

UL 844

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Subjects 1598 (1570, 1571, 1572, 844)
 (In reply, refer to Subject 1598)

12 Laboratory Drive
 Research Triangle Park, NC 27709
 November 15, 1996

TO: Consumer Advisory Council of Underwriters Laboratories Inc.,
 Electrical Council of Underwriters Laboratories Inc.,
 Subscribers to UL's Standards Services for:
 Fluorescent Lighting Fixtures,
 Incandescent Lighting Fixtures,
 High Intensity Discharge Lighting Fixtures, and
 Electric Lighting Fixtures for Use in Hazardous (Classified) Locations

SUBJECT: Request for Comments on Proposed Requirements for the Proposed Bi-National
 Standard for Luminaires, UL 1598; PROPOSED EFFECTIVE DATES AND
 PROPOSED IMPLEMENTATION PLAN

SUMMARY OF TOPICS

This bulletin proposes the adoption of the First Edition of UL 1598, the Bi-National Standard for Luminaires and an implementation plan for adopting the standard.

COMMENTS DUE: January 17, 1997

Attached as Appendix A for your review and comment are the RATIONALE and IMPACT statements pertaining to the proposed requirements for UL 1598 as well as a proposed plan for implementation. Attached as Appendix B are the proposed requirements for UL 1598. Questions regarding interpretation of requirements should be directed to the responsible UL Staff. Please see Appendix C of this bulletin regarding designated responsibility for the subject product categories.

Please note that proposed requirements are of a tentative and early nature and are for review and comment only. Current requirements are to be used to judge a product until these requirements are published in final form.

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Subjects 1598 (1570, 1571, 1572, 884)

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November 15, 1996

PROPOSED EFFECTIVE DATE

The proposed requirements will not necessitate a review or additional testing of currently Listed and Recognized products. Therefore, UL proposes that these requirements become effective upon publication.

REQUEST FOR COMMENTS ON PROPOSALS

Please provide the following:

1. Your comments concerning the proposed requirements; and
2. Your comments concerning the proposed effective date, should the proposals be adopted.

Written comments should be sent by regular mail, fax, or e-mail to the attention of Sarah Brooks at UL's Research Triangle Park office, 12 Laboratory Drive, Research Triangle Park, NC 27709-3995. (If responding by e-mail please include full name and company address.) Please reference all correspondence to Subject 1598.

All comments should be sent by January 17, 1997.

Unless specifically requested to do so, UL will not acknowledge comments indicating concurrence with these proposals.

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SR:DES

1598BUL.002

PROPOSED REQUIREMENTS ARE OF A TENTATIVE AND EARLY NATURE AND ARE FOR REVIEW AND COMMENT ONLY. CURRENT REQUIREMENTS ARE TO BE USED TO JUDGE A PRODUCT UNTIL THESE REQUIREMENTS ARE PUBLISHED IN FINAL FORM.

A P P E N D I X A

RATIONALE AND IMPACT STATEMENTS FOR
PROPOSED REQUIREMENTS AND PROPOSED EFFECTIVE DATE
FOR THE FIRST EDITION OF THE BI-NATIONAL STANDARD FOR
LUMINAIRES, UL 1598

PROPOSED IMPLEMENTATION PLAN

IMPLEMENTATION

UL is proposing the following implementation plan for the BiNational Standard for Luminaires:

- It is proposed that UL 1598 become effective upon publication – tentatively, April 1, 1997.
- Submittals made after publication of UL 1598 will be investigated using UL 1598, unless the manufacturer specifically requests Listing using the UL 1570 series.
- UL 1570, UL 1571, and UL 1572 will be withdrawn on April 1, 1998 to afford UL the time required to relocate requirements not covered in the BiNational Standard. Whenever possible, this material will be adopted as supplements to the BiNational Standard (FUS Supplements, marine lighting supplement), but will not be part of the Bi-National Standard.

No changes in certification and follow-up services are expected. UL will continue to apply the UL and cUL marks as applicable to products covered by the proposed standard.

RATIONALE

General

UL proposes that the Bi-National Standard for Luminaires be adopted. The Luminaire Harmonization Committee (LHC) has completed its work on the development of the proposed standard that is provided in Appendix B of this bulletin. The LHC has considered input from many sources, including the IAC for UL 1570, UL 1571, and UL 1572, the Technical Subcommittee for Luminaires for CSA C22.2 No.9, the American Lighting Association (ALA) Engineering Committee, and the NEMA Lighting Group.

What follows is a summary of each section of the proposed standard. Each summary contains information pertaining to how the section is arranged and highlights significant changes from the current requirements in UL 1570, UL 1571, UL 1572.

Section 1 – General

New elements in this section are as follows:

- a) National deviations, found throughout the draft standard, are compiled for easy reference within this section. The LHC has recommended deviations in the cases of conflict with the national installation codes or other national practice.
- b) A component used in a product covered by this standard is required to comply with the UL standards and the CSA standards for the component.
- c) References made to other standards, such as other CSA or UL standards or ASTM standards, are summarized in this section.
- d) The metric values are the specification in the draft standard; the English values are approximate.

The scope of the standard differs from the current 1570 series in that the following sections have been deleted:

- a) Reflector Kits – UL 1570, Section 50 – These products do not fit the definition of a luminaire, and it is the LHC's recommendation that they should not be included in the proposed standard. A separate standard is expected to be developed specifically for this product. The new reflector kit standard would reference the Binational Standard for the evaluation of the reflector kit installed in the luminaire.
- b) Line Voltage Garden Lighting – These are ground mounted or in-ground mounted wet locations luminaires. The construction and test requirements are found in Clauses 10 and 11 of the proposed standard.
- c) Open Wiring Systems – UL 1571, Section 73 – Open wiring is described in Article 320 of the NEC. It is limited to circuits operating at 600 volts or less for industrial or agricultural establishments only. There are no references to open wiring in the CEC. This is a special installation and luminaires constructed to be installed on open wiring systems are deficient in certain construction features that would not permit them to be installed on a conventional wiring system; however, luminaires designed for conventional wiring systems can be installed on open wiring systems. There is no need to include special requirements for luminaires to be installed using this wiring method; it could create problems.

The definitions for risk of fire and risk of electric shock are included. The definition for risk of electric shock references 30 V RMS as the voltage limit for both dry and wet locations.

Section 2 – Mechanical construction

Clauses in this section address the general mechanical construction requirements applicable to all luminaires covered by this standard. The following issues are treated differently in the proposed standards than in the UL 1570 series:

- a) Corrosion protection – proposed 2.6 – Luminaires are typically protected against corrosion to maintain the integrity of the enclosure, ensure the effectiveness of the grounding and bonding system, and preserve the aesthetics of the product. The minimum level of corrosion protection for dry locations luminaires is not specified in the UL 1570 series. In 1982 a UL Ad Hoc committee was established to study and identify an appropriate level of corrosion protection for damp locations luminaires. The conclusion based on comparison tests was the paint, plating or powder coating systems used on typical dry locations luminaires performed at or above the corrosion protection level being proposed for damp locations luminaires. Based on all the above the Binational draft specifies the same corrosion protection for both dry and damp locations luminaires.
- b) Polymeric accessibility barriers – UL 1571, paragraph 21.4.2(c) – The requirement for HWI of 30 and HAI of 60 has been deleted. The current UL 1570 series of Standards does not specify a minimum thickness or mechanical integrity evaluation for accessibility barriers made of plastic. The draft standard proposes that accessibility barriers made of plastic less than the specified minimum thickness be subjected to the same test to which barriers of other materials are subjected. This will ensure the same level of risk reduction regardless of the barrier material.

- c) Glass support – proposed 2.17.3 replaces UL 1571, paragraphs 12.2.2 – 12.2.7 and is less restrictive. It recognizes the luminaire manufacturer wants to secure the glass adequately and there are many ways to do this.
- d) Wire protection – proposed 2.14.1 – The use of glass fiber sleeving in this application is not permitted in the UL 1570 series. It has been permitted in CSA Spec 9 for years with no known problems. It has been proposed by the LHC for inclusion in the Binational based upon the field experience in Canada.
- e) Thermal Insulation Rigidity Test – UL 1571, paragraph 23.5 – The LHC is proposing to delete this test. It was originally adopted by UL to provide the Follow-Up Field Representative with a means to identify fiberglass pads with sufficient density to be used as thermal insulation in some surface mounted luminaire designs. Without the pad the normal outlet box operating temperatures of the luminaire exceed the limits.

Experience has shown that the test results are not always conclusive, leaving room to err on either side. Recognizing the many years of experience both manufacturers and safety certifiers have using the proper materials and that the materials can be identified by specifying the minimum density of the material, it is the recommendation of the LHC that visual examination and documentation be used during any follow-up inspection at the manufacturing facility to qualify a material used to prevent excessive temperatures in the outlet box.

