



UL 1576

STANDARD FOR SAFETY

Flashlights and Lanterns

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UL Standard for Safety for Flashlights and Lanterns, UL 1576

Second Edition, Dated May 13, 2022

Summary of Topics

This is the Second edition of ANSI/UL 1576, Standard for Flashlights and Lanterns dated May 13, 2022. This standard is being co-published with CSA Group as a Bi-National Standard.

The new requirements are substantially in accordance with Proposal(s) on this subject dated December 17, 2022.

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CSA Group
CSA C22.2 No. 250.5:22
First Edition



Underwriters Laboratories Inc.
UL 1576
Second Edition

Flashlights and Lanterns

May 13, 2022

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ANSI/UL 1576-2022



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This ANSI/UL Standard for Safety consists of the Second edition. The most recent designation of ANSI/UL 1576 as an American National Standard (ANSI) occurred on May 13, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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

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Preface

This is the harmonized CSA Group and UL Standard for Flashlights and Lanterns. It is the first edition of CSA C22.2 No. 250.5 and the second edition of UL 1576. This edition of UL 1576 supersedes the previous edition published in 2018.

This harmonized standard was prepared by CSA Group and Underwriters Laboratories Inc. (UL). The effort and support of the Technical Harmonization Group on Flashlights and Lanterns are gratefully acknowledged.

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

This Standard was reviewed by the CSA Integrated Committee on Lighting Products (ICLP), under the jurisdiction of the CSA Technical Committee on Consumer and Commercial Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the Technical Committee. This Standard has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be considered 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 is published as an identical standard for CSA Group and UL.

An identical standard is a standard that is exactly the same in technical content except for national differences resulting from conflicts in codes and governmental regulations. Presentation is word for word except for editorial changes.

Reasons for differences from IEC

This standard provides requirements for flashlights and lanterns for use in accordance with the electrical installation codes of Canada and the United States. This standard does not employ any IEC standard for base requirements.

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 flashlights and lanterns powered by secondary (rechargeable) batteries and general purpose primary (non-rechargeable) batteries with a maximum voltage of 75 V d.c. The terms flashlights and lanterns as used within this standard refer to products that are battery-powered.

1.2 Flashlights and lanterns that are battery-powered and also powered from a line-voltage supply are also covered within this standard, in accordance with CSA C22.1, Canadian Electrical Code (CE Code), Part I and the National Electrical Code (NEC), ANSI/NFPA 70, on circuits having a nominal voltage not exceeding 250 V.

1.3 These requirements also apply to automatic flashlights and lanterns which are normally connected to a line voltage supply and, upon loss of the line voltage supply, will turn on the lamp.

1.4 This standard is not used in conjunction with CSA C22.2 No. 250.0.

1.5 These requirements do not apply to:

- a) Stand-alone battery chargers;
- b) Cord and plug connected work lights and hand lights without batteries that are within the scope of UL 153 and CSA C22.2 No. 250.4;
- c) Cord and plug connected portable luminaires other than work lights and hand lights, with or without batteries, that are within the scope of UL 153 and CSA C22.2 No. 250.4;
- d) Aquarium lighting that is within the scope of UL 1018 and CSA C22.2 No. 250.4;
- e) Emergency lighting that is within the scope of UL 924 and CSA C22.2 No. 141;
- f) Products with ultraviolet (UV) radiation sources greater than "Exempt Group" as specified in IEC 62471 and CSA C22.2 No. 62471; and
- g) Products intended for hazardous locations.

1.6 This standard alone is not intended to apply to permanently installed lighting that is capable of being battery powered, since it will not be sufficient to ensure that all hazards are considered for these products.

1.7 Most requirements for battery operation and charging are incorporated by reference to CSA C22.2 No. 0.23 and UL 2595 and are subject to the limitations of voltage in that standard.

Note: Products operating at voltages in excess of those specified in CSA C22.2 No. 0.23 and UL 2595 may require additional considerations.

1.8 Requirements for all battery-operated flashlights and lanterns are specified in Part I. Additional requirements for battery operated flashlights and lanterns that may also be connected to line-voltage supply for any purpose are specified in Part II.

1.9 The terms flashlights and lanterns are considered to be interchangeable and can be referred to as products within this Standard.

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.

CSA Standards

CSA C22.1:21, *Canadian Electrical Code, Part I*

CSA C22.2 No. 0:20, *Canadian Electrical Code, Part II, General Requirements*

CSA C22.2 No. 0.1:19, *General Requirements for Double-Insulated Equipment*

CSA C22.2 No. 0.2:16 (R2020), *Insulation Coordination*

CSA C22.2 No. 0.15-16, *Adhesive Labels*

CAN/CSA C22.2 No. 0.17-00 (R1018), *Evaluation of Properties of Polymeric Materials*

CSA C22.2 No. 0.23:15 (R2010), *General Requirements for Battery Powered Appliances*

CSA C22.2 No. 5-16, *Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures*

CSA C22.2 No. 18.1-13 (R2018), *Metallic Outlet Boxes*

CSA C22.2 No. 18.2-06 (R2016), *Nonmetallic Outlet Boxes*

CSA C22.2 No. 18.3-12 (R2017), *Conduit, Tubing and Cable Fittings*

CSA C22.2 No. 18.5-13 (R2020), *Positioning Devices*

CSA C22.2 No. 21-18, *Cord Sets and Power-Supply Cords*

CSA C22.2 No. 38-18, *Thermoset-Insulated Wires And Cables*

CSA C22.2 No. 42.1-13 (R2020), *General Use Receptacles, Attachment Plugs, And Similar Wiring Devices*

CSA C22.2 No. 43-17, *Lampholders*

CSA C22.2 No. 49-18, *Flexible Cords and Cables*

CSA C22.2 No. 62.2:21, *Low Voltage Transformers – Part 2: General Purpose Transformers*

CSA C22.2 No. 65-18, *Wire Connectors*

CSA C22.2 No. 66.1-06 (R2020), *Low Voltage Transformers – Part 1: General Requirements*

CSA C22.2 No. 66.2, *Low Voltage Transformers – Part 2: General Purpose Transformers*

CSA C22.2 No. 66.3-06 (R2020), *Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers*

CSA C22.2 No. 68-18, *Motor-Operated Appliances (Household And Commercial)*

CSA C22.2 No. 74-16 (R2020), *Equipment For Use With Electric Discharge Lamps*

CSA C22.2 No. 75-17, *Thermoplastic-Insulated Wires And Cables*

CSA C22.2 No. 111-18, *General-Use Snap Switches*

CSA C22.2 No. 141-15 (R2020), *Emergency Lighting Equipment*

CSA C22.2 No. 144.1-16 (R2020), *Ground-Fault Circuit Interrupters*

CSA C22.2 No. 153-14 (R2020), *Electrical Quick-Connect Terminals*

CSA C22.2 No. 158-10 (R2019), *Terminal Blocks*

CSA C22.2 No. 177-13 (R2018), *Clock-operated switches*

CSA C22.2 No. 188-18, *Splicing Wire Connectors*

C22.2 No. 197-M83 (R2018), *PV Insulating Tape*

CSA C22.2 No. 198.1-06 (R2020), *Extruded Insulating Tubing*

CSA C22.2 No. 198.3:05 (R2019), *Coated Electrical Sleeving*

CSA C22.2 No. 210:15 (R2020), *Appliance Wiring Material Products*

CSA C22.2 No. 223:15 (R2020), *Power Supplies With Extra-Low-Voltage Class 2 Outputs*

CSA C22.2 No. 235-04 (R2017), *Supplementary Protectors*

CSA C22.2 No. 248 (series of standards), *Low-Voltage Fuses*

CSA C22.2 No. 248.1-11 (R2020), *Low-Voltage Fuses – Part 1: General Requirements*

CSA C22.2 No. 248.5:00 (R2019), *Low-Voltage Fuses – Part 5: Class G Fuses*

CSA C22.2 No. 248.14:00 (R2019), *Low-Voltage Fuses – Part 14: Supplemental Fuses*

CSA C22.2 No. 250.0-18, *Luminaires*

CSA C22.2 No. 250.4:20, *Portable Luminaires*

CSA C22.2 No. 256-14 (R2019), *Direct Plug-In Nightlights*

CSA C22.2 No. 270-16, *Arc Fault Protective Devices*

C22.2 No. 284-16 (R2020), *Nonindustrial photoelectric switches for lighting control*

CSA C22.2 No. 308-18, *Cord Reels And Multi-Outlet Assemblies*

CSA C22.2 No. 2459-08 (R2018), *Insulated Multi-Pole Splicing Wire Connectors*

CSA C22.2 No. 4248.1-17, *Fuseholders – Part 1: General Requirements*

CSA C22.2 No. 4248.9-07 (R2016), *Fuseholders – Part 9: Class K*

CSA C22.2 No. 60320-1-19, *Appliance Couplers For Household And Similar General Purposes – Part 1: General Requirements*

CAN/CSA-C22.2 No. 60335-1:16, *Household and similar electrical appliances – Safety – Part 1: General requirements*

CSA C22.2 No. 60691:19, *Thermal-Links – Requirements And Application Guide*

CSA C22.2 No. 61058-1:17, *Switches For Appliances – Part 1: General Requirements*

CSA C22.2 No. 61058-1-1:17, *Switches For Appliances – Part 1-1: Requirements For Mechanical Switches*

CSA C22.2 No. 61058-1-2:17, *Switches For Appliances – Part 1-2: Requirements For Electronic Switches*

CSA C22.2 No. 62115:20, *Electric Toys*

CSA C22.2 No. 61730-1-19, *Photovoltaic (PV) Module Safety Qualification – Part 1: Requirements For Construction*

CSA C22.2 No. 62471:12 (R2020), *Photobiological Safety of Lamps and Lamp Systems*

CAN/CSA-E60384-14:14 (R2018), *Fixed Capacitors For Use In Electronic Equipment – Part 14: Sectional Specification – Fixed Capacitors For Electromagnetic Interference Suppression And Connection To The Supply Mains*

CAN/CSA-E60730-1:15 (R2020), *Automatic Electrical Controls – Part 1: General Requirements*

CAN/CSA-E60730-2-7:18, *Automatic Electrical Controls – Part 2-7: Particular Requirements For Timers And Time Switches*

UL Standards

UL 20, *General Use Snap Switches*

UL 44, *Thermoset-Insulated Wires and Cables*

UL 62, *Flexible Cords and Cables*

UL 66, *Fixture Wire*

UL 73, *Motor-Operated Appliances*

UL 83, *Thermoplastic-Insulated Wires and Cables*

UL 94, *Tests for Flammability of Plastic Materials for Parts in Devices and Appliances*

UL 153, *Portable Electric Luminaires*

UL 157, *Gaskets and Seals*

UL 224, *Extruded Insulating Tubing*

UL 248 (series of standards), *Low-Voltage Fuses*

UL 248-1, *Low-Voltage Fuses – Part 1: General Requirements*

UL 248-5, *Low-Voltage Fuses – Part 5: Class G Fuses*

UL 248-14, *Low-Voltage Fuses – Part 14: Supplemental Fuses*

UL 310, *Electrical Quick-Connect Terminals*

UL 355, *Cord Reels*

UL 486A-486B, *Wire Connectors*

UL 486C, *Splicing Wire Connectors*

UL 486E, *Aluminum and/or Copper Conductors*

UL 489, *Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures*

UL 496, *Lampholders*

UL 498, *Attachment Plugs and Receptacles*

UL 510, *Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape*

UL 514A, *Metallic Outlet Boxes*

UL 514C, *Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers*

UL 514D, *Cover Plates for Flush-Mounted Wiring Devices*

UL 635, *Insulating Bushings*

UL 696, *Electric Toys*

UL 746C, *Polymeric Materials – Use in Electrical Equipment Evaluations*

UL 746E, *Polymeric Materials – Industrial Laminates, Filament Wound Tubing, Vulcanized Fibre, and Materials Used In Printed Wiring Boards*

UL 758, *Appliance Wiring Material*

UL 773A, *Nonindustrial Photoelectric Switches for Lighting Control*

UL 796, *Printed-Wiring Boards*

UL 817, *Cord Sets and Power-Supply Cords*

UL 840, *Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment*

UL 917, *Clock-Operated Switches*

UL 924, *Emergency Lighting and Power Equipment*

UL 935, *Fluorescent-Lamp Ballasts*

UL 943, *Ground-Fault Circuit-Interrupters*

UL 943B, *Appliance Leakage-Current Interrupters*

UL 969, *Marking and Labeling Systems*

UL 969A, *Marking and Labeling Systems – Flag Labels, Flag Tags, Wrap-Around Labels and Related Products*

UL 1018, *Aquarium Equipment*

UL 1029, *High-Intensity Discharge Lamp Ballasts*

UL 1053, *Ground-Fault Sensing and Relaying Equipment*

UL 1059, *Terminal Blocks*

UL 1077, *Supplementary Protectors for Use in Electrical Equipment*

UL 1097, *Double Insulation Systems for Use in Electrical Equipment*

UL 1310, *Class 2 Power Units*

UL 1412, *Fusing Resistors and Temperature-Limited Resistors for Radio- and Television-Type Appliances*

UL 1441, *Coated Electrical Sleeving*

UL 1446, *Systems of Insulating Materials – General*

UL 1557, *Electrically Isolated Semiconductor Devices*

UL 1565, *Positioning Devices*

UL 1699, *Arc-Fault Circuit-Interrupters*

UL 1703, *Flat Plate Photovoltaic Modules and Panels*

UL 1786, *Direct Plug-In Nightlights*

UL 2459, *Insulated Multi-Pole Splicing Wire Connectors*

UL 2595, *General Requirements for Battery-Powered Appliances*

UL 4200A, *Products Incorporating Button or Coin Cell Batteries of Lithium Technologies*

UL 4248-1, *Fuseholders – Part 1: General Requirements*

UL 4248-9, *Fuseholders – Part 9: Class K*

UL 5085-1, *Low Voltage Transformers: General Requirements*

UL 5085-2, *Low Voltage Transformers: General Purpose Transformers*

UL 5085-3, *Low Voltage Transformers, Class 2 and Class 3 Transformers*

UL 60320-1, *Appliance Couplers For Household And Similar General Purposes – Part 1 General Requirements*

UL 60384-14, *Fixed Capacitors for Use in Electronic Equipment – Part 14: Sectional Specification: Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains*

UL 60691, *Thermal-Links (Thermal Cutoffs) for Use in Electrical Appliances and Components*

UL 60730-1, *Automatic Electrical Controls for Household and Similar Electrical Controls for Household and Similar Use; Part 1: General*

UL 60730-2-7, *Automatic Electrical Controls for Household and Similar Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches*

UL 61058-1, *Switches for Appliances – Part 1: General Requirements*

UL 61058-1-1, *Switches For Appliances – Part 1-1: Requirements For Mechanical Switches*

UL 61058-1-2, *Switches For Appliances – Part 1-2: Requirements For Electronic Switches*

UL 61730-1, *Photovoltaic (PV) Module Safety Qualification – Part 1: Requirements For Construction*

ASTM Standards

ASTM E230/E230M, *Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples*

IEC Standards

IEC 60384-14, *Fixed Capacitors for Use in Electronic Equipment Part 14: Sectional Specification: Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains*

IEC 60384-16, *Fixed Capacitors for Use in Electronic Equipment – Part 16: Sectional Specification: Fixed Metallized Polypropylene Film Dielectric D.C. Capacitors*

IEC 60417 DATABASE, *Graphical Symbols For Use On Equipment*

IEC 60825-1, *Safety Of Laser Products – Part 1: Equipment Classification And Requirements*

IEC 62471, *Photobiological Safety of Lamps and Lamp Systems*

ISO Standards

ISO 7010, *Graphical Symbols – Safety Colours And Safety Signs – Registered Safety Signs*

NFPA Standards

ANSI/NFPA 70, *National Electrical Code*

NEMA Standards

ANSI/NEMA WD 6-2016, *Wiring Devices-Dimensional Specifications*

3 Definitions

3.1 The following definitions apply in this Standard.

Note: Defined terms are shown as bolded text throughout the standard.

