



Self-Ballasted Lamps and Lamp Adapters

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UL Standard for Safety for Self-Ballasted Lamps and Lamp Adapters, UL 1993

Fourth Edition, Dated December 4, 2012

Summary of Topics

This new edition of ANSI/UL 1993, the harmonized ANCE, CSA, and UL Standard for Self-Ballasted Lamps and Lamp Adapters, includes the following major changes:

a) Miscellaneous corrections and revised marking section; b) Clarify use of polymeric materials in 5.3.1; c) Change of end product requirement to material requirement in Clause 5.3.4; d) Change of material requirement to end product requirement in Clauses 5.3.6 and 8.9.2; e) Add requirements for screwshell metal of device bases for damp location applications; f) Clarification fusing resistors used for thermal protection; g) Clarification of insulation system requirement; h) Relocate qualifying requirements for humidity conditioning; i) Provide additional requirements for small coils for inductor thermal measurement method in temperature test; j) Delete subsequent testing by dielectric voltage withstand in 8.9.3; k) Temperature test fixture dimension correction; and l) Add Supplement A for Devices Using Light Emitting Diodes (LED)

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated November 25, 2011 and July 6, 2012.

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The following table lists the future effective dates with the corresponding reference.

Future Effective Date	References
December 4, 2015	Clause 6.4.6

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Association of Standardization and Certification
NMX-J-578/1-ANCE
Second Edition



CSA Group
CSA C22.2 No. 1993-12
Second Edition



Underwriters Laboratories Inc.
UL 1993
Fourth Edition

Self-Ballasted Lamps and Lamp Adapters

December 4, 2012



ANSI/UL 1993-2012

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

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This ANSI/UL Standard for Safety consists of the Fourth Edition.

The most recent designation of ANSI/UL 1993 as an American National Standard (ANSI) occurred on December 4, 2012. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, Preface, or effective date information.

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Preface

This is the harmonized ANCE, CSA Group, and UL Standard for Self-Ballasted Lamps and Lamp Adapters. It is the second edition of NMX-J-578/1-ANCE, the second edition of CSA C22.2 No. 1993, and the fourth edition of UL 1993. This edition of CSA C22.2 No. 1993 replaces the Technical Information Letter TIL No. B-36B "Self-Ballasted Fluorescent Lamps with Medium Screw-Base and Integral-Ballasted Adapters with Medium Screw-Base for Fluorescent Lamps." This edition of UL 1993 supersedes the previous edition published in 2009.

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This harmonized standard was prepared by the Association of Standardization and Certification (ANCE), the CSA Group, and Underwriters Laboratories Inc. (UL). The efforts and support of the Technical Harmonization Committee for Self-Ballasted Lamps, of the Council of the Harmonization of Electrotechnical Standards for the Nations of the Americas (CANENA), 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 Subcommittee on Lighting Products, 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 CSA Technical Committee.

In Canada, for general information on the Standards of the Canadian Electrical Code, Part II, see the preface to CAN/CSA-C22.2 No. 0.

This standard has been approved by the American National Standards Institute (ANSI) as an American National Standard.

A UL standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

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.

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Level of harmonization

This standard is published as an equivalent standard for CSA Group and UL and a proposed equivalent standard for ANCE. An equivalent standard is a standard that is substantially the same in technical content, except as follows. Technical national differences are allowed for codes and governmental regulations as well as those recognized as being in accordance with NAFTA Article 905, for example, because of fundamental climatic, geographical, technological, or infrastructural factors, scientific justification, or the level of protection that the country considers appropriate. Presentation is word for word except for editorial changes.

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.

ANCE effective date

The effective date for ANCE will be announced through the *Diario Oficial de la Federation (Official Gazette)*.

CSA Group effective date

The effective date for CSA Group will be announced through CSA Informs or a CSA Group Certification Notice.

UL effective date

As of December 4, 2012, all products Listed or Recognized by UL must comply with the requirements in this standard except for clauses, figures, and tables in the following list, which are effective December 4, 2015.

Clause 6.4.6.

Between December 4, 2012 and December 4, 2015, new product submittals to UL may be evaluated under all requirements in this standard or, if requested in writing, evaluated under presently effective requirements only. The presently effective requirements are contained in the Third Edition of UL 1993.

A UL effective date is one established by Underwriters Laboratories Inc. and is not part of the ANSI approved standard.

1 Scope

1.1 These requirements are intended to cover both self-ballasted lamps and self-ballasted lamp adapters rated 120 to 347 V AC nominal for connection to screw-base, pin-base, or recessed single contact (RSC or R7) lampholders. These devices are intended for use in accordance with the National Electrical Code, ANSI/NFPA 70, and the Canadian Electrical Code, Part I, in non-hazardous locations, and the Instalaciones Eléctricas (utilización), NOM-001-SEDE.

1.2 These devices incorporate resistance, reactance, or electronic (solid-state) type ballasts or power supplies. These devices employ various lamp technologies including, but not limited to, incandescent, fluorescent, high-intensity discharge lamps, light-emitting diodes.

1.3 These requirements also include Supplemental Requirements for Light-Emitting Diodes (LED), Supplement SA, for:

- a) Self-contained LED lamps, rated 120 to 347 V AC nominal for connection to screw-, pin-base, and recessed single contact (RSC or R7) lampholders,
- b) Lamps for replacement of an ANSI standardized fluorescent lamp, and consisting of light-emitting-diode (LED) lamp technologies, with control circuitry, and a driver or power supply. The LED driver and control circuitry will be either integral with the lamp or remote from the lamp, and
- c) Component LED lamps, with or without control circuitry, an ANSI base other than bases mentioned in (a), for connection to LED driver having a low voltage output, such as replacement for tungsten-halogen, MR11 and MR16 shaped lamps.