Section 3 – Electrical construction

Clauses in this section address the general electrical construction requirements applicable to all luminaires covered by this standard. The following issues are treated differently in the proposed standard than in the UL 1570 series:

- a) Lampholders – UL 1571, paragraphs 17.1 – 17.4, and UL 1572, paragraphs 18.1 – 18.4 – These specifications are evaluated during the investigation of a lampholder for Listing or Recognition. They were included in the Standards to ensure that they would be applied with the lampholder mounted in the luminaire. The experience of UL's engineering staff is there has not been a need to apply them; therefore, it is the recommendation of the LHC to omit them from the Binational Standard.

Clause 3.3.3 specifies that lampholders with screw terminals have the screw terminals enclosed by a material that complies with enclosure requirements in Section 2. This includes the sleeve over "candle" style lampholders used in chandeliers, wet locations luminaires, and the like. While this represents an upgrade from the current UL 1570 series requirements it is expected to have minimal impact. A cursory poll of luminaire manufacturers indicates the candelabra lampholders they currently use in Listed products come with integral leads, not screw terminals.

- b) Switches – Proposed Table 3.2 requires a switch load rating factor of 3 for an ac only or ac/dc rated switch used to control a tungsten filament load; the 1570 series of UL standards specifies a factor of 6. Researching the rationale for the UL factor revealed that it is a very conservative value. A factor of 3 has been specified in CSA Spec 9 for years. CSA has no known field problems using the lower value thus the LHC to recommends adopting it in the Binational Luminaire Standard.

- c) Fuses – proposed 3.6.3 – This clause is a change from the 1570 series of UL Standards. It is expected to have minimal impact as few luminaires have fuses.
- d) Ballasts and transformers – proposed 3.7 – The CEC Part 1 requires a luminaire with an isolation ballast to ground the screw shell of a lampholder connected in the isolated secondary. The NEC does not have a similar requirement. The alternatives to resolving this deviation are to specify grounding of isolated lampholder screwshells in the Binational Luminaire Standard or change the CEC to remove this requirement.
- e) Conductors and cords – proposed 3.9 – There are different wire and flexible cord types that exist in one country and not the other. In effort to maintain the level of risk defined by the existing standards, all existing types have been included. The LHC will be reviewing these tables further during the review period to determine if the differences can be resolved and the tables combined.
- f) Wiring compartment and junction box volume determination – proposed 3.16 – During development of the proposed standard, the LHC reviewed the methods of calculation of the required volume for junction boxes using the requirements of the NEC and CEC. The LHC was not able to agree to use the NEC or CEC method. The LHC did conclude that the NEC and CEC requirements represent rules applied to the installation of electrical systems and may be used as a guide when developing product standards. With this in mind, the requirements proposed in 3.16 were developed to ensure adequate space in a wiring compartment to install all the conductors permitted by any accepted wiring method in either national installation code. The result is the choice of using a calculation method that accounts for all the conductors permitted in the wiring compartment to determine the minimum volume or a practical test.

Section 4 – Incandescent luminaires

This section contains the requirements for temperature test exempt incandescent luminaires. It has been completely re-written from the 1570 series of UL standards for clarity and simplification; however, the basic requirements are unchanged except for the addition of Clause 4.1.2. Note that proposed Clause 4.1.2 – Maximum lamp wattage and lamp type – requires a lamp replacement marking on all test exempt incandescent luminaires. This was done to ensure acceptance of these products by the local electrical inspectors in Canada. It is expected to have minimal impact on currently Listed products since many already have the marking even though it is not required.

Section 5 – Fluorescent luminaires – This section includes the unique requirements for luminaires employing a fluorescent light source. Note that proposed Clause 5.3.3 – Flexible supply cords and conductors – is a deviation, permitted in Canada only. The NEC does not permit flexible cord to be used to connect a recessed luminaire to the branch circuit supply.

Section 6 – HID luminaires – This section includes the unique requirements for luminaires employing an HID light source. No significant changes from the UL 1570 series are proposed.

Section 7 – Surface mounted luminaires

This section includes the supplementary requirements for surface-mounted and pendant-mounted luminaires. The following issues are treated differently in the proposed standard than in the UL 1570 series:

- a) Proposed Clause 7.2.5 – deviations due to differences in maximum luminaire weight permitted to be supported solely by the outlet box in the model National installation code.
- b) Proposed Clause 7.2.12(a) – Increases the maximum mass that a not-for-hard usage (SV, SVT, etc.) flexible cord specified to support from 1.65 kg to 2.3 kg (5 lb). CSA C22.2, No. 9 has permitted this for years with no known related problems reported from the field.
- c) Proposed Clauses 7.4.3 – 7.4.5 – General purpose holes, mounting holes, and component holes requirements have been rewritten to simplify and clarify them.
- d) Proposed Clause 7.5 – Accessibility of supply connections – There are significant changes in the requirements from what they are in the 1570 series of UL standards for any outlet box mounted luminaire that weighs more than 4.54 kg but less than 11.35 kg. The maximum weight for a luminaire is reduced from 11.35 kg to 4.54 kg and the weight times dimension factor is deleted. Clause 7.5.2 specifies that a luminaire weighing more than 4.54 kg have an access opening to inspect the splices or a supporting means for the luminaire when it is removed to make the inspection.
- e) Proposed Clause 7.6.2 – The proposed Binational Luminaire Standard specifies SPT-1 as the minimum flexible cord type for chain supported; UL 1571 specifies SPT-1-1/2. CSA has always permitted SPT-1 minimum flexible cord to be accessible if it is woven through the chain of a chain suspended pendant luminaire. There are no known problems in Canada related to the flexible cord on chain supported luminaires. Based on this experience which supports the premise that the probability of damage to a flexible cord in a chain supported luminaire is substantially less than in a portable appliance, the LHC is recommending this proposal.
- f) Proposed Clauses 7.6.9 – 7.6.10 – National deviations due to differences in supply wire temperature ratings permitted by the model National installation codes.

Section 8 – Recessed luminaires

This section includes the supplementary requirements for recessed luminaires. The following are highlights of the proposed changes:

- a) Suspended Ceiling Luminaires – are a type of Non-IC recessed luminaire. They are mounted above the ceiling line, close off the opening in the ceiling and may be subject to thermal insulation being installed in contact with or over them. Therefore, they should comply with all of the recessed luminaire construction and test requirements. However, since there are some unique features, for example, mounting, there are some additional construction requirements that are included.

- b) **Marked Spacings Luminaires** – It is the LHC's recommendation to eliminate Residential Marked Spacings tests and the "Not for Residential Use Marking". The LHC views Marked Spacings as a sub-class of Type Non-IC. Marked spacings luminaires are typically large, custom built luminaires, not sold in retail outlets and are installed by qualified persons. The "Not for Residential Use" marking would not permit them in the lobbies or entrances of condominiums. Assuming a qualified person installs the luminaire, what is the added risk of installing them in a residence as opposed to a commercial application? It is the LHC's opinion that there is a very low probability that the thermal protector would be removed from the circuit if it cycled. UL was being very conservative when these requirements were adopted due to lack of experience with this new product. Based on the fact that after years of experience in the field there are no known problems, UL supports this rationale and recommendation.
- c) **Proposed Clause 8.3** – The LHC proposes that the minimum junction box thickness be 1.3 mm, which is a reduction from that specified in the UL 1570 series. Canada has good field experience with this reduced thickness.
- d) **Proposed Clause 8.6.2 – Tap conductors** – This is a deviation. The USA position is based on Section 410-67 of the 1996 NEC; the Canadian position is based on test data. To resolve this issue it is recommended that the Canadian position be adopted and a proposal be made to NFPA for the 1999 Code cycle to revise the Code to specify 450 mm (18") as the minimum length for a luminaire tap conductor based on the Canadian data.
- e) **Proposed Clause 8.6.3 – Rough-in and finishing sections** – The LHC does not view a recessed luminaire comprised of a rough-in and finishing section any different than one comprised of a housing and trim. The proposed Binational Luminaire Standard acknowledges the two types of recessed luminaire constructions exist but treats them equally. The result is there is only one additional requirement that is unique to the rough-in and finishing genre.
- f) **Proposed Clause 8.8.2 – Lamp replacement markings** – Have been substantially rewritten from what is in the 1570 series of UL standards to simplify and clarify them. It is intended that the meaning not be changed.
- g) **Proposed Clause 8.8.5 – Convertible recessed luminaires** – This is a USA deviation due to lack of acceptance of this type of recessed luminaire by the Canadian inspection authorities.

Section 9 – Miscellaneous luminaires

Air-handling luminaires – This section addresses the requirements unique to air-handling luminaires. No changes are proposed from the UL 1570 series; however, national deviations are included due to differences in national building codes.

Cooking luminaires – This section addresses the requirements unique to recessed and surface-mounted luminaires for use in exhaust ducts and hoods above cooking equipment in nonresidential occupancies. No changes are proposed from the UL 1570 series.

Elevated ambient luminaires – This section includes the supplementary performance and marking requirements for luminaires intended for use in locations that experience a continuous elevated ambient temperature. No changes are proposed from the UL 1570 series.

Section 10 – Damp locations luminaires

This section includes the supplementary requirements for a luminaire intended for use in damp locations. Note that the corrosion protection requirements for damp locations luminaires currently in the 1570 series are now general requirements.

