UL 1598

STANDARD FOR SAFETY

Luminaires

UL Standard for Safety for Luminaires, UL 1598

Third Edition, Dated September 17, 2008

Summary of Topics

These revisions to UL 1598 include the following changes in requirements:

1. Revise requirements for mechanical joints and fastenings in Section 5.10

2. Add wire style TFN to Table 6.9.2

3. Correct Enclosed Lamp Compartment entry in legend to Figure 7.2.1.1

4. Increase minimum temperature ratings in Table 7.2.2.1 for partially enclosed lamp compartment rated 60 W or less

5. Revise Canada only branch circuit disconnect requirements for fluorescent luminaires

6. Change language for polymeric lenses in luminaires

7. Remove Canadian requirements to Exit signs

8. How to replace incandescent bulbs with CFLs and LEDs

9. Additional Canada only annex for RV luminaires

10. Clarification of required marking in Clause 11.3.4

11. Clarification of required rated thermal resistance in Clause 19.16.1

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

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated September 23, 2011.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the preface. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a ″SUPERSEDED REQUIREMENTS″ notice.

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

Future Effective Date	References
April 17, 2014	Clauses 5.10.8.1, 5.10.8.2, and 9.3.5.1

Association of Standardization and Certification
NMX-J-307/1-ANCE
Second Edition

CSA Group
CSA C22.2 No. 250.0-08
Third Edition

Underwriters Laboratories Inc.
UL 1598
Third Edition

Luminaires

September 17, 2008

(Title Page Reprinted: October 17, 2012)

ANSI/UL 1598-2012

Commitment for Amendments

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

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This ANSI/UL Standard for Safety consists of the Third Edition including revisions through October 17, 2012. The most recent designation of ANSI/UL 1598 as an American National Standard (ANSI) occurred on October 17, 2012. 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 http://csds.ul.com.

To purchase UL Standards, visit Comm 2000 at http://www.comm-2000.com/help/how_to_order.aspx or call toll-free 1-888-853-3503.

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Annex H (CAN) (normative) LUMINAIRES FOR USE IN RECREATIONAL VEHICLES

No Text on This Page

Preface

This is the harmonized ANCE, CSA, and UL Standard for Luminaires. It is the first edition of NMX-J-307/1-ANCE, the third edition of CSA C22.2 No. 250.0, and the third edition of UL 1598. This edition of CSA C22.2 No. 250.0 supersedes the previous editions published in 2004 and 2000. This edition of UL 1598 supersedes the previous editions published in 2004 and 2000. The CSA Standard also replaces the Technical Information Letter TIL B-78, “Interim Certification Requirements for Ballast Disconnect Means in Fluorescent Luminaires Installed on Branch Circuits with Voltages Exceeding 150-Volts-to-Ground.”

The Canadian Standards Association (CSA) and Underwriters Laboratories Inc. (UL) prepared the first edition of this common standard. The efforts and support of the Canadian Lamp and Fixture Manufacturers Association (CLFMA) and the American Lighting Association (ALA) are gratefully acknowledged. Later the same organizations with the added participation of the Association of Standardization and Certification (ANCE) and the National Electrical Manufacturers Association (NEMA) expanded the document to cover requirements for Canada, Mexico, and the United States.

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.

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

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

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 effective date

The effective date for CSA will be announced through *CSA Informs* or a CSA certification notice.

UL effective date

As of October 17, 2012, all products Listed or Recognized by UL must comply with the requirements in this standard except for clauses in the following list, which are effective April 17, 2014.

Clauses 5.10.8.1, 5.10.8.2, and 9.3.5.1.

Between October 17, 2012 and April 17, 2014, 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 second edition of UL 1598.

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

1 Scope

1.1 This Standard applies to luminaires for use in non-hazardous locations and that are intended for installation on branch circuits of 600 V nominal or less between conductors in accordance with the *Canadian Electrical Code, Part I (CEC)*, CSA C22.1, with the U.S. *National Electrical Code (NEC)*, ANSI/NFPA 70, and with the Mexican National Electrical Code, NOM-001-SEDE.

1.2 This Standard does not apply to luminaires covered by other standards. The luminaries not covered by this Standard include:

Amateur Movie Lights;
Aquarium Lights;
Cabinet Lights;
Decorative Lighting Strings;
Combination Fan/IR Lamps Used for Heating;
Electric Signs;
Exit Signs;
Junction Boxes for Swimming Pool Fixtures;
Lamp Adapters;
Low-Level Path Marking and Lighting Systems in the United States;
Low-Voltage Landscape Lighting as follows:

For products intended for installation in Canada, landscape lighting systems that are 30 V nominal or less; and

For products intended for installation in Mexico, low-voltage landscape lighting devices that are 24 V nominal or less.

For products intended for installation in the United States, low-voltage landscape lighting devices that are of 15 V nominal or less;

Low Voltage Lighting Fixtures for Use in Recreational Vehicles;
Low Voltage Marine Lighting;
Luminaires for Hazardous Locations;
Luminaires for Recreational Vehicles in the United States;
Marine Navigational Lights;
Marine-Type Fixtures;
Portable Electric Displays;
Portable Hand Lamps;
Portable Luminaires;
Portable Sun/Heat Lamps;
Self-Ballasted Lamps and Lamp Adapters;
Stage and Studio Luminaires;
Submersible Luminaires;
Swimming Pools Luminaires;
Temporary Lighting Strings;
Therapeutic Lamps;
Track Lighting Systems;
Under-cabinet Lights in Canada and Cord-connected Under-cabinet Lights in the United States; and
Unit Equipment for Emergency Lighting.

2 Reference publications

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 all revisions published to that edition up to the time the Standard was approved.

ANCE (Mexican National Standards)

NMX-J-198-ANCE-2005
Electrical Products – Lighting – Ballast for fluorescent lights – Test methods

NMX-J-230-ANCE-2001
Ballast Lighting – Electromagnetics and electronics for mercury vapour lights of high pressure and metallic additives – Specifications and test methods

NMX-J-547-ANCE-2005
Lighting – Metal halide lamps – Specifications

NMX-J-553-ANCE-2002
Wires and cables – Weather resistance of insulation or jacket of electrical conductors – Test method

NMX-J-565/2-11-ANCE-2005
Fire hazard testing – Part 2-11: Glow/hot-wire-based test methods – Glow-wire flammability test

NMX-J-565/3-ANCE-2006
Safety requirements – Flammability of plastic materials for parts in devices and appliances – Test methods

NMX-J-565/6-ANCE-2007
Safety requirements – Hot wire resistance to ignition – Test method

NMX-J-565/7-ANCE-2007
Safety requirements – High-current arc resistance to ignition – Test method

NOM-001-SEDE
Mexican National Electrical Code

NOM-064-SCFI-2000
Electrical appliances – Lamps for indoor and outdoor use – Safety specifications and test methods

CSA (Canadian Standards Association)

C22.1-06
Canadian Electrical Code, Part I (CEC)

C22.2 No. 0.15-01 (R2006)
Adhesive Labels

CAN/CSA-C22.2 No. 0.17-00 (R2004)
Evaluation of Properties of Polymeric Materials

C22.2 No. 62-93 (R2003)
Surface Raceway Systems

C22.2 No. 74-96 (R2005)
Equipment for Use With Electric Discharge Lamps

C22.2 No. 84-05
Incandescent Lamps

C22.2 No. 206-M1987 (R2004)
Lighting Poles

UL (Underwriters Laboratories Inc.)

UL 5
Standard for Safety Surface Metal Raceways and Fittings

UL 723
Standard for Test for Surface Burning Characteristics of Building Materials

UL 746C
Standard for Polymeric Materials – Use in Electrical Equipment Evaluations

UL 935
Standard for Safety Fluorescent-Lamp Ballasts

UL 969
Standard for Marking and Labeling Systems

ANSI (American National Standards Institute)

ANSI C78.380 (2005)
Electric Lamps — High Intensity Discharge Lamps, Method of Designation

ANSI/IESNA (Illuminating Engineering Society of North America)

ANSI/IESNA RP-27 series of standards
Photobiological Safety for Lamps and Lamp Systems

ASME (American Society of Mechanical Engineers)

ANSI/ASME B1.20.1-1983 (R2001)
Pipe Threads, General Purpose (Inch)

ASTM (American Society for Testing and Materials)

ASTM D 635-03
Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

ASTM D 1000-99
Standard Test Method for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications

ASTM D 3801-00
Standard Test Method for Measuring the Comparative Burning Characteristics and Resistance of Solid Plastics in a Vertical Position

ASTM D 5048-03
Standard Test Method for Measuring the Comparative Burning Characteristics and Resistance to Burn Through of Solid Plastics Using 125 mm Flame

ASTM G 151-00
Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources

ASTM G 153-00ae1
Standard Practice for Operating Enclosed Carbon Arc Light-Apparatus for Exposure of Nonmetallic Materials

ASTM G 155-00ae1
Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials

ASTM MNL 12-1993
Manual on the Use of Thermocouples in Temperature Measurements: Fourth Edition

Government of Canada

National Building Code of Canada, 2005

NFPA (National Fire Prevention Association)

ANSI/NFPA 70-2005
National Electrical Code (NEC)

NFPA 90A-1993
Standard for Installation of Air Conditioning and Ventilating Systems

NIST (National Institute of Standards and Technology)

NIST ITS-90
Thermocouple Database

IEC (International Electrotechnical Commission)

IEC 60695-2-10:2000
Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure

ISA (The Instrumentation, Systems, and Automation Society)

ISA MC 96.1-1982
Temperature Measurement Thermocouples

3 Definitions

The following definitions apply in this Standard:

Baffle – a part of a luminaire that allows air passage but limits the emission of flame, arcs, or molten material from exiting the enclosure.

Ballast – in Canada and the United States, a device that by means of reactance or resistance, singly or in combination, limits the current of a lamp to the required value for proper operation and, where necessary, provides adequate starting voltage. In the case of rapid start circuits, it provides voltage for low-voltage lamp filament heating.

Ballast (MEX) – in Mexico an electromagnetic, electronic, or hybrid device that, through inductances, capacitances, resistances, and/or electronic elements (transistor, thyristors, etc.), alone or in combination, limit the lamp current, and, when necessary, the starting current and voltage. The electromagnetic and hybrid ballast has the same output frequency as the mains (60 Hz). Electronic ballasts are those that have at least one frequency converter.