1.4 This standard does not apply to medium-to-medium base (E26) fittings that incorporate controls such as photocells, motion detectors, radio controls, or dimmers covered by other standards.

1.5 These devices are not intended for use with emergency exit fixtures or emergency exit lights.

2 Reference Publications

2.1 Normative references

2.1.1 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.

ANCE (Mexican National Standards)

NMX-J-024-ANCE

Iluminación – Portalámparas roscados tipo Edison – Especificaciones y métodos de prueba

NMX-J-325-ANCE

Iluminación – Portalámparas para lámparas fluorescentes – Especificaciones y métodos de prueba

NMX-J-565/2-11-ANCE

Prueba de riesgo de incendio – Parte 2-10: Métodos de prueba basados en hilo incandescente/caliente – Método de prueba de inflamabilidad de hilo incandescente para productos finales

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NOM-001-SEDE

Instalaciones Eléctricas (utilización)

NOM-058-SCFI

Productos eléctricos – Balastros para lámparas de descarga eléctrica en gas – Especificaciones de seguridad

NMX-J-578-ANCE

Iluminación – Lámparas fluorescentes compactas autobalastradas – Seguridad y métodos de prueba

CSA Group

C22.1-12

Canadian Electrical Code (CEC), Part I, Safety Standard for Electrical Installations

CAN/CSA-C22.2 No. 0-10

General Requirements – Canadian Electrical Code, Part II

C22.2 No. 0.1-M1985 (R2008)

General Requirements for Double-Insulated Equipment

C22.2 No. 0.15-01 (R2006)

Adhesive labels

CAN/CSA-C22.2 No. 0.17-00 (R2009)

Evaluation of Properties of Polymeric Materials

CAN/CSA-C22.2 No. 43-08

Lampholders

C22.2 No. 66.1-06 (R2011)

Low Voltage Transformers – Part 1: General Requirements

CAN/CSA-C22.2 No. 74-96 (R2010)

Equipment for use with electric discharge lamps

CAN/CSA-C22.2 No. 250.0-08

Luminaires

C22.2 No. 250.13-12

Light Emitting Diode (LED) Equipment for Lighting Applications

C22.2 No. 256-05 (R2010)

Direct Plug-In Nightlights

CAN/CSA-C22.2 No. 60065-03 (R2008)

Audio, Video and Similar Electronic Apparatus – Safety Requirements

C22.2 No. 60950-1-07 (R2012)

Information Technology Equipment – Safety – Part 1: General Requirements

CAN/CSA-E60384-14-09

Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains

UL (Underwriters Laboratories Inc.)

UL 94

Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 101

Leakage Current for Appliances

UL 496

Lampholders

UL 746C

Polymeric Materials – Use in Electrical Equipment Evaluations

UL 746F

Polymeric Materials – Flexible Dielectric Film Materials for Use in Printed-Wiring Boards and Flexible Materials Interconnect Constructions

UL 796

Printed-Wiring Boards

UL 840

Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment

UL 935

Fluorescent-Lamp Ballasts

UL 969

Marking and Labeling Systems

UL 1029

High-Intensity-Discharge Lamp Ballasts

UL 1310

Standard for Class 2 Power Units

UL 1412

Fusing Resistors and Temperature-Limited Resistors for Radio- and Television-Type Appliances

UL 1446

Systems of Insulating Materials – General

UL 1598

Luminaires

UL 1694

Standard for Tests for Flammability of Small Polymeric Component Materials

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UL 2097

Reference Standard for Double Insulation Systems for Use in Electronic Equipment

UL 8750

Standard for Light Emitting Diode (LED) Equipment for Use In Lighting Products

UL 60950-1

Information Technology Equipment – Safety – Part 1: General Requirements

ANSI (American National Standards Institute)

ANSI C78.24

Electric Lamps: Two-inch (51-mm) Integral-Reflector Lamps with Front Covers and GU5.3 of GX5.3 Bases

ANSI C78.81

Electric Lamps – Double-Capped Fluorescent Lamps – Dimensional and Electrical Characteristics

ANSI C81.61

Specifications for Bases (Caps) for Electric Lamps

ANSI C81.62

Electric Lampholders

ANSI C81.63

Gauges for Electric Lamp Bases and Lampholders

ANSI/ISA (American National Standards Institute/Instrumentation, Systems, and Automation Society)

ANSI/ISA MC96.1

Temperature Measurement Thermocouples

ASTM (American Society for Testing and Materials)

ASTM D 1000

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

ASTM E 28

Standard Test Methods for Softening Point of Resins Derived from Naval Stores by Ring-and-Ball Apparatus

NFPA (National Fire Protection Association)

NFPA 70

National Electrical Code (NEC)