Section 11 – Wet locations luminaires

This section includes the supplementary requirements for a luminaire intended for use in wet locations. The following issues are noteworthy:

Corrosion protection – proposed 11.3 – The corrosion protection requirements are less specific than in the 1570 series of UL standards.

The following are changes in water shield requirements from the current 1570 series.

a) Plastic Water Shields – UL 1571, paragraph 69.5.1(a) – The LHC proposes to delete the requirement that the diffuser/water shield be minimum 94 HB. There is no minimum flammability rating for materials used to fabricate the diffuser of a dry locations luminaire unless it also functions as a required part of an enclosure. This requirement was intended to ensure the material forming the water shield was a sufficiently substantial material since its function is safety related. There are tests specified in the Binational Luminaire Standard which determine the effectiveness of a material to function as a water shield.

b) Water Shield Thermal Conditioning Test – UL 1571, paragraph 71.9.1 – The LHC's research into the rationale for this UL requirement resulted in a proposal to reduce the conditioning time from 1000 hours to 168 hours.

c) Water Shield Impact Test – UL 1571, paragraph 71.2.1 – The LHC proposes to delete the 1.4 N·m and 4.1 N·m "bean-bag" impact tests on non metallic water shields. This test is the result of US industry asking UL to revise the water shield impact tests so that all materials were treated equally. At the time plastic water shields were subjected to a 7.0 N·m impact test and glass was not impacted at all. The result is the requirements in place today.

It is the experience of the US Task Group manufacturer members and UL Staff that there has never been a test failure when conducting the 4.1 N·m test on glass. Therefore, the safety value added by conducting it is questionable and it is recommended that it not be included in the Binational Standard.

d) Water Shield Thermal Shock Test – UL 1571, paragraph 71.8.1 – It is proposed that this test be omitted. It is conceded that there may be a difference in the temperature of a glass water shield on an operating luminaire and precipitation – rain, sleet or snow – that can contact it, but it is the opinion of the US Task Group, based on testing and field experience, that the temperature difference is not enough to cause the glass to break. Further, this evaluation is made to a lesser extent during the rain test, the main difference being the temperature of the water.

e) Dielectric testing – The 1570 series of UL standards require a visual examination of a product at the completion of the rain test to determine compliance. CSA's C22.2, No. 9 requires a visual exam and a dielectric test. The Binational Luminaire draft proposes both a visual exam and dielectric test. This is not expected to affect currently Listed products.

Section 12 – Normal temperature tests

This section includes the test methodologies for the various constructions of surface and recessed luminaires. Noteworthy issues are as follows:

a) Proposed Clause 12.1.4 – Components and materials operating at temperatures that exceed limits of Table 12.2 – this clause is a footnote in the temperature limits table in the 1570 series of UL standards.

b) Proposed Table 12.2 – represents a combination of the temperature limit tables in the 1570 series of UL standards and CSA Spec 9.

Nickel plated Copper Parts of a Lampholder – Though not stated in the 1570 series of UL standards, this is the limit applied.

Nickel Alloy Parts of a Lampholder – The limit – 315°C is based on research conducted and reported by CSA.

Capacitor – In the 1570 series of UL standards the limits do not apply to capacitors that are an integral part of an enclosed ballast and there is a distinction made between electrolytic and other types of capacitors. The draft Binational Standard proposes the same temperature limit for all capacitors that are not integral to an enclosed ballast, regardless of type. This increases the limit on electrolytics from 65°C to 90°C. The LHC recommends the increased limit based on the fact that the typical electrolytic capacitor is rated 85°C or higher.

Electrical Insulating Materials: In the 1570 series of UL standards no specific mention is made of materials used as an electrical insulator. Under the current requirements insulating materials are evaluated using the applicable requirements in UL 746C. The proposed Binational Luminaire Standard may specify a different temperature limits for a material depending on its use in the luminaire. The limits in the proposed table are not changed with the following exceptions:

Silicone Rubber (Not Stressed) – The 200°C limit specified is the limit is the same as that for silicone rubber used as a gasket.

Silicone Rubber (Compressed) – The proposed limit is 170°C.

Neoprene Rubber (Dry Locations) – The proposed limit is 90°C.

Neoprene Rubber (Oil or Wet Locations) – The proposed limit is 60°C.

Melamine – The proposed limit – 130°C – is from CSA Spec 9 and is the same in UL 746C.

Nylon – The proposed limit – 105°C – is from CSA Spec 9. The generic limit in UL 746C is 65°C.

Urea – The proposed limit – 100°C – is from CSA Spec 9 and is the same in UL 746C. The 1570 series includes urea with phenolic with a limit of 150°C.

Non-electrical insulating materials:

Silicone rubber – The proposed limit is 230°C.

EPDM – No manufacturer of EPDM has submitted it to UL for long term heat aging, so there is no EPDM on the market that has an RTI above the basic generic temperature rating of 50°C. However, there are UL Recognized Gaskets and Seals - JMLU2 - made of EPDM with Maximum Service Temperatures of up to 115°C. CSA has accepted EPDM up to 90°C for years with no field problems. The input from Canadian luminaire manufacturers is the temperature rating of EPDM is higher than 90°C. They cite data printed in the "Standard Handbook for Electrical Engineers" and some Westinghouse data pages printed in 1970 that specify a continuous use temperature rating of 90°C for EPDM. EPDM has also been used for years in UL Listed luminaires where the operating temperatures exceed 50°C, if it passes the tests in paragraph 71.9.2 or 71.9.4 of UL 1571. So, there is a means acceptable to both UL and CSA to use it in products evaluated to the draft Binational Standard. Based on all the data available, especially the CSA and UL field data, it is recommended that the generic temperature rating for EPDM be 90°C and that the UL 1570 series adopt this value.

Rubber (Ordinary) – The proposed limit is 70°C. The current limit in the 1570 series and Spec 9 is 60°C.

Section 13 – Abnormal temperature tests

This section includes the abnormal test methodologies for the various types of recessed luminaires. These tests have been completely re-written in a new format for clarification. The content remains the same except for the simplification of the reduced spacing test procedure.

Section 14 – General mechanical tests

This section includes the mechanical test methodologies applicable to all luminaires. They are a compilation of the tests from the 1570 series of UL standards and Spec.9, and tests from standards referenced in them. The materials tests are from UL 746C the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations. Clauses with notable changes in them are as follows:

14.2 – Metal equivalency tests – It is proposed to delete the loading test as superfluous considering all the other required tests.

14.21.1.2 – Specifies the maximum permitted movement of the flexible cord as a result of the strain relief test.

14.31 – Junction box rigidity test – There are significant changes in the test methodology.

14.5.12 – Paint adhesion test – This is a new test used to determine the adequacy of a paint or powder system used as corrosion protection that has been used by CSA for years.

Section 15 – General electrical tests

This section includes the electrical test methodologies applicable to all luminaires. No changes are proposed from the UL 1570 series.

Section 16 – Manufacturing and production tests

This section includes the tests required to be performed in the factory.

Section 17 – Test procedures and apparatus

This section specifies standard procedures, for example, measurement of ambient, determination of temperature stabilization, installation and support of the luminaire under test, as well as the test lamps and apparatus required to perform the tests specified in the standard.

The noteworthy modification of existing requirements is the new supply wire temperature probe design. CSA was assigned the task of doing some comparative testing using the UL temperature probe and the CSA method for measuring outlet box temperatures. The test results show the UL probe is difficult to position, the ears break off easily, measures temperatures on the top of the insulation pad instead of the outlet box and results in higher temperatures. The LHC has developed a light weight probe made of a copper clad industrial laminate. It reduces or eliminates the deficiencies in either current system. A couple of the US manufacturer members of the LHC have done comparison testing and found excellent correlation. There would be no reason to retest any product. The LHC recommends adopting the new design.

The following clauses contain significant changes:

17.8 – The incandescent test lamps specified in Clause 17.8 and Tables 12.3, 12.4, and 13.2 must comply with the temperature profile of C84. While the test lamps are not the "standardized" lamps specified in UL 1571, there will be no retesting of any UL Listed incandescent luminaires. CSA included samples of the UL standardized lamps in its research testing which formed the basis for the revised temperature profiles in CSA Spec 84. The results of testing revealed that the temperature profiles of the UL lamps are within 2°C of the temperature profiles specified in Spec 84. This small difference is not expected to result in any noticeable difference in luminaire operating temperatures.

17.16 – The cellulosic insulation with an "R" factor in the range specified in the UL Standards has become hard to find in the USA and Canada. After much research, testing and discussion the LHC recommends a cellulosic insulation that has a slightly lower R-factor and is available. The difference in the R-factor is due to a change in the method of calculating R factor, not a change in the insulation. No impact on the operating temperatures of a luminaire are expected; therefore, no retests are required.

Section 18 – Markings

As mentioned in previous correspondence pertaining to the developing Binational Luminaire Standard, the objective of the significantly revised markings is to improve their effectiveness. The LHC is proposing the following convention for marking requirements. The intent of the marking is stated within the text of the requirement. The text includes reference to a Table that includes all pertinent information for the marking including specific verbiage and format requirements. It is anticipated that this convention will promote a clear understanding of each marking.