Ballast, fluorescent, thermally protected – in Canada and the United States, a ballast that complies with the Class P requirement of UL 935 or the requirements for thermally protected ballasts in CSA C22.2 No. 74.

Ballast, fluorescent, thermally protected (MEX) – in Mexico, a ballast that contains a thermal protector or is inherently protected.

Ballast, reactor (simple reactance) – a reactance-type ballast in which the lamp ballasting impedance is provided by a single coil inductor, not a transformer or inductor with additional components.

Ballast, remote– a ballast that is not mounted on a luminaire, or one that is mounted on the luminaire 460 mm (18 in) or more from the luminaire housing, as measured from the nearest point on the ballast to the nearest point (other than an incidental projection) on the luminaire housing. The ballast may or may not be provided with the luminaire.

Barrier – a part of the luminaire intended to reduce the risk of shock or injury to persons.

Bonding – a low impedance path obtained by permanently joining all non-current-carrying metal parts to achieve electrical continuity and having the capacity to conduct any current likely to be imposed on it.

Canopy – a plate or similar fitting intended to provide a cover over an outlet box.

Canopy, drop – a canopy that can be lowered for access to the supply connections without lowering the luminaire. The canopy does not support the luminaire.

CEC – *Canadian Electrical Code, Part I.*

Cellulosic – a paper or wood type product that is treated or processed. Examples include insulation, paper, and fiber.

Comply with – a term to denote that the requirements specified for the construction or material have been fulfilled by

(a) conducting a specified test;

(b) confirming that a specified test has been conducted on the same or similar construction or material; or

(c) determining by an engineering evaluation that equivalent, or greater, acceptable compliance has been demonstrated.

Conductor, insulated – a conductor encased within material recognized as electrical insulation.

Conductor, neutral – the identified grounded conductor, referred to as “the neutral”.

Decorative part– a part of the luminaire, outside the enclosure, that has no safety function.

Diffuser – a device to redirect or scatter the light from a source, primarily by the process of diffuse transmission.

Electrical spacing – the minimum distance, measured through the air or over an insulating surface, between an uninsulated live part and ground or between uninsulated live parts of opposite polarity.

Electric-discharge lamp – a lamp in which the light (or radiant energy near the visible spectrum) is produced by the passage of an electric current through a vapor or gas (e.g., a fluorescent or HID lamp, such as metal halide, sodium vapor, and mercury).

Enclosure, electrical – a part of the luminaire intended to reduce the risk of electric shock.

Fixture – referenced as a luminaire in this Standard.

Flat glass – a glass panel, usually formed from sheet stock, the overall shape of which is essentially flat. The panel can have a slight curvature or bend, and the surface may be smooth or textured.

Gasket – a resilient material used between two rigid surfaces.

Ground screw assembly – the combination of a machine or thread forming screw and a threaded hole in a metal part of the luminaire enclosure or mounting crossbar for the purpose of securing the branch circuit equipment-grounding conductor.

Guard – the part of a luminaire provided primarily for the purpose of reducing the risk of injury to persons by limiting user access to components that can have a high temperature or may be damaged by impact.

Insulation, basic – insulation applied to live parts to provide basic protection against electric shock.

NOTE In Mexico, basic insulation does not necessarily include insulation used exclusively for functional purposes.

Insulation, supplementary – independent insulation applied in addition to basic insulation.

Knockout – a partially cut-out opening that is closed until the precut material is removed.

Lamp – a device, intended to be inserted into a lampholder, that produces light (commonly called “light bulb”).

Lamp compartment – a construction for test-exempt luminaires that restricts the dissipation of heat.

Lamp containment barrier – any part of the luminaire that surrounds the lamp to contain hot particles of the lamp in the event it ruptures.

Lampholder – a wiring device intended for making connection to the electrical circuits of a lamp and, in some cases, providing support.

Lamp-supported lampholder – a lampholder supported by the lamp that, in turn, is supported by the luminaire.

Live part – a conductive part without basic insulation, where there is a risk of electric shock. The neutral conductor is considered to be a live part.

Location, damp – an exterior or interior location that is normally or periodically subject to condensation of moisture in, on, or adjacent to, electrical equipment, and includes partially protected locations.

Location, dry – a location not normally subject to dampness, but may include a location subject to temporary dampness, as in the case of a building under construction, provided ventilation is adequate to prevent an accumulation of moisture.

Location, wet – a location in which water or other liquid can drip, splash, or flow on or against electrical equipment.

Luminaire – a complete lighting unit consisting of a lamp or lamps, together with the parts designed to distribute the light, to position and protect the lamps and ballast (where applicable), and to connect the lamps to the power supply.

Luminaire, canopy type – a luminaire intended for installation through an opening in an outdoor canopy or marquee. It is not intended for indoor use or outdoor installations that can have thermal insulation installed.

Luminaire, convertible – a recessed luminaire that can be converted by the installer from a Type Non-IC to a Type IC or from a Type IC to Type Non-IC recessed luminaire.

Luminaire, cord-connected – a luminaire that is designed to be connected to the power source by means of a cord, with or without an attachment plug, and that is not normally moved from one place to another.

Luminaire fitting – a luminaire subassembly, such as a reflector, ballast assembly, enclosure end plate, mounting hanger assembly, adapter plate, pole, or other part, that is shipped separately and field-assembled to one or more other luminaire fittings or to an otherwise complete luminaire.

Luminaire, ground-mounted recessed – a luminaire in which the supply connection or electrical components are located below ground level.

Luminaire, ground-mounted surface – a luminaire mounted at ground level in which the supply connection or electrical components are located above ground level.

Luminaire, pendant – a luminaire that is designed to be suspended below the mounting surface.

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

Luminaire, recessed finishing section – the portion of the luminaire that consists of the recessed housing or the lampholder, or both, that is necessary to complete the luminaire.

Luminaire, recessed rough-in section – the portion of the luminaire that includes all electrical parts and wiring to which the branch circuit shall be connected but may not be provided with the recessed housing or the lampholder, or both.

Luminaire, recessed, Type IC (intended for insulation contact) – a recessed luminaire that is designed and identified for installation in a cavity filled with thermal insulation. The luminaire may be in direct contact with combustible materials and the insulation.

Luminaire, recessed, Type IC, inherently protected (intended for insulation contact) – a recessed luminaire that does not require a thermal protective device and that complies with the normal temperature limits of this Standard under all conceivable operating conditions.

Luminaire, recessed, Type Non-IC (not intended for insulation contact) – a recessed luminaire designed for installation in a cavity that has minimum dimensions and spacings to thermal insulation and combustible material in compliance with the installation code. It is not intended to be in contact or covered with thermal insulation.

Luminaire, recessed, Type Non-IC, marked spacings (not intended for insulation contact) – a recessed luminaire designed to be installed in a cavity where the clearance to combustible building members and thermal insulation are specified by the manufacturer.

Luminaire, surface – a luminaire that is designed to be mounted directly to a wall or ceiling surface.

Manufacturer – (for the purposes of this Standard) the company, agency, or individual submitting the product for evaluation; the term does not necessarily refer to the actual manufacturer of the product.

NEC – the *National Electrical Code* of the United States.

Nominal system voltage – the system-designated rms voltage.

Open hole – an aperture in a luminaire enclosure or a recessed housing that is not covered or filled by another part.

Opening – an aperture in an enclosure that is covered or filled by a plug or knockout and that has the potential of becoming an open hole.

Ordinary tools – tools that can normally be expected to be available to the user, such as screwdrivers, hammers, nut drivers, and pliers.

Polymeric material – a manufactured material comprised of a polymer or a combination of polymers, in combination with additives, such as colors, stabilizers, plasticizers, anti-oxidants, lubricants, anti-static agents, fillers, and reinforcing, that possess properties useful for fabrication of functional articles.

Power limited circuit — see *NEC*, Section 725 and *CEC*, Section 16.

Recessed housing – a part of a recessed luminaire that projects into the ceiling or wall cavity and serves to close off the opening from the room side, and does not necessarily enclose conductors or similar components.

Risk of electric shock – in Canada and the United States, a risk of electric shock exists between any two uninsulated conductive parts of a luminaire or between an uninsulated conductive luminaire part and earth ground if the continuous current flow through a 1500 Ω resistor in parallel with a 0.15µF capacitor connected between the two points exceeds 5 mA rms (7 mA peak) and if the open circuit voltage exceeds 30 V rms or 42.4 V peak for dry, damp, and wet locations.

Risk of electric shock (MEX) – in Mexico, a risk of electric shock exists between any two uninsulated conductive parts of a luminaire or between an uninsulated conductive luminaire part and earth ground if the continuous current flow through a 1500 Ω resistor in parallel with a 0.015µF capacitor connected between the two points exceeds 5 mA rms (7 mA peak) and if the open circuit voltage exceeds 30 V rms or 42.4 V peak for dry, damp, and wet locations.

Risk of fire – a risk of fire exists between two conductive parts if V_{max}, I_{max}, or VA_{max} exceeds Class 2 circuit limitations as defined in Section 725 of *NEC*, Section 16 of *CEC*, and Section 725 of NOM-001-SEDE.

Splice – the joining of conductors:

(a) by welding or soldering their ends together and applying an insulating outer covering that serves as basic insulation; or

(b) using wire connectors, designed and certified for that purpose.

Strain relief device – a knot, bushing, clamp, or equivalent device designed to prevent strain from being transmitted through a conductor or cord to a termination point inside a luminaire.

Tap conductor – a conductor between the luminaire and the branch circuit.

Tempered glass – glass that is heated to near its softening point and then rapidly cooled under rigorous control to enhance its mechanical and thermal endurance by creating a compression stress on all surfaces and edges balanced by tension stress in the core.

Thermal shock and impact-resistant tempered glass (MEX) – in Mexico, glass that has undergone a heat treating process to give it certain hardness or elasticity characteristics.

Through wire – a current-carrying branch circuit conductor that does not supply the luminaire, but passes through the luminaire wiring compartment or integral junction box.

User maintenance – servicing operations, such as re-lamping and cleaning, expected to be carried out by untrained persons.

Water shield – a structural part of a wet location luminaire, relied upon to reduce or prevent the entrance of water into a luminaire or onto current-carrying parts.

Wire binding screw – a screw used to secure an electrical conductor.

Wiring diagram – a line drawing, graphic, and/or written instructions to identify conductors and make connections to the luminaire.

Wiring terminal – pressure or wire binding terminals used for making wiring connections.

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.

