UL 844

STANDARD FOR SAFETY

Luminaires for Use in Hazardous (Classified) Locations

UL Standard for Safety for Luminaires for Use in Hazardous (Classified) Locations, UL 844

Thirteenth Edition, Dated June 29, 2012

Summary of Topics

This revision to ANSI/UL 844 dated October 11, 2021 is being issued to correct errors in -60°C Explosion Test Wording; 26.18 and Table 28.1

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

The revised requirements are substantially in accordance with Proposal(s) on this subject dated September 3, 2021.

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UL 844

Standard for Luminaires for Use in Hazardous (Classified) Locations

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The Department of Defense (DoD) has adopted UL 844 on June 6, 1989. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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

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INTRODUCTION

1 Scope

1.1 These requirements cover fixed and portable luminaires for installation and use in hazardous (classified) locations, Class I, Divisions 1 and 2, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class II, Division 2, Groups F and G; and Class III, Divisions 1 and 2, in accordance with the National Electrical Code, NFPA 70.

1.2 These requirements also cover luminaires for installation and use in Class I, Zones 1 and 2, Groups IIA, IIB, IIB plus Hydrogen, and IIC, and Zone 20, 21 and 22 hazardous (classified) locations in accordance with the National Electrical Code, NFPA 70.

1.3 These requirements cover luminaires for use only under the following atmospheric conditions:

a) A minimum ambient temperature of minus 60°C (minus 58°F);

b) An oxygen concentration not greater than 21 percent by volume; and

c) A nominal barometric pressure of one atmosphere.

2 General

2.1 Luminaires for use in hazardous locations shall also comply with the applicable requirements for luminaires for use in unclassified locations.

2.2 Low-pressure sodium lamps shall not be used in a luminaire for use in Division 1 hazardous locations.

3 Components

3.1 Except as indicated in 3.2, a component of a product covered by this standard shall comply with the requirements for that component.

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

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

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

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

4 Units of Measurement

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

5 Undated References

5.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

6 Class, Zone, and Group Equivalency

6.1 Class I, Zone 1, Group IIA

6.1.1 Luminaires intended to be marked in accordance with 74.4 shall comply with all the requirements for luminaires for use in Class I, Division 1, Group D hazardous (classified) locations.

6.2 Class I, Zone 1, Group IIB

6.2.1 Luminaires intended to be marked in accordance with 74.5 shall comply with all the requirements for luminaires for use in Class I, Division 1, Group C hazardous (classified) locations.

6.3 Class I, Zone 1, Group IIB plus hydrogen

6.3.1 Luminaires intended to be marked in accordance with 74.6 shall comply with all the requirements for luminaires for use in Class I, Division 1, Group B hazardous (classified) locations.

6.4 Class I, Zone 1, Group IIC

6.4.1 Luminaires intended to be marked in accordance with 74.7 shall comply with all the requirements for luminaires for use in both Class I, Division 1, Group A and Class I, Division 1, Group B hazardous (classified) locations.

6.5 Class I, Zone 2, Group IIA

6.5.1 Luminaires intended to be marked in accordance with 74.8 shall comply with all the requirements for luminaires for use in Class I, Division 2, Group D hazardous (classified) locations.

6.6 Class I, Zone 2, Group IIB

6.6.1 Luminaires intended to be marked in accordance with 74.9 shall comply with all the requirements for luminaires for use in Class I, Division 2, Group C hazardous (classified) locations.

6.7 Class I, Zone 2, Group IIB plus hydrogen

6.7.1 Luminaires intended to be marked in accordance with 74.10 shall comply with all the requirements for luminaires for use in Class I, Division 2, Group B hazardous (classified) locations.

6.8 Class I, Zone 2, Group IIC

6.8.1 Luminaires intended to be marked in accordance with 74.11 shall comply with all the requirements for luminaires for use in both Class I, Division 2, Group A and Class I, Division 2, Group B hazardous (classified) locations.

6.9 Zone 20 and 21

6.9.1 Luminaries intended to marked in accordance with 74.14 shall comply with all the requirements for luminaries for use in Class II, Division I, Group E, F, or G hazardous (classified) locations.

6.10 Zone 22

6.10.1 Luminaires intended to be marked in accordance with 74.15 shall comply with all the requirements for luminaires for use in Class II, Division 2, Group F or G hazardous (classified) locations.

7 Luminaires Subject to Deposits of Combustible-Paint Residue

7.1 A luminaire marked in accordance with 74.25 shall comply with the requirements in 9.2, 24.1, 25.1, and 25.26 – 25.28.

8 Enclosure Types

8.1 An enclosure shall comply with the applicable requirements specified in Table 8.1.

8.2 An enclosure that is intended for use in environmental conditions other than those defined in Table 8.1, and that has a marked enclosure type designation, shall also comply with the applicable requirements for each enclosure type, as specified in the Standard for Enclosures for Electrical Equipment, Non-Environmental Considerations, UL 50; for example, Type 3, 4X, or 6.