3.2 **APPLIANCE COUPLER** – A single-outlet, female contact device for attachment to a flexible cord as part of a detachable power-supply cord to be connected to an appliance inlet (motor attachment plug).

3.3 **APPLIANCE INLET (MOTOR ATTACHMENT PLUG)** – A male contact device mounted on an end product appliance to provide an integral blade configuration for the connection of an appliance coupler or cord connector.

3.4 **AUTOMATIC FLASHLIGHT OR LANTERN** – A flashlight or lantern incorporating a switching device which, when the unit is connected to a line voltage supply, will maintain an open circuit between the battery and lamp and, upon loss of the line voltage supply, will close the circuit between the battery and the lamp.

3.5 **BATTERY, PRIMARY** – A battery which can only be discharged once. It is not designed to be rechargeable and must be protected from a charging current.

3.6 **BATTERY, SECONDARY** – A battery intended to be discharged and recharged many times.

3.7 **CHILD-APPEALING FEATURE** – A feature that provides visual appeal and attraction to children in the form of shape, decoration, bright colors, or unusual illuminations.

3.8 **LOW VOLTAGE CIRCUIT** – A circuit involving a peak open-circuit potential of not more than 42.4 V a.c. or 60 V d.c. supplied by a battery, by a Class 2 transformer or power unit, or by a combination of a transformer and a fixed impedance that as a unit, complies with all performance requirements for a Class 2 transformer or power unit. A circuit derived from a line-voltage circuit by connecting a resistance in series with the supply circuit as a means of limiting the voltage and current, is not considered to be a low voltage circuit.

3.9 **PORTABLE PRODUCT** – A product that is easily carried or moved from one place to another in normal use.

3.10 **RISK OF ELECTRIC SHOCK** – A risk of electric shock is considered to exist:

- a) At any part if the potential between the part and earth ground or any other accessible part is greater than 42.4 V peak or 60 V continuous dc and such that a continuous current through a 1500 ohm resistor connected across the potential exceeds 0.5 mA rms; or

b) Meets the definition for hazardous voltage as defined in CSA C22.2 No. 0.23 and UL 2595.

3.11 RISK OF FIRE – A risk of fire is considered to exist at a component part or assembly if an investigation shows that the supply for such part or assembly is capable of delivering a power of more than 15 W into an external resistor connected between the points in question and any return to the power supply.

4 General

4.1 General requirements

4.1.1 For products intended for use in Canada, general requirements are given in CAN/CSA-C22.2 No. 0 and grounding and bonding requirements are given in C22.2 No. 0.4.

4.1.2 Where a standard requirement indicates compliance to either a CSA or UL standard, compliance to Canadian National Requirements is achieved by meeting the requirements of the CSA standard, and compliance to U.S. National Requirements is achieved by meeting the requirements of the UL standard. Binational compliance is achieved by complying with both standards.

4.2 Components

4.2.1 Except as indicated in [4.2.2](#), a component of a product covered by this standard shall:

- a) Comply with the requirements for that component as specified in this Standard;
- b) Be used in accordance with its rating(s) established for the intended conditions of use;
- c) Be used within its established use limitations or conditions of acceptability;
- d) Additionally comply with the applicable requirements of this end product standard; and
- e) Not contain mercury, except when contained in lamps.

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

4.2.2 A component of a product covered by this standard is not required to comply with a specific component requirement that:

- a) involves a feature or characteristic not required in the application of the component in the product;
- b) is superseded by a requirement in this standard; or
- c) is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

4.3 Units Of measurement

4.3.1 The values given in SI (metric) units shall be normative. Any other values given shall be for information purposes only.”

4.3.2 Unless indicated otherwise, all voltage and current values specified in this standard are rms.

PART I – REQUIREMENTS SPECIFIC TO BATTERY- POWERED FLASHLIGHTS AND LANTERNS

CONSTRUCTION

5 Components

5.1 General

5.1.1 Components shall comply with the safety requirements specified in the relevant UL standards as far as they reasonably apply, and to the extent that:

- a) The proper functioning of the component is required for the safety of the end-product; and
- b) The component itself does not increase the risk of fire or risk of electric shock or personal injury when operated under either normal use conditions or under the abnormal conditions described in this standard.

5.1.2 Components that are generally required to comply with the safety requirements in the component standards in their entirety are specified in [5.2](#), Specific Component Requirements; others are referenced throughout this end-product standard.

5.1.3 A component that is required by this standard to comply with a particular referenced component standard shall:

- a) Be described within the scope of that standard;
- b) Be employed in the end product in a manner consistent with the intended use described in the component standard;
- c) Be used in accordance with its rating(s) established for the intended conditions of use or its established Conditions of Acceptability; and
- d) Additionally comply with the applicable requirements in this end product standard.

5.1.4 With respect to [5.1.3](#), a component of a product specified in this standard is not required to comply with a specific component requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product;
- b) Is superseded by a requirement in this standard; or
- c) Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

5.1.5 For products where various battery packs are recommended for use in the instruction manual, the most unfavorable configuration shall be selected for each test or evaluation unless otherwise specified.

5.2 Specific component requirements

5.2.1 Internal wiring

5.2.1.1 Internal wiring composed of insulated conductors subjected to hazardous voltages as defined in CSA C22.2 No. 0.23 and UL 2595 shall comply with CSA C22.2 No. 210 and UL 758.

5.2.1.2 With respect to [5.2.1.1](#), insulated conductors are not required to comply with CSA C22.2 No. 210 and UL 758 if they comply with CSA C22.2 No. 38 and UL 44, CSA C22.2 No. 75 and UL 83, UL 66, or the applicable UL standard(s) for other insulated conductor types specified in Wiring Methods and Materials, Chapter 3 of NFPA 70.

5.2.1.3 With respect to [5.2.1.1](#), Insulated conductors for specialty applications (e.g. data processing or communications) and located in a low voltage circuit not involving the risk of fire or personal injury are not required to comply with CSA C22.2 No. 210 and UL 758.

5.2.2 Gaskets and seals

5.2.2.1 Gaskets and seals that comply with UL 157, are considered to comply with the requirements in [10.2](#). Rubber or neoprene compounds relied upon for protection from rain are only required to comply with Clause [26](#), Accelerated Aging Test.

5.2.3 Marking and labeling systems

5.2.3.1 A marking and labeling system shall comply with CSA C22.2 No. 0.15 and UL 969 under the specified environmental conditions. A marking or labeling system that complies with Clause [21](#), Permanence of Marking Test, is considered to comply with this requirement.

5.2.4 Printed wiring boards

5.2.4.1 Printed wiring boards, including the coatings, shall comply with UL 796. The printed-wiring board shall have a flammability rating of V-1 or better as determined by an evaluation to CAN/CSA C22.2 No. 0.17 and UL 94. Insulating coatings shall comply with UL 746E and Annex F of CSA C22.2 No. 250.0.

5.2.4.2 With respect to [5.2.4.1](#), a printed-wiring board in a circuit other than hazardous voltage as defined in CSA C22.2 No. 0.23 and UL 2595 is not required to comply with the bonding requirements in UL 796 if the board is separated from parts of other circuits such that loosening of the bond between the foil conductor and the base material will not result in the foil conductors or components coming in contact with parts of other circuits of the control or of the end-use product.

5.2.5 Semiconductors and small electronic components

5.2.5.1 The insulation of a power switching semiconductor device that isolates live parts from the mounting surfaces shall have an isolation voltage rating not less than the electric strength test potential required in Clause [66](#), Dielectric-Voltage Withstand Test.

5.2.5.2 Optical isolators (optocouplers), used as a means of achieving electrical isolation, shall have an isolation voltage rating not less than the electric strength test potential required in Clause [66](#), Dielectric-Voltage Withstand Test.

5.2.5.3 Except as otherwise specified in this Standard, component requirements are not specified for small electronic components on printed wiring boards, including diodes, transistors, resistors, inductors, integrated circuits, and capacitors not directly connected to the supply source.

5.2.6 Lithium button or coin cell batteries

5.2.6.1 A product that incorporates or may use a lithium button or coin cell battery shall comply with UL 4200A.

5.2.7 Photovoltaic sources

5.2.7.1 Photovoltaic sources of supply shall comply with UL 1703. Each photovoltaic module shall be operated within its maximum electrical parameters. However, the possibility of overcharging of lithium-ion cells shall not be dependent on photovoltaic sources operating within their limits of current and voltage.

5.2.7.2 Photovoltaic sources of supply that comply with the following are not required to comply with CSA C22.2 No. 61730-1 and UL 61730-1, or UL 1703:

- a) The maximum output voltage is less than 30 V rms (42.4 V peak);
- b) The maximum output power is less than 100 VA;
- c) The supply is provided with backfeed protection; and
- d) The panel is not intended to be mounted on or in a building structure.

6 Frame And Enclosure

6.1 A product shall be so formed and assembled so that it will have the strength and rigidity necessary to resist the abuses that it is likely to be subjected to, without increasing the likelihood of fire, electric shock, or injury to persons due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects.

6.2 All electrical parts, except a supply cord or interconnecting cord, that may involve a risk of fire, risk of electric shock, or injury to persons under any condition of use, shall be enclosed in an acceptable enclosure. The material requirements for polymeric enclosures are specified in Clause [44](#), Polymeric Materials and Enclosures.

6.3 A polymeric enclosure, frame or cover of a product which generate ultraviolet (UV) radiation shall be suitable for UV exposure as determined by the applicable test of UL 746C or the Weatherometer Test of CAN/CSA C22.2 No. 0.17 under the conditions of exposure or shall be suitably shielded if degradation would result in noncompliance with other requirements in this Standard.

6.4 A door or a cover of an enclosure that provides access to any overload protective device intended to be reset or renewed by the user shall be hinged or otherwise attached in an equivalent manner.

6.5 Means shall be provided for holding the door or cover over a fuseholder in a closed position, and the door or cover shall be tight-fitting.

6.6 An enclosure of a product capable of being charged by solar power and comprised of a polymeric material shall comply with the Ultraviolet Light Exposure Test, UL 746C and the Weatherometer Test of CAN/CSA C22.2 No. 0.17.

6.7 A product intended to be installed outdoors shall comply with the Clause [67](#), Water Spray Test. If the enclosure is constructed of polymeric material, the enclosure shall also comply with the Ultraviolet Light Exposure Test, UL 746C and the Weatherometer Test of CAN/CSA C22.2 No. 0.17.

7 Child-Appealing Features

7.1 In addition to complying with the requirements in this standard, a product intended for children or with child-appealing features shall also comply with the applicable requirements in UL 696 and CSA C22.2 No. 62115.

7.2 Removable parts of a product intended for children or with child-appealing features shall not present a risk of injury to persons from a sharp edge after being subjected to the drop or impact test requirements in accordance with [15.2](#). Removable parts shall be tested both attached to the product and separated from the product. 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.

8 Adhesives Used To Secure Parts

8.1 An adhesive that is relied upon to reduce a risk of fire, risk of electric shock, or injury to persons shall comply with the requirements for adhesives in UL 746C and Annex DVD of CAN/CSA-C22.2 No. 60335-1.

8.2 The requirement in [8.1](#) also applies to an adhesive used to secure a conductive part, that may, if loosened or dislodged:

- a) Energize an accessible dead metal part;
- b) Make a live part accessible;
- c) Reduce spacings below the minimum acceptable values; or
- d) Short-circuit live parts.

8.3 Whether the conditions specified in [8.2](#) (a) – (d) can occur shall be considered with respect to both:

- a) A part inside the device; and
- b) A part on the outside of the device that may affect equipment in which the device shall be installed.

9 Mechanical Assembly

9.1 Parts, including switches, shall be securely mounted and shall be prevented from turning, if such repositioning results in noncompliance with this standard.

9.2 A movable joint, such as a swivel joint or telescoping arm, containing conductors shall be constructed so that movement of the joint will not result in damage to the insulation of conductors. Rotation shall be limited to 370 degrees, or the movable joint shall comply with the movable joint endurance test in Clause [22](#), Moveable Joint Rotation Test.

9.3 A movable joint containing conductors shall comply with the movable joint torsion and pull tests in Clause [23](#), Moveable Joint Torsion and Pull Test, and shall remain intact and operable.

9.4 A wall-hung product shall comply with Clause [24](#), Mounting Means Strength Test.

9.5 A handle used to support or carry a product shall comply with Clause [25](#), Strength of Handles Test.

9.6 A supporting device, such as chains, hooks, hanger holes, notches, magnets or the like used to support the product, shall comply with the requirements in [24.3](#), Products Mounted On Other Surfaces.

10 Protection Against Corrosion

10.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means, if corrosion of such unprotected parts would be likely to result in a risk of fire, risk of electric shock, or injury to persons.

10.2 With respect to [10.1](#), surfaces of sheet-steel and cast-iron parts within an enclosure may not be required to be protected against corrosion if the oxidation of the metal due to the exposure to air and moisture is not likely to be appreciable. The thickness of metal and temperature are also to be considered.

10.3 The requirement in [10.2](#) does not apply to bearings, laminations, or minor parts of iron or steel, such as washers, screws, and the like.

10.4 If deterioration of a liquid container provided as a part of a product would result in a risk of fire or risk of electric shock, the container shall be of a material that is resistant to corrosion by the liquid intended to be used therein.

11 Bushings For External Conductors

11.1 At a point where a supply cord or interconnecting cord, if damaged, may create a risk of fire, risk of electric shock, or injury to persons, passes through an opening in a wall, barrier, or enclosing case, there shall be a bushing or the equivalent that shall be reliably secured in place, and shall have a smooth, rounded surface against which the cord may bear.

11.2 An insulating bushing shall be provided if:

- a) Type SP-2, SPE-2, SPT-2, or other cord lighter than Type SV or SVE is employed;
- b) The wall or barrier is of metal; or
- c) The construction is such that the cord may be subjected to strain or motion.

11.3 With respect to [11.2](#), an insulated metal grommet having insulating material that is not less than 0.8 mm (1/32 inch) thick and fills completely the space between the grommet and the metal in which it is mounted may be used instead of an insulating bushing.

11.4 A cord hole in wood, porcelain, phenolic composition, or other non-conducting material and having a smooth, rounded surface is considered to be equivalent to a bushing.

11.5 Ceramic materials and some molded compositions are generally acceptable for insulating bushings.

11.6 A separate bushing shall not be made of wood or of hot-molded shellac-and-tar compositions.

11.7 A vulcanized fiber bushing shall not be less than 1.2 mm (3/64 inch) thick and formed and secured in place so that it will not be adversely affected by conditions of ordinary moisture.

11.8 A separate soft-rubber, neoprene, or polyvinyl chloride bushing shall not be employed in the product.

11.9 A bushing of any of the materials specified in [11.8](#) may be employed at any point in a product if used in conjunction with a type of cord for which an insulating bushing is not required. If a bushing of one of these materials is used anywhere in the product, the edges of the hole in which the bushing is mounted shall be smooth and free from burrs, fins, and the like.