2.2 Informative references

2.2.1 See Annex A for a list of component standards.

3 Definitions

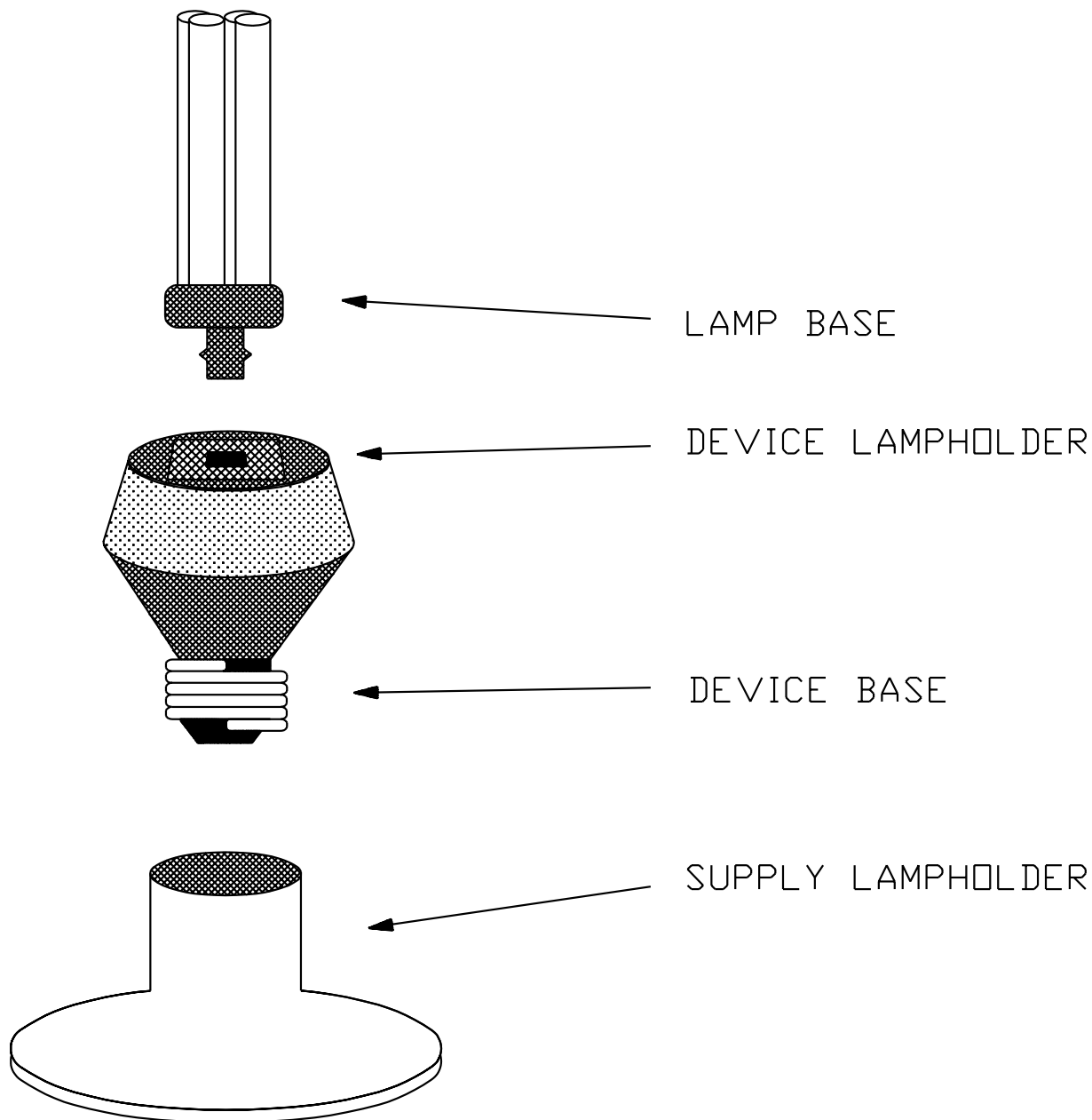
3.1 The following terms and definitions apply in this standard. See Figure 3.1 for illustrations of the definitions in Clauses 3.4, 3.5, and 3.20.

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Figure 3.1
Example of terminology for lamp adapters
(See Clause 3.1)



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3.2 ACCESSIBLE NON-CURRENT-CARRYING CONDUCTIVE (METAL) PART – a conductive part without basic insulation that, under normal operating conditions, carries no electrical current. A grounded dead conductive part may carry leakage current.

3.3 DEVICE – a self-ballasted lamp or lamp adapter. The specific name is used when it applies to only one of the devices.

3.4 DEVICE BASE – a screw-base or other ANSI base that connects the device to a mating lampholder for outlet boxes or to lampholders provided in luminaires, portable luminaires, or signs.

3.5 DEVICE LAMPHOLDER – a lampholder provided for the replaceable light source.

3.6 DEVICE LAMPHOLDER KEYING – a lampholder design that can accommodate only matching lamp bases.

3.7 DOUBLE INSULATION – an insulation system comprised of both basic insulation and supplementary insulation.

3.8 ELECTRONIC BALLAST – a ballast, generally involving high-frequency switching that is controlled by active components (transistors, thyristors, and the like), and with the lamp ballasting impedance provided by a series capacitive or inductive reactance appropriate for the high switching frequency. “Ballast” also refers to other drivers or supplies that operate lamp technologies other than fluorescent.

3.9 ENCLOSURE – a material provided to enclose parts and components that can involve the risk of fire or electric shock hazard.

3.10 LAMP ADAPTER – a self-ballasted lamp with a replaceable light source.

3.11 LAMP CONNECTOR – a set of contacts attached to flexible conductors that provides a removable means for electrical connection to a lamp but does not provide mechanical support.

3.12 LAMP, SELF-BALLASTED – a device provided with a lamp base and incorporating a non-replaceable light source and any additional elements necessary for starting and stabilizing operation of the light source, which cannot be dismantled without being permanently damaged.

3.13 LIVE PART – a metal or other conductive part that, during intended use, has an electrical potential difference with respect to earth ground or any other conductive part. The grounded (or neutral) supply conductor is considered to be a live part.

3.14 LIVE PART, HAZARDOUS – a conductive part without basic insulation, where a risk of electric shock exists.

3.15 LOCATION, DAMP – an exterior or interior location that is normally or periodically subject to condensation of moisture in, on, or adjacent to electrical equipment, including partially protected locations. The interior of a luminaire or sign intended for wet locations is considered a damp location.

Note 1: Examples of such locations include partially protected locations under canopies, marquees, roofed open porches, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold storage warehouses.

Note 2: Devices intended for damp locations may also be used in dry locations.

3.16 LOCATION, DRY – a location not normally subject to dampness, but could include a location subject to temporary dampness.

Note: For example, a building under construction.

3.17 LOCATION, WET – a location in which water or other liquid can drip, splash, or flow on or against a device.

Note 1: For example, vehicle washing areas, showers, or unprotected locations exposed to weather.