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

(a) involves a feature or characteristics not needed 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 accepted as being incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as temperatures not exceeding specified limits, and shall be used only under those specific conditions for which they have been investigated.

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 all 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 and summarized in Table 4.2.1.

4.2.4 Products intended for use in Mexico shall comply with those requirements listed and summarized in Table 4.2.2 (MEX).

4.2.5 A country specific requirement clause has the same clause number as the requirement, but with the suffix (CAN), (MEX), or (USA). Table 4.2.1 provides a summary of the country-specific clauses, tables, and figures.

4.3 Units of measurement

4.3.1 The values given in SI (metric) units shall be normative. Any other values shall be for information purposes only. See Annex E for metric conversion multipliers.

4.3.2 Temperatures are given in degrees Celsius only.

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

Table 4.2.1
Summary of country-specific requirements

(See Clauses 4.2.3 and 4.2.5)

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5 Mechanical construction

5.1 General

5.1.1 The requirements in Clause 5 shall be used in conjunction with the applicable supplementary requirements in this Standard.

5.1.2 A part removed during user maintenance shall be:

(a) designed to prevent replacement in a position that would affect the intended operation of the luminaire; or

(b) marked to indicate proper replacement, in accordance with Table 20.1.1, Item 1.33.

5.1.3 There shall be no sharp edges, burrs, or method of construction that can damage electrical insulation or reduce electrical spacings.

5.2 Assembly and packaging

5.2.1 All splices and electrical connections shall be completed at the factory, unless packaging requires partial disassembly. Only assembly and electrical connections that can be accomplished with ordinary tools or tools supplied with the luminaire shall be completed at the installation site.

5.2.2 A luminaire that requires partial assembly in the field shall be provided with assembly instructions as specified in Table 20.1.1, Item 1.33.

5.2.3 All the parts required to complete a luminaire shall be shipped together, or shipped separately and marked in accordance with Table 20.1.1, Item 1.8.

5.2.4 Parts such as decorative glassware may be shipped separately and do not require identification.

5.2.5 An unassembled luminaire with accessible non-current-carrying parts that can be energized after the luminaire is installed shall be provided with means for fastening and bonding those parts. The use of screws or snap-in or tab-mounted parts shall meet the intent of this requirement.

5.2.6 The number of conductors shall not exceed 5 when using a twist-on wire connector for field wire connection.

5.2.7 Conductors intended for field connection shall have matching identification by color, number, letter, or other acceptable means.

5.2.8 A field connection between conductors of adjoining sections shall be accessible for inspection without the disconnection of any portion of the wiring.

5.3 Enclosures

5.3.1 A luminaire enclosure shall perform the following functions:

(a) reduce the risk of contact with live parts;

(b) enclose electrical parts and components that can involve a risk of fire;

(c) protect internal parts from mechanical damage; and

(d) protect internal parts from the environment.

5.3.2 All splices, open coil devices, capacitors, leads or terminals for field connection of supply wires, and other arcing live parts shall be provided with an enclosure.

5.4 Barriers

5.4.1 A barrier shall be constructed of one of the following:

(a) ferrous or nonferrous metal at least 0.41 mm (0.016 in) thick;

(b) glass or ceramic at least 3 mm (0.118 in) thick;

(c) impregnated glass fiber sleeving at least 0.25 mm (0.010 in) thick that is rated for the temperature involved;

(d) vulcanized fiber at least 0.71 mm (0.028 in) thick; or

(e) a polymeric material that complies with Clause 5.7.1.6.

5.4.2 A barrier, other than of polymeric material, may be of a thickness less than that specified in Clause 5.4.1 if it complies with the barrier strength test of Clause 16.1.

5.5 Metal thickness for enclosures

5.5.1 The thickness of an enclosure material constructed of:

(a) sheet metal and extruded aluminum shall be in accordance with Table 5.5.1 or shall comply with the metal thickness equivalency test of Clause 16.2; and

(b) cast metal shall be in accordance with Table 5.5.2 or shall comply with the metal thickness equivalency test of Clause 16.2.

Table 5.5.1
Minimum thickness of uncoated sheet metal and extruded aluminum for enclosures

(See Clauses 5.5.1, 11.3.5, 11.3.7, 11.3.11, 12.3.2.2, and 16.2.5.1.1, and Table 5.5.2.)

Specific construction		Steel				Copper, brass, aluminum sheet, and extruded aluminum			
		Unreinforced		Reinforced		Unreinforced		Reinforced	
		mm	(in)	mm	(in)	mm	(in)	mm	(in)
At opening for conduit connection		0.66	(0.026)	0.66	(0.026)	0.81	(0.032)	0.81	(0.032)
Length more than 660 mm (26 in)	No electrical component support	0.51	(0.020)	0.41	(0.016)	0.56	(0.022)	0.43	(0.017)
	Electrical component support	0.66	(0.026)	0.51	(0.020)	0.71	(0.028)	0.56	(0.022)
Length not more than 660 mm (26 in)	No electrical component support	0.41	(0.016)	0.33	(0.013)	0.51	(0.020)	0.41	(0.016)
	Electrical component support	0.51	(0.020)	0.41	(0.016)	0.64	(0.025)	0.51	(0.020)
Length not more than 380 mm (15 in)	No electrical component support	0.41	(0.016)	0.33	(0.013)	0.51	(0.020)	0.41	(0.016)
	Electrical component support	0.41	(0.016)	0.41	(0.016)	0.51	(0.020)	0.51	(0.020)

NOTES

(1) “Reinforced” refers to a form of construction that provides equivalent mechanical strength.

(2) “No electrical component support” refers to the minimum thickness required for mounting of non-electrical parts.

(3) Examples of acceptable methods of reinforcement are

(a) a single piece of sheet metal that is formed to result in a maximum internal angle of 120 degrees;

(b) 13 × 13 mm (0.5 × 0.5 in) 90 degrees formed from sheet steel, 0.81 mm (0.032 in) minimum thickness, used to divide a surface into small sections and, unless along the greater dimension, are additionally secured to the adjacent sides of the enclosure;

(c) flat steel bars, 9.5 mm (0.375 in) wide minimum, 3.2 mm (0.125 in) thick minimum, used and secured as in (b); and

(d) curved, ribbed, or flanged surfaces. A surface is considered to be flanged if the two opposite sides are bent 13 mm (0.5 in) or wider at right angles to the surface.

(4) For coated or finished metals, the minimum thickness is considered to be obtained if the overall thickness exceeds that required in this table by at least 0.013 mm (0.0005 in) for each side coated or finished.

(5) “Length” refers to the longest straight line that can be drawn on any unreinforced flat section.

Table 5.5.2
Minimum thickness of cast metal for enclosures

(See Clauses 5.5.1, 11.3.7, and 11.3.11.)

Material	Unreinforced		Reinforced	
	mm	(in)	mm	(in)
Cast metal	3.2	(0.126)	2.4	(0.094)
Cast malleable iron	2.4	(0.094)	1.6	(0.063)
Permanent mold – cast aluminum	2.4	(0.094)	1.6	(0.063)
Die-cast metal	2.0	(0.079)	1.2	(0.047)

NOTE Reinforced dimensions are acceptable at the root of threads, for a surface that is curved or otherwise reinforced, and for a surface of such shape or size, or both, that the strength contemplated is provided. Areas for breakouts or similar reasons, may have thinner sections providing the strength of structure is not affected, but in no case be thinner than permitted for sheet metal. See Clause 5.5.1 and Table 5.5.1.

5.5.2 The thickness of a metal surface for mounting a convenience receptacle of the snap-in type shall comply with the receptacle manufacturer's metal thickness specification but shall not be less than 0.51 mm (0.020 in).

5.6 Corrosion protection

5.6.1 All ferrous metal parts, including hinges, bolts, and fasteners, exposed after assembly shall be protected against corrosion by painting, coating, or plating. Copper, aluminum, alloys of copper and aluminum, stainless steel, and similar materials having inherent resistance to atmospheric corrosion are not required to have additional corrosion protection.

5.6.2 Edges, punched holes, and spot welds in prefinished steel, enclosed steel pipe, and hanger locations for painting or plating in ferrous metals do not require any corrosion protection.

5.6.3 The requirements of Clause 5.6.1 shall not apply to the following:

(a) bearings, sliding surfaces of a hinge or shaft, hinge pins, and similar parts located on the exterior of enclosures where such protection is not practicable; and

(b) decorative parts.

5.6.4 Vitreous enamels may be used as a protective coating for ferrous sheet metal having a minimum thickness of 0.6 mm (0.025 in).

5.7 Polymeric materials

5.7.1 General

5.7.1.1 Polymeric materials shall comply with the applicable requirements of Clauses 5.7.1.2 to 5.7.1.7.

5.7.1.1 (MEX) In Mexico, polymeric materials shall have minimum thickness in accordance with Table 5.7.1 (MEX).

Table 5.7.1 (MEX)
Minimum thickness for polymeric materials

(See Clause 5.7.1.1 (MEX).)

Specific construction		Polymeric sheet			
		Un-reinforced		Reinforced	
		mm	(in)	mm	(in)
At opening for conduit connection		1.016	(0.040)	1.016	(0.040)
Length more than 660 mm	No electrical component support	0.81	(0.032)	0.81	(0.032)
	Electrical component support	1.016	(0.040)	1.016	(0.040)
Length larger than 380 mm and up to 660 mm	No electrical component support	0.81	(0.032)	–	–
	Electrical component support	0.81	(0.032)	–	–
Length not more than 380 mm	No electrical component support	0.71	(0.028)	–	–
	Electrical component support	0.71	(0.028)	–	–

NOTES

(1) “Reinforced” refers to a form of construction that provides equivalent mechanical strength.

(2) “No electrical component support” refers to the minimum thickness required for mounting of non-electrical parts.

(3) Examples of acceptable methods of reinforcement are curved, ribbed, and flanged surfaces.

(4) “Length” refers to the longest straight line that can be drawn on any un-reinforced flat section.

5.7.1.2 An enclosure of polymeric material where all live parts are insulated or permanently spaced more than 0.8 mm (0.032 in) from the enclosure shall:

(a) have a minimum 5VA flammability rating or comply with the five-inch flame test of Clause 16.3;

(b) have a temperature rating equal to or greater than its maximum operating temperature in the luminaire;

(c) comply with the polymeric impact test of Clause 16.41 for the parts that can be subject to impact after installation;

(d) comply with the mold stress-relief test of Clause 16.4 for molded or formed thermoplastic material;

(e) comply with the abnormal overlamping operation test in Clause 15.5; and

(f) be resistant to UV radiation where the material is exposed to the sun or to fluorescent or unjacketed metal halide light sources. The material shall be UV rated, tested in accordance with the UV exposure test of Clause 16.5.5, or comply with the exposure to UV light test of UL 746C.