11.10 At any point in a product, a bushing of the same material as, and molded integrally with, the supply cord is acceptable on a Type SP-2 or harder-service cord if the built-up section is not less than 11.6 mm (1/16 inch) thick at the point where the cord passes through the enclosure.

11.11 A flexible cord used for external interconnection shall comply with the requirements in Clause [68](#), Strain-Relief Test, unless the construction is such that the cord will be protected from stress.

12 Current-Carrying Parts

12.1 Ordinary iron or steel shall not be used as a current-carrying part. Ordinary iron or steel provided with a corrosion-resistant coating may be used for a current-carrying part if otherwise acceptable.

13 Internal Wiring

13.1 Mechanical protection

13.1.1 Wiring and connections between parts of a product shall be protected or enclosed. A length of flexible cord may be employed for external connections if flexibility is essential. See Clause [11](#), Bushings for External Conductors.

13.1.2 Wires within an enclosure, a compartment, a raceway, or the like shall be routed or otherwise protected so that damage to conductor insulation cannot result from contact with any rough or sharp part.

13.1.3 A hole through which insulated wires pass in a sheet-metal wall within the overall enclosure of a product shall be provided with a smooth, rounded bushing or shall have smooth, rounded surfaces upon which the wires may bear.

13.1.4 Insulated wires may be bunched and passed through a single opening in a metal wall within the enclosure of a product.

13.1.5 A conductor utilizing beads for insulation shall not be employed outside an enclosure.

13.1.6 Internal wiring shall consist of wires of a type or types that are acceptable for the application, when considered with respect to the temperature and voltage to which the wiring is likely to be subjected and with respect to its exposure to oil, grease, or other conditions of service to which it is likely to be subjected.

13.1.7 Thermoplastic-insulated wire employed for internal wiring shall be standard building wire or appliance wiring material acceptable for the purpose.

13.1.8 With reference to exposure of insulated wiring through an opening in the enclosure of a product, the protection of such wiring required by [13.1.1](#) is considered to exist if, when judged as though it were film-coated wire, the wiring would be acceptable according to [50.1](#) and [50.2](#). Internal wiring not so protected may be accepted if it is secured within the enclosure so that it is unlikely to be subjected to stress or mechanical damage.

13.1.9 Wiring that may be located in proximity to combustible material or may be subjected to mechanical damage shall be in armored cable, rigid metal conduit, electrical metallic tubing, metal raceway, or be otherwise equivalently protected.

13.2 Splices and connections

13.2.1 Each splice and connection shall be mechanically secure and shall provide reliable electrical contact. A soldered connection shall be mechanically secured before being soldered if breaking or loosening of the connection may result in a risk of fire or risk of electric shock.

13.2.2 Connectors that terminate a wire, other than connectors that comply with CSA C22.2 No. 153 and UL 310 or CSA C22.2 No. 65 and UL 486A-486B, shall withstand a pull of 1.1 lbf (5 N) applied for 10 s through the wire in the opposite direction from the force used to apply the connector. Neither the connector

nor the wire shall become disconnected. In the case where the direction of the application is not in line with the exit direction of the wire, then the force shall be applied in both directions, one at a time.

13.2.3 For a product in which excessive vibration is likely to occur, the requirement in [13.2.1](#) will require the use of lock washers or other equivalent means to reduce the risk of wire-binding screws and nuts from becoming loosened.

13.2.4 A splice shall be provided with insulation equivalent to that of the wires involved if permanence of spacing between the splice and other metal parts may not be maintained.

13.2.5 Aluminum conductors, insulated or uninsulated, used as internal wiring, such as for internal connection between current-carrying parts or as motor windings, shall be terminated by a method acceptable for the combination of metals involved at the point of connection.

13.2.6 With reference to the requirements in [13.2.5](#), a wire-binding screw or a pressure wire connector used as a terminating device shall be acceptable for use with aluminum.

13.2.7 Insulation consisting of two layers of friction tape, two layers of thermoplastic tape, or of one layer of friction tape on top of one layer of rubber tape is acceptable on a splice if the voltage involved is less than 250 V. In determining if splice insulation consisting of coated-fabric, thermoplastic or other type of tubing is acceptable, consideration shall be given to such factors as its dielectric properties, heat-resistant and moisture-resistant characteristics, and the like. Thermoplastic tape wrapped over a sharp edge is not acceptable.

13.2.8 If stranded internal wiring is connected to a wire-binding screw, loose strands of wire shall be prevented from contacting other uninsulated live parts that are not always of the same polarity as the wire and from contacting dead metal parts. This may be accomplished by use of pressure terminal connectors, soldering lugs, crimped eyelets, soldering all strands of the wire together, or other reliable means.

14 Sharp Edges

14.1 An enclosure, a frame, a guard, a handle, or the like shall not be sufficiently sharp to constitute a risk of injury to persons in normal maintenance and use.

PERFORMANCE – ALL PRODUCTS

15 Mechanical Strength Test

15.1 A product shall comply with the test specified in [15.2](#). As a result of the test, there shall be no condition or damage that could result in a risk of injury to persons. In addition, the product shall comply with:

- a) The requirements in CSA C22.2 No. 0.23 and UL 2595 in battery-operated mode;
- b) The requirements in Clause [50](#), Accessibility Of Uninsulated Live Parts And Film-Coated Wire, with respect to uninsulated live parts for products powered by line-voltage supply; and
- c) The requirements in Clause [65](#), Dielectric Voltage-Withstand Test, with respect to a condition that would increase the likelihood of an electric shock for products powered by line-voltage supply.

15.2 The product with any batteries connected shall be dropped in accordance with (a), (b) or (c) at room ambient. A product with operating instructions that allow the product to be charged at a temperature of 10 °C (50 °F) or lower shall additionally be dropped or impacted after conditioning at 0 ±1 °C (32 ±1.8 °F) and maintained at this temperature for 3 hours. A solar-powered product as specified in [6.6](#) shall be

cooled to a temperature of minus 35.0 ± 2.0 °C (minus 31.0 ± 3.6 °F) and maintained at this temperature for 3 hours. While the product is still at the conditioned temperature, the product shall be subjected to the impact specified in (a) – (b), as applicable. For the test, the product shall be equipped and configured as specified in the instruction manual or as intended during normal use. After the test, compliance with this standard shall not be impaired. Batteries shall be fully charged prior to the test in accordance with Clause [29](#), Operating Instructions.

- a) A product that is hand-held, body supported, or having a supporting device as specified in [9.6](#), with any detachable battery pack attached, is to withstand being dropped three times in total on a concrete surface from a height of 1 m (3.3 ft). For these three drops, the sample shall be tested in the three most unfavorable positions, the lowest point of the product being 1 m (3.3 ft) above the concrete surface.
- b) A counter- or bench-supported product with the battery pack attached is to withstand three impacts of a 50 ± 2 mm (2.0 ± 0.08 in) steel ball dropped with a minimum impact energy of 1.02 J (0.75 ft-lbf). The point of impact shall be varied without striking the same location more than once in an effort to produce the most adverse results.
- c) A floor-supported product with the battery pack attached shall withstand three impacts of a 50 ± 2 mm (2.0 ± 0.08 in) steel ball dropped with a minimum impact energy of 6.8 J (5 ft-lbf). The point of impact shall be varied without striking the same location more than once in an effort to produce the most adverse results.

16 Stability Test

16.1 A product, other than those that are completely hand supported in normal use and those with a mass less than 3 kg (6.6 lbs) and height less than 200 mm (7.87 in), shall be tested as specified in [16.2](#) – [16.4](#). As a result of the test, the product shall not overturn.

16.2 The product is not to be energized during the stability test. The test shall be conducted under conditions most likely to cause the product to overturn. The following conditions shall be such as to result in the least stability:

- a) Position of all doors, drawers, casters, and other movable or adjustable parts, including that of the supply cord resting on the surface supporting the product;
- b) Connection of or omission of any attachment made available or recommended by the manufacturer;
- c) Provision of or omission of any normal load if the product is intended to contain a liquid or other mechanical load; and
- d) Direction in which the product is tipped or the supporting surface is inclined.

16.3 In conducting the stability test, the product shall be:

- a) Placed on a plane inclined at an angle of 10° from the horizontal; or
- b) Tipped through an angle of 10° from an at rest position on a horizontal plane.

16.4 With reference to the requirement in [16.3\(b\)](#), for a product that is constructed so that while being tipped through an angle of 10° , a part or surface of the product not normally in contact with the horizontal supporting surface touches the supporting surface before the product has been tipped through an angle of 10° , the tipping shall be continued until the surface or plane of the surface of the product originally in contact with the horizontal supporting surface is at an angle of 10° from the horizontal supporting surface.

17 Exterior Surfaces Test

17.1 A product, when operated as specified in CSA C22.2 No. 0.23 and Clause 9, Heating Test, of UL 2595 and, if applicable, the requirements in Clause 64, Temperature Test, shall not attain a temperature of more than 125 °C (257 °F) on any exterior surface in proximity to the light source that may be laid on combustible material or against which combustible material may be laid, and there shall be no emission of smoke or molten material.

17.2 For a product as specified in 17.1, temperatures may exceed 125 °C (257 °F) on exterior surfaces in proximity to the light source, if the product is marked in accordance with 27.3.2, includes the instructions in accordance with 28.1(i) and complies with the tests in (a) or (b), as applicable.

a) If the light source is operable while the product is counter supported, there shall be no ignition of the supporting surface when the product is operated continuously while positioned as close to and directed towards the softwood supporting surface to the greatest degree permitted and in a position representing the most severe condition by the unit construction. The supporting surface shall be knot-free softwood covered with a double layer of white tissue paper.

b) For a direct plug-in product, if the light source is operable while the product is supported by the receptacle, there shall be no exposure of live parts or ignition of the vertical softwood surface when the product is operated continuously while positioned as close to and directed towards a vertical softwood surface to the greatest degree permitted and in a position representing the most severe condition by the unit construction. The vertical surface shall be knot-free softwood covered with a double layer of white tissue paper and positioned at 90° from the wall supporting the receptacle.

18 Radiation

18.1 A product that produces radiation, such as visible, ultraviolet, or infrared light, created by optical sources, such as lasers, LEDs, or lamps, shall be investigated with respect to the effects of the radiation on users and service personnel as specified in 18.2 for coherent optical sources and 18.3 for non-coherent optical sources.

18.2 If a product is fitted with a laser, the laser class shall be:

a) 2M or lower; or

b) Be designed such that human accessible emission is less than Class 2M limits according to IEC 60825-1.

In addition, the product shall be marked with the symbol(s) as required by IEC 60825-1 for the relevant laser class.

18.3 If a product is fitted with non-coherent light sources, users of products shall be cautioned as to the risk of potential photo-biological harm, if such harm exists. Depending on the type of light source, the requirements in 18.4, 18.5 or 18.6 apply.

18.4 Visible light indicators (pilot lamps) and infrared sources used for signaling and communication are considered to have no risk of photo-biological harm and require no marking.

Note: This requirement is associated with sources being no greater than Risk Group 1.

18.5 Products emitting visible light from electroluminescent, incandescent or LED sources are considered to be for short term, non-general light services use where exposure is both incidental and intermittent. Products emitting light from these sources shall be marked in accordance with 27.1.11.

Note 1: This requirement is associated with sources being no greater than Risk Group 2.

Note 2: Hazards associated with sources of Risk Group 3 or greater are not addressed by the requirements in this standard.

18.6 With respect to products specified in [18.5](#), the marking of [27.1.11](#) is not required if the emitted light, as measured by the methods specified in IEC 62471, poses no reasonable risk of harm. No reasonable risk or harm from the emitted light is considered if either:

- a) At a distance of 200 mm along any direction of the product, the light emission is less than 500 Lux;
- b) In the range of visible light, the luminance light emission is less than 10,000 cd/m²;
- c) The light source (if not focused by external optics) is in Risk Group 1 or lower; or
- d) The product itself is determined to be in Risk Group 1 or lower.

18.7 For sources other than those specified in [18.5](#) the product shall be evaluated:

- a) In accordance with Clause [19](#), Ultraviolet (UV) Photobiological Safety Assessment, for ultraviolet sources; or
- b) Not be greater than Risk Group 2 as determined by CSA C22.2 No. 62471 and IEC 62471 otherwise.

18.8 Products that include elements where there may be risks encountered due to the emission of radio frequency radiation other than light or the inclusion of radioisotopes, such as Light Emitting Plasma (LEP), shall be additionally evaluated by the relevant standards or national regulations associated with the exposure to these emissions.

19 Ultraviolet (UV) Photobiological Safety Assessment

19.1 An ultraviolet (UV) radiation source shall not pose a risk of optical injury to persons due to exposure necessary for the normal operation, maintenance and servicing of the equipment. A UV-emitting source shall be fully shielded by opaque (non-light transmitting) materials unless the product complies with either [19.2](#) or [19.3](#).

19.2 Each LED within the product shall emit less than 10 percent of its relative intensity below 400 nm as indicated by the LED manufacturer's data.

19.3 The product shall be subjected to a photobiological safety assessment across the wavelength range from 200 nm through 400 nm in accordance with the requirements in CSA C22.2 No. 62471 or IEC 62471. The measurement distance from the radiation source to the measuring instrument shall be set at 20 cm (7.9 in) as recommended in CSA C22.2 No. 62471 or IEC 62471 for a non-GLS (general lighting services) light source for ultraviolet hazard from the spectral band 200 nm to 400 nm.

Note: "Exempt Group" is considered to be an optical source that does not pose any photobiological hazard.

19.4 The assigned IEC 62471 risk group classification for the product resulting from the photobiological safety assessment shall not be greater than "Exempt Group" as specified in CSA C22.2 No. 62471 or IEC 62471.

Note: "Exempt Group" is considered to be an optical source that does not pose any photobiological hazard.

20 Ozone Test

20.1 A product that produces ozone during normal operation shall be tested as specified in [20.3](#) – [20.6](#). As a result of the test, the product shall not produce an average time weighted concentration above background in excess of 0.1 part per million, nor a transitory concentration of more than 0.3 part per million.

20.2 With reference to the requirement in [20.1](#), the normal functioning of electrical contact points is not considered to be capable of generating an unacceptable concentration of ozone.

20.3 Ozone concentration shall be measured at all operating positions while the product is located in the center of a closed room of 1,000 ft³ (28.3 m³), approximately 8 by 12 by 10 ft (2.4 by 3.7 by 3.0 m). All test room walls shall be covered with sheet polyethylene.

20.4 The room shall be maintained at a temperature of approximately 25 °C (77 °F) and a relative humidity of 50 %. Prior to and immediately after the test, the ozone background level shall be measured with the product off. The background level average shall be calculated and subtracted from the maximum measurement during the test.

20.5 During the test, the product shall be operated in the same manner and for the length of time as specified in CSA C22.2 No. 0.23 and Clause 9, Heating Test, of UL 2595 and, if applicable, the requirements in Clause [64](#), Temperature Test. The average time weighted concentration shall be considered as the average concentration of ozone extrapolated for an 8-hour operating period.

20.6 If the product can be operated with any of its fans, heaters, or the like not functioning, with replaceable charges, filters, or the like removed, or with paper, fluid, or the like exhausted, the test specified in [20.3](#) – [20.5](#) shall be repeated a sufficient number of times with the various components not operating or with the items removed or exhausted to determine that these conditions do not result in ozone emission exceeding that specified in [20.1](#).