To further their effectiveness and simplify markings all markings contain just the recommended action to reduce the risk being addressed. The other parts of the three-part marking currently found in the 1570 series of UL standards for example, the signal word ("CAUTION") and a statement of the risk – are omitted in this proposal. Input from the industry based on their experience is too many markings or markings that are verbose are more likely to be ignored.

Appendix A – Standards for components

This appendix specifies those CSA and UL standards that are to be used in the evaluation of components used in products covered by the proposed standard.

Appendix B – Markings – French translation

This appendix specifies the French translations for the required markings specified in Section 18.

Appendix C – Pictograms

This appendix specifies the pictograms that may be substituted for the corresponding text of the marking Table.

Appendix D – Metric conversion and wire size tables

This appendix provides a reference for metric conversions used in the draft standard.

IMPACT

The requirements of the proposed standard have been drafted with the intent to minimize change to that required to harmonize the current 1570 series of UL standards with CSA C22.2, No. 9. The LHC believes it has accomplished this goal. While there are some changes, their impact on the level of safety relative to the existing luminaire standards is expected to be negligible. A product complying with this draft Binational Luminaire Standard would also comply with UL 1570, UL 1571, or UL 1572 and CSA C22.2, No.9. No review or retest of currently Listed products is planned.

PROPOSED REQUIREMENTS ARE OF A TENTATIVE AND EARLY NATURE AND ARE FOR REVIEW AND COMMENT ONLY. CURRENT REQUIREMENTS ARE TO BE USED TO JUDGE A PRODUCT UNTIL THESE REQUIREMENTS ARE PUBLISHED IN FINAL FORM.

APPENDIX B

PROPOSED REQUIREMENTS AND PROPOSED EFFECTIVE DATE FOR THE FIRST EDITION OF THE STANDARD FOR LUMINAIRES, UL 1598

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1 General

1.1 Scope

1.1.1

This standard applies to luminaires for use in nonhazardous locations 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 (CE Code, Part I), and the ANSI/NFPA 70 National Electrical Code (NEC).

1.1.2

This standard does not apply to luminaires covered by other standards such as:

- Electric Signs
- Portable Electric Displays
- Portable Luminaires
- Christmas Tree and Other Decorative Lighting Devices
- Combination Fan/IR Lamps Used for Heating
- Submersible Luminaires
- Therapeutic Lamps
- Luminaires for Hazardous Locations
- Unit Equipment for Emergency Lighting
- Stage and Studio Luminaires
- Exit Luminaires
- Track Lighting Systems

For products intended for installation in the United States, Low-Voltage Landscape Lighting Devices-Nominal 12 V

For products intended for installation in Canada, Landscape Lighting Systems – Nominal 30 V rms

1.2 Definitions

1.2.1

The following definitions apply in this Standard:

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

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 457 mm (18 inches) 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.

Ballast, fluorescent, thermally protected – a ballast that contains a thermal protector or is inherently protected and complies with the Class P requirements.

Barrier – a part of the luminaire intended to reduce the risk of shock, fire, 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.

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 shall be fulfilled by:

- a) conducting the specified test; or
- b) confirming that the 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, which has no safety function.

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 may have a slight curvature or bend, and the surface may be smooth or textured.

Gasket – a resilient material used between two rigid surfaces.

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

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

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 which produces light, commonly called a 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.

Lamp-supported lampholder – a lampholder used with side- or end-prong lamps, such that the lampholder is supported by the lamp that is in turn supported by the luminaire.

Live part – a conductive part carrying electrical current or having an electrical potential with respect to parts of opposite polarity or to ground. A grounded conductor is considered 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 may drip, splash, or flow on or against electrical equipment.

Low density ceiling – cellulose fiberboard with a density of 320 kg/m^3 (20 lbs/ft³) or less.

Luminaire – a complete lighting unit designed to accommodate a lamp and to connect the lamp to a power source.

Luminaire, canopy – 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 may have thermal insulation installed.

Luminaire, convertible – a recessed luminaire which can be installed in either insulated or non-insulated recessed wall or ceiling applications.

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

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

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

Luminaire, Type IC – 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 or the insulation.

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

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

Luminaire, Type Non-IC, marked spacings – 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.

Nominal system voltage – the system-designated rms voltage.

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.

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

Ordinary tools – tools which may 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 which possess properties useful for fabrication of functional articles.

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 – 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 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.

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 twist-on or crimp-on 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.

Supply current – the current at the supply terminals when the luminaire has stabilized in normal use at the rated voltage and frequency.

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

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

User maintenance – servicing operations, such as relamping 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.

1.3 Components

1.3.1

Except as indicated in Clause 1.3.2 a component of a product covered by this Standard shall comply with the requirements for that component. See Appendix A for a list of Standards covering components generally used in the products covered by this Standard. A component shall comply with the Underwriters Laboratories Inc. standards and the Canadian Standards Association standards for the component.

1.3.2

A component need not 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.

1.3.3

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

1.3.4

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

1.4 Reference publications

1.4.1

Where reference is made to CSA and UL Standards, such reference shall be considered to refer to the latest edition and all amendments published to that edition up to the time when this Standard was approved.

CSA Standards

B140.0-M87

General Requirements for Oil Burning Equipment

C22.1-94

Canadian Electrical Code, Part I

C22.2 No.0.15-M90

Adhesive Labels

C22.2 N0.17-92

Evaluation of Properties of Polymeric Materials

UL Standards

UL 723

Test for Surface Burning Characteristics of Building Materials

UL 724C

Polymeric Materials - Use in Electrical Equipment Evaluation

UL 969

Marking and Labeling System

1.4.2

This Standard refers to the following publications and where such reference is made it shall be to the edition listed below.

ANSI/NFPA 70-1996
National Electrical Code

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

ASTM Standards

ASTM D3801-1987
Method for Measuring the Comparative Burning Characteristics and Resistance of Solid Plastics in a Vertical Position

ASTM D5048-1990
Measuring the Comparative Burning Characteristics and Resistance to Burn Through Solid Plastics using 125 mm Flame

ASTM D635-1991
Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

ASTM G26-1994
Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) with and without Water for Exposure of Nonmetallic Materials

Other References

IEC 695-2-1/0-1994
Fire hazard Testing Part 2: Test Methods Section 1/Sheet 0: Glow-Wire Test Methods – General

National Building Code of Canada

1.5 Units of measurement**1.5.1**

The values given in SI (metric) units are the standard. The imperial values given in parenthesis are for information only. See Appendix D for metric conversion multipliers.

1.5.2

Temperatures are given in degrees Celsius only.

1.5.3

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

1.6 National deviations**1.6.1**

When compliance with the requirements of this Standard result in conflict with national installation code requirements or other national practice, the following modifications to the requirements shall be applied.

1.6.2

The requirement deviation for each country is designated using the clause number with a suffix (USA) or (CAN).

1.6.3

The requirement deviations are located in the applicable clause, and for clarity repeated in Table 1.1.

Table 1.1 – Summary of deviations
(See Clause 1.6.3)

2.7.1.2	An enclosure of polymeric material where all live parts are insulated shall meet the following requirements: a) have a minimum 5VA flammability rating, or comply with the five inch flame test of Clause 14.3; b) have a minimum mechanical temperature rating equal to its maximum operating temperature in the luminaire; c) comply with the impact test of Clause 14.2.3; d) comply with the mold stress relief test of Clause 14.4 for molded or formed thermoplastic material; e) comply with the abnormal overlamping operation test in Clause 13.5; f) comply with the compression test of Clause 14.2.2; (USA) g) for products intended for installation in the United States, materials that are required to be resistant to UV radiation shall comply with the exposure to the ultraviolet light test of UL 746C or the UV exposure conditioning test of Clause 14.5.5 for materials exposed to the sun or integral fluorescent light sources; or (CAN) h) for products intended for installation in Canada, materials that are required to be resistant to UV radiation shall be UV rated or shall comply with the UV exposure conditioning test of Clause 14.5.5.
3.7.1.3 (CAN)	For products intended for installation in Canada, when a luminaire is intended to be connected to the line and neutral grounded conductors of a branch circuit, as shown in Figure 3.1, 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.

3.7.1.3 (USA)

For products intended for installation in the United States, when a luminaire is intended to be connected to the line and neutral grounded conductors of a branch circuit, as shown in Figure 3.2, 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;
- b) an isolating type transformer or ballast, the screwshell of the lampholder is not required to be separately bonded to ground; or
- c) an auto-transformer or auto-transformer type ballast that operates at a potential to ground, and between conductors, at 30 V rms (42.4 V peak) or less, the screwshell of the lampholder is not required to be bonded to ground.

3.7.1.4 (CAN)

For products intended for installation in Canada, when a luminaire is intended to be connected to the line-to-line conductors of a branch circuit, as shown in Figure 3.1, 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.