Note 2: Devices intended for wet locations may also be used in dry and damp locations.

3.18 LUMINAIRE, RECESSED – a luminaire that is designed to be either wholly or partially recessed in a mounting surface.

3.19 POWER CAPACITOR – a capacitor used with a magnetic ballast that is connected:

- a) In series with a lamp or lamps and provides the ballast impedance for the lamp current, or
- b) For power-factor correction across the input leads of the ballast or across an extension of the primary winding.

3.20 SUPPLY LAMPHOLDER – a lampholder of a luminaire or portable luminaire or sign that can accommodate and supply power to a self-ballasted lamp or lamp adapter.

3.21 TYPE TEST – testing of a representative sample of the device with the objective of determining if the device, as designed and manufactured, can meet the requirements of this standard.

4 General Requirements

4.1 Components

4.1.1 Except as indicated in Clause 4.1.2, a component of a product covered by this standard shall comply with the requirements for that component. See Annex A for a list of standards covering components generally used in the products covered by this standard. A component shall comply with the ANCE, CSA, or UL standards as appropriate for the country where the product is to be used.

In Mexico, the requirements of Clause 4.1 do not apply.

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

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

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

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

4.2 Application of requirements

4.2.1 The requirements of the national installation codes and other practices of Canada, Mexico, and the United States have been addressed in the requirements of this standard.

4.2.2 A product intended to be used in Canada, Mexico, and the United States shall comply with the requirements of this standard for those countries.

4.2.3 A product to be used only in Canada, Mexico, or the United States shall comply with the common requirements of this standard and the applicable country-specific requirements, where so noted.

4.3 Units of measurement

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

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

4.3.3 All values of voltage and current are root mean square (rms) values unless otherwise noted.

4.3.4 Temperatures are given in Celsius only.

4.4 Assembly and packaging

4.4.1 A device shall be completely assembled and wired with each electrical component mounted in place and with each splice and connection completed when shipped from the factory. The lamp may be packaged separately in the case of a lamp adapter.

4.5 Principles

4.5.1 Risk of electric shock

4.5.1.1 Risk of electric shock can occur due to a number of factors, including:

- a) Voltage between conductive parts,
- b) Current available,
- c) Whether the current is pulsed or continuous,
- d) Frequency of voltage and current,
- e) Pathway through the human body, and
- f) Skin resistance.

4.5.1.2 Risk of electric shock is usually defined only in terms of electrical voltage, current, and frequency. Throughout this standard, voltage between parts greater than $30 V_{\text{rms}}$, $42.4 V_{\text{peak}}$ (and DC) – half of these limits for wet locations – is considered to be a risk of electric shock. When the current available is greater than $0.5 \text{ mA}_{\text{rms}}$ for perception and greater than $5.0 \text{ mA}_{\text{rms}}$ for let-go, for direct current and alternating current up to 1 kHz, the current is considered to be a risk of electric shock. A passive network connected across the meter input terminals of a measuring instrument compensates for the pathway body impedance and frequency. The test method and meter network are described in UL 101.

4.5.2 Risk of fire

4.5.2.1 The risk of fire can occur when electrical energy is converted to heat, and the heat is entrapped. It is difficult to define the energy level in terms of electrical parameters alone because the degree of entrapped heat will determine whether or not there would be combustion. In addition, risk of fire can be abated by a suitable enclosure (fire can be confined by the enclosure).

4.5.2.2 There are several possible indicators that are used while conducting a given test. Throughout this standard, the check for fire hazard is either by a specific temperature limit or a change of an indicator. For example, one fire indicator is a layer of cheesecloth, and its change of state occurs when it ignites and causes combustion.

4.5.2.3 Throughout this standard, an energy level of 15 VA is considered to be a sufficient level to support a fire. A circuit having 15 VA available is considered to be a fire-hazardous circuit.

4.5.2.4 Throughout this standard, a suitable enclosure is described in Clauses 5.1 and 5.3.

5 Mechanical Construction

5.1 Enclosures

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

5.1.2 An enclosure shall be of metal or of a polymeric material that complies with Clause 5.3.

5.1.3 A metal enclosure shall comply with the minimum thickness specified in Table 5.1.

Table 5.1
Thickness of metal enclosures
(See Clause 5.1.3)

Metal	Minimum thickness, mm (in)	
Cast metal	1.2	(0.047)
Uncoated sheet steel	0.66 ^a	(0.026)
Nonferrous sheet metal	0.81	(0.032)
^a Uncoated sheet steel with a minimum of 0.51 mm (0.020 in) is acceptable if the ballast part of the device is filled with potting compound.		

5.1.4 An enclosure constructed of iron or steel shall be protected against corrosion by plating, painting, or the equivalent on both inside and outside surfaces.

5.2 Openings

5.2.1 An enclosure shall not have openings wider than 2 mm (0.078 in), unless they do not permit a 2 mm (0.078 in) diameter rod of any length to contact live parts. The uninsulated live parts of a lampholder into which a lamp connects are not required to comply.

5.2.2 The enclosure openings in a lamp adapter shall be evaluated with the lamp removed.

5.2.3 A hole in an enclosure through which wires emerge to connect with a lamp connector shall be:

- a) Close-fitting to the emerging lead wires,
- b) Free of burrs, sharp edges, and the like, that can abrade the insulation, and
- c) Provided with a strain-relief means that complies with the strain relief test for lamp connectors of Clause 8.11.

5.3 Polymeric materials

5.3.1 (CAN) In Canada, a polymeric material shall comply with the requirements in CAN/CSA-C22.2 No. 0.17 and with the requirements of Clauses 5.3.2 to 5.3.4 and Clause 5.3.6 when the material is used to:

- a) Enclose electrical parts,
- b) Provide direct or indirect support of live parts, or
- c) Both.