21 Permanence Of Marking Test

21.1 A marking that is required to be permanent shall be molded, die-stamped, paint-stenciled, stamped or etched metal that is permanently secured, or indelibly stamped lettering on a pressure-sensitive label secured by adhesive that, upon investigation, is found to be acceptable for the application. Ordinary usage, handling, storage, and the like of a product are considered in the determination of the permanence of a marking.

21.2 Unless it has been investigated and found to be acceptable for the application, a pressure-sensitive label or a label that is secured by cement or adhesive and that is required to be permanent shall comply with the applicable requirements in UL 969 and CSA C22.2 No. 0.15.

22 Movable Joint Rotation Test

22.1 A movable joint specified in [9.2](#) shall be tested as specified in [21.2](#). As a result of the test, there shall not have damage to the jacket or the insulation of the conductors.

22.2 The movable joint specified in [22.1](#) shall be capable of withstanding 6,000 cycles of motion, linear or rotational. One cycle shall consist of moving the part to the maximum extent possible in one direction and back again, then to the maximum extent possible in the opposite direction.

23 Movable Joint Torsion And Pull Test

23.1 A movable joint as specified in [9.3](#) shall be tested as specified in [23.2](#). As a result of the test, there shall not be damage to the product that results in a risk of fire, risk of electric shock, or injury to persons.

23.2 The movable joint specified in [23.1](#) shall be subjected to the following conditions for 1 minute:

- a) A torsion of $2.26 \pm 0.056 \text{ N}\cdot\text{m}$ ($20 \pm 0.5 \text{ lb}\cdot\text{in}$); and
- b) A straight pull applied by a mass of 16 kg (35 lb) or four times the maximum weight recommended by the manufacturer, whichever is greater.

24 Mounting Means Strength Test

24.1 General

24.1.1 A product intended to be mounted or installed, on a wall, ceiling, or other supporting structure shall be tested as in [24.2](#), Wall-Hung Products, for wall-mounted products or [24.3](#), Products Mounted On Other Surfaces, for all other mounted products.

24.1.2 For products intended for mounting on a wall and, alternatively, other surfaces, the product shall comply with the tests specified in [24.2](#), Wall-Hung Products, and [24.3](#), Products Mounted On Other Surfaces.

24.2 Wall-hung products

24.2.1 A wall-hung product, other than those mounted by magnets, shall be tested as specified in [24.2.2](#). As a result of the test, the effectiveness of the mounting or hanging means shall not be impaired.

24.2.2 The product shall be mounted in accordance with the manufacturer's installation instructions using fasteners and constructions (brackets, screws, and similar limitations specified by the manufacturer) as described. When the support surface is not specified, a support surface of 9.5-mm 3/8-in thick drywall (plasterboard) on 2 by 4 studs on 406-mm (16-inch) centers shall be used. Fasteners shall be applied as specified in the instructions or, when not specified, shall be positioned in the drywall between studs. An adjustable product shall be adjusted to the position that gives the maximum projection from the wall. A gradually increasing force shall be applied to act vertically through the center of gravity of the product in the extended position. The force shall be increased over a period of not less than 5 and not more than 10 seconds until a load of four times the weight of the product, and not less than 10 lb (44.5 N), is applied to the mounting system. The load shall be maintained for 1 minute.

Note: 2 by 4 studs are made of softwood, such as spruce or pine, and have actual dimensions of 38.1 mm (1-1/2 inch) by 88.9 mm (3-1/2 inches). The drywall is affixed to the 38.1 mm (1-1/2 inch) surfaces.

24.3 Products mounted on other surfaces

24.3.1 A product, other than those marked in accordance with [28.1\(g\)](#), shall be tested as specified as in [24.3.2](#). As a result of the test, the effectiveness of the mounting or hanging means shall not be impaired.

24.3.2 The product shall be hung in the intended manner in accordance with the manufacturer's installation instructions. A weight equal to three times the weight of the product shall be applied to the product, positioned so that it is approximately in the geometric center axis of the equipment. The weight shall be applied for 5 minutes.

25 Strength Of Handles Test

25.1 To determine compliance with the requirement in 9.5, a product shall be tested as specified in 25.2 and 25.3. As a result of the test, a handle used to support or carry a product shall not become detached from the product or have the function of the handle impaired.

25.2 The weight of the product plus a force of three times the weight of the product shall be used. The load shall be uniformly applied over a 76 mm (3 inch) width at the center of the handle, without clamping. The load shall be started at zero and gradually increased so that the test value is attained in 5 –10 seconds; the test values shall be maintained for 1 minute. If a product has more than one handle and cannot be carried by one handle, the distribution of forces shall be determined by measuring the percentage of the product weight sustained by each handle with the product in the normal carrying position. If a product is furnished with more than one handle and can be carried by only one handle, each handle is to withstand the total force.

25.3 If the handle, its securing means, or that portion of the enclosure to which the handle is attached is constructed of polymeric material, the test specified in 25.2 shall be conducted both in the as-received condition and following mold-stress relief conditioning, in accordance with CAN/CSA C22.2 No. 0.17 and UL 746C.

26 Accelerated Aging Test

26.1 A rubber or other elastomeric compound, other than forming a part that is depended upon for protection from rain shall be tested as specified in 26.2 and 26.3. As a result of the test, the part shall have physical properties as specified in Table 26.1 before and after aging.

Table 26.1
Accelerated Aging Test

Temperature of component during temperature test		Accelerated aging procedure	Minimum acceptable percent of unaged value for samples	
°C	°F		Tensile strength	Elongation
60 or less	140 or less	Air oven aging for 70 h at 100 °C ±1.0 °C (212 ±1.8 °F)	60	60
61 – 75	142 – 167	Air oven aging for 168 h at 100 °C ±1 (212 ±1.8 °F)	50	50
76 – 90	169 – 194	Air oven aging for 168 h at 121.0 ±1.0 °C (249.8 ±1.8 °F)	50	50
91 – 105	196 – 221	Air oven aging for 168 h at 136.0 ±1.0 °C (276.8 ±1.8 °F)	50	50

26.2 The test procedure for determining whether a part complies with the requirement in 26.1 depends upon the material of which it is composed, its size and shape, the application in the product, and other factors. The test procedure may include visual inspection for cracks, deformation, and the like after accelerated aging, as well as comparison of hardness, tensile strength, and elongation before and after accelerated aging.

26.3 With reference to the requirements in 26.1 and 26.2, a part of rubber or other elastomeric compound, if tested to compare its tensile strength and elongation before and after accelerated aging, is acceptable if these properties are not less than the minimum values specified in Table 26.1, corresponding to the temperature of the component during the temperature test. Neoprene rubber is acceptable for 60 °C (140 °F) and silicone rubber is acceptable for 105 °C (221 °F) without being subjected to the test.

MARKING

27 Details

Advisory Note: In Canada, there are two official languages, English and French. Annex [A](#) provides translations in French of the English 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.

27.1 General

27.1.1 A product shall be plainly and permanently marked where it will be readily visible. For a permanently connected product, the marking shall be readily visible after installation with:

- a) The manufacturer's name, trade name, or trademark, or other descriptive marking by which the organization responsible for the product may be identified;
- b) A distinctive catalog number or the equivalent; and
- c) The date or other dating period of manufacture not exceeding any three consecutive months.

27.1.2 With respect to [27.1.1\(a\)](#), the manufacturer's identification may be in a traceable code if the product is identified by the brand or trademark owned by a private labeler.

27.1.3 With respect to [27.1.1\(c\)](#), the date of manufacture may be abbreviated; or may be in a nationally accepted conventional code or in a code affirmed by the manufacturer, provided that the code does not:

- a) Repeat in less than 10 years; and
- b) Require reference to the production records of the manufacturer to determine when the product was manufactured.

27.1.4 A cautionary marking intended to instruct the operator shall be legible and visible from the position normally assumed by the operator when starting the product or from the position normally assumed for the specific operation involved. Other such markings for servicing or making settings and adjustments shall be legible and visible to the individual when such work is being accomplished.

27.1.5 A marking intended to inform the user of a risk of fire, risk of electric shock, or injury to persons shall be prefixed by a signal word "CAUTION," "WARNING," or "DANGER." The signal word shall be in letters not less than 2.4 mm (3/32 inch) high. The signal word shall be more prominent than any other required marking on the product and shall not be separated from the cautionary statement.

27.1.6 A cautionary marking shall be permanent and legible and shall be located on a permanent part of the product. See Clause [21](#), Permanence of Marking Test.

27.1.7 A product or a separately packaged attachment having a hidden or unexpected risk of fire, risk of electric shock, or injury to persons shall be marked to inform the user of the risk.

27.1.8 If a manufacturer produces or assembles products at more than one factory, each finished product shall have a distinctive permanent marking by means of which it may be identified as the product of a particular factory.

27.1.9 An attachment that is packaged and marketed separately from the basic product and recommended by the manufacturer for use on the basic product shall be marked to identify the basic

product with which it is intended to be used. The marking shall appear in at least one of the following locations:

- a) On the attachment;
- b) On the package housing the attachment;
- c) In the instruction manual for the basic product; or
- d) In the instruction manual furnished with the attachment.

27.1.10 A product intended to be operated at different voltages by means of a selector switch shall be clearly marked as to which input voltage corresponds to each position.

27.1.11 A product as described in [18.5](#) shall be marked:

- a) "CAUTION – Do not stare at operating lamp.";
- b) The symbol IEC 60417-6041 of IEC 60417 DATABASE; or
- c) The symbol IEC 60417-6159-1 of IEC 60417 DATABASE.

27.2 Products suitable for rain

27.2.1 A product that is not intended to be used in the rain shall be marked "Do not expose to rain." or "indoor use" or the equivalent.

27.2.2 A product that has been found suitable for exposure to rain in accordance with Clause [66](#), Water Spray Test, and with reference to [31.1](#)(b) as applicable, does not require marking specified in [27.2.1](#).

27.3 Hot surfaces

27.3.1 Products with surface temperatures near the light source exceeding the limits in Maximum Outside Surface Temperature Rises, K, Table 9.1 of UL 2595 or CSA C22.2 No. 0.23, shall be marked with the following or equivalent: "WARNING – Hot Surface: Risk of Burns – Do Not Touch." Or symbol W017 as specified in ISO 7010.

27.3.2 Products with exterior temperatures near the light source exceeding the 125 °C (257 °F) in accordance with Maximum Outside Surface Temperature Rises, K, Table 9.1 of UL 2595 or CSA C22.2 No. 0.23, shall additionally be marked with the following statement or the equivalent: "WARNING – Keep Away From Combustible Materials – Risk of Fire."

INSTRUCTIONS

28 Safety Warnings

28.1 The instructions pertaining to a risk of fire, risk of electric shock, or injury to persons shall include those items in the following list that are applicable to the product. Equivalent wording in equally definitive terminology may be used when they comply with the intent of the instructions, except for the signal word.

WARNING – When using flashlights or lanterns, additional precautions should always be followed, including the following:

- a) To reduce the risk of injury, close supervision is necessary when a product is used near children.

- b) Do not contact hot parts.
 - c) Only use attachments recommended or sold by the manufacturer.
 - d) Do not use in the rain. (This warning is not required if the product has been evaluated for exposure to rain.)
 - e) To reduce the risk of electrical shock, do not put + in water or other liquid. Do not place or store product where it can fall or be pulled into a tub or sink.
- + Replace with specific part of product in question.
- f) For a product that does not comply with [18.5](#), the following statement, or the equivalent, is required:

"WARNING: To reduce the risk of injury, do not stare at operating lamp. Serious eye injury could occur."
 - g) For a product that employs a magnet for mounting, other than those that comply with the test in [24.3](#), Products Mounted on Other Surfaces, the following statement, or the equivalent, is required:

"WARNING: Do not use magnet for horizontal overhead mounting."
 - h) Products with surface temperatures near the light source exceeding the limits in accordance with Maximum Outside Surface Temperature Rises, K, Table 9.1 of UL 2595 or CSA C22.2 No. 0.23, shall be provided with the following instructions or the equivalent, "WARNING – The lens gets very hot during use. To reduce the risk of burns, do not touch hot lens."
 - i) Products with exterior surface temperatures near the light source exceeding 125 °C (257 °F) in accordance with Maximum Outside Surface Temperature Rises, K, Table 9.1 of UL 2595 or CSA C22.2 No. 0.23, shall be provided with the instructions in accordance with [29.1](#) with the addition of the following statement or the equivalent, "To reduce the risk of fire, keep away from combustible materials while in operation."

29 Operating Instructions

29.1 Operating instructions shall contain all the information required to operate the product as intended, and shall be preceded by the heading "OPERATING INSTRUCTIONS" or the equivalent.

29.2 With respect to [29.1](#), instructions and warnings provided in accordance with the requirements for instructions pertaining to a risk of fire, risk of electric shock, or injury to persons in Clause [28](#), Safety Warnings, and, if applicable, Clause [77](#), Installation Instructions, are not required to be repeated in the operating instructions if there is a reference to the applicable instructions and warnings in the operating instructions.

29.3 Operating instructions shall explain and describe the location, function, and operation of each user-operated control of the product, and warn against tampering with such devices.

29.4 The literature accompanying a package containing a basic product and attachments intended to be marketed as a complete unit shall indicate what attachments are intended for use with the basic product if use of such attachments may expose the user to a risk of injury.

29.5 For a product intended to be operated at multiple rated input voltages by use of a selector switch, instructions for the proper use of the switch shall be included in the instructions.

29.6 An explanation of the symbols required by this standard and used on the product shall be provided in the instructions.

30 User Maintenance Instructions

30.1 Instructions for user maintenance shall include explicit instructions for all cleaning and servicing – adjustments, and similar operations – that are intended to be performed by the user, and shall be preceded by the heading "USER-MAINTENANCE INSTRUCTIONS" or the equivalent.

30.2 Instructions shall indicate to the user the proper method of replacement. For user replaceable lamps, the permitted replacement lamps by manufacturer and part number shall be specified. Lamps intended for service replacement only shall be clearly marked to indicate the need for servicing.

31 Applicable Construction and Performance Requirements from C22.2 No. 0.23 and UL 2595

31.1 Battery-powered products, shall comply with the requirements specified in CSA C22.2 No. 0.23 and UL 2595, and with the conditions and specifications as specified in Indent Instructions, Annex D of CSA C22.2 No. 0.23 and UL 2595, as specified in (a) – (i).

a) Indent A – The requirements in Part 2 of this standard do not apply in their entirety, except as amended below:

1) The portions of Clause [67](#), Water Spray Test, that require the outcome of conditioning or testing to comply with dielectric voltage withstand and/or leakage current, and the wetting of any electrical components, shall instead consider increased risk of fire, risk of electric shock, or injury to persons for those areas where the voltages are in excess of the hazardous voltage. (See Clause 8, Protection Against Electric Shock, of CSA C22.2 No. 0.23 and UL 2595.)

2) The test specified in Clause [15](#), Mechanical Strength Test, applies to the product, but the acceptance/compliance criteria of Clause 15, Mechanical Strength Test, of CSA C22.2 No. 0.23 and UL 2595 is also to be applied.

b) Indent B – Products intended to be hand-held and suitable for the use in the rain as specified in Products Suitable for Rain, [27.2](#), are likely to have users that are wet during use.

c) Indent C – An LT specification is required for products used in unheated spaces. An ELT: -35 °C specification is required for solar-powered products as described in [6.6](#).

