parts of opposite polarity and insulating sheets of the electroluminescent lamp panels; and

(3) displacement of structural parts; and

(b) the two sample devices complying with the voltage withstand test of Clause 8.3.

11.7.3 It is acceptable that the samples are no longer operable as a result of the test.

11.8 Leakage-current test

11.8.1 A device with an electroluminescent panel shall be tested in accordance with Clauses 11.8.2 to 11.8.8. Leakage-current shall not be more than 0.5 MIU (for the measurement circuit described in Clause 11.8.4) or 0.5 mA (for the measurement circuit described in Clause 11.8.5) for either a two-wire plug-connected device or a three-wire (including grounding conductor) plug-connected device. See Clause 6.12 for the term “MIU”.

11.8.2 All accessible conductive parts shall be tested for leakage-currents. Leakage-currents from these parts shall be measured to the grounded supply conductor individually, as well as collectively if simultaneously accessible, and from one part to another if simultaneously accessible. A part shall be considered to be accessible unless it is guarded by an enclosure that is acceptable for protection against the risk of electric shock as defined in Clauses 11.8.4 – 11.8.7. Conductive parts shall be considered to be simultaneously accessible if they can be readily contacted by one or both hands of a person at the same time. These measurements shall not apply to terminals operating at voltages that are not considered to involve a risk of electric shock. If all accessible conductive parts are bonded together and connected to the grounding-plug blade , the leakage-current may be measured between the grounding-plug blade of the product and the grounded supply conductor.

11.8.3 If a conductive part other than metal is used for an enclosure or part of an enclosure, leakage-current shall be measured using a metal foil with an area of 10 x 20 cm in contact with the surface. If the conductive surface has an area less than 10 x 20 cm, the metal foil shall be the same size as the surface. The metal foil shall conform to the shape of the surface but shall not remain in place long enough to affect the temperature of the product.

11.8.4 Typical measurement circuits for leakage-current with the ground connection open are illustrated in Figure 15. The measurement instrument is defined in Figure 1. The meter that is actually used for a measurement need only indicate the same numerical value for a particular measurement as would the defined instrument; it need not have all the attributes of the defined instrument. Over the frequency range 20 Hz to 1 MHz with sinusoidal currents, the performance of the instrument shall be as follows:

(a) the measured ratio V_1/I_1 with sinusoidal voltages shall be as close as feasible to the ratio V_1/I_1 calculated with the resistance and capacitance values of the measurement instrument shown in Figure 1; and

(b) the measured ratio V_3/I_1 with sinusoidal voltages shall be as close as feasible to the ratio V_3/I_1 calculated with the resistance and capacitance values of the measurement instrument shown in Figure 1. V_3 shall be measured by the meter M in the measuring instrument. The reading of meter M in RMS volts is converted to MIU by dividing the reading by 500 Ω and then multiplying the quotient by 1000 Ω. The mathematical equivalent is to multiply the RMS voltage reading by 2.

11.8.5 As an alternate to the instrumentation described in Clause 11.8.4, the measurement circuit for the equipment leakage-current test may be as shown in Figure 1 and Figure 15. The ideal measurement instrument is defined in Items (a) – (d) (the meter that is actually to be used for a measurement is only required to indicate the same numerical value for the particular measurement as would the ideal instrument. The meter used is not required to have all of the attributes of the ideal instrument):

(a) The meter shall have an input impedance of 1500 Ω resistive shunted by a capacitance of 0.15 μF.

(b) The meter shall indicate 1.11 times the average of the full-wave rectified composite waveform of voltage across the resistor or current through the resistor.

(c) Over a frequency range of 0 to 100 kHz, the measurement circuitry shall have a frequency response (ratio of indicated to actual value of current) that is equal to the ratio of the impedance of a 1500 Ω resistor shunted by a 0.15 μF capacitor to 1500 Ω. At an indication of 0.5 mA, the measurement shall have an error of not more than 5 percent at 60 Hz.

(d) Unless the meter is being used to measure current from one part of the equipment to another, the meter shall be connected between the accessible parts and the grounded supply conductor.

11.8.6 Unless the measurement instrument is being used to measure leakage-current from one part to another part of the device, it shall be connected between accessible parts and the supply conductor connected to ground (the grounded or grounding conductor) that has the least extraneous voltages introduced from other equipment operated on the same supply.

11.8.7 A sample of the device shall be tested for leakage-current starting with the as-received condition, the as-received condition that includes not having been previously energized, except as may occur as part of the production-line testing. The supply voltage shall be adjusted to rated voltage. Any switches or photocells shall be set so as to allow normal operation. The test sequence shall be as follows, with reference to the Figure 15 measurement circuit:

(a) With switch S1 open, the device shall be connected to the measurement circuit. Leakage-current shall be measured using both positions of switch S2.

(b) Switch S1 shall then be closed, energizing the device. Within 5 s, the leakage-current shall be measured using both positions of switch S2.

(c) Leakage-current shall be monitored until thermal stabilization. Both positions of switch S2 shall be used in determining this measurement. Thermal stabilization shall be obtained by operation as in the normal temperature test.

(d) The leakage-current shall also be monitored with switch S1 open while the device is at operating temperature and while cooling.

11.8.8 Normally a sample will be subjected to the entire leakage-current test, as specified in Clause 11.8.7, without interruption for other tests. With the concurrence of those concerned, the leakage-current test may be interrupted to conduct other nondestructive tests.

11.9 Grounding continuity test

11.9.1 A grounding continuity test shall be performed on devices provided with a grounding plug and incorporating:

(a) accessible metal parts; and

(b) a receptacle with a ground pin which is not a combined ground pin and receptacle contact formed as one piece.

This test is not necessary when the combined plug grounding pin and receptacle contact is one solid piece.

11.9.2 In Canada, the grounding continuity test method in Annex B (CAN) shall be used.

11.9.3 In the United States, the grounding continuity test apparatus shall consist of an indicating instrument and an ac or dc power supply of approximately 12 V providing a current of 25 A through the bonding means being evaluated. Alternatively, the grounding continuity test apparatus may be an ohmmeter or similar indicating instrument capable of measuring 0.10 ohms.

11.9.4 In the United States, the measured or calculated resistance between the point of connection of grounding means and any non-current-carrying metal shall not exceed 0.10 ohms.

11.10 Crush test

11.10.1 Three nightlights containing a liquid shall be tested. Any part removable without the use of tools shall be removed prior to the test where its removal would represent a more severe test condition. The portion of the nightlight containing the liquid shall be placed between two rigid flat surfaces, parallel to each other and parallel to the major axis of the vessel. A crush force of 30 lbs (133.7 N) shall be applied for 1 min to the sample under test.