5.3.1 (MEX) In Mexico, the parts of insulating material that contain live parts and external parts of insulating material that provide protection against electrical shock shall be subjected to the glow-wire test in accordance with NMX-J-565/2-11-ANCE and to the following:

- a) The test specimen shall be an end product. If it is necessary to take a part from the lamp in order to perform the test, care shall be taken to assure that the test conditions are not significantly different from that which occurs in normal use conditions;
- b) The temperature in the tip of the glow-wire shall be 650 °C.

5.3.1 (USA) In the United States, a polymeric material shall comply with the requirements for portable equipment specified in UL 746C and with the requirements of Clauses 5.3.2 to 5.3.6 when the material is used to:

- a) Enclose electrical parts,
- b) Provide direct or indirect support of live parts, or
- c) Both.

5.3.2 A polymeric material used to enclose electrical parts shall have a Relative Thermal Index (RTI), including electrical and mechanical, with impact properties of at least the temperature measured during the temperature test of Clause 8.5, unless the measured temperature is less than 65 °C.

5.3.3 A polymeric material used as an enclosure shall have a flammability rating of 5-VA, 5-VB, or V-0 in accordance with UL 94 or CAN/CSA-C22.2 No. 0.17.

5.3.4 A polymeric material used as an enclosure of a device marked for wet location use shall comply with the ultraviolet light exposure test specified in UL 746C or CAN/CSA-C22.2 No. 0.17.

5.3.5 With respect to UL 746C, the following tests are not required to be conducted:

- a) The abnormal operation and severe conditions test,
- b) The input after mold-stress relief distortion test, and
- c) the volume resistivity test.

5.3.6 A device shall comply with the mold-stress relief distortion test of Clause 8.9.

5.3.7 A polymeric material used for direct support as electrical insulation shall be able to withstand the hot wire ignition (HWI), the comparative tracking index test (CTI), and the high current arc ignition (HAI) to a level of at least the values in accordance with Table 5.2.

Table 5.2
Ratings of polymeric materials^a
(See Clause 5.3.7)

Environmental rating	Flammability classification ^b	CTI ^c		HWI ^d		HAI ^e	
		Minimum volts	PLC ^f	Minimum seconds	PLC ^f	Minimum seconds	PLC ^f
Dry location	5-VA, 5-VB, V-0	100	4	—	—	—	—
Damp location	5-VA, 5-VB, V-0	175	3	—	—	—	—
Wet location	5-VA, 5-VB, V-0	250	2	—	—	—	—
Any	5-VA, 5-VB	—	—	15	3	30	2
Any	V-0, VTM-0	—	—	7	4	15	3

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

^b Flammability classification determined by prior classification or by 12-mm end-product (needle) flame test described in UL 746C or CAN/CSA-C22.2 No. 0.17.

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

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

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

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

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5.4 Weight and moment

5.4.1 A device shall have weight and moment limitations as specified in Table 5.3.

Table 5.3
Weight and moment limitations
(See Clause 5.4.1)

Device base	Maximum weight, ^{a,c} kg (lbs)	Maximum moment, ^{a,b} N·m (in-lbs)
E12 (Candelabra)	0.50 (1.15)	0.60 (5.54)
E17 (Intermediate)	0.75 (1.63)	0.09 (7.85)
E26 (Medium), GU10, GU24	1.15 (2.5)	1.35 ^c (12)
E39 (Mogul)	1.70 (3.75)	2.05 (18)
^a For weight and moment measurements, lamp adapters shall be provided with lamps. ^b The moment is the weight of a device multiplied by the distance between the center contact of the device lamp base and the center of gravity of the device. ^c Includes the weight of any glassware and/or shade provided with the device. See Clause 5.4.3.		

5.4.2 A device that is constructed so that the alignment with the existing incandescent luminaire or portable luminaire requires an adjustment greater than ± 20 degrees shall be provided with adjustment of the device base with relation to the remainder of the device. Examples include:

- a) A rectangular-shaped device in which the device is to be parallel with existing walls when installed in a ceiling surface luminaire, and
- b) A device incorporating a ballast compartment or lamp support arms that will in some cases have to be rotated more than 20 degrees to properly clear harps in portable luminaires.

5.4.3 A device intended to be used with a shade, glassware, or diffuser shall be provided with that accessory.

5.4.4 A lamp adapter shall be provided with a positive means to retain the lamp or lamps in place in any possible mounting orientation, such as by clips, retaining springs, or the equivalent. A securing means relying solely on the electrical contacts of the lampholder does not meet this requirement.

5.4.5 When the integrity of the lamp securing means of a lamp adapter cannot be determined, the device lampholder shall comply with the minimum retention force values specified in ANSI C81.62, using the appropriate plug gauge specified in ANSI C81.63 for the intended lamp type.

6 Electrical Construction

6.1 Lamp bases and lampholders

6.1.1 A device lampholder and device base shall comply with the requirements of CSA C22.2 No. 43 and UL 496. The screw base metal shell, including double contact types (3-way), shall comply with the material, thickness, and dimensional construction requirements. The screw base metal shall be subjected to the pull, torque, and go/not-go tests. A device screw base intended to lock in place and be

non-removable shall be provided with a ratcheting mechanism, or the equivalent, so that the lampholder in which it is installed is not damaged. A skeleton type of construction shall not be used on a device screw base.

In Mexico, a device lampholder and device base shall comply with the requirements of NMX-J-024-ANCE and NMX-J-325-ANCE.

6.1.2 A screwshell metal of a device base shall be made from:

- a) Copper alloy with a minimum of 80 percent copper,
- b) Nickel alloy,
- c) Stainless steel, or
- d) Aluminum or copper alloy electroplated with nickel alloy covering all surfaces (after forming and trimming).

Unplated aluminum is acceptable as a screwbase metal only for devices intended for dry and damp locations.