5.7.1.3 An enclosure of polymeric material where any uninsulated live parts are located within 0.8 mm (0.032 in) of the enclosure shall comply with Clause 5.7.1.2 and shall:

(a) have a minimum hot-wire ignition rating (HWI) of 15 s or comply with the hot-wire ignition test of Clause 16.6 or the glow-wire end product test of Clause 16.7; and

(b) have a minimum high-current arc resistance to ignition rating (HAI) of 15 arcs or comply with the high-current arc ignition test of Clause 16.8 or the end-product arc resistance test of Clause 16.9.

5.7.1.4 An enclosure of polymeric material where arcing parts, such as unenclosed switch contacts, are located:

(a) more than 13 mm (0.5 in) from the enclosure shall comply with Clause 5.7.1.2;

(b) within 13 mm (0.5 in) of the enclosure shall comply with Clause 5.7.1.2 and the hot-wire ignition test of Clause 16.6 or the glow-wire end product test of Clause 16.7.

5.7.1.5 A polymeric part used to suspend another part shall:

(a) have a minimum HB flammability rating or comply with the horizontal burning flame test of Clause 16.25;

(b) have a temperature rating equal to or greater than the highest temperature measured on the part during the normal temperature test of Clause 14; and

(c) comply with the polymeric support test of Clause 16.10 when the suspended part weighs more than 0.9 kg (2 lb).

5.7.1.6 A polymeric material used as a barrier shall:

(a) have a minimum HB flammability rating or comply with the horizontal burning flame test of Clause 16.25;

(b) have a temperature rating equal to or greater than its maximum operating temperature in the luminaire;

(c) for molded or formed thermoplastic parts, comply with the mold stress-relief test of Clause 16.4; and

(d) comply with the barrier strength test of Clause 16.1.

5.7.1.7 A polymeric material that can affect the integrity of a grounding or bonding means shall:

(a) have a minimum HB flammability rating or comply with the horizontal burning flame test of Clause 16.25;

(b) have a temperature rating equal to or greater than its maximum operating temperature in the luminaire; and

(c) in the case of thermoplastic parts, also comply with the mold stress-relief test of Clause 16.4 followed by the bonding circuit impedance test of Clause 17.2.

5.7.2 Metallized polymeric parts

5.7.2.1 Metallized polymeric parts coated with an electrically conductive material shall comply with the metallized polymeric parts coating adhesion test of Clause 16.11 if peeling of the conductive material from the polymeric parts can result in the risk of electric shock, fire, or operating temperature limits being exceeded.

5.7.2.2 The metallized parts that are accessible during user maintenance or component replacement without the use of tools and can involve the risk of shock shall be bonded to ground in accordance with Clause 6.14.3.

5.8 Baffles

5.8.1 A baffle shall:

(a) be made of metal that complies with the appropriate requirements of Clause 5.5; or

(b) be made of nonmetallic material that complies with the five-inch flame test of Clause 16.3 or has a minimum 5VA flammability rating; and

(c) if made of perforated material, have one of the following constructions:

(1) a galvanized steel screen, or the equivalent, having a 14 x 14 mesh per square inch and wire with a minimum diameter of 0.46 mm (0.018 in);

(2) a perforated metal plate, having evenly distributed openings that are not more than 11 per cm^2 (71 per in^2) and that have a maximum dimension of 1.6 mm (0.063 in); or

(3) a perforated panel that complies with the flaming oil test of Clause 16.12.

5.9 Conduit knockouts and twistouts

5.9.1 A conduit knockout or twistout shall be secured in place so it can be removed without distorting the enclosure but it remains in place during normal handling and shall comply with the conduit knockout and twistout test of Clause 16.13.

5.10 Mechanical joints and fastenings

5.10.1 The method of making a joint shall provide strength and rigidity and prevent turning that can result in movement of conductors or wiring devices after the assembly is completed.

5.10.2 Self-threading screws, including sheet-metal screws, used to secure electrical or enclosure component parts in place or together, shall comply with the self-threading screw torque test in Clause 16.14, when the screw threads into nonferrous metal or polymeric material.

5.10.3 A self-threading or sheet metal screw used for mounting or supporting a part that weighs more than 3.4 kg (7.5 lb) per screw shall comply with the self-threading screw torque test in Clause 16.14.

5.10.3 (MEX) In Mexico, a self-threading or sheet-metal screw used for mounting or supporting a part shall comply with the self-threading screw torque test of Clause 16.14.1 (MEX).

5.10.4 If threads of sheet-metal or self-tapping screws extend into a wiring compartment for a distance of more than 5 mm (0.2 in), the conductors shall be reliably positioned away from the projecting screws, or the conductors shall be sufficiently loose to prevent damage to the insulation.

5.10.5 Frictional contact between parts alone shall not be acceptable as means of preventing turning. Turning may be prevented by the use of a suitable lockwasher properly applied, a locknut seated against another nut, or an equivalent threaded assembly, or by some other equivalent method such as swaging or suitable adhesive.

5.10.6 A sheet metal nut for bolts larger than 6.4 mm (0.250 in) in diameter may be used to prevent turning or loosening if it is not depended upon for mechanical strength.

5.10.7 Sheet-metal nuts fabricated of heat-treated steel may be used:

(a) for assembly;

(b) to prevent turning of threaded tubing no larger than 1/4 IPS; or

(c) on bolts or studs that are no larger than 6.4 mm (0.250 in) in diameter.

5.10.8 When used as a supporting device, unthreaded tubing joints shall comply with the loading test of Clause 16.15.

5.10.8.1 Fasteners, such as ferrules secured to the end of steel support cable used to support all or part of the luminaire, shall comply with the loading test of Clause 16.15.

5.10.8.2 Cast metal fasteners, such as chains, hooks, threaded nipples, and hickeys, used to support the luminaire or sections of the luminaire, shall comply with the loading test of Clause 16.15.

5.10.9 Enclosure parts shall be secured by positive mechanical means, such as screws, welding, or interference fit.

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5.10.10 Enclosure parts may be secured by frictional contact alone under the following conditions:

(a) the part does not have a knockout or conduit opening and complies with the snap-in or tab-mounted parts pull test without conduit opening of Clause 16.16; or

(b) the part has a knockout or conduit opening and complies with the snap-in or tab-mounted parts pull tests with conduit opening of Clause 16.17.

5.10.11 Snap-in and tab-mounted parts that are secured together by interference fit alone and that have a knockout or conduit opening shall comply with the snap-in and tab-mounted parts test with conduit opening of Clause 16.17.

5.10.12 Decorative parts of a luminaire secured by friction alone or an adhesive alone shall comply with the loading test in Clause 16.15.

5.11 Means of mounting

5.11.1 A luminaire shall have means for mounting, and if special hardware is required, the hardware shall be provided and shall comply with the loading test of Clause 16.15.

5.12 Movable joints

5.12.1 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 of Clause 16.19.

5.12.2 A movable joint containing conductors shall comply with the movable joint torsion and pull tests of Clause 16.20 and shall remain intact and operable.

5.13 Raceway tubing

5.13.1 Tubing shall be free from kinks or cracks, and if it is:

(a) unthreaded metal tubing, it shall be at least 0.5 mm (0.020 in) thick;

(b) threaded metal tubing, it shall be at least 1.0 mm (0.040 in) thick; or

(c) metal tubing with rolled threads, it shall be at least 0.5 mm (0.020 in) thick.

5.14 Conductor protection

5.14.1 Conductors that pass over edges or through openings in metal shall be secured from contacting the edges or be protected from cutting and abrasion. For sheet metal less than 1.1 mm (0.042 in) thick, protection shall be provided by one of the following methods:

(a) rolling the edge of the metal not less than 120 degrees;

(b) a bushing or grommet of a material other than rubber at least 1.2 mm (0.047 in) thick; or

(c) glass sleeving at least 0.25 mm (0.010 in) thick.

5.15 Strain relief

5.15.1 General

5.15.1.1 A strain-relief shall be provided for a flexible cord or conductor that can be subjected to pulling, pushing, flexing, or twisting after the luminaire has been installed.

5.15.1.2 A strain-relief device, including a bushing with an integral strain-relief means, shall be designed to limit the holding pressure without damaging the cord jacket or conductor insulation.

5.15.2 Flexible cord

5.15.2.1 A strain relief for a flexible cord shall comply with the 15.9 kg (35 lb) strain-relief test of Clause 16.21.1.

5.15.2.2 A strain relief shall be provided at both ends of a flexible cord when the cord supports a luminaire or luminaire part.

5.15.2.3 A strain relief shall be provided at only one end of a flexible cord under the following conditions:

(a) the cord is attached directly to a wiring device, such as an attachment plug, by the wiring device manufacturer; or

(b) comply with the strain-relief test of Clause 16.21.1.

5.15.2.4 A strain relief shall not be required at the canopy end of a cord-pendant luminaire if instructions, in accordance with Table 20.1.1, Item 1.33, are furnished with the luminaire to show the method of strain relief that shall be applied in the field, such as a knot in the cord.

5.15.2.5 A cord-equipped luminaire without an attachment plug shall be provided with one of the following:

(a) a strain-relief device for use in a standard conduit opening; or

(b) instructions to identify the strain relief to be used, in accordance with Table 20.1.1, Item 1.33.

5.15.3 Conductors

5.15.3.1 The strain relief for a conductor shall comply with the pull test of Clause 16.21.2.

5.16 Glass

5.16.1 General

5.16.1.1 Edges of glass accessible during normal use or maintenance shall be seamed, swiped, fire-polished, or similarly treated to eliminate sharpness.

5.16.2 Minimum thickness

5.16.2.1 The minimum thickness and exposed area of glass used as an enclosure shall be in accordance with Table 5.16.2.1.

Table 5.16.2.1
Thickness of glass panels

(See Clauses 5.16.2.1 to 5.16.2.5.)