11.10.2 As a result of the test, there shall be no visible cracking of the vessel or leakage of liquid. Damage to parts of the nightlight other than the liquid vessel shall not be considered.

11.11 Torque test

11.11.1 A device provided with an integral stop to limit rotation of the plug face shall be tested as described in Clause 11.11.2 and comply with Clause 11.11.3.

11.11.2 Six samples of the device shall be tested. The device shall be inserted into a duplex receptacle and rotated clockwise until the integral stop prevents further rotation. Then a torque of 2.26 N·m (20 in-lbf) shall be applied clockwise for one minute in an attempt to override the stop. The test shall be repeated on the same samples with counterclockwise rotation and application of torque.

11.11.3 There shall be no damage to the device, conductors, or electrical connections. The rotational mechanism shall not be able to rotate past the stop position.

11.12 Rotational endurance test

11.12.1 In accordance with Clause 7.7.4, a device shall be tested as described in Clauses 11.12.2 and comply with Clause 11.12.3.

11.12.2 Six samples of the device shall be tested. The device shall be inserted into a duplex receptacle and rotated clockwise from a reference position up to 370 degrees or until an integral stop prevents further rotation. The device shall then be rotated 370 degrees counterclockwise back to the reference position or until the integral stop again prevents further rotation. This range of motion shall be repeated for 1,000 cycles, at a rate of 6 – 10 cycles per minute. Care should be taken to not apply a torque sufficient to override the integral stop. The device shall be energized throughout the test.

11.12.3 There shall not be any visible damage to the device, conductors, or electrical connections. Following the test of Clause 11.12.2, the device shall comply with the Dielectric-Withstand Test of Clause 8.3 and the Temperature Test of Clause 9.1.

12 Factory Production Tests

12.1 Dielectric voltage-withstand test

12.1.1 Each device shall withstand without electrical breakdown, as a routine production-line test, the application of a 40 – 70 Hz potential of 1000 V for 60 s or 1200 V for 1 s between the primary wiring, including connected components, and:

(a) accessible non-current-carrying metal parts that are likely to become energized; and

(b) accessible low-voltage metal parts, including terminals.

This test shall not be required if there are no exposed non-current-carrying metal parts.

12.1.2 The test shall be conducted when the device is complete (fully assembled) and with the primary switch in the “on” position. It is not intended that the device be un-wired, modified, or disassembled for the test. A part such as a snap cover or friction-fit knob that would interfere with the performance of the test need not be in place. The test may be performed before final assembly if the device as tested is representative of a completed device. The test may be conducted before a solid-state component that can be damaged by the dielectric potential is electrically connected. However, a random sampling of each day's production shall be tested at the potential specified in Clause 12.1.1, but the circuitry may be rearranged for the test to reduce the likelihood of solid-state-component damage while retaining representative dielectric stress on the circuit.

12.1.3 The test equipment shall include a transformer having an essentially sinusoidal output, a means of indicating the test potential, an audible or visual indicator of electrical breakdown, and either a manually reset device to restore the equipment after electrical breakdown or an automatic reject feature of any unacceptable unit.

12.1.4 If the output of the test equipment transformer is less than 500 V·A, the equipment shall include a voltmeter in the output circuit to directly indicate the test potential.

12.1.5 If the output of the test equipment transformer is 500 V·A or larger, the test potential may be indicated by:

(a) a voltmeter in the primary circuit or in a tertiary winding circuit;

(b) a selector switch marked to indicate the test potential; or

(c) a marking in a readily visible location to indicate the test potential of equipment having a single test potential output.

12.1.6 Test equipment other than that described in Clauses 12.1.3 – 12.1.5 may be used if found to accomplish the intended factory control.

12.1.7 During the test, both sides of the primary circuit of the nightlight shall be connected together to one terminal of the test equipment; the second test equipment terminal shall be connected to the accessible non-current-carrying metal of the device under test.

12.2 Additional factory production tests in Canada

12.2.1 In Canada, the additional factory production tests of Annex D are required.

13 Marking

Advisory Note: In Canada, there are two official languages, English and French. Annex E provides French translations of the markings specified in this Standard. Markings required by this Standard may have to be provided in other languages to conform with the language requirements of the country where the product is to be used.

13.1 Each device shall be plainly and permanently marked with the following information where it will be readily visible:

(a) manufacturer's or submitter's name, trademark, or other recognized symbol of identification;

(b) a distinctive catalog number or the equivalent; and

(c) input rating in volts, hertz, and watts.

The catalog number or the equivalent need not be marked on the nightlight if it appears on the smallest unit shipping carton or other container in which the nightlight is packaged.

13.2 Relampable devices that require a limitation of the lamp wattage shall be permanently and legibly marked, where readily visible during relamping, with the words “MAX... WATTS”, and lamp type, or equivalent.

(a) “MAX” shall be at least 1.6 mm (1/16 in) (7 point).

(b) All other letters shall be 1.2 mm (3/64 in) (5 point).

13.3 The smallest unit package of a device shall include all of the following markings or equivalent wording:

(a) CAUTION: Risk of Electric Shock and Fire Hazard or Warning: Risk of Electric Shock and Fire Hazard.

(b) This is not a toy and is not intended for use by children.

(c) For adult use only.

(d) For safe use, plug only into exposed wall outlets where a device is ventilated and cannot contact bed covering or other material.

(e) Do not use with extension cords.

Note: The word “CAUTION” may be replaced by the word “WARNING” at the manufacturer's discretion.

13.4 A device provided with a polarized plug shall be marked “MATCH WIDE BLADE OF PLUG TO WIDE SLOT, FULLY INSERT” in addition to the marking in Clause 13.3.

13.5 The cautionary markings in Clauses 13.3 and 13.4 shall be:

(a) in letters minimum 1.6 mm (0.062 in) high on a contrasting background;

(b) separated from all other markings by a single line minimum 1.6 mm (0.062 in) wide that completely encloses the marking; and

(c) visible at the point of purchase while the product is enclosed within or secured to the packaging.

13.6 The packaging material attached to or provided with a nightlight shall not display any of the following:

(a) pictures or sketches showing the nightlight used in a nursery or child's room;

(b) a statement indicating that the product is suitable for use in a child's room or in a nursery; or

(c) a statement indicating that the product is suitable for use by a child.

Table 1
Tracking Index (CTI), Hot Wire Ignition (HWI), and High Current Arc Resistance to Ignition (HAI) Ratings of Polymeric Materials [a]

(See Clauses 7.2.2, 7.2.3, 7.2.4 and 7.16.2.)