6.1.3 In Canada and the United States, a device lampholder of a fluorescent lamp adapter shall be tested with the lamp or lamps that the device is intended to accommodate. The lampholder shall be keyed to accommodate a specific lamp or lamps or comply with Clause 6.1.4. The lampholder keying shall comply with ANSI C81.61, C81.62, and C81.63.

In Mexico, a device lampholder of a fluorescent lamp adapter shall be tested with the lamp or lamps that the device is intended to accommodate. The lampholder shall be keyed to accommodate a specific lamp or lamps or comply with Clause 6.1.4. The lampholder keying shall comply with NMX-J-024-ANCE and NMX-J-325-ANCE.

6.1.4 A device which does not comply with Clause 6.1.3 shall comply with the lamp starting and operating measurements of Clause 8.3.

6.2 Current-carrying parts

6.2.1 A wire shall have insulation rated for the voltage, temperature, and conditions of intended use.

6.2.2 Where loosening or breaking of electrical connections involves a risk of fire or electric shock, the connections shall be soldered, welded, or otherwise securely connected. A soldered joint shall be mechanically secure before soldering. A surface mount component not exceeding a maximum dimension of 13 mm (0.5 in) need not comply with this requirement.

6.2.3 A wire is considered to be mechanically secure when one or more of the following is provided:

- a) At least one full wrap around a terminal,
- b) At least one right angle bend when passed through an eyelet or opening, except on printed-wiring boards where components are properly inserted and soldered or mechanically secured by design, or
- c) It is twisted with other conductors.

6.2.4 Iron or steel, plain or plated, shall not be used for current-carrying parts unless it is a wire integral to the lamp light source or parts used for the containment of electromagnetic or electrostatic fields.

6.2.5 An uninsulated live part shall be permanently mounted and secured in accordance with Clause 6.2.3 to reduce the likelihood of turning or shifting position if such motion can result in a reduction of spacings below minimum acceptable values.

6.2.6 An accessible wire between a lamp connector for a circular lamp and the device enclosure shall:

- a) Be a continuous length of stranded wire with no splices,
- b) Incorporate a conductor of 0.52 mm² (20 AWG) or larger,
- c) Have insulation 0.8 mm (1/32 in) thick or greater, and
- d) Comply with the strain relief test of Clause 8.11.

6.3 Printed circuit boards

6.3.1 In Canada, printed circuit wiring boards shall comply with Annex E.

In the United States, printed circuit wiring is considered part of the ballast, and shall comply with UL 935 (see Clause 6.4.1).

In Mexico, Clause 6.3 does not apply because in Mexico the tests are carried out on the end product, not to components.

6.4 Ballasts and LED drivers

6.4.1 In Canada, a conventional magnetic ballast for discharge lamps shall comply with the requirements of CSA C22.2 No. 74 and have a thermal protector. Electronic ballasts for discharge lamps may be inherently protected.

In Mexico, a ballast shall comply with the requirements of NOM-058-SCFI and have a thermal protector.

In the United States, a ballast for fluorescent lamps shall comply with the requirements of UL 935 and have Class P thermal protection. A ballast for high-intensity discharge lamps shall comply with the requirements of UL 1029 and UL 935.

6.4.2 A ballast not previously investigated as described in Clause 6.4.1 shall be evaluated in the device. The construction requirements of UL 935 or CSA C22.2 No. 74 or NOM-058-SCFI shall apply. See the appropriate standard for details on coil insulation materials, thermal and overcurrent protective components, printed wiring boards, and spacing of electrical parts on the printed wiring board.

6.4.3 A ballast for fluorescent lamps shall be subjected to the following tests:

- a) For the normal temperature test of Clause 8.5, the device shall be installed in the test fixture described therein. The maximum surface ballast temperature shall be measured by a thermocouple on the outer surface of the device, and
- b) The abnormal-temperature test and fault-condition test (Class P) thermally protected ballasts described in UL 935 or the fault conditions test described in CSA C22.2 No. 74 or the Condición de falla described in NOM-058-SCFI.

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6.4.4 Regarding the fault condition testing specified in Clause 6.4.3 (b), the following fault conditions shall be introduced, one at a time – not necessarily in the order indicated:

- a) For a transformer winding or power inductor, two outer layers of a layer wound coil or 20 percent of the turns of a random wound coil are short-circuited, and
- b) Any electrolytic capacitor or semiconductor junctions shall be short-circuited or open-circuited.

6.4.5 A fusing resistor used for thermal protection shall comply with UL 1412 or the requirements of CAN/CSA-C22.2 No. 60065-03 (R2008) or the requirements of NMX-J-578-ANCE. Testing shall include the Limited Short Circuit test while installed in the application, unless the test was previously conducted in accordance with UL 1412 or CSA C22.2 No. 256. If a clearance to combustible materials was used during the Overload Test, as permitted in UL 1412, the clearance shall be maintained or, the Overload Test shall be conducted while the resistor is installed in the application.

6.4.6 A printed wiring board trace intended to open as a result of an abnormal condition is not permitted.

6.4.7 In Canada, a magnetic coil shall have an insulation system complying with the General Requirements – Canadian Electrical Code, Part II, CAN/CSA-C22.2 No. 0.

In the United States, a magnetic coil operating above Class 105 temperature limits shall have an insulation system complying with UL 1446. A ballast completely enclosed in a polymeric enclosure complying with Clause 5.3, and with no accessible current-carrying (such as low voltage circuitry) or non-current-carrying (such as a ferrite core) metal parts that are capable of being energized is not required to comply with UL 1446. However, the respective electrical Relative Thermal Index (RTI) of the individual materials shall be greater than the operating temperature determined during the temperature test in Clause 8.5.

In Mexico, Clause 6.4.7 does not apply.