3.7.1.4 (USA)

For products intended for installation in the United States, when a luminaire is intended to be connected to the line-to-line conductors of a branch circuit, as shown in Figure 3.2, and is provided with:

- a) an auto-transformer or auto-transformer type ballast, the screwshell of the lampholder is not required to be separately bonded to ground;
- b) an isolating type transformer or ballast, the screwshell of the lampholder is not required to be separately bonded to ground; or
- c) an auto-transformer or auto-transformer type ballast that operates at a potential to ground, and between conductors, at 30 V rms (42.4 V peak) or less, the screwshell of the lampholder is not required to be bonded to ground.

3.9.2 (CAN)

For products intended for installation in Canada, conductors shall be minimum No. 18 AWG, except as specified in Clause 3.9.3, and shall be rated for the voltage, current, temperature, and condition of service to which they will be subjected in accordance with Table 3.4.

3.9.2 (USA)

For products intended for installation in United States, conductors shall be minimum No. 18 AWG, except as specified in Clause 3.9.3, and shall be rated for the voltage, current, temperature, and condition of service to which they will be subjected, in accordance with Tables 3.5 to 3.7.

3.14.2.4 (USA)

For products intended for installation in the United States, a mounting cross-bar supplied with a luminaire that does not have a means of grounding to accommodate the branch circuit grounding conductor shall be provided with a grounding means.

3.14.3.1 (CAN)

For products intended for installation in Canada, a bonding means shall consist of one of the following:

- a) a pigtail lead bonding conductor of at least No. 18 AWG;
- b) a terminal;
- c) a welded, soldered or brazed joint;
- d) a screw, rivet or welded stud;
- e) a pressure terminal connector; or
- f) an assembly of bolt, nut, and lockwasher or starwasher, or other compressive fastener that complies with the grounding continuity test of Clause 15.2.

3.14.3.1 (USA)

For products intended for installation in the United States, a bonding means shall consist of one of the following:

- a) a pigtail lead bonding conductor of at least No. 18 AWG;
- b) a terminal;
- c) a welded, soldered or brazed joint;
- d) a screw, rivet or welded stud;
- e) a pressure terminal connector;
- f) an assembly of bolt, nut, and lockwasher or starwasher, or other compressive fastener that complies with the grounding continuity test of Clause 15.2;
- g) an assembly of flexible metal conduit of not more than 1.83 m (6 ft) and connectors that comply with the grounding continuity test of Clause 15.2, if the input to the luminaire is not more than 16 A; or
- h) an equivalent conductive path that complies with the grounding continuity of Clause 15.2.

3.15.1.5 (CAN)

For products intended for installation in Canada, a luminaire required to be connected to branch circuit conductors rated higher than 75°C shall be marked for the temperature rating of the branch circuit conductors, in accordance with Table 18.1, Item 1.1.

3.15.1.5 (USA)

For products intended for installation in the United States, a luminaire required to be connected to branch circuit conductors rated higher than 60°C shall be marked for the temperature rating of the branch circuit conductors, in accordance with Table 18.1, Item 1.1.

5.3.3 (CAN)

For products intended for installation in Canada, the supply cord of a cord- and plug-connected recessed fluorescent luminaire intended for installation in an accessible suspended ceiling shall be as follows:

- a) of the hard-usage type, for system voltage of 300 V or less, or of the extra-hard-usage type, for system voltage of 301 to 600 V or less;
- b) no longer than 3 m (9.8 ft);
- c) fitted with an attachment plug; and
- d) of a minimum temperature rating of 90°C.

5.3.3 (USA)

For products intended for installation in the United States, a recessed luminaire shall not be provided with flexible cord for connection to the supply.

5.5.4 (USA)

For products intended for installation in the United States, a luminaire intended to be mounted on a low density ceiling and marked in accordance with Table 18.1 Item 1.3 is temperature test exempt under the following conditions:

- a) the ballast has a maximum lamp current of 460 mA; and
- b) the construction spaces the ballast at least 9 mm (0.375 in) from the ceiling.

6.2.2 (CAN)

For products intended for installation in Canada, a luminaire with two lampholders connected in series does not require bonding of one lampholder screwshell to ground provided that removal of its lamp isolates the screwshell.

7.2.5 (CAN)

For products intended for installation in Canada, a luminaire weighing more than 11.4 kg (25 lb), including lamps, shall be provided with means for supporting the luminaire, independent of the outlet box. Installation instructions shall be provided in accordance with Table 18.1, Items 1.21 and 1.33.

7.2.5 (USA)

For products intended for installation in the United States, a luminaire weighing more than 22.7 kg (50 lb), including lamps, shall be provided with means for supporting the luminaire, independent of the outlet box.

7.6.9 (CAN)

For products intended for installation in Canada, the temperature measured on the supply connections of a luminaire intended to be mounted on or over an outlet box during the normal temperature test of Clause 12 shall meet the following criteria:

- a) for wall-mounted not exceed 75°C; and
- b) for ceiling-mounted not exceed 75°C, or
- c) for ceiling-mounted not exceed 90°C, and be marked for use with minimum 90°C supply conductors in accordance with Table 18.1, Item 1.1; or
- d) for ceiling or wall-mounted not exceed 200°C, and be marked:
 - 1) to prohibit use in dwellings in accordance with Table 18.1, Item 2.5; and
 - 2) for use with minimum 90, 105, 125, 150 or 200°C supply conductors in accordance with Table 18.1, Item 1.1.

7.6.9 (USA)

For products intended for installation in the United States, the temperature measured on the supply connections of a surface-mounted luminaire during the normal temperature test of Clause 12 shall meet the following criteria:

- a) not exceed 60°C; or
- b) not exceed 90°C, and be marked for use with minimum 75 or 90°C supply conductors in accordance with Table 18.1, Item 1.1; or
- c) not exceed 200°C, and be marked:
 - 1) to prohibit use in dwellings in accordance with Table 18.1, Item 2.5; and
 - 2) for use with minimum 75, 90, 105, 125, 150 or 200°C supply conductors in accordance with Table 18.1, Item 1.1.

7.6.10 (CAN)

For products intended for installation in Canada, the temperature measured on the supply connections of a surface-mounted luminaire with an integral outlet box during the normal temperature test of Clause 12 shall meet the following criteria:

- a) not exceed 75°C; or
- b) not exceed 90°C, and be marked for use with minimum 90°C supply conductors in accordance with Table 18.1, Item 1.1; or
- c) not exceed 200°C, and be marked:
 - 1) to prohibit use in dwellings in accordance with Table 18.1, Item 2.5; and
 - 2) for use with minimum 90, 105, 125, 150 or 200°C supply conductors in accordance with Table 18.1, Item 1.1.

7.8.1 (USA)

For products intended for installation in the United States, a luminaire that may be installed in a dwelling, is intended to be connected to or over an outlet box, and is marked for supply connections rated 75° or 90°C shall include the marking in Table 18.1, Item 1.32 in the instructions and on the carton.

7.8.5 (USA)

For products intended for installation in the United States, a luminaire having a power supply cord that is not mounted in place and connected shall be provided with installation instructions in accordance with Table 18.1, Item 1.33.

8.6.2.1 (CAN)

For products intended for installation in Canada, a tap conductor supplied with a luminaire shall meet the following criteria:

- a) be enclosed in a raceway extending at least 450 mm (18 in) but not more than 2 m (6.5 ft) from the luminaire;
- b) extend at least 150 mm (6 in) from the raceway; and
- c) be at least No. 18 AWG with a factory installed raceway, or at least No. 14 AWG when supplied with a raceway and connectors for field installation.

8.6.2.1 (USA)

For products intended for installation in the United States, tap conductors furnished with a recessed luminaire shall be building or fixture wire with an insulation thickness and the maximum number specified in Table 8.2 and extend at least 1.4 m (4.5 ft) but not more than 2 m (6.5 ft) beyond the recessed enclosure.

8.6.2.2 (USA)

For products intended for installation in the United States, if flexible metal conduit is provided with a luminaire to enclose the tap conductors, it shall extend at least 1.2 m (4 ft) but not more than 1.8 m (6 ft) from the enclosure of the luminaire.

8.6.2.3 (USA)

For products intended for installation in the United States, a luminaire furnished with tap conductors without flexible metal conduit shall be furnished with a connection fitting for either:

- a) 1/2 inch or larger trade size conduit, or
- b) 3/8 inch trade size conduit provided the maximum number of conductors and the type of fitting are in accordance with the wire size and type shown in Table 8.2.

8.7.1.8 (CAN)

For products intended for installation in Canada, a trim/finishing section manufactured by other than the recessed housing/rough-in section manufacturer shall not be used.

8.7.1.8 (USA)

For products intended for installation in the United States, a trim/finishing section manufactured by other than the recessed housing/rough-in section manufacturer shall be tested with all the lamp types and wattages identified for use with the trim/finishing section it is intended to replace.

8.8.1.12 (CAN)

For products intended for installation in Canada, a Type IC luminaire shall be marked in accordance with Table 18.1, Item 1.14 to indicate the minimum vapor barrier temperature.