Flammability classification [b]	CTI [c]		HWI [d]		HAI [e]	
	–	PLC [f]	–	PLC [f]	–	PLC [f]
V-0, VTM-0	175 v min	4	7 sec min	4	15 arcs min	3
V-1, VTM-1	175 v min	4	15 sec min	3	30 arcs min	2
V-2, VTM-2	175 v min	4	15 sec min	2	30 arcs min	2

[a] Enclosures of phenolic, urea, or other thermoset materials are acceptable as legacy materials. Thermoplastic materials shall comply with this Table. First, the flammability classification is determined, and then CTI, HWI, and HAI requirements are determined as a function of the flammability classification.

[b] Flammability classification – Determined by prior classification or by 12 mm end-product flame test described in UL 746C and CAN/CSA-C22.2 No. 0.17.

[c] Comparative tracking index – Determined by prior classification or by end-product test described in UL 746C and CAN/CSA-C22.2 No. 0.17.

[d] Hot wire ignition – Determined by prior classification or by end-product test described in UL 746C and CAN/CSA-C22.2 No. 0.17.

[e] High-current arc resistance to ignition – Determined by prior classification or by end-product test described in UL 746C and CAN/CSA-C22.2 No. 0.17.

[f] For materials with other than VTM flammability classifications, the performance level class (PLC) for material shall be evaluated using the specimen thickness employed in the end product. PLCs have been established in order to give a consistent numbering for improved performance (PLC=0 is best; PLC=5 is poorest) and avoid an excessive level of implied precision. Material performances for several tests and recorded as PLC values are based on the mean test results (rather than recording the exact numerical results).

Table 2
Minimum Relative Thermal Indices of Polymeric Materials

(See Clause 7.2.5.)

		Minimum RTI[a] – degrees C	
Application	**Material**	**Electrical**	**Mechanical with impact**
Enclosure and electrical insulation	Thermoplastic	60	60
	Thermoset	100	100

[a] Relative thermal index – Described in UL 746C and CAN/CSA-C22.2 No. 0.17. For materials with other than VTM flammability classifications, the material shall be evaluated using specimen thickness of no more than the thickness employed in the end product.

Table 3
Spacing of Conductive Parts

(See Clauses 7.13.1, 7.13.5, 7.13.6, 10.1.4.1, 10.2.1.1, 10.4.2, and 10.7.2.)

Item	Through air	Over an insulated surface
Live parts to non-current-carrying metal	1.2 mm (0.047 in)	1.2 mm (0.047 in)
Live parts of opposite polarity	1.2 mm (0.047 in)	1.2 mm (0.047 in)
printed-wiring board – foil to foil	N/A	1.2 mm (0.047 in)
Live parts of opposite polarity on an electroluminescent panel and associated connections to other parts	1.2 mm (0.047 in)	2.4 mm (0.094 in)
printed-wiring board – component to component	3.2 mm (0.125 in)	N/A

Table 4
Maximum Tipping Moment

(See Clauses 7.15.1 and 7.15.2.)

Algebraic quantity	Maximum acceptable value
W	0.79 kg (28 oz)
WY/Z	1.36 kg (48 oz)
WY/S	1.36 kg (48 oz)
WgX (WX)	0.56 N·m (80 oz-in)

In this table the variables are defined as follows:

W = the weight of the device in kg (oz) and is considered to be a force equal to the device mass of kg (oz) as measured on a scale or balance.

Y = the distance, in meters (inches), illustrated in Figure 6.

Z = the shorter distance, in meters (inches), of Z_1 or Z_2, illustrated in Figure 6.

S = the shorter distance, in meters (inches), of S_1 or S_2, illustrated in Figure 6.

g = acceleration due to gravity, 9.806 meters/sec^2

X = the longer distance, in meters (inches), of X_1 or X_2, illustrated in Figure 6.

Table 5
Test Plan Summary

(See Clause 8.1.1.)

Number of samples	Tested requirements	Reference
1	Spacing of conductive parts	7.13
1	Maximum tipping moment requirements	7.15
1	Plug blades	7.6
1	Accessibility of live parts	8.2
1	Dielectric-withstand test	8.3
1	Plug blades accessibility	8.4
1	Temperature test	9.1
1	Lampholder and lamp base accessibility	9.2
6	Overload	10.1.2
Same 6 samples as overload	Endurance	10.1.3
12 or 18	Plug blade secureness	10.2
1	Folded blade compression test	10.3
1	Mold stress-relief distortion test	10.4
1	Lamp cavity separation test	10.5
3	Pull test	10.6
3	Enclosure impact test	10.7
1	Blanketing test	11.1
1	Overlamping test	11.2
6	Limited short-circuit test	11.3
1	Overvoltage test	11.4
1 per fault	Component breakdown test	11.5
1	Voltage surge test	11.6
2	Humidity conditioning test	11.7
1	Leakage-current test	11.8
1	Grounding continuity test	11.9
Note: This table is a summary of test samples typically needed. Actual number of samples may vary where agreeable to all parties concerned.		

Table 6
Temperature

(See Clauses 9.1.1, 9.1.4, and 9.1.5.)

Materials and components	°C
Lamp if no shade is provided	90
Exposed surfaces intended to be grasped for removal or adjustment	75
Polymeric materials	a
Components	b
Blades	55

[a] Polymeric material shall not exceed the relative thermal index (RTI) of the material.

[b] A component (for example, a printed circuit-board, wiring, and the like) shall comply with the temperature limits for which the component was investigated. See Clause 3.

Figure 1

Leakage-Current Measurement Instrument

(See Clauses 6.12, 11.8.4, and 11.8.5.)