6.4.8 Drivers for light-emitting diodes (LEDs) vary in complexity from simple to complex circuits. For the circuits, the requirements for construction and testing would be similar to what is required for fluorescent lamp ballasts. The construction features of the overall device affect the evaluation of the LED driver. When the LEDs are accessible to the user, it is necessary to determine that the LEDs are not hazardous live parts and that basic insulation exists in the driver circuitry between the accessible live parts and the source of supply. When the LEDs are inaccessible and enclosed in a suitable electrical enclosure, it will in some cases not be necessary to determine that a basic insulation exists in the driver circuitry between the internal live parts of the LEDs and the source of supply.

6.5 Power capacitors

6.5.1 In Canada, a power capacitor shall comply with the applicable requirements specified in CSA C22.2 No. 74.

In the United States, a power capacitor shall comply with the applicable requirements specified in UL 935.

6.6 Spacing of electrical parts

6.6.1 For other than on a printed wiring board, the spacing of electrical parts through air (clearance) and over the surface of insulating material (creepage distance) shall be at least as described in Clauses 6.6.2 and 6.6.3 for the following:

- a) Uninsulated live parts of opposite polarity, and
- b) An uninsulated live part and a non-current-carrying metal part exposed to contact by persons.

6.6.2 Alternate spacing requirements may be applied as specified in Clauses 6.6.5 to 6.6.7.

6.6.3 A spacing described in Clause 6.6.1 shall not be less than the values specified in Table 6.1.

Table 6.1
Minimum spacing, dry, damp, and wet locations
(See Clause 6.6.3)

Location Type	Potential, V ^a	Minimum spacing, mm (in)	
		Through air or over surface	
Dry or damp	300 or less (425)	1.2	(0.046)
Dry or damp	301 – 600 (426 – 846)	3.2	(0.125)
Wet	Less than 600 (848)	4.8	(0.187)

^a The figures in parentheses are peak voltages. When evaluating the voltage of a circuit that produces other than sinusoidal waveform, both rms and peak values are evaluated and the requirement for the larger spacing shall be applied.

6.6.4 For a printed wiring board, the spacing of electrical parts for the ballast shall comply with the requirements of UL 935 or CSA C22.2 No. 74 as applicable. However,

- a) When the power available between two insulated parts is less than 50 W when determined in accordance with the fault condition test of UL 935 (maximum: 1 minute), the spacing is not required to comply with this requirement.
- b) When the minimum spacing is determined by the dielectric voltage-withstand test to a dielectric potential of $2 V + 1000 V$ DC for 1 min, where V equals the maximum peak potential, in volts, between the foil traces, the spacing is not required to comply with this requirement.

6.6.5 In the United States, as an alternative to the spacing requirements specified in Clauses 6.6.2 to 6.6.4, the clearance and the creepage distance between conductive parts that are rigidly held in place and reliably spaced in production may be evaluated for compliance with UL 840. The spacing requirements in UL 840 shall not be applied to a spacing to an exposed non-current-carrying metal enclosure. Creepage distances shall not be less than clearances.

6.6.6 In the United States, when applying the requirements specified in UL 840 to determine clearances, the device may be considered as operating on a supply circuit having an over-voltage of Category II.

6.6.7 In the United States, when applying the requirements specified in UL 840 to determine environmental pollution, the device may be evaluated with different environmental pollution degrees. The following conditions apply:

- a) A device marked for wet use shall be exposed to environmental pollution degree 3.
- b) A device intended for dry or damp locations shall be exposed to environmental pollution degree 2.
- c) The portion of a printed wiring board covered with a potting compound or a conformal coating that complies with the requirements in conformal-coating tests described in UL 746C shall be exposed to environmental pollution degree 1.

6.6.8 In Canada, printed circuit boards covered with potting compound or a conformal coating shall comply with the requirements of Annex E.

6.7 Accessibility of live parts

6.7.1 Accessibility of hazardous live parts shall be determined when the articulated probe of Clause 9.6 is inserted through any opening without contacting any hazardous live parts.

6.7.2 The articulated probe of Clause 9.6 shall not contact any bare live parts of the lampholder contacts of a fluorescent adapter with the lamp removed.

6.7.3 A non-current-carrying metal part, such as the head of a screw or rivet, is not considered to be exposed to contact if it is recessed to clear the surface by at least 5 mm (0.197 in) in a hole not more than 7 mm (0.275 in) in diameter.

6.8 Light source – fluorescent lamps

6.8.1 Fluorescent discharge lamps shall be tested to simulate end-of-lamp-life conditions as follows:

- a) For a lamp operated with a conventional magnetic ballast, the lamp shall be subjected to a shorted starter or deactivated lamp condition as described in the abnormal temperature test in UL 935 or in CSA C22.2 No. 74.
- b) For either self-ballasted lamps or lamp adapters that employ an electronic ballast, the lamp fault conditions test as described in Clause 8.16 shall be conducted.
- c) For lamp adapters that employ an electronic ballast, one of the end-of-lamp-life tests as described in Clause 8.17 shall be conducted. Note that there are three tests described although it is only necessary to comply with one of the tests.
- d) For self-ballasted lamps that employ an electronic ballast, the one filament, emissive-mix-free test as described in Clause 8.18 shall be conducted.

6.9 Light source – light emitting diodes (LED)

6.9.1 Light-emitting diodes (LEDs) emitting coherent light shall not be used.

6.9.2 LEDs used in the subject screw-base lamps shall not be user replaceable.

6.9.3 LEDs used in the subject screw-base lamps shall not be provided with shunt devices that would handle the current in the event the LEDs had open-circuited.

6.10 Light source – non-discharge lamps

6.10.1 Adapters with a lamp containment barrier and employing replaceable tungsten halogen lamps shall be marked with a lamp caution in accordance with Table 10.1, Items 8 and 16.

In Canada, the caution marking of Table 10.1, Item 8, is not required.