8.8.1.14 (USA)

For products intended for installation in the United States, a trim/finishing section intended for use with another manufacturers housing/rough-in section shall be marked in accordance with Table 18.1, Item 1.10.

8.8.4.1 (USA)

For products intended for installation in the United States, a recessed luminaire intended for installation only in a non-fire rated ceiling shall be marked in accordance with Table 18.1, Item 1.26.

8.8.5 Convertible recessed luminaires**8.8.5.1 (USA)**

The requirements of Clauses 8.8.5.2 to 8.8.5.8 are applicable to those products intended for installation in the United States.

8.8.5.2 (USA)

A housing/rough-in section shall be marked to identify it as a convertible luminaire housing/rough-in section in accordance with Table 18.1, Item 1.36. The blank space is to be filled in with the catalog designation for the rough-in section.

8.8.5.3 (USA)

A rough-in section for a convertible recessed luminaire shall be marked with correlation markings which identify the trim/finishing section combinations that result in a Non-Type IC luminaire and those that result in a Type IC luminaire. The marking shall be in accordance with Table 18.1, Item 1.38 and be located inside the housing or rough-in section.

8.8.5.4 (USA)

A trim/finishing section for a convertible recessed luminaire shall be marked with the manufacturer's identification and catalogue designation in accordance with Table 18.1, Items 4.1 and 4.2.

8.8.5.5 (USA)

A finishing section for a convertible recessed luminaire shall have a correlation marking in accordance with Table 18.1, Item 1.35.

8.8.5.6 (USA)

A marking instructing the installer to keep insulation 76 mm (3 in) away in accordance with Table 18.1, Item 1.13 shall be provided and located on the back of the housing or rough-in section. The label shall be easily removable. The installation instructions shall specify that this label is to be removed when installed as a Type IC luminaire.

8.8.5.7 (USA)

The Type IC marking in Table 18.1, Item 2.23 shall not be provided.

8.8.5.8 (USA)

Installation instructions in accordance with Table 18.1, Item 1.33 shall be provided with each housing/rough-in section and shall include the following:

- a) a statement defining each type of installation. For example:
 - 1) Type IC installation – luminaire housing/rough-in section is in direct contact with thermal insulation; and
 - 2) Type Non-IC installation – thermal insulation does not cover top of luminaire housing/rough-in section and is spaced 76 mm (3 in) from all sides.
- b) instructions for IC installations to remove the peel off label on top of housing section which advises not install insulation within 76 mm (3 in) of any part of the luminaire in accordance with Table 18.1, Item 1.13; and
- c) instructions directing the installer how to make the proper choice of finishing section/trim and lamp for the application shall be included in the installation instructions.

9.2.2.3 (CAN)

For products intended for installation in Canada, a nonmetallic material, adhesive, or coating used for a part other than a lamp, lampholder, or light diffuser, that is located in the air path or plenum shall comply with the flame test of Clause 9.2.3.1.

9.2.2.3 (USA)

For products intended for installation in the United States, a nonmetallic material, adhesive, or coating used for a part other than a lamp, lampholder, or light diffuser, that is located in the air path or plenum shall comply with one of the following:

- a) the material shall have a maximum 25 flamespread rating and a smoke developed rating of maximum 50 or "light" or "negligible". The ratings shall be obtained as described in UL 723; or
- b) the material shall not ignite or flame during or after the flame test of Clause 9.2.3.1.

9.2.2.4 (USA)

For products intended for installation in the United States, a frame or support for a plastic diffuser shall meet the following criteria:

- a) provide a complete metal U-shaped channel around the perimeter of the diffuser; and
- b) overlap the diffuser maximum 19.1 mm (0.75 in) at either (short) end and maximum 12.7 mm (0.5 in) on either (long) side; and
- c) provide a visible clearance between the diffuser and each section of the channel; or
- d) be tested and found to be equivalent.

9.2.2.5 (CAN)

For products intended for installation in Canada, a plastic lens or light diffuser used with an air handling luminaire shall comply with the National Building Code of Canada, Article 3.1.13.4.

9.2.2.5 (USA)

For products intended for installation in the United States, a plastic lens or light diffuser used with an air handling luminaire shall meet the following criteria:

- a) be subjected to the large scale fallout test of Clause 9.2.3.2 and impingement fire test of Clause 9.2.3.3 to determine the maximum area of plastic material and the minimum distance over metal surfaces between exposed plastic material on adjacent luminaires; and
- b) found suitable for use without a complete frame door unless shipped with a complete frame or door.

9.2.3.2.1 (USA)

For products intended for installation in the United States, a plastic diffuser is to be subjected to the test of Clauses 9.2.3.2.2 and 9.2.3.2.3.

9.2.3.2.2 (USA)

The luminaire is to be mounted in a 3.6 m by 2.4 m (12 ft by 8 ft) draft-free test room with a 3 m (10 ft) ceiling. The luminaire is to be connected to an air duct with a controlled positive or negative air flow, as appropriate, of 6.8 m³ per minute (240 m³ per minute).

9.2.3.2.3 (USA)

A 53.3 cm², 10.2 cm deep, 6 mm thick (21 in², 4 in deep, 0.25 in thick) steel pan is to be filled with minimum 5.1 cm (2 in) of alcohol. The pan is to be located 121.9 cm (4 ft) below the center of the diffuser surface and the alcohol ignited and allowed to burn until the alcohol is depleted or the diffuser falls from the luminaire.

9.2.3.2.4 (USA)

The diffuser shall not ignite while it is in its intended position.

9.2.3.3.1 (USA)

For products intended for installation in the United States, a plastic diffuser is to be subjected to the test of Clauses 9.2.3.3.2 and 9.2.3.3.3.

9.2.3.3.2 (USA)

Two luminaires are to be mounted with ends touching in a draft free test room with a 3 m (10 ft) ceiling. One luminaire is to be connected to an air duct with a controlled positive or negative air flow, as appropriate, of 6.8 m³ per minute (240 ft³ per minute).

9.2.3.3.3 (USA)

A 15.25 cm (6 in) diameter, 10.2 cm (4 in) deep steel container is to be filled with minimum 10.2 cm (4 in) of alcohol. The axial center of the pan is to be located at the center point of the diffuser edge which is farthest away from the luminaire connected to the air duct, the surface of the alcohol is to be 15.25 cm (6 in) from the diffuser. The alcohol is to be ignited and allowed to burn until the alcohol is depleted or the diffuser falls from the luminaire.

9.2.3.3.4 (USA)

The flame shall not be propagated from the ignited diffuser to the adjacent diffuser.

9.2.4.4 (USA)

For products intended for installation in the United States, a plastic light diffuser that depends on a luminaire for provision of a frame and that is shipped separately from the luminaire shall be marked in accordance with Table 18.1, Item 1.10.

14.2.5 Torque and cantilever tests**14.2.5.1 General****14.2.5.1.1 (USA)**

The torque and cantilever tests described in Clauses 14.2.5.2 and 14.2.5.3 are applicable to products intended for installation in the United States.

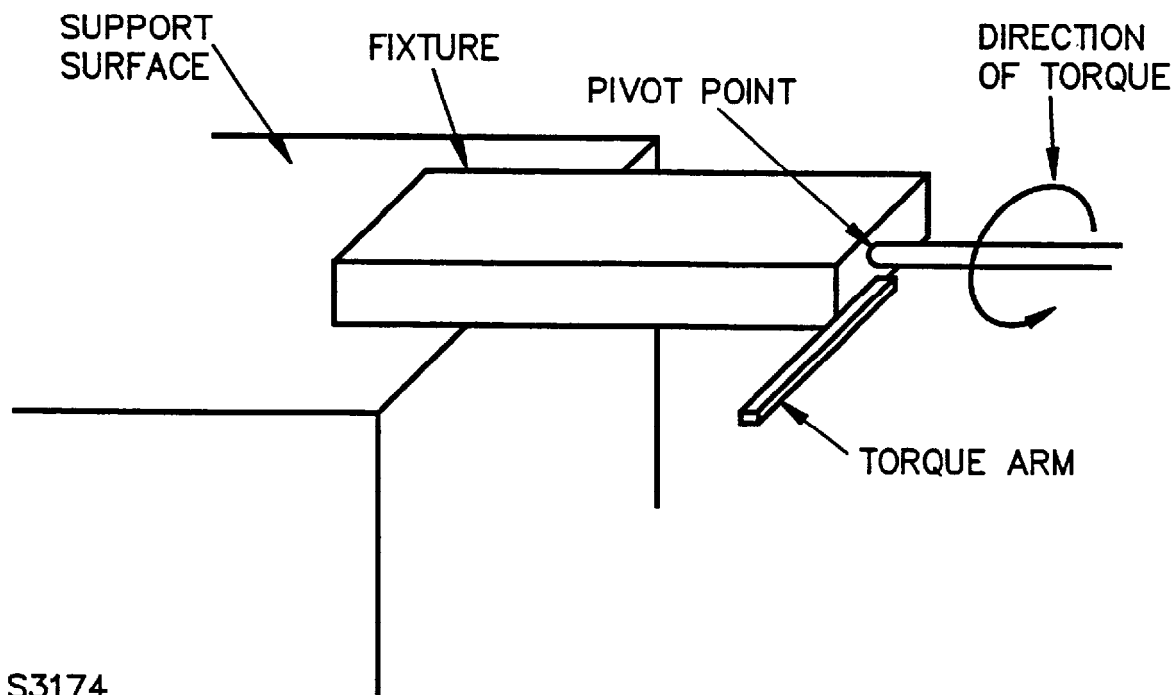
14.2.5.1.2 (USA)

During the torque and cantilever tests described in Clauses 14.2.5.2 and 14.2.5.3, a comparison is to be made between a control sample luminaire having minimum metal thickness as specified in Table 2.1 and a test sample luminaire having reduced metal thickness.