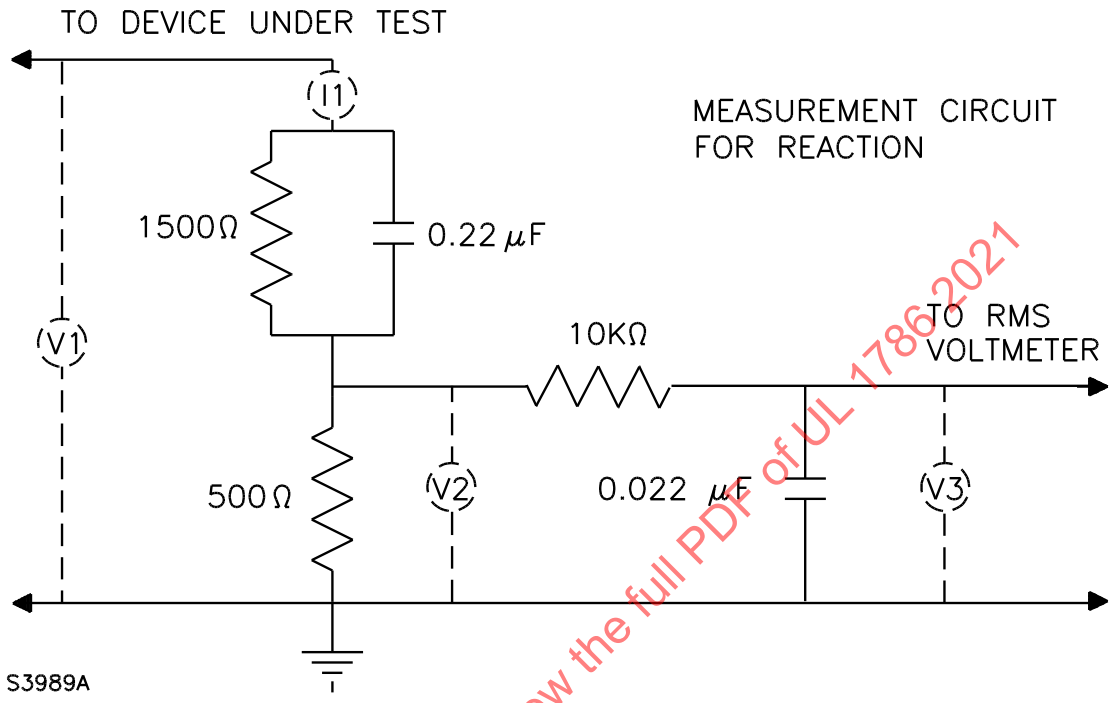
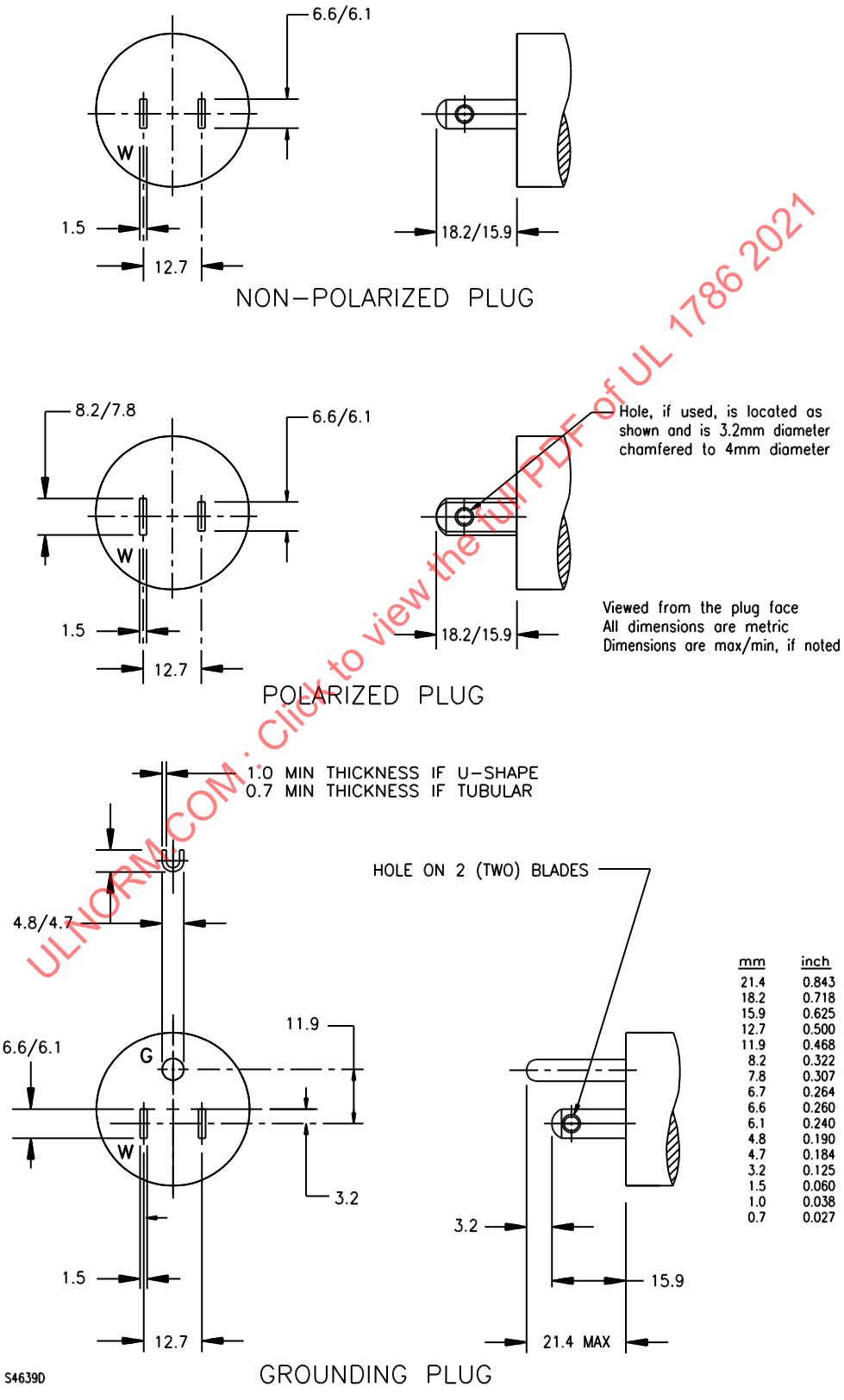


Figure 2

Plug Dimensions

(See Clauses 7.6.2 and 7.8.1.)