6.10.2 Adapters employing replaceable tungsten halogen lamps where the lamp has an integral containment barrier shall be marked with a maximum lamp caution in accordance with Table 10.1, Items 8 and 15.

6.10.3 Adapters complying with Clause 6.10.1 or Clause 6.10.2 may be marked indicating the lamp is suitable for use in an open type luminaire in accordance with Table 10.1, Item 17. Alternatively, the adapter may be marked with the symbol shown in Annex F, Figure F.1, along with instructions on the packaging explaining the symbol and that this type of lamp does not require additional shielding.

7 Environmental Locations

7.1 Dry locations

7.1.1 A device intended for use only in dry locations shall be marked in accordance with Table 10.1, Item 9.

7.1.2 The device or packaging of a device intended for use in dry locations shall not be marked in any manner that could imply or depict that it is suitable for a damp or wet use location.

7.2 Damp locations

7.2.1 A device intended for use in damp locations and marked in accordance with Table 10.1, Item 10, shall:

- a) Comply with the spacing requirements for damp locations or pollution degree 2 of Clause 6.6,
- b) Have base contacts made of materials suitable for use in damp locations that comply with the requirements in Clause 6.1.2, and
- c) Comply with the humidity test of Clause 8.13 if the device has accessible non-current-carrying metal parts.

7.3 Wet locations

7.3.1 A device intended for use in wet locations and marked in accordance with Table 10.1, Item 11 or 12, shall:

- a) Comply with the spacing requirements for wet locations or pollution degree 3 of Clause 6.6,
- b) Have base contacts made of materials suitable for use in wet locations that comply with the requirements in Clause 6.1.2,
- c) Have polymeric enclosures comply with the UV rating of Clause 5.3,
- d) Comply with the humidity test of Clause 8.13 if the device has accessible non-current-carrying metal parts,
- e) Comply with the water spray test of Clause 8.14, and
- f) Comply with the cold impact test of Clause 8.15.

8 Tests

8.1 General

8.1.1 Compliance with this standard is checked by conducting the tests specified and appropriate for the product. Tests according to this standard are tests that are done on samples that represent others of similar construction. The requirements and tolerances permitted by this standard are related to testing of representative samples submitted by the manufacturer for that purpose. Compliance of the sample does not ensure compliance of the whole production of a manufacturer with this safety standard. Conformity of production is the responsibility of the manufacturer and can additionally include routine factory audits, tests, and quality assurance.

8.1.2 Tests described in this section use instrumentation, apparatus, and environmental conditions that are described in Clause 9.

8.1.3 Manufacturing and production tests shall be carried out in accordance with Annex D.

8.1.4 The tests shall be conducted on samples as specified in Table 8.1. The test plan summary provides the number and any special preparation of the sample or samples.

Table 8.1
Test plan summary
(See Clause 8.1.4)

Test description	Reference	Number and description of samples
Electrical Tests		
Input measurements	8.2	1 sample of device along with lamps it is intended to operate with.
Lamp starting and operating measurements	8.3	1 sample of device along with lamps it is intended to operate with; can be same as used in the input test.
Enclosure leakage-current test	8.4	1 sample of device along with lamps it is intended to operate with; can be same as used in the input test.
Normal temperature test	8.5	1 sample of device along with lamp that drew the greatest wattage in input test. If the device were normally potted, it would be necessary to prepare a sample with thermocouples attached prior to potting. If acceptable to all parties concerned, the sample for test can be unpotted.
Dielectric voltage-withstand test	8.6	1 sample of the device – can be the same as used for input measurements, but not the sample for temperature test as the thermocouples can interfere with the test.
Harmonic distortion test	8.7	1 sample of the device – can be the same as used for input measurements.
Mechanical Tests		
Lamp base test in UL 496 or CAN/CSA-C22.2 No. 43	6.1.1	6 samples, assembled (Pull test); 6 samples, assembled (Torque); 6 samples, unmounted (Go / Not-go gauging tests)
Drop impact test	8.8	If the enclosure is plastic, one sample of each enclosure type can be subjected to 3 drops, or if suitable to all concerned, three samples each of which can be subjected to one drop.
Enclosure mold-stress relief conditioning	8.9	1 sample of each enclosure type; may be same as used in drop test.
Deflection test	8.10	1 sample of each enclosure type; may be same as used in drop test.
Strain relief test	8.11	If device has lead wires and is not potted, 1 sample; can be the same as used above.
Special Tests		
Tests with dimmer circuits	8.12	1 sample; may be used in previous tests.
Humidity conditioning test	8.13	For damp location rating, 1 sample; may be used in previous tests.
Water spray test	8.14	For wet location rating and device is not potted, 1 sample of each enclosure type; can be the same as used above.
Cold impact test	8.15	For wet location rating, three samples of each enclosure type.
Lamp fault conditions tests	8.16	For devices with electronic ballast, multiple test conditions are defined in this section. Samples should be easily disassembled to access lamp filament connections; minimum of 6 samples recommended.
End of lamp life tests for adapters	8.17	For lamp adapters with electronic ballasts, three tests are described in this section. If previously determined which test of the three will be conducted, only one sample is needed. If the test has not been previously determined, one sample would be needed for each of the three tests.
End of lamp life tests for self-ballasted fluorescent lamps	8.18	For self-ballasted lamps with electronic ballasts, specially prepared samples are needed. Three samples shall have no emission mix on one lamp filament, and three samples shall have no emission mix on the other filament.
Component abnormal conditions	6.4.3 (b)	1 sample for each component fault, or less if it can be determined that fewer samples would be needed if the fault condition would cause the sample to be unusable. Potted samples would need to have additional wires to attach to internal connections so that the short condition can easily be created. Devices that are normally potted can be tested without potting if agreeable to all parties concerned.
Miscellaneous		