14.2.5.2 Torque test**14.2.5.2.1 (USA)**

The control and test sample luminaires are to be secured to a solid horizontal surface. The opposite end of each luminaire is to be supported at the same height as the fixed end by a pivot arm which is attached to the luminaire but allows free rotation of the luminaire around its major axis. A 610 mm (24 in) long torque arm is to be connected to the pivot end of each luminaire at a right angle to its major axis as shown in Figure 14.2.

Figure 14.2 – Torque test
(See Clause 14.2.5.2.1)

**14.2.5.2.2 (USA)**

A 4.4 N (1 lb) force is to be applied to one end of the arm in a direction to result in luminaire rotation deflection around the major axis.

14.2.5.2.3 (USA)

During or after the test, the deflection of the test sample luminaire shall be equal to or less than the deflection of the control sample luminaire.

14.2.5.3 Cantilever test**14.2.5.3.1 (USA)**

The control and test sample luminaires are to be secured at one end to a solid horizontal surface. The opposite end of each luminaire is to be suspended by the support provided with the luminaire.

14.2.5.3.2 (USA)

A 11.3 kg (25 lb) weight is to be applied to the suspended end of each luminaire. The weight is to be applied for 1 minute.

14.2.5.3.3 (USA)

During or after the test, the deflection of the test sample luminaire shall be equal to or less than the deflection of the control sample luminaire.

16.2.2.1 (CAN)

For products intended for installation in Canada, a grounding continuity test is to be performed on a representative design at least once per quarter.

16.2.2.2 (CAN)

For products intended for installation in Canada, the grounding continuity test for a luminaire that is shipped with the enclosure unassembled, or with snap-in or tab-mounted parts, is to be conducted in the following manner:

- a) the luminaire is to be completely assembled in accordance with the assembly instructions. The grounding continuity test is to be performed after the applicable parts pull test of items (b) and (c). The grounding continuity test apparatus shall be in accordance with Clause 17.19. The resistance between the two test points shall not exceed 0.10 ohm;
- b) if the assembled enclosure part is not provided with a knockout, the parts pull test of Clause 14.16 is to be conducted; and
- c) if the assembled enclosure part is provided with a knockout, the parts pull test of Clause 14.17 is to be conducted.

18.2.1 (USA)

A luminaire shall be marked with the following;

- a) manufacturer's identification in accordance with Table 18.1, Item 4.1;
- b) date code of at least month and year of manufacture, in accordance with Table 18.1, Item 4.3;
- c) for products intended for installation in the United States, factory identification, if more than one location, in accordance with Table 18.1, Item 4.6; and
- d) other markings, as required.

18.2.5 (CAN)

For products intended for installation in Canada, bilingual marking is the jurisdiction of Canadian Provincial Regulatory Authorities which may require marking to also be in French as shown in Appendix B.

18.5.1 (USA)

For products intended for installation in the United States, unless a luminaire is intended and marked for damp or wet locations, it shall be marked for dry locations in accordance with Table 18.1, Item 2.1.

2 Mechanical construction**2.1 General****2.1.1**

These requirements shall be used in conjunction with the applicable supplementary requirements in this Standard.

2.1.2

A part that may be removed during user maintenance shall be designed to prevent replacement in a position that would affect the intended operation of the luminaire or shall be clearly marked to indicate proper replacement.

2.1.3

There shall be no sharp edges, burrs, or any other method of construction that might damage electrical insulation or reduce electrical spacings.

2.2 Assembly and packaging**2.2.1**

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. All other splices and electrical connections shall be completed at the factory, unless otherwise specified in this standard.

2.2.2

A luminaire that is intended to be assembled in the field shall be provided with assembly instructions as specified in Table 18.1, Item 1.33.

2.2.3

All the parts required to complete a luminaire shall be shipped together, or shipped separately and marked in accordance with Table 18.1, Item 1.8.

2.2.4

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

2.2.5

An unassembled luminaire with accessible non-current-carrying parts that may 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 meets the intent of this requirement.

2.3 Enclosures

2.3.1

A luminaire enclosure shall perform the following functions:

- a) reduce the risk of unintentional contact with live parts;
- b) contain fire, flame and molten material;
- c) protect internal parts from mechanical damage; and
- d) protect internal parts from the environment.

2.4 Barriers

2.4.1

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 2.7.1.5.

2.4.2

A barrier, other than of polymeric material, may be of a thickness less than that specified in Clause 2.4.1 if it complies with the barrier strength test of Clause 14.1.

2.5 Metal thickness for enclosures

2.5.1

The thickness of an enclosure material constructed of:

- a) sheet metal and extruded aluminum shall be in accordance with Table 2.1, or comply with Clause 2.5.3; and
- b) cast metal shall be in accordance with Table 2.2, or comply with Clause 2.5.4.

2.5.2

For determination of the thickness of metal enclosures, the following defined terms shall apply when using Tables 2.1 and 2.2:

- a) length – the longest straight line that can be drawn on any unreinforced flat section; and
- b) reinforced – a form of construction that provides equivalent mechanical strength.

Table 2.1 – Minimum thickness of uncoated sheet metal for enclosures
(See Clauses 2.5.1, 2.5.2, 8.3.5, 9.3.2.2, and 14.2.5.1.2)

Specific construction		Steel sheet		Nonferrous sheet copper, brass, aluminum	
		Unreinforced mm (in)	Reinforced mm (in)	Unreinforced mm (in)	Reinforced 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 – a form of construction that provides equivalent mechanical strength.
- (2) No electrical component support – 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 by 13 mm (0.5 by 0.5 in) 90 degrees formed from sheet steel, 8.1 mm (0.266 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 (0.05 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 Table 2.1 by at least 0.013 mm (0.0005 in) for each side coated or finished.

Table 2.2 – Minimum thickness of cast metal for enclosures
(See Clauses 2.5.1 and 2.5.2)

Material	Unreinforced		Reinforced	
	mm	(in)	mm	(in)
Cast metal	3.2	(0.128)	2.4	(0.094)
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, 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 thinner than permitted for sheet metal. See Clause 2.5.1 and Table 2.1.				

2.5.3

Metal enclosure material having a thickness less than those specified in Clause 2.5.4 shall comply with the metal thickness equivalency tests of Clause 14.2.

2.5.4

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 not be less than 0.51 mm (0.020 in).

2.6 Corrosion protection

2.6.1

All ferrous metal parts, including hinges, bolts, and fasteners, visible 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 be provided with additional corrosion protection.

2.6.2

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.

2.6.3

The requirements of Clause 2.6.1 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 practical; and
- b) decorative parts.

2.6.4

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

2.7 Polymeric materials**2.7.1 General****2.7.1.1**

Polymeric materials shall comply with the applicable requirements of Clauses 2.7.1.2 to 2.7.1.6.

2.7.1.2

An enclosure of polymeric material where all live parts are insulated shall meet the following requirements:

- a) have a minimum 5VA flammability rating, or comply with the five inch flame test of Clause 14.3;
- b) have a minimum mechanical temperature rating equal to its maximum operating temperature in the luminaire;
- c) comply with the impact test of Clause 14.2.3;
- d) comply with the mold stress relief test of Clause 14.4 for molded or formed thermoplastic material;
- e) comply with the abnormal overlamping operation test in Clause 13.5;
- f) comply with the compression test of Clause 14.2.2;
- (USA) g) for products intended for installation in the United States, materials that are required to be resistant to UV radiation shall comply with the exposure to the ultraviolet light test of UL 746C or the UV exposure conditioning test of Clause 14.5.5 for materials exposed to the sun or integral fluorescent light sources; or
- (CAN) h) for products intended for installation in Canada, materials that are required to be resistant to UV radiation shall be UV rated or shall comply with the UV exposure conditioning test of Clause 14.5.5.

2.7.1.3

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 2.7.1.2 and the following requirements:

- a) a minimum hot-wire ignition rating (HWI) of 15 seconds, or comply with the hot-wire ignition test of Clause 14.6 or the glow-wire end product test of Clause 14.7; and
- b) a minimum high-current arc resistance to ignition rating (HAI) of 15 arcs, or comply with the high-current arc ignition test of Clause 14.8 or the end-product arc resistance test of Clause 14.9.