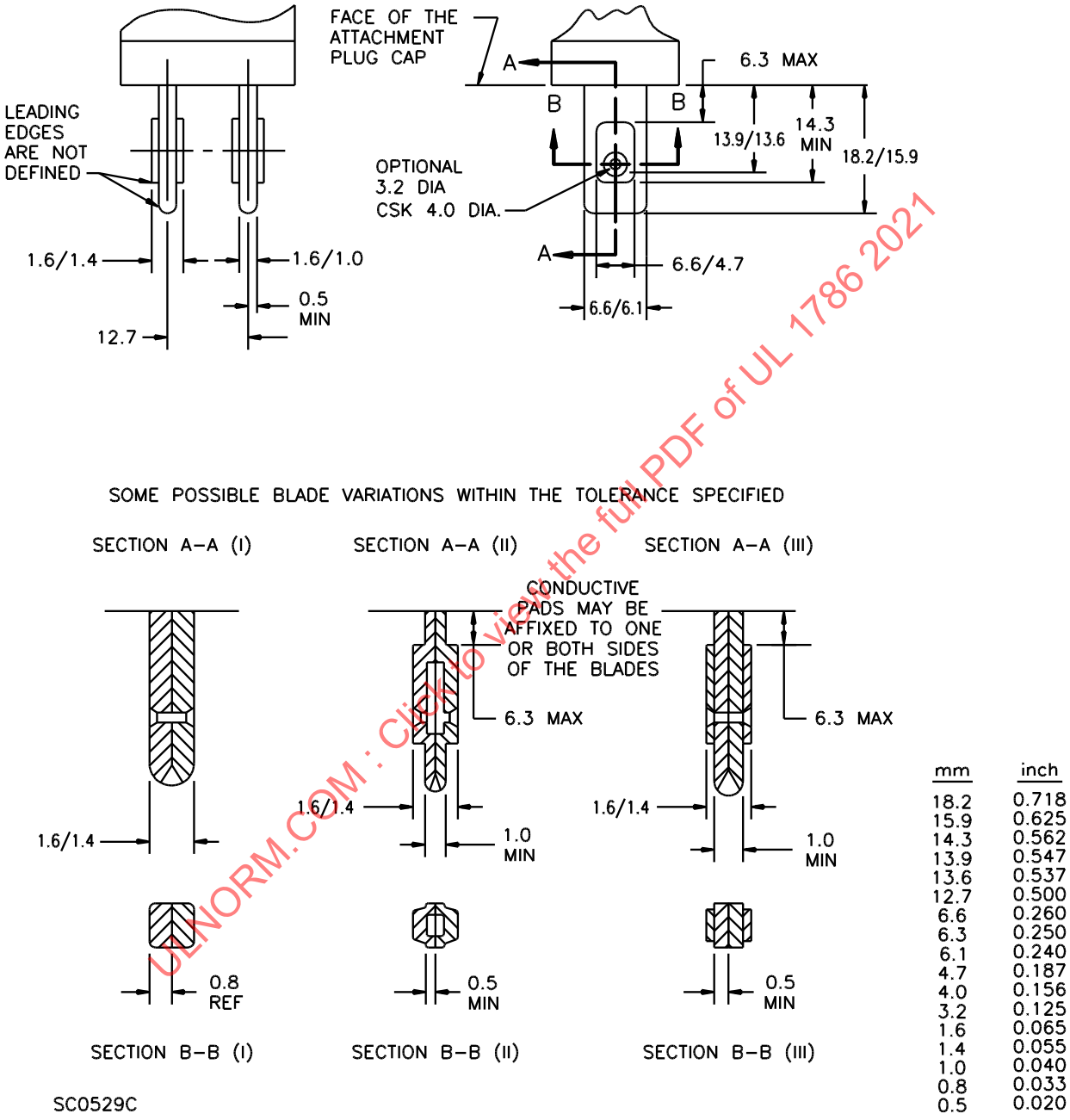


mm	inch
21.4	0.843
18.2	0.718
15.9	0.625
12.7	0.500
11.9	0.468
8.2	0.322
7.8	0.307
6.7	0.264
6.6	0.260
6.1	0.240
4.8	0.190
4.7	0.184
3.2	0.125
1.5	0.060
1.0	0.038
0.7	0.027

Figure 3

Folded Blade Construction

(See Clauses 7.6.2 and 7.8.1.)

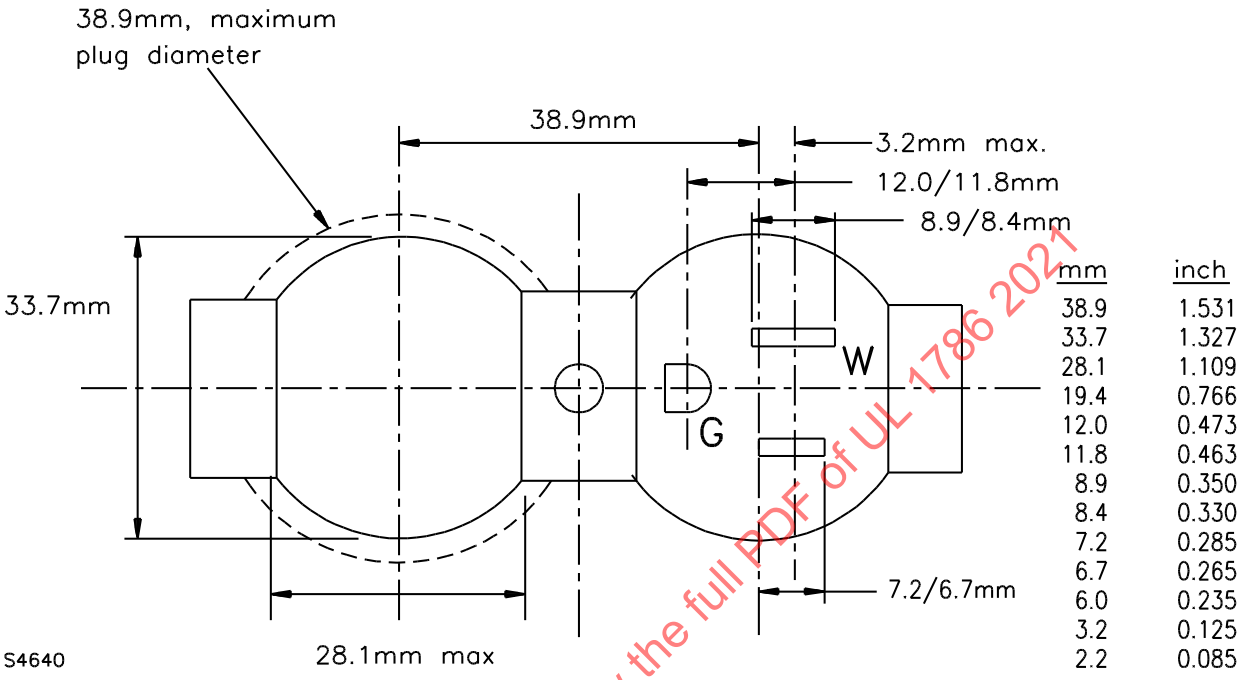


mm	inch
18.2	0.718
15.9	0.625
14.3	0.562
13.9	0.547
13.6	0.537
12.7	0.500
6.6	0.260
6.3	0.250
6.1	0.240
4.7	0.187
4.0	0.156
3.2	0.125
1.6	0.065
1.4	0.055
1.0	0.040
0.8	0.033
0.5	0.020

Figure 4

Parallel Blade Receptacle

(See Clause 7.7.2.)



mm	inch
38.9	1.531
33.7	1.327
28.1	1.109
19.4	0.766
12.0	0.473
11.8	0.463
8.9	0.350
8.4	0.330
7.2	0.285
6.7	0.265
6.0	0.235
3.2	0.125
2.2	0.085

Figure 5

Nightlight Plug Face Dimensions

(See Clauses 7.7.1 and 8.4.1.)