Note: These requirements are consistent with those specified in [15.2](#).

d) Indent D – During the heating test, the product is operated at its highest output setting in the orientation or configurations specified in the instruction manual that would yield the highest temperatures. For an automatic flashlight or lantern, the product shall be operated with the light energized.

e) Indent E – The temperature limits specified in CSA C22.2 No. 0.23 and UL 2595, are considered suitable. The lens and surrounding bezel of the product may exceed the indicated temperature rise if marked as specified in [27.3.1](#), except that if the temperature exceeds 125 °C (257 °F), the product shall additionally be marked as required in [27.3.2](#).

f) Indent F – The following additional abnormal condition shall be conducted. For the shorted bulb test, one sample shall be operated with the bulb shorted. The "on-off" switch shall be closed so that the bulb circuit is energized.

g) Indent G – Additional or alternative Safety Critical Functions (SCFs) are specified in [Table 31.1](#).

- h) Indent H – The impact surface shall be concrete.
- i) Indent I – Products specified in this standard do not require this additional protection.
- j) Indent J – Battery-operated products that may also be operated or charged by mains or a non-isolated source as described in CSA C22.2 No. 0.23 and UL 2595, shall also comply with the requirements in Part 2 of this Standard that apply to the risk of electric shock. For those products that are designed for direct plug-in to 5-15R and 5-20R receptacles, as defined in ANSI/NEMA WD6, and the requirements for the construction of direct plug-in power units of CSA C22.2 No. 223 and UL 1310 apply. Products that contain motors that are connected to mains or a non-isolated source shall also comply with the applicable requirements in CSA C22.2 No. 68 and UL 73.

Table 31.1
Flashlights and Lanterns – Required Performance Levels

Type and purpose of SCF	Minimum Performance Level (PL)
A timer or time switch, incorporating electronic timing circuits or switching circuits, with or without separable contacts, that functions as a protective control, as specified in 45.5 .	b

PART II – REQUIREMENTS SPECIFIC TO BATTERY-POWERED FLASHLIGHTS AND LANTERNS ALSO POWERED BY LINE-VOLTAGE SUPPLY

32 General

- 32.1 All requirements in this standard apply unless otherwise specified in Part II of this standard.
- 32.2 A flashlight or lantern which may also be powered by supply voltage and intended to be employed as nightlights shall also comply with CSA C22.2 No. 256 and UL 1786.

33 Attachment Plugs, Receptacles, Connectors, and Terminals

33.1 Attachment plugs, receptacles, appliance couplers, appliance inlets (motor attachment plugs), and appliance (flat iron) plugs, shall comply with the following as applicable:

- a) CSA C22.2 No. 42 and UL 498; or
- b) CSA C22.2 No. 60320-1 and UL 60320-1.

See [33.10](#).

33.2 Attachment plugs and appliance couplers integral to cord sets or power supply cords are not required to comply with the standards referenced in [33.1](#) if the devices are investigated in accordance with the requirements in CSA C22.2 No. 21 and UL 817.

33.3 A fabricated pin terminal assembly(ies) is not required to comply with CSA C22.2 No. 21 and UL 498 if it complies with the following and the applicable performance requirements when tested in the end-product standard:

- a) Clause [9](#), Mechanical Assembly;
- b) Clause [12](#), Current-Carrying Parts;
- c) Clause [50](#), Accessibility Of Uninsulated Live Parts And Film-Coated Wire; and

d) Clause [60](#), Spacings.

33.4 Wire connectors shall comply with CSA C22.2 No. 65 and UL 486A-486B.

33.5 Splicing wire connectors shall comply with CSA C22.2 No. 188 and UL 486C.

33.6 Multi-pole splicing wire connectors that are intended to facilitate the connection of hard-wired utilization equipment to the branch-circuit conductors of buildings shall comply with CSA C22.2 No. 2459 and UL 2459. See [33.10](#).

33.7 Equipment wiring terminals for use with all alloys of copper, aluminum, or copper-clad aluminum conductors, shall comply with CSA C22.2 No. 65 and UL 486E.

33.8 Terminal blocks shall comply with CSA C22.2 No. 158 and UL 1059, and, if applicable, be suitably rated for field wiring.

33.9 With respect to [33.8](#), other than protective conductor terminal blocks, a fabricated part performing the function of a terminal block is not required to comply with CSA C22.2 No. 158 and UL 1059, if the part complies with the requirements in Clause [12](#), Current-Carrying Parts, and Clause [60](#), Spacings of this end-product standard and the applicable performance requirements when tested in the end product.

33.10 Female devices (such as receptacles, appliance couplers, and connectors) that are intended, or that may be used, to interrupt current in the end product, shall be suitably rated for current interruption of the specific type of load, when evaluated with its mating plug or connector. For example, an appliance coupler that can be used to interrupt the current of a motor load shall have a suitable horsepower rating when tested with its mating plug.

34 Boxes and Raceways

34.1 Electrical boxes, and the associated bushings and fittings, and raceways, of the types specified in Wiring Methods and Materials, Chapter 3 of NFPA 70 and that comply with the relevant UL standard (such as CSA C22.2 No. 18.1 and UL 514A, CSA C22.2 No. 18.2 and UL 514C, CSA C22.2 No. 42.1 and UL 514D, and [5.1](#), Components – General) are considered to comply with the requirements in this end-product standard.

35 Controls

35.1 A thermal cutoff shall comply with CSA C22.2 No. 60691 and UL 60691.

36 Cords, Cables, and Internal Wiring

36.1 A cord set or power supply cord shall comply with CSA C22.2 No. 21 and UL 817.

36.2 Flexible cords and cables shall comply with CSA C22.2 No. 49 and UL 62. Flexible cord and cables are considered to comply with this requirement when preassembled in a cord set or power supply cord that complies with CSA C22.2 No. 21 and UL 817.

36.3 A flexible power supply cord provided with a work light or hand light shall not be lighter than Junior Hard Service cord, such as Type SJ.

36.4 A portable hand light provided with a candelabra- or intermediate-base lampholders and are not provided with a receptacle may employ Type SVT, SVTO, SVTOO, SVOO flexible cord when the light is marked in accordance with [75.5.1](#).

36.5 Internal wiring composed of insulated conductors shall comply with CSA C22.2 No. 210 and UL 758.

36.6 With respect to [36.5](#), insulated conductors are not required to comply with CSA C22.2 No. 210 and UL 758 if they comply with CSA C22.2 No. 38 and UL 44, CSA C22.2 No. 75 and UL 83, UL 66, or with the applicable UL standard(s) for other insulated conductor types specified in Wiring Methods and Materials, Chapter 3 of NFPA 70.

36.7 With respect to [36.5](#), insulated conductors for specialty applications (e.g. data processing or communications) and located in a low-voltage circuit not involving the risk of fire or personal injury are not required to comply with CSA C22.2 No. 210 and UL 758.

37 Cord Reels

37.1 A cord reel shall comply with "special use cord reel" requirements in C22.2 No. 308 and UL 355.

38 Film-Coated Wire (Magnet Wire)

38.1 The component requirements for film-coated wire and Class 105 (A) insulation systems are not specified.

38.2 Film-coated wire in intimate combination with one or more insulators, and incorporated in an insulation system rated Class 120 (E) or higher, shall comply with the magnet wire requirements in UL 1446.

39 Ground-Fault, Arc-Fault, and Leakage Current Detectors/Interrupters

39.1 Ground-fault circuit-interrupters (GFCI) for protection against electrical shock shall comply with CSA C22.2 No. 144.1 and UL 943. The following statement, or equivalent, shall be included as a marking near the GFCI, or as an instruction in the manual: "Press the TEST button (then RESET button) every month to assure proper operation."

39.2 Appliance-leakage-current interrupters (ALCI) for protection against electrical shock shall comply with CSA C22.2 No. 270 and UL 943B. An ALCI is not considered an acceptable substitute for a GFCI when a GFCI is required.

39.3 Equipment ground-fault protective devices shall comply with UL 1053, and the applicable requirements in CSA C22.2 No. 144.1 and UL 943.

39.4 Arc-fault circuit-interrupters (AFCI) shall comply with CSA C22.2 No. 270 and UL 1699.

39.5 Leakage-current detector-interrupters (LCDI) and any shielded cord between the LCDI and the product shall comply with CSA C22.2 No. 270 and UL 1699.

40 Insulation Systems

40.1 Materials used in an insulation system that operates above Class 120 (E) temperatures shall comply with UL 1446.

40.2 All insulation systems employing integral ground insulation shall comply with the requirements specified in UL 1446.

41 Light Sources and Associated Components

41.1 Other than for lampholders that form part of a luminaire and that comply with the applicable UL luminaire standard, lampholders and indicating lamps with integral lamp/lampholder (e.g. neon pilot lamp) shall comply with CSA C22.2 No. 43 and UL 496.

41.2 Other than for ballasts forming part of a luminaire that comply with the applicable UL luminaire standard, lighting ballasts shall comply with CSA C22.2 No. 74 and UL 935 or UL 1029.

42 Overcurrent Protection

42.1 Fuses shall comply with CSA C22.2 No. 248.1 and UL 248-1, and the applicable Part 2 (e.g. CSA C22.2 No. 248.5 and UL 248-5). Defined use fuses that comply with CSA C22.2 No. 248.1 and UL 248-1 and another applicable standard for the fuses are considered to comply with this requirement.

42.2 Fuseholders shall comply with CSA C22.2 No. 4248.1 and UL 4248-1, and the applicable Part 2 (e.g. CSA C22.2 No. 4248.9 and UL 4248-9).

42.3 Supplementary protectors shall comply with CSA C22.2 No. 235 and UL 1077.

42.4 Fusing resistors shall comply with UL 1412.

43 Polymeric Materials and Enclosures

43.1 Unless otherwise specified in this end product standard, polymeric electrical insulating materials and enclosures for a direct plug-in or cord-connected product shall comply with the applicable requirements in CAN/CSA-C22.2 No. 0.17 and UL 746C.

43.2 Metallized or painted polymeric parts or enclosures shall comply with the applicable requirements in CAN/CSA-C22.2 No. 0.17 and UL 746C. This requirement is not applicable to exterior surfaces of polymeric enclosure materials or parts, provided that the metallized coating or paint does not offer a continuous path for an internal flame to propagate externally.

43.3 A power switching semiconductor device that is relied upon to provide isolation to ground shall comply with UL 1557. If considered necessary, the dielectric voltage withstand tests required by UL 1557 shall be conducted applying the criteria of Clause 65, Dielectric Voltage-Withstand Test.

44 Supplemental Insulation, Insulating Bushings, and Assembly Aids

44.1 The requirements for supplemental insulation (e.g. tape, sleeving or tubing) are not specified unless the insulation or device is required to comply with [13.2.7](#) or a performance requirement of this Standard. In such cases:

- a) PVC insulating tape shall comply with CSA C22.2 No. 197 and UL 510.
- b) Sleeving shall comply with CSA C22.2 No. 198.3 and UL 1441.
- c) Tubing shall comply with CSA C22.2 No. 198.1 and UL 224.

44.2 Wire positioning devices shall comply with Clause 53, Separation of Circuits. A device that complies with CSA C22.2 No. 18.5 and UL 1565 is considered to comply with this requirement.

44.3 Insulating bushings that comply with CSA C22.2 No. 18.3 and UL 635 are considered to comply with the requirements in this Standard. Tests specified in this standard (e.g. [51.2](#), Strain Relief Test) may

still need to be performed to confirm the combination of the insulating bushing and the supporting part are suitable.

45 Switches for Primary Circuits

45.1 A switch that is provided for controlling loads in the primary circuit shall comply with the following:

- a) CSA C22.2 No. 61058-1 and CSA C22.2 No. 61058-1-1, and UL 61058-1 and UL 61058-1-1;
- or
- b) CSA C22.2 No. 61058-1 and CSA C22.2 No. 61058-1-2, and UL 61058-1 and UL 61058-1-2; as applicable;
- or
- c) CSA C22.2 No. 111 and UL 20;
- or
- d) CSA C22.2 No. 284 and UL 773A;

based upon the intended loads controlled and rated for the sum of all load currents.

45.2 Switching devices that comply with the applicable UL standard for specialty applications (e.g. transfer switch equipment), industrial use (e.g. contactors, relays, auxiliary devices), or are integral to another component (e.g. switched lampholder) is not required to comply with the requirements in [45.1](#).

45.3 A clock-operated switch, in which the switching contacts are actuated by a clock-work, by a gear-train, by electrically wound spring motors, by electric clock-type motors, or by equivalent arrangements shall comply with CSA C22.2 No. 177 and UL 917, or CAN/CSA-E60730-1 and UL 60730-1 or CAN/CSA-E60730-2-7 and UL 60730-2-7.

45.4 A timer or time switch, incorporating electronic timing circuits or switching circuits, with or without separable contacts, shall comply with the requirements for an operating control with Type 1 action for 6,000 cycles of operation, or as a manual control for 5,000 cycles of operation, in accordance with the following:

- a) CAN/CSA-E60730-1 and UL 60730-1; or
- b) CAN/CSA-E60730-2-7 and UL 60730-2-7.

45.5 A timer or time switch, incorporating electronic timing circuits or switching circuits, with or without separable contacts, which functions as a protective control, shall comply with the requirements for a protective control.

46 Transformers and Power Units

46.1 General-purpose transformers shall comply with CSA C22.2 No. 66.1 and UL 5085-1 and CSA C22.2 No. 66.2 and UL 5085-2.

46.2 Other than transformers located in a low voltage circuit that do not involve a risk of fire or personal injury, Class 2 and Class 3 transformers shall comply with CSA C22.2 No. 66.1 and UL 5085-1 and CSA C22.2 No. 66.3 and UL 5085-3.

46.3 Class 2 power units shall comply with CSA C22.2 No. 223 and UL 1310.

47 Printed Wiring Boards

47.1 Printed wiring boards, including the coatings, shall comply with UL 796.

47.2 With respect to [47.1](#), a printed-wiring board in a Class 2 circuit is not required to comply with the bonding requirements in UL 796 if the board is separated from parts of other circuits such that loosening of the bond between the foil conductor and the base material will not result in the foil conductors or components coming in contact with parts of other circuits of the control or of the end-use product.

47.3 A printed-wiring board containing circuitry in a line-connected circuit shall comply with the direct-support requirements for insulating materials in CAN/CSA-C22.2 No. 0.17 and UL 746C.

47.4 Unless otherwise specified, the flammability class and temperature rating shall be that specified for insulating materials in CAN/CSA-C22.2 No. 0.17 and UL 746C.

48 Frame And Enclosure

48.1 A cord-connected product that is provided with keyhole slots, notches, hanger holes, or the like for hanging on a wall shall be constructed in such a manner that the hanging means is not accessible without removing the product from the supporting means.

48.2 To determine whether a product complies with the requirement in [48.1](#), any part of the enclosure or barrier that can be removed without the use of tools to gain access to the hanging means shall be removed.

48.3 An opening in the product provided for hanging shall be located or guarded so that a nail, hook, or the like does not displace a part that would create a risk of fire or risk of electric shock, and does not contact one of the following:

- a) An uninsulated live part;
- b) Magnet wire;
- c) Internal wiring; or
- d) Any other part likely to create a risk of fire or electric shock.