Exposed area of glass		Minimum thickness of glass			
		Flat glass		Curved glass	
cm^2	(in^2)	mm	(in)	mm	(in)
0 – 968	(0 – 150)	2.11	(0.083)	2.11	(0.083)
969 – 3226	(150 – 500)	2.54	(0.100)	2.11	(0.083)
3227 – 7097	(500 – 1100)	3.56	(0.140)	2.54	(0.100)
7098 – 9316	(1100 – 1444)	3.56	(0.140)	2.54	(0.100)

5.16.2.2 The minimum thickness and exposed area of flat glass panels, smooth or otherwise, shall be in accordance with Table 5.16.2.1.

5.16.2.3 The minimum thickness and exposed area of glass that is curved or bent, or of globes of any shape shall be in accordance with Table 5.16.2.1, unless the exposed area is less than 1774 cm^2 (275 in^2).

5.16.2.4 Untempered glass that is not in accordance with the minimum thickness shown in Table 5.16.2.1 shall provide equivalent mechanical strength.

5.16.2.5 Tempered glass that is not in accordance with the minimum thickness and exposed area shown in Table 5.16.2.1 shall comply with the tempered glass impact test of Clause 16.22.

5.16.2.6 The minimum thickness of fluted, ribbed, or patterned glass shall be measured from a valley of one side to the other flat side, or between valleys on opposite sides.

5.16.2.7 (MEX) In Mexico, borosilicate and tempered glass shall comply with the thermal shock tests of Clause 16.36 (MEX).

5.17 Glass support

5.17.1 Glass shall be secured in place and shall not be subjected to undue strain that can result in breakage or release during normal use or maintenance.

5.17.2 Glass mounted in a frame that is required to be opened or removed for maintenance shall be secured to the frame.

5.17.3 Clips that are used to secure a glass panel to the frame shall overlap the glass at least 5 mm (0.20 in).

5.17.4 An adhesive material used as the sole support of glassware shall comply with the adhesive support test of Clause 16.23.

5.17.5 A channel or frame for holding glass diffusers shall be:

(a) steel at least 0.4 mm (0.016 in) thick;

(b) nonferrous metal at least 0.5 mm (0.020 in) thick; or

(c) polymeric material at least 1.5 mm (0.059 in) thick.

5.17.6 Glass globes, glass panels, or decorative glass parts shall be secured by one or more of the following means:

(a) a circular fitter with at least three supports;

(b) a threaded stud and nut;

(c) a threaded glass part and associated fitter;

(d) a frictional contact assembly that complies with the glass support test of Clause 16.24;

(e) an adhesive that complies with Clause 5.17.4;

(f) its own weight in a frame or fitter that is not hinged; and

(g) a straight rod with a stop or a hook through a hole in the glass.

5.18 Thermal insulation

5.18.1 Thermal insulation shall be fire-resistant material, such as glass fiber, inorganic material, or polymeric material.

5.18.2 A polymeric thermal insulation material shall:

(a) have a temperature rating equal to or greater than the operating temperature in the luminaire; and

(b) have a minimum HB flammability rating, or comply with the horizontal burning flame test of Clause 16.25.

5.18.3 Thermal insulation shall be reliably secured in place. It shall be attached to the luminaire in the correct position by at least one of the following means:

(a) staples or bolts;

(b) adhesive applied to at least one-third of the surface of the insulation;

(c) parts of the luminaire that do not have to be removed for installation. A supply conductor projecting through the insulation is not acceptable for securing the insulation in place; and

(d) other means if investigated and found to be mechanically equivalent.

5.18.4 Thermal insulation shall not be located within 6.4 mm (0.25 in) of any opening for the connection of conduit unless the insulation is attached to a cover or other part that will be removed when conduit is being attached to the luminaire.

5.18.5 Glass fiber thermal insulation provided as an integral part of the luminaire shall have a minimum density of 9.6 kg/m^3 (0.6 lb/ft^3).

5.19 Continuous row mounting

5.19.1 A luminaire intended for continuous row mounting shall have provision for a coupling method and be marked in accordance with Table 20.1.1, Item 2.16.

5.19.2 A luminaire intended for continuous row mounting shall have adequate space for at least four 12 AWG branch circuit conductors.

5.20 Raceways

5.20.1 The requirements in Clause 5.20 shall apply to surface-mounted or recessed luminaires intended to serve as a raceway for conductors of a circuit other than the conductors of the branch-circuit supplying the luminaire.

5.20.2 The raceway portion of a luminaire shall comply with the applicable requirements of UL 5 or CSA C22.2 No. 62.

5.20.3 The luminaire shall comply with the temperature test of Clause 14.11 and be marked as suitable for use as a raceway, in accordance with Table 20.1.1, Item 1.7.

6 Electrical construction

6.1 General

6.1.1 The requirements in Clause 6 shall be used in conjunction with the applicable supplementary requirements in this Standard.

6.1.2 Current-carrying parts shall be copper, copper alloy, nickel alloy, or stainless steel, unless otherwise specified in this Standard.

6.2 Wiring devices

6.2.1 A wiring device shall be rated for the temperatures, locations, voltage, and current encountered during normal operation.

6.2.2 A luminaire incorporating a wiring device rated for ac use shall be marked with the frequency or for ac use only, in accordance with Table 20.1.1, Item 1.4 or 3.7.

6.2.3 A wiring device shall be prevented from any turning that can apply tension to conductor connections, result in damage to the conductor, or otherwise adversely affect the assembly. Friction alone between the mating parts of the assembly shall not be acceptable as a means to prevent turning.

6.2.4 Parts of wiring devices that are removable from outside the enclosure without the use of ordinary tools shall not result in access to live parts within the enclosure.

6.2.5 The rating of an attachment plug assembled to a flexible cord for connection to a branch circuit shall comply with Table 6.2.1.

Table 6.2.1
Attachment plug ratings for cord-connected luminaires

(See Clause 6.2.5)

Maximum luminaire input rating in amperes	Minimum attachment plug rating in amperes
12	15
16	20
24	30
40	50

6.3 Lampholders

6.3.1 A lampholder of a luminaire shall be suitable for the application.

6.3.2 A lamp-supported lampholder shall be provided with stranded conductors.

6.3.3 A husk or sleeve made of treated cellulosic fiber, provided to electrically insulate the terminals and screwshell of a lampholder, shall be at least 0.8 mm (0.032 in) thick and shall be positively retained. If the wire terminals of the lampholder are accessible with the husk or sleeve removed, they shall be additionally enclosed in accordance with Clause 5.3.

6.3.4 The screwshell of a lampholder directly supplied by the branch circuit shall be connected to the neutral grounded conductor.

6.4 Switches

6.4.1 General

6.4.1.1 A switch shall have a minimum ampere rating equal to the total load current it controls multiplied by the load factor shown in Table 6.4.1.1.

6.4.1.2 A switch shall disconnect all of the ungrounded conductors of a supply circuit simultaneously, except as specified in Clause 6.4.1.4.

6.4.1.3 A single-pole switch shall not be connected in the neutral grounded conductor.

6.4.1.4 When a single-pole photocontrol switch is used on a line-to-line supply, the luminaire shall be marked with a caution to disconnect the power before servicing, in accordance with Table 20.1.1, Items 3.18 and 3.6.

6.4.1.4 (CAN) In Canada, the caution marking of Table 20.1.1, Item 3.18, shall not be required.

6.4.1.5 A luminaire provided with a receptacle for a photocontrol shall be:

(a) shipped with the control or shorting plug; or

(b) marked to require the installation of the control or plug, in accordance with Table 20.1.1, Item 1.20.

Table 6.4.1.1
Switch rating load factor

(See Clause 6.4.1.1.)

Type of load	Special use switches				General use switches
	L-rated (ac only)	T-rated (ac/dc)	Ampere rated (ac only)	Ampere rated (ac/dc)	Ampere rated (ac only)
Tungsten filament	1	1	3	3	1
Inductive	1	1	2	2	1
Receptacle	1	1	3	3	1

6.4.2 Interlock switches

6.4.2.1 An interlock switch shall be rated for the load it controls or shall comply with Clauses 6.4.2.2 to 6.4.2.4.

6.4.2.2 A polymeric switch enclosure shall:

(a) have a minimum V-2 flammability rating, or shall comply with the vertical burning flame test of Clause 16.26 or the needle flame test of Clause 16.27; and

(b) have a temperature rating suitable for the temperature attained during the normal temperature test of Clause 14.

6.4.2.3 Current-carrying parts shall be copper, copper alloy, or stainless steel, except that stainless steel shall not be used for quick-connect terminals, solder terminals, and arcing parts.

6.4.2.4 An interlock switch shall comply with the interlock switch endurance test of Clause 17.3.

6.5 Receptacles

6.5.1 A convenience receptacle in a luminaire shall be a grounding type and marked for maximum load in accordance with Table 20.1.1, Item 3.3 or 3.4.

6.5.2 A convenience receptacle shall not be provided in a ground-mounted recessed or ceiling-mounted luminaire.

6.5.3 A luminaire may be provided with a maximum of one duplex or two single convenience receptacles.

6.6 Fuses and fuseholders

6.6.1 A replaceable fuse shall be of the type that requires mounting in a fuseholder.

6.6.2 The fuse identification and ampere rating shall be marked on or adjacent to the fuseholder as specified in Table 20.1.1, Item 3.5.

6.6.3 A fuseholder shall disconnect all ungrounded conductors of the supply circuit simultaneously during fuse replacement.

6.6.3 (USA) In the United States, the fuseholder is not required to disconnect all ungrounded conductors during fuse replacement.

6.6.4 A fuse shall not be connected in the neutral grounded conductor.

6.7 Ballasts and transformers

6.7.1 General

6.7.1.1 A luminaire incorporating a ballast or transformer having an open circuit voltage of more than 1000 V shall be marked not for use in dwellings, in accordance with Table 20.1.1, Item 2.5.

6.7.1.2 A ballast or transformer required to operate lamps of the type and wattage for which the luminaire was designed shall be provided with the luminaire and shall be wired in accordance with the diagram or instructions on or with the ballast. For luminaires designed for use with remote ballasts, see also Clause 6.7.2.

6.7.1.3 When a luminaire is intended to be connected to the line and neutral grounded conductors of a branch circuit, as shown in Figure 6.7.1.1, and is provided with:

(a) an auto-transformer or an auto-transformer-type ballast, the screwshell of the lampholder shall be connected to the neutral grounded conductor, unless provision is made to protect against accidental contact with the lamp screwbase during insertion or removal of the lamp; or

(b) an isolating-type transformer or ballast, the screwshell of the lampholder shall be separately bonded to ground, unless provision is made to protect against accidental contact with the lamp screwbase during insertion or removal of the lamp.