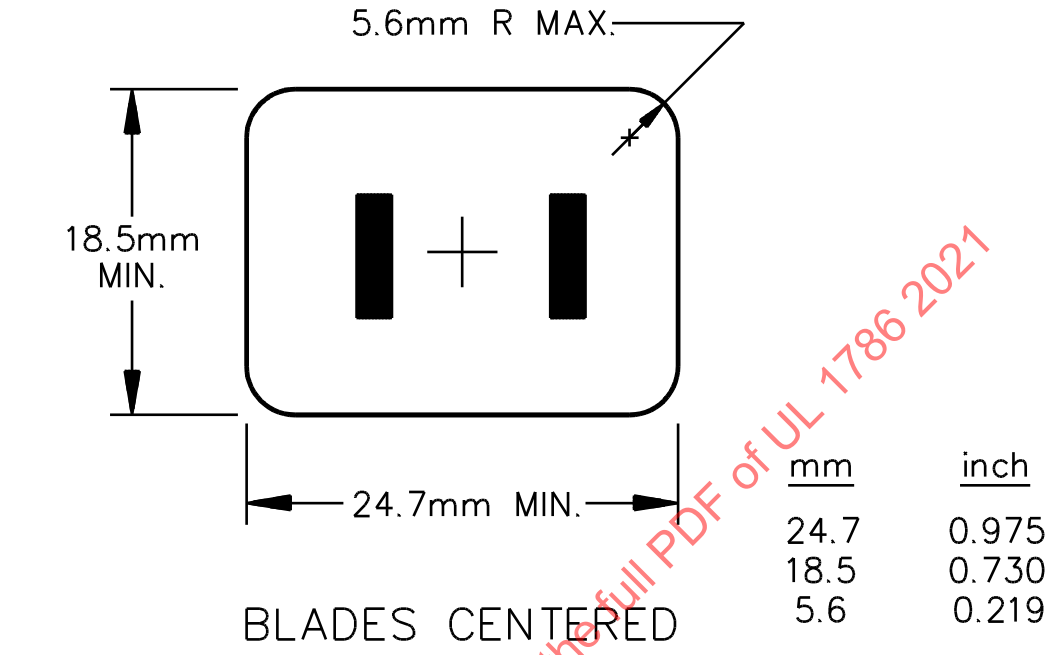
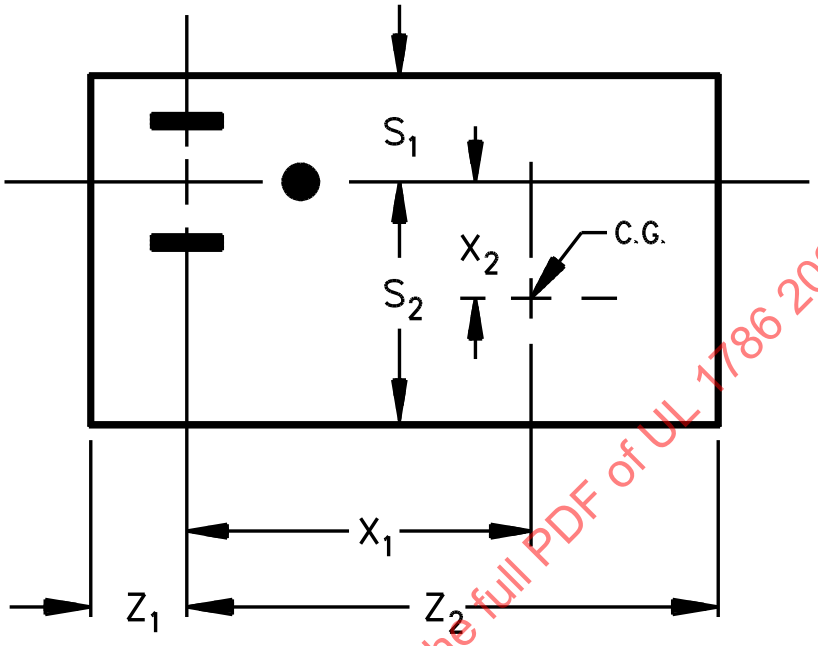


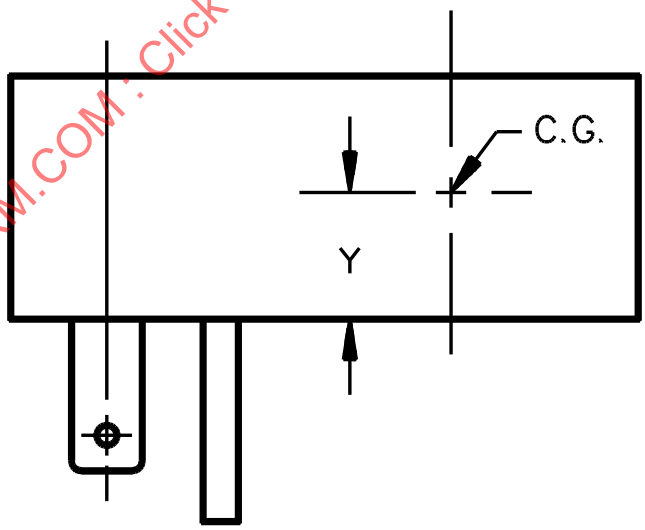
Figure 6

Dimensions of a Nightlight

(See Clause 7.15.1 and Table 4.)



FRONT VIEW



SIDE VIEW

C.G. = Center of Gravity

CP100A

Figure 7

Articulate Probe

(See Clauses 8.2.2, 8.3.2, 9.2.2, 9.2.3, 9.2.4, and D.3.1.)