2.7.1.4

An enclosure of polymeric material where arcing parts, such as unenclosed switch contacts, are located within 13 mm (0.5 in) of the enclosure shall comply with Clause 2.7.1.2 and the hot-wire ignition test of Clause 14.6 or the glow-wire end product test of Clause 14.7.

2.7.1.5

A polymeric part used to suspend another part shall meet the following criteria:

- a) have a minimum HB flammability rating;
- b) have a mechanical temperature rating equal to the highest temperature measured on the part during the normal temperature test of Clause 12; and
- c) comply with the polymeric support test of Clause 14.10 when the suspended part weighs more than 0.9 kg (2 lb).

2.7.1.6

A polymeric material used as a barrier shall meet the following criteria:

- a) have a minimum mechanical temperature rating equal to its maximum operating temperature in the luminaire;
- b) have a minimum HB flammability rating;
- c) for molded or formed thermoplastic parts, comply with the mold stress relief test of Clause 14.4; and
- d) comply with the barrier strength test of Clause 14.1.

2.7.2 Metallized polymeric parts**2.7.2.1**

Metallized polymeric parts coated with an electrically conductive material shall comply with the metallized plastic parts adhesion test of Clause 14.11, if peeling of the conductive material from the polymeric parts may result in the risk of electric shock, fire or operating temperature limits being exceeded.

2.7.2.2

The metallized parts that are accessible during user maintenance or component replacement without the use of tools and may become live shall be bonded to ground in accordance with Clause 3.14.3.

2.8 Baffles**2.8.1**

A baffle shall meet the following criteria:

- a) be made of metal meeting the appropriate requirements of Clause 2.5; or
- b) be made of non-metallic material that complies with the five inch flame test of Clause 14.3 for 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 and wire with a minimum diameter of 0.46 mm (0.018 in);
 - 2) a perforated metal plate, in accordance with Table 2.3; or
 - 3) a perforated panel that complies with the flaming oil test of Clause 14.12.

Table 2.3 – Perforated metal plates
(See Clause 2.8.1)

Thickness		Diameter of holes		Spacing of holes center to center	
mm	(in)	mm	(in)	mm	(in)
0.75	(0.030)	1.1	(0.045)	1.7	(0.067)
0.75	(0.030)	1.2	(0.047)	2.4	(0.093)
0.90	(0.035)	1.9	(0.075)	3.0	(0.125)
1.00	(0.039)	1.6	(0.063)	2.8	(0.109)

2.9 Knockouts and twistouts

2.9.1

A knockout or twistout shall be secured in place so it can be removed without distorting the enclosure but will remain in place during normal handling and shall comply with the conduit knockout and twistout test of Clause 14.13.

2.10 Mechanical joints and fastenings

2.10.1

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

2.10.2

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 14.14, when the screw threads into non-ferrous metal or polymeric materials.

2.10.3

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 14.14.

2.10.4

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 equivalent threaded assembly, or by some other equivalent method such as swaging or suitable adhesive. The additional means of holding are not required to be provided if the joint consists of a full tapered pipe thread.

2.10.5

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.

2.10.6

Sheet metal nuts may be used if supplied as part of an armored cable or flexible conduit and, if fabricated of heat-treated steel:

- a) for assembly;
- b) to prevent turning of threaded tubing no larger than 1/4 IPS; and
- c) on bolts or studs that are no larger than 6.4 mm (0.250 in) in diameter.

2.10.7

When used as a supporting device, unthreaded tubing joints shall comply with the loading test of Clause 14.15.

2.10.8

Threads of sheet metal and self tapping screws shall not extend into a wiring compartment for a distance of more than 5 mm (0.2 in), except if the conductors are reliably positioned away from projecting screws, or if the conductors are sufficiently loose to prevent damage of insulation.

2.10.9

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

2.10.10

Enclosure parts may be secured by frictional contact or snap-in or tab-mounting under the following conditions:

- a) the part does not have a conduit opening and complies with the snap-in or tab-mounted parts pull test without conduit of Clause 14.16; or
- b) the part has a conduit opening and complies with the snap-in or tab-mounted parts pull tests with conduit of Clause 14.17.

2.11 Means of mounting**2.11.1**

A luminaire shall have means for mounting, and if special hardware is required, it shall be provided. Mounting hardware shall comply with the loading test of Clause 14.15.

2.11.2

A luminaire provided with integral suspended ceiling clips shall comply with the security of clips test of Clause 14.18.

2.12 Swivels**2.12.1**

A movable joint, such as a swivel joint or telescoping arm, shall be constructed so that turning will not result in damage to the insulation of conductors. Rotation shall be limited to 370 degrees, or the moveable joint shall comply with the swivel rotation test of Clause 14.19.

2.12.2

A swivel joint containing conductors shall comply with the torsion and pull tests of Clause 14.20.

2.13 Raceway tubing**2.13.1**

Tubing shall be free from kinks or cracks and meet the following thickness criteria:

- a) unthreaded metal tubing shall be at least 0.5 mm (0.020 in) thick;
- b) threaded metal tubing shall be at least 1.0 mm (0.040 in) thick; and
- c) metal tubing with rolled threads shall be at least 0.5 mm (0.020 in) thick.

2.14 Wire protection

2.14.1

Conductors which 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 grommet;
- c) a bushing of a material other than rubber at least 1.2 mm (0.047 in) thick; or
- d) glass sleeving at least 0.25 mm (0.010 in) thick.

2.15 Strain relief

2.15.1 General

2.15.1.1

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

2.15.2 Flexible cord

2.15.2.1

A strain relief for a flexible cord shall comply with the 15.9 kg (35 lb) strain relief test of Clause 14.21.1.

2.15.2.2

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

2.15.2.3

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; and
- b) a test equivalent to Clause 14.21 has been conducted.

2.15.2.4

A strain relief is not required to be provided at the canopy end of a cord-pendant luminaire if instructions are furnished with the luminaire to show the method of strain relief that is to be applied in the field, such as a knot in the cord, in accordance with Table 18.1, Item 1.33.

2.15.2.5

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 18.1, Item 1.33.

2.15.3 Conductors**2.15.3.1**

The strain relief for a conductor shall comply with the 89 N (20 lb) pull test of Clause 14.21.2.

2.16 Glass**2.16.1 General****2.16.1.1**

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

2.16.2 Minimum thickness**2.16.2.1**

The minimum thickness and exposed area of untempered glass used as an enclosure shall be in accordance with Table 2.4.

2.16.2.2

The minimum thickness and exposed area of untempered flat glass panels, smooth or otherwise, shall be in accordance with Table 2.4.

2.16.2.3

The minimum thickness and exposed area of untempered glass that is curved, bent, or globes of any shape shall be in accordance with Table 2.4 unless the exposed area is less than 1774 cm² (275 in²).

2.16.2.4

Untempered glass that is not in accordance with the minimum thickness shown in Table 2.4 shall provide equivalent mechanical strength.

2.16.2.5

Tempered glass that is not in accordance with the minimum thickness and exposed area shown in Table 2.4 shall comply with the tempered glass impact test of Clause 14.22.

Table 2.4 – Thickness of glass panels
(See Clauses 2.16.2.1 to 2.16.2.5)

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)

2.16.2.6

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.

2.17 Glass support

2.17.1

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

2.17.2

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

2.17.3

Clips that are used to secure a glass panel to the frame shall overlap the glass at least 5 mm (0.196 in).

2.17.4

An adhesive material relied upon to secure glassware to the frame shall comply with the adhesive support test of Clause 14.23.

2.17.5

A channel or frame for holding glass diffusers shall meet the following thickness criteria:

- a) steel shall be at least 0.4 mm (0.016 in) thick;
- b) non-ferrous metal shall be at least 0.5 mm (0.020 in) thick; and
- c) polymeric material shall be at least 1.5 mm (0.059 in) thick.

2.17.6

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 14.24;
- e) an adhesive that complies with Clause 2.17.4;
- f) its own weight in a frame or fitter that is not hinged; and
- g) a hook or rod with a stop through a hole in the glass.

2.18 Thermal insulation

2.18.1

Thermal insulation shall be fire-resistant.

2.18.2

A polymeric thermal insulation material shall meet the following criteria:

- a) have a minimum mechanical temperature rating equal to its maximum operating temperature in the luminaire; and
- b) have a minimum HB flammability rating, or comply with the horizontal burning flame test of Clause 14.25.

2.18.3

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 methods:

- 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.

2.18.4

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.

2.18.5

Glass fiber thermal insulation provided as an integral part of the luminaire shall have a minimum density of 9.6 kg/m³ (0.6 lb/ft³).

2.19 Continuous row mounting**2.19.1**

A luminaire intended for continuous row mounting shall have provision for a coupling method and be marked in accordance with Table 18.1, Item 2.16.

2.19.2

A luminaire intended for continuous row mounting shall have adequate space for at least four No. 12 AWG branch circuit conductors.

2.19.3

A luminaire which complies with the requirements of Clauses 2.19.1 and 2.19.2 may be marked as a raceway in accordance with Table 18.1, Item 1.7.

3 Electrical construction**3.1 General****3.1.1**

These requirements shall be used in conjunction with the applicable supplementary requirements in this Standard.