6.7.1.3 (USA) In the United States, when a luminaire intended to be connected to the line and neutral grounded conductors of a branch circuit, as shown in Figure 6.7.1.1 (USA), and provided with:

(a) an auto-transformer or an auto-transformer-type ballast, the screwshell of the lampholder shall be connected to the neutral grounded conductor, unless provision is made to protect against accidental contact with the lamp screwbase during insertion or removal of the lamp; or

(b) an isolating-type transformer or ballast, the screwshell of the lampholder shall not be required to be separately bonded to ground.

Figure 6.7.1.1
Ballast and transformer connection diagrams

(See Clauses 6.7.1.3 and 6.7.1.4.)

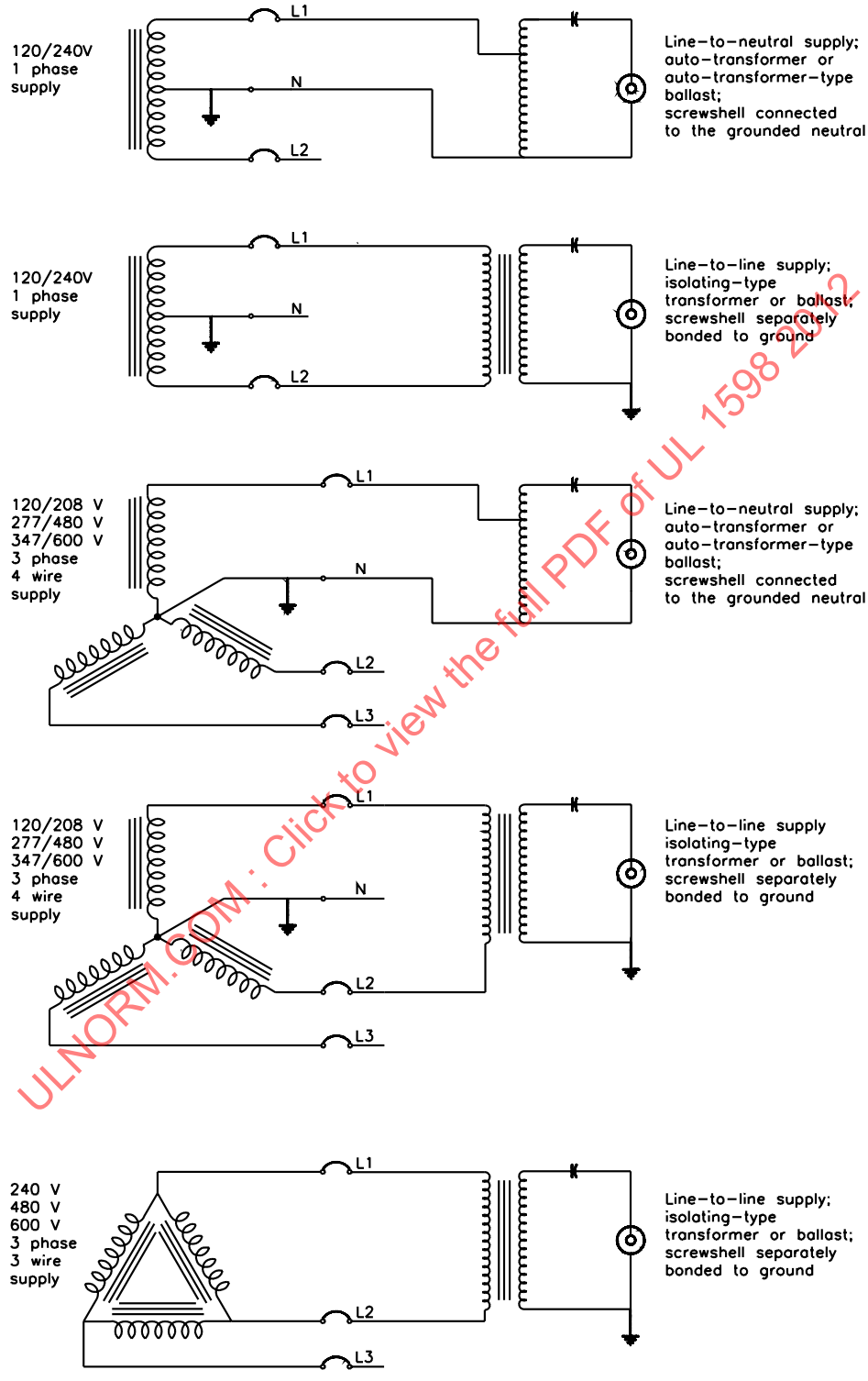
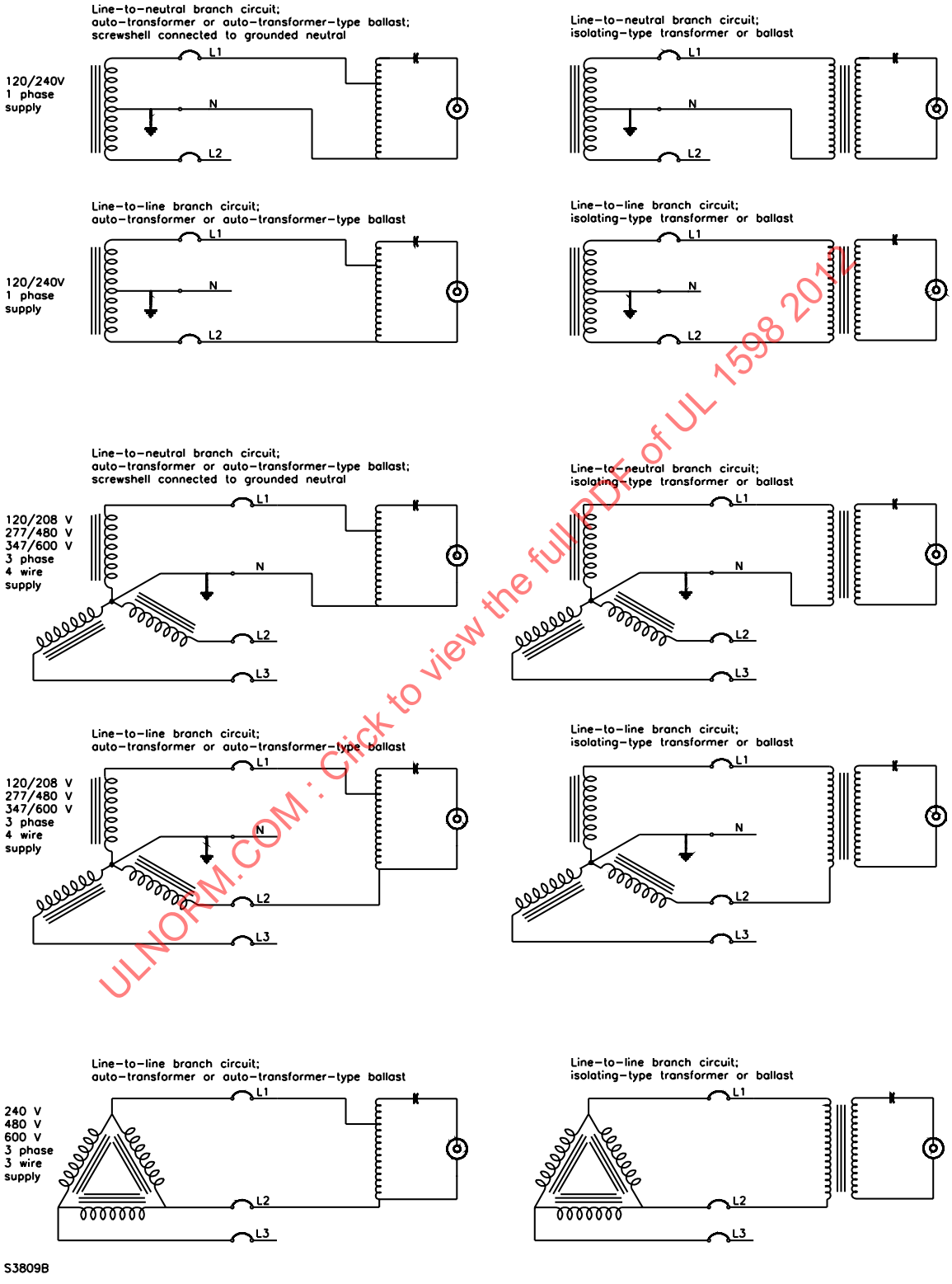


Figure 6.7.1.1 (USA)
Ballast and transformer connection diagrams for United States

(See Clauses 6.7.1.3 (USA) and 6.7.1.4 (USA).)



6.7.1.4 When a luminaire intended to be connected to the line-to-line conductors of a branch circuit, as shown in Figure 6.7.1.1, and is provided with:

(a) an auto-transformer or auto-transformer-type ballast, provision shall be made to protect against accidental contact with the lamp screwbase during insertion or removal of the lamp; or

(b) an isolating-type transformer or ballast, the screwshell of the lampholder shall be separately bonded to ground, unless provision is made to protect against accidental contact with the lamp screwbase during insertion or removal of the lamp.

6.7.1.4 (USA) In the United States, when a luminaire intended to be connected to the line-to-line conductors of a branch circuit, as shown in Figure 6.7.1.1 (USA), and provided with:

(a) an auto-transformer or auto-transformer-type ballast, provision may be made to protect against accidental contact with the lamp screwbase during insertion or removal of the lamp; or

(b) an isolating-type transformer or ballast, the screwshell of the lampholder shall not be required to be separately bonded to ground.

6.7.1.5 Allowing the thermal test results of one HID ballast to represent other HID ballasts shall be acceptable, with the following exceptions:

(a) a metal halide or mercury vapor type shall not represent a high-pressure sodium type.

(b) a high pressure sodium type shall not represent a metal halide or mercury vapor type.

(c) a lower wattage shall not represent a higher wattage type.

(d) a ballast with one class insulation system shall not represent a ballast with a different class insulation system.

(e) for a ballast of other than the enclosed and potted type with a Class 105 insulation system, a ballast with a bench-test temperature shall not represent a ballast with a higher bench-test temperature.

(f) a ballast that is not thermally protected shall not represent a ballast whose thermal protector:

(1) is buried within the ballast and has a temperature rating of less than the rating of the ballast system; or

(2) is located on the ballast core or under the wrap of an open coil and has a temperature rating of less than 90 °C for a Class 105 system, 110 °C for a Class 130 system, or 150 °C for a Class 180 system.