49 Protection Against Electric Shock

49.1 Products shall be one of the following constructions with respect to protection against electric shock:

- a) Grounded product;
- b) Double-insulated construction;
- c) Grounded product with areas of double-insulated construction; and
- d) Powered by a Class 2 transformer or power unit.

49.2 A grounded product shall have a metal enclosure connected to a grounded branch circuit connection that encloses all energized parts that would present a risk of electric shock if there was a failure of basic insulation. These products shall have basic insulation and comply with Clause [50](#),

Accessibility of Uninsulated Live Parts and Film-Coated Wire, Clause [55](#), Grounding, Clause [60](#), Spacings, and Clause [61](#), Leakage Current Test.

49.3 A double-insulated product shall rely upon the presence of both basic and supplementary insulation or alternatively reinforced insulation and shall comply with Clause [50](#), Accessibility of Uninsulated Live Parts and Film-Coated Wire, and UL 1097. For the determination of accessibility of basic insulation as required by UL 1097 the accessibility criteria in Clause [50](#) shall be used. These products are not required to comply with the requirements in Clause [55](#), Grounding, Clause [60](#), Spacings, and Clause [61](#), Leakage Current Test.

49.4 For products where protection against electric shock is provided by a grounded metal enclosure in some areas and double or reinforced insulation in other areas, the requirements in [49.2](#) and [49.3](#) are applied, as applicable.

49.5 Products powered by a Class 2 transformer or power unit are considered not to constitute a risk of electric shock and is not required to comply with the requirements in [49.2](#) or [49.3](#).

50 Accessibility of Uninsulated Live Parts and Film-Coated Wire

50.1 To reduce the likelihood of unintentional contact that may involve a risk of electric shock from an uninsulated live part or film-coated wire, as specified in [50.5](#), an opening in an enclosure shall comply with either (a) or (b).

- a) For an opening that has a minor dimension (see [50.3](#)) less than 25.4 mm (1 inch), such a part or wire shall not be contacted by the probe illustrated in [Figure 50.1](#).
- b) For an opening that has a minor dimension of 25.4 mm (1 inch) or more, such a part or wire shall be spaced from the opening as specified in [Table 50.1](#).

Figure 50.1
Articulate Probe with Web Stop

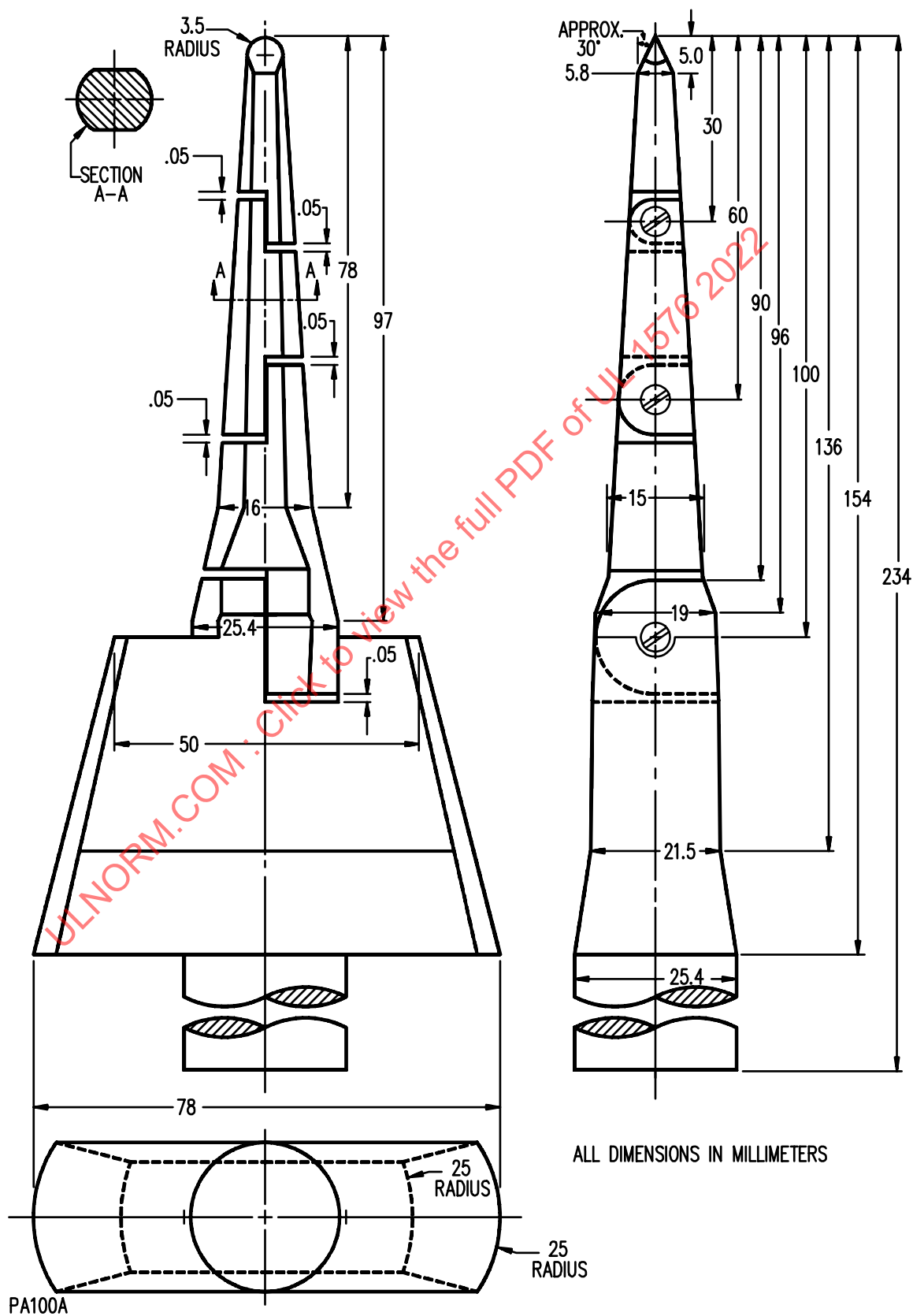


Table 50.1
Minimum Acceptable Distance from an Opening to a Part that may Involve a Risk of Electric Shock

Minimum dimension ^a of opening ^b		Minimum distance from opening to part ^b	
mm	(inch)	mm	(inch)
19.1 ^c	(3/4)	114	(4-1/2)
25.4 ^c	(1)	165	(6-1/2)
31.8	(1-1/4)	190	(7-1/2)
38.1	(1-1/2)	318	(12-1/2)
47.6	(1-7/8)	394	(15-1/2)
54.0	(2-1/8)	444	(17-1/2)
d		762	(30)

^a See [50.3](#).
^b Between 19.1 mm (3/4 inch) and 54.0 mm (2 1/8 inch), interpolation shall be used to determine a value between values specified in the table.
^c Any dimension less than 25.4 mm (1 inch) applies to a motor only.
^d More than 54 mm (2-1/8 inch), but not more than 152 mm (6 inch).

50.2 The probes specified in [50.1](#) and illustrated in [Figure 50.1](#) shall be applied to any depth that the opening will permit, and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to examine the enclosure. The probe illustrated in [Figure 50.1](#) shall be applied in any possible configuration; and, if necessary, the configuration shall be changed after insertion through the opening.

50.3 With reference to the requirements in [50.1](#), the minor dimension of an opening is the diameter of the largest cylindrical probe having a hemispherical tip that can be inserted through the opening.

50.4 During the examination of a product to determine whether it complies with the requirements in [50.1](#), a part of the enclosure that may be opened or removed by the user without a tool (to attach an accessory, to make an operating adjustment, or for other reasons) shall be opened or removed. If the part is marked in accordance with [75.1.3](#), the part is not required to be removed.

50.5 A part that represents a risk of electric shock shall be considered to be a live part as described in [50.1](#). An accessible part that is connected to a live part by protective impedance, shall not be considered to be a live part.

50.6 In the case of protective impedance, as specified in [50.5](#), the short circuit current between the parts shall not exceed 2 mA for d.c. or 0.7 mA peak for a.c. and there shall not be more than 0.1 µF capacitance directly between the parts.

50.7 Protective impedance, as specified in [50.5](#) shall consist of at least two separate components. If any one of the components is short-circuited or open-circuited based upon the components anticipated failure modes, the values specified in [50.6](#) shall not be exceeded.

50.8 A single Y1 or Y2 capacitor that complies with CAN/CSA-E60384-14 and UL 60384-14 or IEC 60384-14 shall be considered to comply with the requirement of [50.7](#).

50.9 Resistors forming a protective impedance circuit as specified in [50.7](#) shall be operated at half of their voltage and power ratings.

50.10 All components are anticipated to fail in the open mode; but, thin film, thick film and wire-wound resistors and metalized capacitors that comply with CAN/CSA-E60384-14 and UL 60384-14, or IEC

60384-14, or IEC 60384-16 are not anticipated to fail in the shorted mode. All other components are anticipated to fail in the shorted mode.

50.11 All components relied upon for compliance with [50.7](#) shall have sufficient voltage, current and power ratings to withstand the additional stress that they may encounter when components fail in their anticipated failure mode, one by one.

51 Cords And Cord Connections

51.1 Cords and plugs

51.1.1 A product intended to be connected to the power-supply circuit by means of a flexible cord shall be provided with a flexible cord and an attachment plug for connection to the supply circuit.

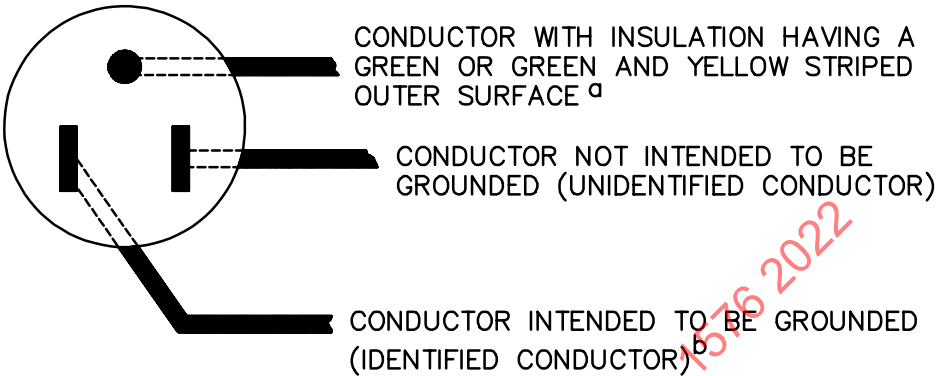
51.1.2 The attachment plug of a product intended to be connected to a nominal 120 V circuit, and employing devices required to be connected to a specific supply conductor as specified in [56.2](#), [58.2](#), and [59.3](#) shall be a polarized type. The connections to the attachment plug shall be in accordance with [Figure 51.1](#). The polarity identification of the supply cord shall be in accordance with [Table 51.1](#). See [77.3](#).

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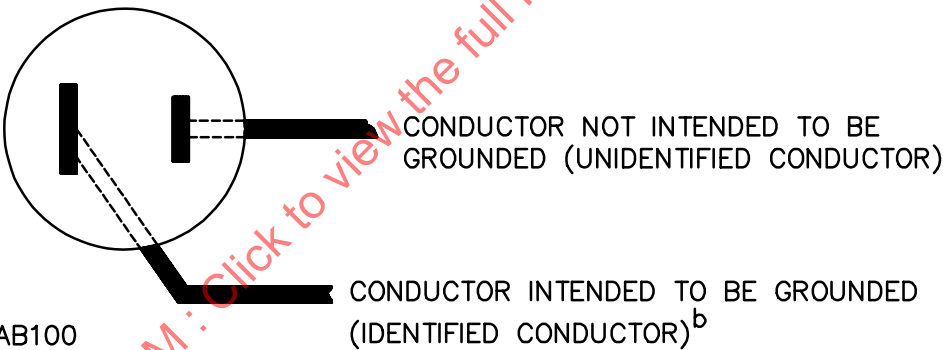
Figure 51.1

Connections to Attachment Plugs

CONNECTIONS OF CORD CONDUCTORS TO GROUNDING – TYPE ATTACHMENT PLUG (FACE OF PLUG REPRESENTED)



CONNECTIONS OF CORD CONDUCTORS TO POLARIZED ATTACHMENT PLUG (FACE OF PLUG REPRESENTED)



NOTES

^a In the above illustration, the blade to which the green conductor is connected may have a U-shape instead of a circular cross section.

^b Signifies a conductor identified in accordance with [Table 51.1](#).

Table 51.1
Polarity Identification Of Flexible Cords

Method of identification	Acceptable combinations	
	Conductor intended to be grounded ^{a,b}	All other conductors ^a
Color of braids on individual conductors	Solid white or gray – without tracer	Solid color other than white or gray – without tracer
	Color other than white or gray – with tracer in braid	Solid color other than white or gray – without tracer
Color of insulation on individual conductors	Solid white or gray ^c	Solid color other than white or gray
	Solid light blue ^d	Solid white or gray ^c
Color of separators	Solid light gray ^e	Solid color other than white, or gray
Other means	Tin or other white metallic coating on all strands of the conductor ^e	No tin or other white metallic coating on the strands of the conductor
	A stripe, ridge, or groove on the exterior surface of the cord ^e	
^a A conductor finished to show a green color with or without one or more yellow stripes or tracers shall be used only as an equipment-grounding conductor. See 55.2.1 and Figure 51.1 . ^b The grounded (identified) conductor is the neutral supply conductor. ^c Only for cords – other than Types SP-2, SPE-2, and SPT-2 – having no braid on any individual conductor. ^d For jacketed cords. ^e Only for cords having insulation on the individual conductors integral with the jacket, such as Types SP-2, SPE-2, and SPT-2 cords.		

51.1.3 A product that is required to employ a polarized attachment plug as specified in [51.1.2](#), and that is provided with a separate or detachable cord set as specified in [51.1.6](#) and in [51.1.10](#) shall also employ a product connector of the polarized type.

51.1.4 The flexible cord shall have a voltage rating not less than the rated voltage of the product, and shall have an ampacity that is not less than the current rating of the product.

51.1.5 A product shall be provided with a flexible cord in accordance with [Table 51.2](#) and an attachment plug for connection to the branch circuit. The blade assembly for connection to the branch circuit shall be of the polarized- or grounding-type. The length of cord external to the unit and including the attachment plug shall not be less than 1.8 m (6 feet) as measured from the face of the attachment plug to the point of attachment or entry.

Table 51.2
Acceptable Flexible Cords For Cord Connected Products

Flexible cord type	Maximum length		Intended use
	feet	(m)	
At least as serviceable as SP-2, SPE-2, SPT-2, SV, SVE, SVT	8	(2.4 m)	Intended solely for hand-held use or charging bases
At least as serviceable as S, SE, SO, SOO, SP-3, SPT-3, ST, STO, SJ, SJE, SJO, SJT, SJTO, ST, STO, STOO SV, SVE, or SVT	Not specified		Not specified

51.1.6 With respect to [51.1.5](#), a product that is not required to be provided with a grounding conductor may be provided with a separate cord set having means for connection to the product and a length of not less than 1.8 m (6 feet).

51.1.7 With respect to [51.1.5](#), a product intended for applications where the plug is likely to be resting in a puddle or wet vegetation shall be provided with an appliance inlet or a flexible power-supply cord either 200 – 460 mm (8 – 18 inches) or not less than 6.1 m (20 ft) long.

51.1.8 With respect to [51.1.5](#), a product that is not capable of relamping by the user and does not possess a convenience receptacle is not required to be provided with a polarized attachment plug.