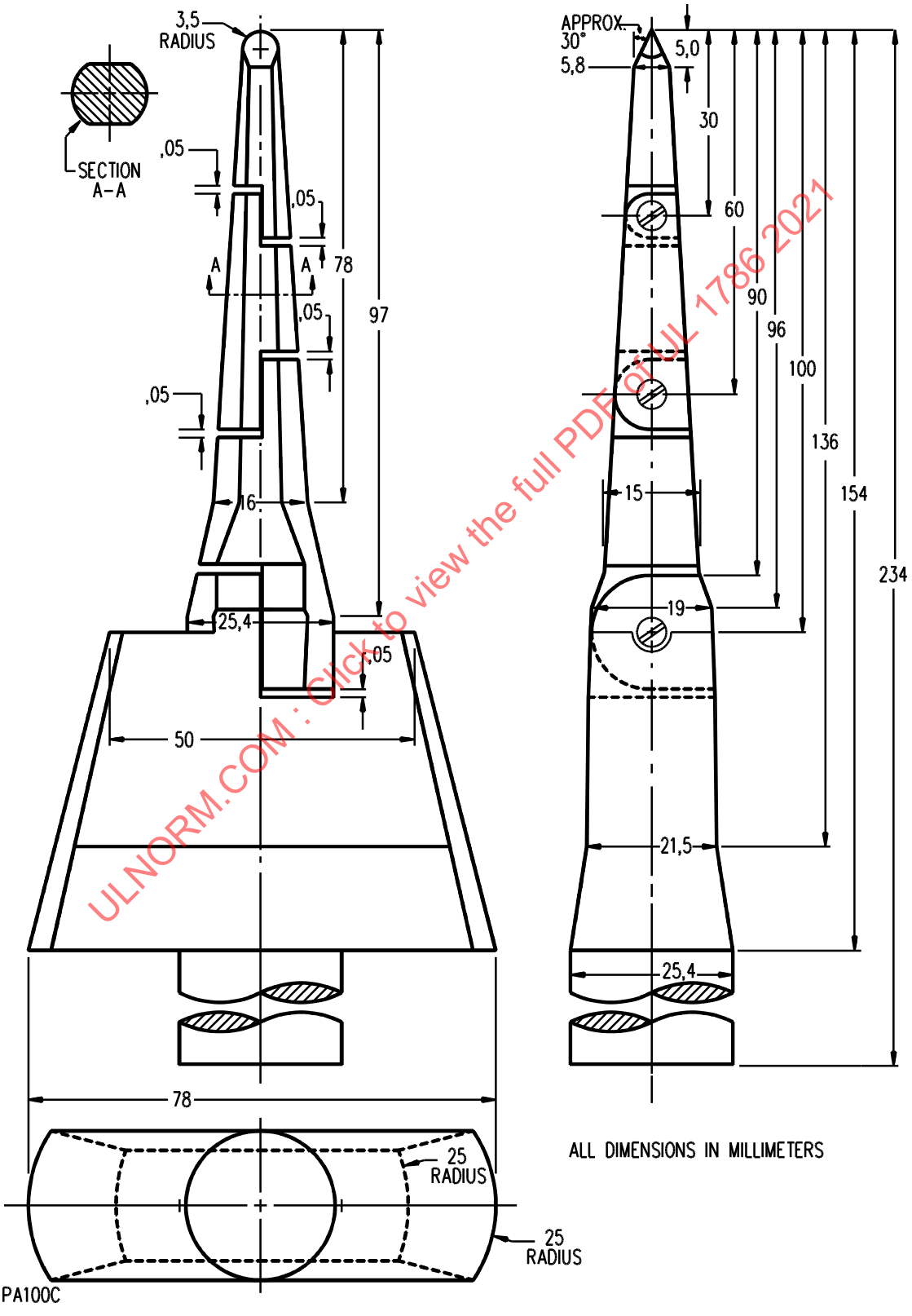
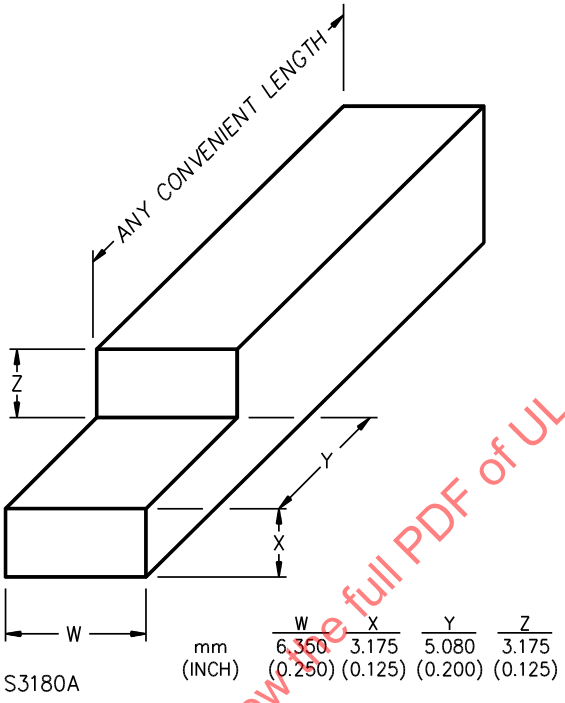


Figure 8

Minimum Face Size Probe

(See Clause 8.4.1.)



	W	X	Y	Z
mm	6.350	3.175	5.080	3.175
(INCH)	(0.250)	(0.125)	(0.200)	(0.125)

Figure 9

Sample Test Lamp

(See Clause 9.2.2.)