6.7.2 Luminaires with remote ballasts or transformers

6.7.2.1 A luminaire designed for use with a remote ballast or transformer and not provided with integral leads shall be provided with a means for terminating the ballast or transformer leads inside the luminaire.

6.7.2.2 A luminaire designed for use with a remotely mounted ballast or transformer shall be thermally protected if it is of incandescent or HID type and is intended for recessed mounting.

6.7.2.3 A luminaire designed for use with a remote ballast or transformer shall be marked with the watts and lamp type in accordance with Table 20.1.1, Item 1.41.

6.7.2.4 A luminaire designed for use with a remote ballast or transformer and required to be connected to secondary circuit conductors rated higher than 60 °C shall be marked to indicate the minimum acceptable temperature rating of the secondary conductors in accordance with Table 20.1.1, Item 1.1.

6.8 Capacitors

6.8.1 A capacitor, other than the type specified in Clause 6.8.2, shall be rated for the appropriate voltage and the maximum available fault current (AFC) to which it can be subjected, as follows:

(a) a value of 10 000 A minimum when connected directly across the branch circuit;

(b) a value of 200 A minimum when connected in series with a ballast coil; or

(c) the maximum current available to the capacitor under capacitor short-circuit condition, as determined by investigation.

6.8.2 A dry metallized-film capacitor operating at a maximum of 330 V shall not be required to have a maximum available fault current rating.

6.8.3 A luminaire incorporating a capacitor as a component separate from the ballast shall:

(a) have a maximum rating of 0.06 µF and a maximum operating potential of 500 V peak; or

(b) provide means to discharge the capacitor within 1 min after removal of the capacitor voltage, in accordance with Clauses 6.8.4 to 6.8.6.

6.8.4 The means to discharge the capacitor may consist of a bleeder resistor or a closed loop of the circuit that is not opened by lamp removal or operation of a switch, fuse, or similar device.

6.8.5 The voltage across the capacitor terminals at the end of 1 minute shall be reduced to a value of 50 V or less, and the energy stored shall be less than 20 J, as determined by the equation:

$$J = 5 \times 10^{-7} CV^2$$

where:

J = the energy stored, J

C = the capacitor rating, µF

V = the capacitor peak voltage, V

6.8.6 The maximum value of a bleeder resistor shall be determined by the equation:

$$R = \frac{K}{C}$$

where:

R = the resistance value, MΩ

K = the resistor factor determined from Table 6.8.1

C = the capacitor rating, µF

Table 6.8.1
Bleeder resistor factor (K)

(See Clause 6.8.6.)

Capacitor voltage		Factor (K)
RMS volts	Peak volts	
0 – 70	0 – 100	85
71 – 78	101 – 110	76
79 – 85	111 – 120	70
86 – 92	121 – 130	63
93 – 99	131 – 140	55
100 – 106	141 – 150	54
107 – 120	151 – 170	50
121 – 141	171 – 200	44
142 – 169	201 – 240	39
170 – 197	241 – 280	35
198 – 230	281 – 325	32
231 – 265	326 – 375	30
266 – 318	376 – 450	27
319 – 353	451 – 500	26
354 – 495	501 – 700	23
496 – 707	701 – 1000	19

NOTE For a transformer-type ballast, the voltage value to be applied according to this table is the rms voltage rating of the capacitor as specified on the ballast.

6.8.7 An oil-filled capacitor shall be provided with an expansion spacing between any luminaire part and the capacitor terminals in accordance with Clause 6.8.8, unless marked otherwise on the capacitor.

6.8.8 In addition to the electrical spacing required in Clause 6.11, the minimum expansion spacing perpendicular to the capacitor terminal shall be:

(a) 11 mm (0.44 in) for a maximum of 300 V; or

(b) 13 mm (0.50 in) for a voltage more than 300 V.

6.9 Conductors and cords

6.9.1 Current-carrying conductors shall be copper, copper alloy, or nickel alloy.

6.9.2 (CAN) In Canada, conductors shall be minimum 18 AWG, except as specified in Clause 6.9.3, and shall be rated for the voltage, current, temperature, and condition of service to which they will be subjected, in accordance with Table 6.9.1 (CAN).

Table 6.9.1 (CAN)
CEC conditions of use and conductor temperature ratings for flexible cords and equipment wires

(See Clauses 6.9.2 (CAN), 6.13.3.2, and 6.13.3.3.)

Location	Usage	Description	Type	Rating, Volts	Temp.. °C	Notes
Dry	Not Hard Usage	Equipment Wire	GTF	600	125	1

Table 6.9.1 (CAN) Continued on Next Page

Table 6.9.1 (CAN) Continued

Location	Usage	Description	Type	Rating, Volts	Temp.. °C	Notes
Dry or Damp	Not Hard Usage	Flexible Cord Equipment Wire	HPN	300	90	
			SPT-1	300	60	2
			SPT-1	300	105	
			SPT-2	300	60	
			SPT-2	300	105	
			SV	300	60	
			SVO	300	60	
			SVT	300	60	
			SVT	300	105	
			CL751	300	75	
			CL901	600	90	1
			CL1051	300	105	
			CL1251	600	125	1
			CL1251-R3	600	150	1
			CL1502	600	150	1
			REW (0.015)	300	105	
			REW (0.030)	600	105	
			SEW-1	300	200	3
			SEWF-1	300	150	3
			SEW-2	600	200	3
			SEWF-2	600	150	3
			TEW	600	105	1 & 2
			TEWN	600	105	1 & 2
			TR-32	600	105	1
			TRB-32	600	105	1
			TR-64	600	105	1
			TRB-64	600	105	1
	For Hard Usage	Flexible Cord	HSJO	300	90	2
			SJ	300	60	
			SJO	300	60	2
			SJT	300	60	
			SJT	300	105	
			SPT-3	300	60	
			SPT-3	300	105	
	For Extra Hard Usage	Flexible Cord	S	600	60	
			SO	600	60	2
			ST	600	60	
			ST	600	105	
Dry or Damp or Wet	Not for Hard Usage	Flexible Cord	CXWT	300	60	
			CXWT	600	60	
			PXWT	300	60	
	For Hard Usage	Flexible Cord	SJOW	300	60	2
			SJTW	300	60	
			SJTW	300	105	
	For Extra Hard Usage	Flexible Cord	SOW	600	60	2
			STW	600	60	
			STW	600	105	

NOTES

(1) A voltage of 1 000 V is permitted when the current is limited by a transformer, reactor, or resistor.

Table 6.9.1 (CAN) Continued on Next Page

Table 6.9.1 (CAN) Continued

Location	Usage	Description	Type	Rating, Volts	Temp.. °C	Notes
(2) Temperature rating is limited to 60 °C when exposed to oil.						
(3) A temperature rating of 250 °C is permitted when the conductor is nickel or nickel-plated copper.						

6.9.2 (USA) In the United States, conductors shall be minimum 18 AWG, except as specified in Clause 6.9.3, and shall be rated for the voltage, current, temperature, and condition of service to which they will be subjected, in accordance with Tables 6.9.2 (USA) and 6.9.3 (USA).

Table 6.9.2 (USA)
NEC temperature and voltage ratings of flexible cords and equipment wire

(See Clauses 6.9.2 (USA), 6.13.3.2, and 6.13.3.3.)

Location	Usage	Description	Type	Rating, V	Temp.. °C	Notes
Dry		Equipment wire				
			FEPW	600	75	
			PFAH	600	250	
			RH	600	75	
			RHH	600	90	
			T	600	60	
			TFE	600	250	
			THHN	600	90	
			THHW	600	90	
			Z	600	90	2
			ZW	600	90	2
Dry	Not hard usage	Flexible cord	C	300	60	
			PD	300	60	

Table 6.9.2 (USA) Continued on Next Page

Table 6.9.2 (USA) Continued

Location	Usage	Description	Type	Rating, V	Temp.. °C	Notes
Dry or damp		Equipment wire	FFH-1	300	75	
			FFH-2	600	75	
			KF-2	600	200	
			KFF-1	300	200	
			KFF-2	600	200	
			HF	600	150	
			HF-1	300	200	
			HFF	600	150	
			PAF	600	250	
			PAFF	600	150	
			PF	600	200	
			PFF	600	150	
			PGF	600	200	
			PGFF	600	150	
			PTF	600	250	
			PTFF	600	150	
			RFH-1	300	75	
			RFH-2	600	75	
			RFHH-2	600	90	2
			RHH	600	90	2
			RHH-3	600	90	2
			SF-1	300	200	
			SF-2	600	200	
			SFF-1	300	150	
			SFF-2	600	150	
			TF	600	60	
			TFF	600	60	
			TFN	600	90	
			THHN	600	90	2
			XHHW	600	90	2
			XF	300	150	
			XFF	300	150	
			Z	600	90	2
			ZF	600	150	
			ZFF	600	150	
			ZHF	600	200	
			ZW	600	90	2
Dry or damp	Not hard usage	Flexible cord	HPW	300	90	2
	Extra-hard usage		S	600	60	
			S	600	75	1
			SE	600	60	
			SE	600	75	1

Table 6.9.2 (USA) Continued on Next Page

Table 6.9.2 (USA) Continued

Location	Usage	Description	Type	Rating, V	Temp.. °C	Notes
	Hard usage		SJ	300	75	1
			SJE	300	75	1
			SJO	300	60	
			SJO	300	75	1
			SJOO	300	60	
			SJOO	300	75	1
			SJT	300	60	
			SJT	300	75	1
			SJT	300	90	1,2
			SJT	300	105	1,2
			SJTO	300	60	
			SJTOO	300	60	
	Not hard usage		SP-1	300	60	
			SP-2	300	60	
			SPE-1	300	60	
			SPE-1	300	75	1
			SPE-1	300	90	1,2
			SPE-1	300	105	1,2
			SPE-2	300	60	
			SPE-2	300	75	1
			SPE-2	300	90	1,2
			SPE-2	300	105	1,2
	Extra-hard usage		SO	600	60	
			SO	600	75	1
			SO	600	90	1,2
			SOO	600	60	
			SOO	600	75	1
			SOO	600	90	1,2
	Not hard usage		SPT-1	300	60	
			SPT-1	300	75	1
			SPT-1	300	90	1,2
			SPT-1	300	105	1,2
			SPT-2	300	60	
			SPT-2	300	90	1,2
			SPT-2	300	105	1,2
	Extra-hard usage		ST	600	60	
			ST	600	75	1
			ST	600	90	1,2
			ST	600	105	1,2
			STO	600	60	
			STOO	600	60	

Table 6.9.2 (USA) Continued on Next Page

Table 6.9.2 (USA) Continued

Location	Usage	Description	Type	Rating, V	Temp.. °C	Notes
	Not hard usage		SV	300	60	
			SVE	300	60	
			SVO	300	60	
			SVO	300	90	1,2
			SVOO	300	60	
			SVOO	300	90	1,2
			SVT	300	60	
			SVT	300	75	1
			SVT	300	90	1,2
			SVT	300	105	1,2
			SVTO	300	60	
			SVTOO	300	60	
Dry, damp, or wet		Wire	RHW	600	75	
			RUW	600	60	
			THW	600	75	
			THWN	600	75	
			TW	600	60	
			XHHW	600	75	
			ZW	600	75	
Dry, damp, or wet	Same as specified for cord type under dry or damp	Flexible cord	Any if marked as specified in Note 3	As marked on cord	As marked on cord	2,3

NOTES:

(1) The insulation temperature rating is marked on the surface of the flexible cord.