51.1.9 The length of an attached flexible cord includes the attachment plug. The length of a cord set includes the fittings.

51.1.10 A product intended for use with a detachable cord set shall not be provided with terminal pins that will accommodate a standard flatiron or appliance plug.

51.1.11 A three- to two-wire, grounding-type adapter shall not be provided with a product if:

- a) Usage of the product is such that it is necessary to connect it by means of an extension cord during normal operation;
- b) The manufacturer makes extension cords available; and
- c) A statement indicating the availability of such extension cords is marked on the product or is included in an instruction book or the like that is regularly furnished with the product.

51.1.12 If a product incorporates a disconnecting means, such as a cord connector in the supply cord, the arrangement shall be such that no live parts will be exposed under any normal conditions.

51.1.13 A flexible power-supply cord provided with a product intended to be used in wet outdoor environments shall be rated for outdoor use. Such cords are identified by the letter "W" following the cord type designation marked on the jacket.

51.1.14 With respect to [51.1.7](#), the 8 – 18 inch flexible power-supply cord shall be such that the connection to an extension cord prevents the connection from being on a surface during intended use of the product. See [75.2.1](#).

51.2 Strain relief

51.2.1 Strain relief shall be provided so that mechanical stress on a flexible cord will not be transmitted to terminals, splices, or interior wiring.

51.2.2 A metal strain-relief clamp or band used with Type SP-2, SPE-2, or lighter general-use rubber-insulated cord shall be provided with auxiliary insulation over the cord for mechanical protection. The auxiliary insulation may be omitted for Type SV, SVE, SVO, or SVOO cord.

51.2.3 A clamp of any material – metal or otherwise – is not acceptable for use on Type SPT-2, SVT, SVTO, or SVTOO cord.

51.2.4 With respect to [51.2.3](#), a metal clamp is acceptable for strain relief on Types SPT-2, SVT, SVTO and SVTOO flexible cords protected by varnished-cloth tubing, phenolic, vulcanized fiber, or the equivalent between the clamp and the cord, if the combination clamp and cord protection installed as intended complies with [69.3](#). Thermoplastic tubing is not acceptable over thermoplastic cords.

51.2.5 With respect to [51.2.3](#), a non-metallic clamp is acceptable on Types SPT-2, SVT, SVTO and SVTOO flexible cords without tubing, fiber, or equivalent cord protection between the clamp and the cord, if the clamp complies with [69.3](#).

51.2.6 For types of thermoplastic-insulated cord, heavier than Type SPT-2, SVT, SVTO, or SVTOO, a clamp may be employed and the auxiliary insulation is not required unless it is judged that the clamp may damage the cord insulation.

51.2.7 Means shall be provided to reduce the risk of a flexible cord from being pushed into a product through a cord-entry hole if such displacement may subject the cord to mechanical damage or to exposure to a temperature higher than that for which the cord is acceptable, or may reduce a spacing, such as to a metal strain-relief clamp, below the minimum acceptable value.

51.2.8 If a knot in a flexible cord serves as strain relief, a surface that the knot may contact shall be free from projections, sharp edges, burrs, fins, and the like that may cause abrasion of the insulation on the conductors.

52 Multiple Rated Voltages

52.1 A multiple input voltage rated product shall comply with (a) – (d):

- a) The blade assembly shall be a 125 volt, 15 amp configuration;
- b) The product shall employ a user adjustable voltage selector and comply with [70.1](#) or be capable of operating at different voltages without user adjustment;
- c) The input voltage rating shall include nominal 120 volt; and
- d) The product shall be provided with instructions as specified in [29.4](#).

53 Separation Of Circuits

53.1 Conductors of circuits operating at different potentials shall be reliably separated from each other unless they are each provided with insulation acceptable for the highest potential involved.

53.2 An insulated conductor shall be reliably retained so that it cannot contact an uninsulated live part of a circuit operating at a different potential.

54 Capacitors

54.1 A capacitor connected across the line, such as a capacitor for radio-interference elimination or power-factor correction, where the short circuit of the capacitor would not result in the opening of a fuse that complies with any of the CSA C22.2 No. 248 and UL 248 series of standards shall comply with CAN/CSA-E60384-14 and UL 60384-14.

55 Grounding and Bonding

55.1 General

Note: The term "grounding" as used in this clause relates to "bonding" in Canada.

55.1.1 A product marked as being provided with double insulation shall not be provided with a means for grounding.

55.1.2 If a grounding means is provided, whether required or not, it shall comply with the requirements in [55.1.3](#). All exposed dead metal parts and all dead metal parts within the enclosure that are exposed to contact during any user servicing operation and are likely to become energized shall be reliably connected to the means for grounding.

55.1.3 The grounding conductor of a supply cord shall be secured to the frame or enclosure of the product by means of a screw that is not likely to be removed during any servicing operation not involving the power-supply cord, or by other equivalent means. Solder alone shall not be used for securing the grounding conductor. Servicing includes repair of the product by qualified service personnel.

55.1.4 The grounding conductor of a cord-connected product shall be connected to the grounding member of an attachment plug. The grounding member shall be fixed.

55.1.5 A separable connection, such as that provided by an attachment plug and a mating connector or receptacle, shall be such that the equipment-grounding connection is made before connection to and broken after disconnection from the supply conductors. Interlocked plugs, receptacles, and connectors that are not energized when the equipment-grounding connection is made or broken are acceptable.

55.1.6 If a product is intended to be grounded and is provided with means for separate connection to more than one power supply, each such connection shall be provided with a means for grounding.

55.2 Grounding identification

55.2.1 The surface of the insulation of a grounding conductor of a flexible cord shall be green with or without one or more yellow stripes.

56 Lampholders

56.1 A lampholder for a low-voltage lamp – for example, a 6-V lamp – shall not be tapped across a part of a winding of a motor if the motor is rated more than 230 V.

56.2 The screw shell of an Edison-base lampholder in a product equipped with a polarized attachment plug shall be connected to the terminal or lead that is intended to be connected to the grounded conductor of the power-supply circuit.

57 Overload Or Thermal-Protective Devices

57.1 An overload- or thermal-protective device shall have a current and voltage rating not less than the load that it controls.

57.2 A protective device that requires resetting or replacement after it opens shall be readily accessible. The protective device is not required to be readily accessible if it complies with the following:

- a) The product, with the protective device shunted out of the circuit, complies with all applicable requirements in this standard; and
- b) The presence of the protective device would ordinarily be unknown to the user of the product because of its location and the omission of reference to the device in the operating instructions, circuit diagrams, and the like for the product.

57.3 A protective device shall be wholly inaccessible from outside the product without opening a door or cover. The operating handle of a circuit breaker, the operating button of a manually operable protector, and similar parts may project outside the product enclosure.

57.4 A fuseholder shall be constructed and installed so that no uninsulated live part other than the screw shell or clips will be exposed to contact by persons removing or replacing fuses. This requirement does not apply if the presence of the protective device would ordinarily be unknown to the user of the product because of its location and the omission of reference to the device in the operating instructions, circuit diagrams, and the like for the product.

57.5 The screw shell of a plug-type fuseholder shall be connected toward the load.

58 Receptacles

58.1 A 15- or 20-A general-use attachment-plug receptacle in a product provided with a means for grounding – a direct plug-in unit with a ground pin or a cord-connected product with a grounding conductor in the cord – shall be of the grounding type. The grounding contact of the receptacle shall be electrically connected to dead metal that will be grounded when the product is in use.

58.2 A general purpose receptacle rated for use on a nominal 120 V circuit shall be of a polarized type. The grounded supply conductor shall be connected to the terminal that is substantially white in color or otherwise marked to indicate that it is intended for connection to the grounded supply conductor.

58.3 The face of a receptacle shall:

- a) Be flush with or project beyond a nonconductive surrounding surface; or
- b) Project at least 0.38 mm (0.015 inch) beyond a conductive surrounding surface.

58.4 A product provided with a general-use receptacle or receptacles shall have a current rating as required in [Table 58.1](#) and be provided with an attachment plug rated not less than the current rating of the product.

58.5 The power-supply cord of a product provided with a general-use receptacle or receptacles shall be of the grounding type and shall employ one of the following flexible cord Types: SJ, SJE, SJO, SJT, SJTO, or equivalent. A cord marked with suffix "W" (such as, SJTW) is required when the product is intended for wet outdoor use.

58.6 The minimum conductor size of the power-supply cord for a product shall be as indicated in [Table 58.1](#).

Table 58.1
Construction and Performance Requirements for General-Use Receptacles

Number of receptacles	Minimum supply cord size	Product current rating, minimum	Supplementary OCP required?	Supplementary OCP rating, if provided	Minimum internal wiring size ^a	Total receptacle load ^b
	AWG (mm ²)	A		A	AWG (mm ²)	A
6	12 (3.3)	20	Yes	20	12 (3.3)	20
5	12 (3.3)	20	No	20	12 (3.3)	20
4	14 (2.1)	15	Yes	15	14 (2.1)	15
1 – 3	14 (2.1)	15	No	15	14 (2.1)	15

^a Size of conductors through which receptacle current is drawn.

^b Additional resistive load applied equally between receptacles shall be used as the normal load in [64.2.2](#). Products Incorporating General Use Receptacles. Smaller load values may be used if the receptacles are provided with a current limitation marking.

58.7 An overcurrent protection device (OCP) as required by [Table 58.1](#) shall be suitably rated and comply with the following:

- a) The requirements in CSA C22.2 No. 235 and UL 1077;
- b) A fuse that complies with the requirements in CSA C22.2 No. 248.14 and UL 248-14; or

c) A circuit breaker that complies with the requirements in CSA C22.2 No. 5 and UL 489.

58.8 The general-use receptacle(s) shall have a current rating of 15 or 20 A and a voltage rating of 125 or 250 V. The receptacles shall have a voltage and current rating equal to that of the attachment plug on the power-supply cord. A 15-A general-use receptacle shall be acceptable for use with a product rated 20 A with a 20-A attachment plug.

58.9 When multiple general-use receptacles are provided, they shall all have the same current rating. These receptacles may be of the same or different slot configurations (locking and non-locking) or employing a spring-actuated latching mechanism for locking a mated attachment plug in place after the blades have been inserted into the female contacts.

58.10 The receptacles of a product shall comply with the applicable requirements in CSA C22.2 No. 42 and UL 498.

59 Switches And Controls

59.1 A switch or other control device shall have a current and voltage rating not less than that of the load that it controls.

59.2 With reference to the requirement in [59.1](#), the current rating of a switch that controls an inductive load other than a motor, such as a transformer or an electric-discharge-lamp ballast, shall not be less than twice the rated full-load current of the transformer or ballast unless the switch has been investigated and found acceptable for the application.

59.3 In a product requiring a polarized or grounded plug as required in [51.1.5](#) a switch or an overcurrent-protective device of the single pole type other than an automatic control without a marked off position shall be electrically connected to a terminal or lead intended for connection to an ungrounded conductor of the supply circuit.

59.4 A switch that controls a medium-base lampholder of other than a pilot or indicating light shall be acceptable for use with tungsten-filament lamps.

60 Spacings

60.1 Other than at wiring terminals, the spacing between uninsulated live parts of opposite polarity and between an uninsulated live part and a dead metal part that is exposed to contact by persons or that may be grounded shall not be less than the value specified in [Table 60.1](#). The inherent spacings of a component of the product, such as a snap switch, are investigated on the basis of the requirements for the component in question. If a spacing complies with [60.3](#), this requirement does not apply.

Table 60.1
Spacings

Potential involved, V	Product ^a			
	Over surface		Through air	
	mm	(inch)	mm	(inch)
0 – 125	2.4	(3/32)	2.4	(3/32)
126 – 250	2.4	(3/32)	2.4	(3/32)
251 – 600	12.7 ^c	(1/2)	9.5 ^c	(3/8)

^a Film-coated wire is considered to be an uninsulated live part. However, a spacing of not less than 2.4 mm (3/32 inch) over surface and through air between film-coated wire, rigidly supported and held in place on a coil, and a dead metal part is acceptable.

60.2 If an uninsulated live part is not rigidly fixed in position by means other than friction between surfaces, or if a movable dead metal part is in proximity to an uninsulated live part, the construction shall be such that the required minimum spacing will be maintained.

60.3 If an isolated dead metal part is interposed between or is in close proximity to live parts of opposite polarity, to a live part and an exposed dead metal part, or to a live part and a dead metal part that may be grounded, the spacing shall be not less than 1.2 mm (3/64 inch) between the isolated dead metal part and any one of the other parts previously specified, provided the total spacing between the isolated dead metal part and the two other parts is not less than the value specified in [Table 60.1](#).

60.4 An insulating lining or barrier of vulcanized fiber or similar materials employed where spacing would otherwise be insufficient shall not be less than 0.8 mm (1/32 inch) thick, and shall be so located or of such material that it will not be adversely affected by arcing. Vulcanized fiber not less than 0.4 mm (1/64 inch) thick may be used in conjunction with an air spacing of not less than 50 % of the spacing required for air alone. Thinner insulating material may be used, if upon investigation, it is found to be acceptable for the application.

60.5 All uninsulated live parts connected to different – line – or low-voltage – circuits shall be spaced from one another as though they were parts of opposite polarity, in accordance with the requirements in [60.1](#) and shall be investigated on the basis of the highest voltage involved.

60.6 The spacing between uninsulated live parts of opposite polarity and between such parts and dead metal that may be grounded in service is not specified for parts of low voltage circuits.

60.7 For printed wiring boards, as an alternative to the spacing requirements in [Table 60.1](#), the spacing requirements in CSA C22.2 No. 0.2 and UL 840 may be used. The spacing requirements in CSA C22.2 No. 0.2 and UL 840 shall not be used for field wiring terminals and spacings to a dead metal enclosure.

60.8 With respect to [60.7](#), all printed wiring boards are presumed to have a minimum comparative tracking index (CTI) of 100, unless known to be greater.

PERFORMANCE

61 Leakage Current Test

61.1 A cord-connected or direct plug-in product rated for a nominal 120-V supply shall be tested in accordance with [61.3](#) – [61.7](#). Leakage current shall not be more than 0.5 mA for a grounded 3-wire portable product.

61.2 Leakage current refers to all currents, including capacitively coupled currents, that may be conveyed between exposed conductive surfaces of a product and ground or other exposed conductive surfaces of a product.

61.3 All exposed conductive surfaces shall be tested for leakage currents. If simultaneously accessible, the leakage currents from exposed conductive surfaces shall be measured to the grounded supply conductor individually as well as collectively, and from one surface to another. A part is considered to be an exposed surface unless guarded by an enclosure that complies with the requirements in Clause [50](#), Accessibility of Uninsulated Live Parts and Film-Coated Wire. Surfaces are considered to be simultaneously accessible when they can be readily contacted by one or both hands of a person at the same time. These measurements do not apply to terminals operating at voltages that do not present a risk of electric shock.

61.4 If a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current shall be measured using a metal foil having an area of 10 by 20 cm in contact with the

surface. If the surface is less than 10 by 20 cm, the metal foil shall be the same size as the surface. The metal foil shall not remain in place long enough to affect the temperature of the product.

61.5 The measurement circuit for leakage current shall be as illustrated in [Figure 61.1](#). The measurement instrument is defined in (a) – (c). The meter that is actually used for a measurement is only required to indicate the same numerical value for a particular measurement as would the defined instrument. The meter used is not required to have all the attributes of the defined 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 – 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 or 0.75 mA, the measurement shall not have an error of more than 5 % at 60 Hz.