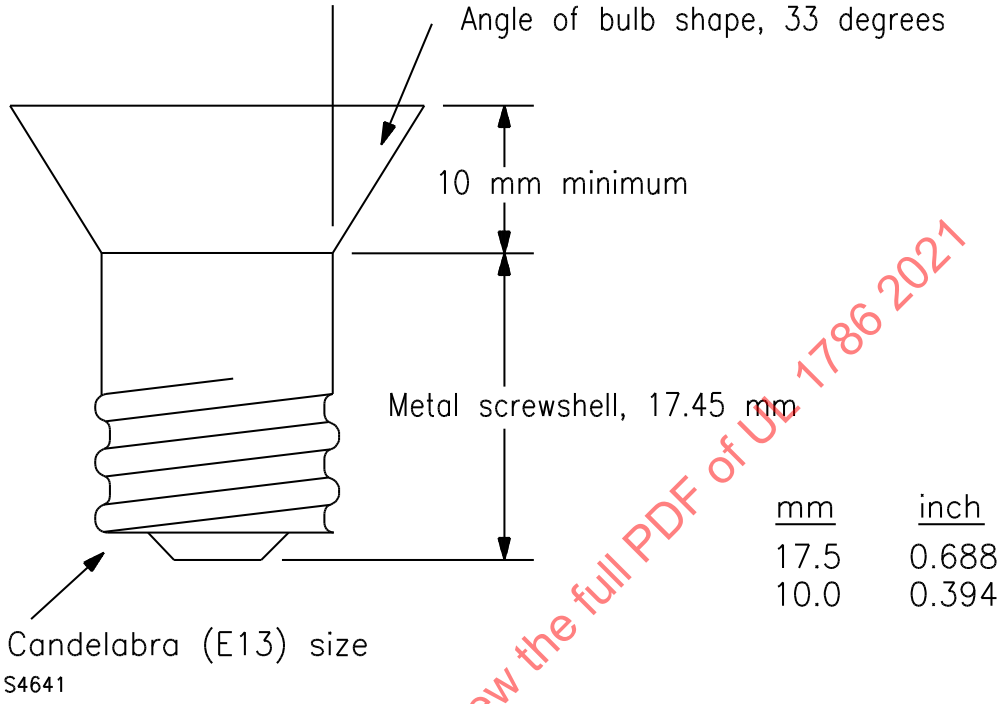


Figure 10

Example of a Cap Pull Test Set-up

(See Clause 10.6.2.)

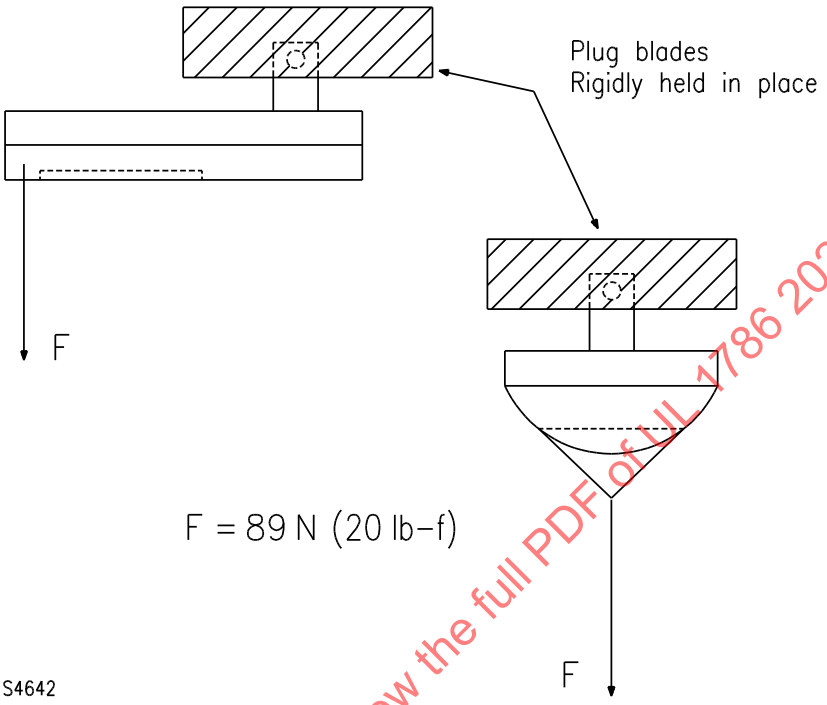


Figure 11

Impact Test Set-up

(See Clause 10.7.1.)

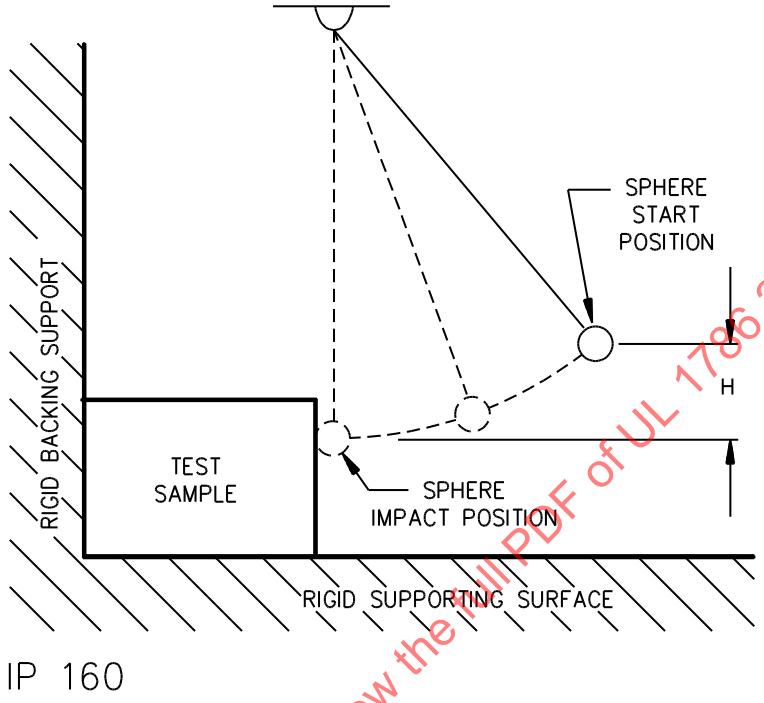


Figure 12

Blanketing Test Set-up

(See Clauses 11.1.3 and 11.1.6.)

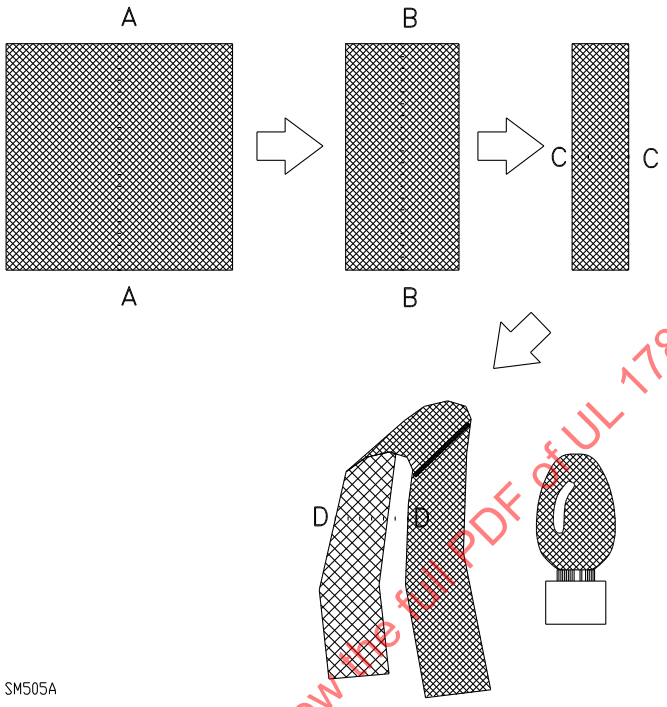


Figure 12A

Test Fixture Wall