(2) See Clause 6.9.7 for increasing the insulation temperature rating using sleeving.

(3) Flexible cord that is suitable for use in a wet location is surface marked with a ″W″ or ″Water Resistant″.

Table 6.9.3 (USA)
Appliance wiring material insulation type, voltage, and temperature ratings for United States

(See Clauses 6.9.2 (USA) and 6.13.3.3.)

Types of insulation	Minimum thickness of insulation							
	300 volts				600 volts			
	Without braid		With added impregnated braid cover		Without braid		With added impregnated braid or nylon cover [min 0.1 mm (0.004 in)]	
	mm	(in)	mm	(in)	mm	(in)	mm	(in)
Thermoplastic	0.33	(0.013)	0.33	(0.013)	0.69	(0.027)	0.38	(0.015)
Thermoset	0.33	(0.013)	0.33	(0.013)	0.69	(0.027)	0.69	(0.027)
Rubber	0.69	(0.027)	0.33	(0.013)	1.02	(0.040)	0.69	(0.027)
Neoprene	0.69	(0.027)	0.33	(0.013)	1.07	(0.042)	0.69	(0.027)
Silicone rubber	–	–	0.33	(0.013)	–	–	0.69	(0.027)
Fluoro-plastic*	0.30	(0.012)	–	–	0.46	(0.018)	–	–

*Polytetrafluoroethylene or fluorinated ethylene propylene.

NOTE The temperature marking of appliance-wiring material or miscellaneous wire consists of:

(1) colored threads;

(2) durable, continuous (unbroken), straight, longitudinal stripes printed in indelible ink on the surface of the insulation; or

(3) durable and legible indelible ink printing (or legible indent printing) of words, stating the temperature in degrees Celsius on (or in) the surface of the insulation.

Table 6.9.3 (USA) Continued on Next Page

Table 6.9.3 (USA) Continued

Types of insulation	Minimum thickness of insulation							
	300 volts				600 volts			
	Without braid		With added impregnated braid cover		Without braid		With added impregnated braid or nylon cover [min 0.1 mm (0.004 in)]	
	mm	(in)	mm	(in)	mm	(in)	mm	(in)
The number and color of the threads or stripes are as follows: one green for 75 °C; one red for 90 °C; one yellow for 105 °C; one blue for 125 °C; one brown for 150 °C; one black for 200 °C; two black for 250 °C. If a stripe or thread is used to identify the temperature of an 80 °C thermoplastic-insulated wire (the identification is not required), the stripe or thread is green.								

6.9.2 (MEX) In Mexico, conductors shall be a minimum of 16 AWG (1.307 mm^2) and shall be rated for the voltage, current, temperature, and conditions of service.

6.9.3 Conductors of a size smaller than 18 AWG may be used under the following conditions:

(a) where they are completely enclosed;

(b) where they are not subject to movement under normal use; and

(c) in the secondary of a transformer, or in a circuit using solid-state devices.

6.9.3 (MEX) In Mexico, conductors of a size smaller than 16 AWG, but not smaller than 18 AWG, shall be permitted to be used where the current does not exceed 6 A.

6.9.4 Conductors of a size smaller than 24 AWG (0.21 mm^2) may be used under the following conditions:

(a) the conductors are in Class 2 power limited circuits only;

(b) the current carrying capacity of the conductor is not exceeded and is sufficient to carry the continuous normal load current without any temperature related issues; and

(c) the construction complies with Item (1) or (2), as follows:

(1) the conductors shall have an insulation rating not less than the voltage on the conductor and be stranded if accessible during use or maintenance, or inaccessible but subject to movement during maintenance, or

(2) the luminaire shall be provided with a barrier to prevent contact with wiring that is not connected to a Class 2 circuit. The width of an opening between a barrier and adjacent parts shall not exceed the diameter of the Class 2 circuit wire. This dimension shall be measured between the barrier and the enclosure walls, components, or the like that serve as part of the compartment for the Class 2 wiring.

6.9.4 (MEX) In Mexico, conductors of a size smaller than 18 AWG (0.82 mm^2) but not smaller than 24 AWG (0.21mm^2) may be used in the secondary of a transformer, ballast, or in a circuit using solid-state devices but they shall not be used in the power supply line.

6.9.5 A conductor or cord that can be flexed because of an adjustable, movable, or flexible part of a luminaire shall be of the stranded type and shall be secured so it will not be cut or abraded under conditions of intended use, including relamping, servicing, and inspection of supply connections.

6.9.6 In a luminaire construction that allows the conductor or cord to be pushed back into the luminaire, the temperature rating of the conductor or cord shall be suitable for the operating temperature of any component it can contact.

6.9.7 An insulated conductor, including each insulated conductor of a cord, that is rated for 90 °C, 105 °C, or 125 °C shall be considered as rated for 150 °C if each conductor is individually provided with supplemental insulation consisting of snugly fitting woven glass fiber sleeving having at least a 0.25 mm (0.010 in) wall thickness or at least two layers of glass fiber tape that provide a total thickness of at least 0.25 mm (0.010 in).

6.9.8 An insulated wire connector having a voltage rating less than that required for the application may be used if the splice, including the connector, is additionally covered with insulation rated for the voltage difference between the required voltage and the rated voltage of the connector.

6.10 Identification and polarity

6.10.1 A conductor terminal intended for the connection of the neutral conductor of the branch circuit shall be substantially white in color or be marked neutral adjacent to the terminal in accordance with Table 20.1.1, Item 1.5.

6.10.2 The insulation on a conductor intended for connection to the neutral conductor of the branch circuit shall be identified by one of the following means:

(a) be colored white or grey;

(b) be of any color except green, with a continuous white tracer throughout its length;

(c) be identified at the point where connected to the branch circuit by white paint, tape, ink, or permanent tag; or

(d) be provided with one or more raised longitudinal ridges, if a parallel conductor flexible cord.

6.10.3 The identified terminal of a wiring device shall be connected to the neutral conductor of the branch circuit.

6.10.4 A cord-and-plug-connected luminaire equipped with a polarized two-pole, two-wire parallel blade attachment plug shall be marked for proper polarity in accordance with Table 20.1.1, Item 4.5.

6.11 Electrical spacings

6.11.1 The minimum spacings shall be not less than those shown in Table 6.11.1 between:

(a) uninsulated live parts of different potential; and

(b) uninsulated live parts and non-current-carrying metal parts.

Table 6.11.1
Minimum spacings – clearance through air and creepage distances for uninsulated live parts

(See Clauses 6.11.1, 6.11.6, and 6.11.9.)

Voltage range, V rms	Voltage range, V peak	Minimum spacing clearance through air		Minimum spacing creepage distance	
		mm	(in)	mm	(in)
0 – 50	0 – 71	1.6	(0.063)	1.6	(0.063)
51 – 150	72 – 212	3.2	(0.125)	6.4	(0.250)
151 – 300	213 – 423	6.4	(0.250)	9.5	(0.375)
301 – 600	424 – 846	9.5	(0.375)	9.5	(0.375)
601 – 2000	847 – 2828	9.5	(0.375)	12.7	(0.500)

6.11.2 Spacings shall be measured with all fittings installed as intended, whether or not they are furnished with the luminaire. Parts that can be rotated after installation shall be moved to a position that minimizes the spacing being measured.

6.11.3 The spacings at fuses and fuseholders shall be measured with the fuses in place and with the fuses removed. The fuses shall be those with the maximum standard dimensions.

6.11.4 The spacing shall be determined using the voltage measured between the electrical parts, other than lamp igniters, operating under normal operation with the luminaire connected to a power supply of rated voltage and frequency.

6.11.5 The spacing between uninsulated live parts of different circuits involving different voltages shall be not less than that required for the circuit of the higher voltage.

6.11.6 The spacings between field wiring terminals of different potential and between the terminals and a grounded non-current-carrying part shall be not less than 3.2 mm (0.125 in) through air and 6.4 mm (0.250 in) over surface or as indicated in Table 6.11.1, whichever is greater.

6.11.7 The spacings of a branch circuit conductor terminal shall be measured with the conductor installed. The size of the conductor shall be suitable for the luminaire current rating but shall not be smaller than 14 AWG.

6.11.8 For the purposes of measuring spacings, a film-coated conductor shall be considered an uninsulated part.

6.11.9 A spade or ring terminal shall be prevented from turning by a reliable restraint such as a shoulder or boss, if by turning the spacing is reduced below the value shown in Table 6.11.1.

6.11.10 (CAN) In Canada, spacings for printed circuit boards shall comply with Annex F.

6.11.10 (USA) In the United States, spacings for printed circuit boards shall comply with applicable component and end product standards.

6.12 Electrical insulation

6.12.1 Electrical insulation, including that used in component wiring devices, shall be of material that is suitable for the particular application. The acceptability of insulating material shall include consideration of the following:

(a) mechanical strength;

(b) dielectric voltage-withstand;

(c) insulation resistance;

(d) heat-resistant and moisture-resistant properties;

(e) degree of enclosure protection;

(f) other factors, such as arcing and aging, that have a bearing on the risk of fire and electric shock under conditions of actual use; and

(g) flammability rating (it shall be at least HB).

6.13 Accessibility of live parts

6.13.1 General

6.13.1.1 Accessibility of a live part shall be determined by the articulate probe test of Clause 17.4 during user maintenance and normal operation.