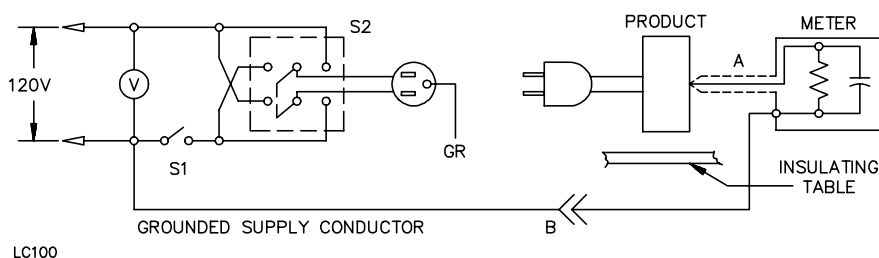
61.6 The meter shall be connected to the accessible part and the grounded supply conductor unless the meter is being used to measure leakage between two parts of a product.

61.7 A sample of the product shall be tested for leakage current starting with the as-received condition but with its grounding conductor, if any, open at the attachment plug. The as-received condition being without prior energization except as may occur as part of the production-line testing. The supply voltage shall be adjusted to 120 V. The test sequence, with reference to the measuring circuit in [Figure 61.1](#) shall be as follows:

- a) With switch S1 open, the product shall be connected to the measuring circuit. Leakage current shall be measured using both positions of switch S2, and with the product switching devices in all their normal operating positions.
- b) Switch S1 shall then be closed energizing the product, and within 5 s, the leakage current shall be measured using both positions of switch S2 with the product switching devices in all their normal operating positions.
- c) The 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.

Figure 61.1

Leakage-Current Measurement Circuit



NOTES:

A: Probe with shielded lead.

B: Separated and used as clip when measuring currents from one part of device to another.

61.8 Normally, the complete leakage current test program as specified in 61.7 shall be conducted without interruption for other tests. However, with the concurrence of those concerned, the leakage current tests may be interrupted for the purpose of conducting other nondestructive tests.

62 Leakage Current Test Following Humidity Conditioning

62.1 A product as described in 61.1 shall comply with the requirements for leakage current in 61.1 following exposure for 48 h to air having a relative humidity of $88 \pm 2\%$ at a temperature of $32 \pm 2^\circ\text{C}$ ($90 \pm 4^\circ\text{F}$).

62.2 A sample of the product shall be heated to a temperature just above 34°C (93°F) to reduce the likelihood of condensation of moisture during conditioning. The heated sample shall be placed in the humidity chamber and conditioned for 48 h under the conditions specified in 62.1. Following the conditioning and while still in the chamber, the sample shall be tested unenergized as described in 61.7(a). Either while the sample is still in the humidity chamber or immediately after it has been removed from the chamber, the sample shall be energized and tested as described in 61.7 (b) and (c). The tests shall be discontinued when the leakage current stabilizes or decreases.

63 Input Test

63.1 The current or wattage input to a product shall not be more than 110 % of the rated value when the product is operated under the conditions specified in 64.2, Maximum Normal Load, as applicable and when connected to a supply circuit of maximum rated voltage and rated frequency.

63.2 For a product having a single voltage rating, such as 115 V, maximum rated voltage is considered to be that single value of voltage. If the rating is given in terms of a range of voltages, such as 110 – 120 V, maximum rated voltage is considered to be the highest value of the range.

64 Temperature Test

64.1 General

64.1.1 A product shall be tested as specified in 64.2, Maximum Normal Load, and shall not reach a temperature at any point high enough to cause a risk of fire, to damage any materials in the product, or to exceed the temperature rises specified in Table 64.1 and the maximum outside surface temperature rises in Maximum Outside Surface Temperature Rises, K, Table 9.1 of CSA C22.2 No. 0.23 or UL 2595.

Table 64.1
Maximum Temperature Rises

Material and component parts		$^\circ\text{C}$	$^\circ\text{F}$
1.	Capacitors:		
	Electrolytic ^a	40	72
	Other types ^b	65	117
2.	Fuses		
	A. Class G, J, L, T, and CC		
	Tube	100	180
	Ferrule or blade	85	153

Table 64.1 Continued on Next Page

Table 64.1 Continued

Material and component parts		°C	°F
B.	Other ^h	65	117
3.	Fiber employed as electrical insulation	65	117
4.	Class A insulation system on coil windings of an ac motor having a diameter of more than 178 mm (7 inch), of a dc motor, and of a universal motor: ^{c,d}		
A.	In an open motor:		
	Thermocouple method	65	117
	Resistance method	75	135
B.	In a totally enclosed motor:		
	Thermocouple method	70	126
	Resistance method	80	144
5.	Class A insulation systems on coil windings of an a-c motor having a diameter of 7 in or less, not including a universal motor, and on a vibrator coil: ^{c,d}		
A.	In an open motor and on a vibrator coil:		
	Thermocouple method or resistance method	75	135
B.	In a totally enclosed motor:		
	Thermocouple method	70	126
	Resistance method	80	144
6.	Class A insulation systems on coil windings of an a-c motor having a diameter of 7 in or less, not including a universal motor, and on a vibrator coil: ^{c,d}		
A.	In an open motor and on a vibrator coil:		
	Thermocouple or resistance method	75	135
B.	In a totally enclosed motor:		
	Thermocouple or resistance method	80	144
7.	Class B insulation systems on coil windings of an a-c motor having a frame diameter of more than 7 in, of a d-c motor, and of a universal motor: ^{c,d}		
A.	In an open motor:		
	Thermocouple method	85	153
	Resistance method	95	171
B.	In a totally enclosed motor:		
	Thermocouple method	90	162
	Resistance method	100	180
8.	Class B insulation system on coil windings or an a-c motor having a diameter of 7 in or less not including a universal motor: ^{c,d}		
A.	In an open motor:		
	Thermocouple or resistance method	95	171
B.	In a totally enclosed motor:		
	Thermocouple or resistance method	100	180
9.	Class F 155 °C insulation system on coil windings or an ac motor having a frame diameter of more than 178 mm (7 inch) and of a dc motor, and a universal motor: ^b		
A.	In an open motor:		
	Thermocouple method	110	198
	Resistance method	120	216
B.	In a totally enclosed motor:		

Table 64.1 Continued on Next Page

Table 64.1 Continued

Material and component parts		°C	°F
Thermocouple method		115	207
Resistance method		125	225
10. Class F insulation system on coil windings or an ac motor having a frame diameter of 178 mm (7 inch) or less, not including a universal motor: ^b	A. In an open motor:		
	Thermocouple method or resistance method	120	216
	B. In a totally enclosed motor:		
	Thermocouple or resistance method	125	225
11. Class 105 insulation systems on windings of a relay, a solenoid, and the like: ^c	Thermocouple method	65	117
	Resistance method	85	153
12. Class 130 insulation systems on windings of a relay, a solenoid, and the like: ^c	Thermocouple method	85	153
	Resistance method	105	189
13. Class 130 insulation systems on vibrator coils:	Thermocouple or resistance method	95	171
14. Phenolic composition employed as electrical insulation or as a part the deterioration of which would result in a risk of fire or risk of electric shock. ^e		125	225
15. Rubber- or thermoplastic-insulated wire and cord. ^{e,f,g}		35	63
16. Sealing compound		40 °C (104 °F) less than melting point	
17. Varnished-cloth insulation		60	108
18. Wood and other combustible material		65	117
19. Transformers – See 46, Transformers and Power Units			

^a The temperature rise on insulating material integral with the enclosure of an electrolytic capacitor that is physically integral with or attached to a motor may be not more than 65 °C (117 °F).

^b A capacitor that operates at a temperature rise of more than 65 °C (117 °F) may be judged on the basis of its marked temperature limit.

^c At a point on the surface of a coil where the temperature is affected by an external source of heat, the temperature rise measured by a thermocouple may be higher by the following amount than the maximum specified provided that the temperature rise of the coil, as measured by the resistance method, is not more than that specified in the table.

Item	Additional temperature rises	
Part A of item 7	15	27
Part A of item 8	5	9
Part A of item 9	20	36
Part A of item 10	10	18
13	15	27
14	15	27

^d The diameter of a motor is the diameter of the circle circumscribing the stator frame measured in the plane of the laminations, excluding lugs, fins, boxes, and the like, used solely for motor mounting, cooling, assembly, or connection. See 31.1(j).

^e The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds that have been investigated and found acceptable for use at higher temperatures.

^f Rubber-insulated conductors within a Class-A-insulated motor, rubber-insulated motor leads, and a rubber-insulated flexible cord entering a motor may be subjected to a temperature rise of more than 35 °C (95 °F), provided that a braid is employed on the conductor of other than a flexible cord. However, this does not apply to thermoplastic-insulated wires or cords.

^g A short length of rubber- or thermoplastic-insulated flexible cord exposed to a temperature of more than 60 °C (140 °F), such as at terminals, is acceptable if supplementary heat-resistant insulation of adequate dielectric strength is employed on the individual conductors of the cord to protect the conductor insulation against deterioration.

^h A fuse that has been investigated and found acceptable for use at a higher temperature may be used at that temperature.

64.1.2 A thermal- or overload-protective device shall not open the circuit during the temperature test.

64.1.3 All values of temperature rise in [Table 64.1](#) are based on an assumed ambient temperature of 25 °C (77 °F). Tests may be conducted at any ambient temperature within the range of 10 – 40 °C (50 – 104 °F).

64.1.4 For the temperature test, the voltage of a direct-current supply circuit shall be 115 V or 230 V, and that of an alternating-current circuit shall be 120 V or 240 V, depending on whether the product has a nominal voltage rating of 115 or 230 V.

64.1.5 A product having a single frequency rating shall be tested at that frequency. A product rated ac or dc shall be tested on direct current or 60 Hz alternating current, whichever results in higher temperatures. A product rated 25 – 60 Hz or 50 – 60 Hz shall be tested on 60 Hz alternating current.

64.1.6 Ordinarily, coil or winding temperatures shall be measured by thermocouples unless the coil is inaccessible for mounting of these devices – for example, a coil immersed in sealing compound – or unless the coil wrap includes thermal insulation or more than two layers – 0.8 mm (1/32 inch) maximum – of cotton, paper, rayon, or the like. For a thermocouple-measured temperature of a coil of an alternating-current motor, other than a universal motor, having a diameter of 178 mm (7 inch) or less – items 8 and 10 in [Table 64.1](#) – the thermocouple shall be mounted on the integrally applied insulation on the conductor.

64.1.7 Thermocouples shall consist of wires not larger than 24 AWG (0.21 mm²) and not smaller than 30 AWG (0.05 mm²). Whenever referee temperature measurements by thermocouples are necessary, thermocouples consisting of 30 AWG iron and constantan wire and a potentiometer-type instrument shall be used. The thermocouple wire shall comply with the requirements for special tolerances as listed in the ASTM E230/E230M.

64.1.8 If a product incorporates a reel for the power-supply cord, one-third of the length of the cord shall be unreeled for the temperature test.

64.1.9 For a product that is obviously not intended for continuous operation, as indicated in the instruction manual, the intermittent or short-time operation of the product as indicated, may be taken into consideration when conducting the temperature test.

64.1.10 With reference to those tests that shall be continued until constant temperatures are attained, thermal equilibrium is considered to exist when three successive readings taken at intervals of 10 % of the previously elapsed duration of the test, but not less than 5-minute intervals, indicate no change.

64.2 Maximum normal load

64.2.1 General

64.2.1.1 In tests on a product, maximum normal load is considered to be the load that approximates as closely as possible the most severe conditions of normal use in accordance with the instruction manual.

64.2.2 Products incorporating general use receptacles

64.2.2.1 Products provided with general use receptacles shall be operated under conditions of maximum normal load for the product with the additional load to the receptacles loaded to the value provided in [Table 58.1](#). See Note B of [Table 58.1](#).

65 Dielectric Voltage-Withstand Test

65.1 A product shall be tested as specified in [65.2](#) – [65.7](#). The product shall withstand the specified conditions for 1 minute without breakdown. The Electric Strength Test of CSA C22.2 No. 0.1 and UL 1097 shall be conducted for areas of products identified by [49.1](#) having double insulated construction.

65.2 A 60-Hz essentially sinusoidal potential with the product at the maximum operating temperature reached in normal use shall be applied between live parts and dead metal parts.

65.3 The test potential for the primary circuit shall be:

- a) One-thousand volts for a product rated 250 V or less; or
- b) One-thousand volts plus twice the rated voltage for a product rated more than 250 V.

65.4 The test potential for the secondary circuit of a product employing a transformer or autotransformer, other than a secondary circuit supplied from a Class 2 transformer or power unit, shall be:

- a) One-thousand volts plus twice the operating voltage if the secondary operates at 251 – 600 V.
- b) One-thousand volts if the secondary operates at 51 – 250 V; or
- c) Five-hundred volts if the secondary operates at 50 V or less.

65.5 A capacitor used for radio-interference elimination or arc suppression shall withstand for 1 min without breakdown the application of a 60 Hz essentially sinusoidal potential between live parts of opposite polarity with the product at the maximum operating temperature reached in normal use. The test potential shall be:

- a) One-thousand volts for a product rated 250 V or less; or
- b) One-thousand volts plus twice the rated voltage for a product rated more than 250 V.

65.6 A capacitor that complies with CAN/CSA-E60384-14 or UL 60384-14 is not required to comply with [65.5](#).

65.7 To determine whether a product complies with the requirements in [65.2](#) – [65.5](#), the product shall be tested by means of a 500 VA or larger transformer, having an output voltage that is essentially sinusoidal and 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.

65.8 With reference to the requirement in [65.7](#), a 500 VA or larger capacity transformer is not required to be used if the transformer is provided with a voltmeter to measure directly the applied output potential.

66 Water Spray Test

66.1 A product suitable for use in the rain as specified in [27.2](#), Products Suitable for Rain, shall be tested as described in [66.3](#) and [66.4](#) and shall comply with the following.

a) During and after the test:

- 1) There shall not be wetting of any electrical component;
- 2) No water shall enter the product in a manner that may result in a reduction of spacings; and

b) After the test:

- 1) A cord-connected or direct plug-in product shall comply with Clause [61](#), Leakage Current Test, except that the test shall be discontinued when the leakage current stabilizes; and
- 2) A product shall comply with Clause [65](#), Dielectric Voltage-Withstand Test, except that the product is not required to be at normal operating temperature.

66.2 With respect to [66.1\(a\)\(2\)](#), the appliance inlet plugs and the blades of the power supply cord are not required to be tested.

66.3 The product shall be operated so that electrical components are energized, and the product is tested under the intended conditions of use considered most likely to cause the entrance of water into or onto electrical components for a total of 1 hour under the following test sequence:

- a) Turn product on for 30 minutes.
- b) Turn product off and start water spray for 30 minutes.
- c) Turn product on and allow water spray to continue for 30 minutes.

66.4 The water spray apparatus shall consist of three spray heads constructed in accordance with the details illustrated in [Figure 66.1](#) and mounted in a water supply pipe rack as illustrated in [Figure 66.2](#). The water pressure shall be maintained at each spray head at approximately 5 lbf/in² (34 kPa). The distance between the center nozzle and the product shall be approximately 5 feet (1.5 m). The product shall be brought into the focal area of the three spray heads in such a position and under such conditions that water will be most likely to enter, except that consideration shall be given to the normal mounting position.