Table 8.1
Enclosure types for hazardous locations

Type number	Application	Requirements
7	Class I, Division 1, Group A, B, C, or D – Indoor Hazardous Locations – Air-Break Equipment	9.1 – 9.3, 10.1.1, 10.1.2, 11.1.1 – 11.4.3, 13.1.1 – 13.1.4, 14.1.1 – 14.2.2, 15.1, 16.1, 17.1.1 – 17.1.18, 18.1 – 21.2, 22.1 – 23.2, 25.1 – 25.21, 25.25 [a] – 28.5, 30.1 – 36.8, 74.1 – 74.21, 74.25 – 74.29, 74.32 – 74.35
9	Class II, Division 1, Group E, F, or G – Indoor Hazardous Locations – Air-Break Equipment	9.1, 9.2, 10.2.1 – 10.2.3.2, 12.1 – 12.7, 13.2.1 – 13.2.4, 14.1.1, 14.3.1, 15.1, 16.1, 17.2.1 – 20.2, 22.1 – 23.2, 25.1 – 25.28, 30.1 – 34.3, 74.1 – 74.3, 74.16, 74.17, 74.19 – 74.21, 74.27 – 74.29, 74.32 – 74.34
[a] Par 25.25 is applicable only to luminaires intended and marked for use where Class I and Class II conditions may exist simultaneously.		

PART I – LUMINAIRES FOR CLASS I, DIVISION 1, GROUPS A, B, C, AND D, AND CLASS II, DIVISION 1, GROUPS E, F, AND G LOCATIONS

CONSTRUCTION

9 Enclosure Material

9.1 The enclosure housing the electrical components shall be made of iron, steel, copper (see 9.3), brass, bronze, or aluminum or its alloys containing not less than 80 percent aluminum or an acceptable nonmetallic material which complies with the requirements in 35, Non-Metallic Enclosure Materials Test. A metal such as zinc or magnesium, or their alloys, is not acceptable.

9.2 For a luminaire intended for use where subject to deposits of combustible-paint residue, all exposed metal parts likely to be struck during cleaning shall be made of bronze, brass, copper, or aluminum.

9.3 Copper shall not be used for an enclosure of a luminaire for use in Class I, Group A locations. A copper alloy shall not be used for an enclosure unless:

a) The alloy is coated with tin, nickel, or other similar coating; or

b) The copper content of the alloy is not over 30 percent.

10 Enclosure Thickness

10.1 Enclosures for Class I locations

10.1.1 The thickness of metal enclosure walls shall not be less than specified in Table 10.1.

10.1.2 A machined or a threaded joint in the wall of a cast-metal enclosure shall have at least the thickness specified in Table 10.1 through the overlap.

Table 10.1
Thickness of metal enclosure

External enclosure dimensions				Minimum thickness, inch (mm)					
Diameter,		Area of any one surface,							
inches	(mm)	square Inches	(m^2)	Cast brass, bronze, copper, malleable iron		Cast iron and aluminum[a]		Sheet steel	
22	(559)	480	(0.310)	0.093	(2.36)	0.125	(3.18)	0.067	(1.70)
30	(762)	620	(0.400)	0.093	(2.36)	0.125	(3.18)	0.093	(2.36)
60	(1524)	1500	(0.968)	0.125	(3.18)	0.187	(4.75)	0.125	(3.18)
Over 60	(1524)	Over 1500	(0.968)	0.187	(4.75)	0.250	(6.35)	0.187	(4.75)

[a] Includes sand-cast, permanent-mold, and die-cast aluminum and sheet aluminum.

10.1.1.1 Glass

10.1.1.1.1 The thickness of a flat panel of glass, smooth or otherwise, shall not be less than specified in Table 10.3. The thickness of a glass lens, glass that is curved or bent, and glass having other shapes shall also not be less than specified in Table 10.3.

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

10.2 Enclosures for Class II locations

10.2.1 Cast metal

10.2.1.1 Except as noted in 10.2.1.2, a cast-metal enclosure shall not be less than 1/8 inch (3.2 mm) thick at every point and not less than 1/4 inch (6.4 mm) thick at tapped holes for conduit.

10.2.1.2 Die-cast metal, except at threaded holes for conduit, may be:

a) Not less than 3/64 inch (1.2 mm) thick for an area of 24 square inches (154.8 cm^2) or less and having no dimension larger than 6 inches (152 mm). This area limitation may be obtained by the provision of reinforcing ribs subdividing a larger area;

b) Not less than 5/64 inch (2.0 mm) thick for an area larger than 24 square inches or having any dimension larger than 6 inches; and

c) Not less than 0.015 inch (0.38 mm) at the bottom of a circular ring having a width of not more than 3/32 inch (2.38 mm) and a diameter of not more than 1-1/2 inches (38.1 mm).

10.2.2 Sheet metal

10.2.2.1 The thickness of a sheet-metal enclosure shall not be less than that specified in Table 10.2.

10.2.2.2 The length of surface in Table 10.2 is considered to be:

a) The diameter of a circular luminaire;

b) The longest diameter of an elliptical luminaire;

c) The longest side of a triangular luminaire;

d) The diagonal of a rectangular luminaire; and

e) The longest diagonal of a multisided luminaire.

Table 10.2
Thickness of sheet metal for Class II, Division 1 locations

Maximum length of surface involved and use to which it is put		Minimum thickness of sheet metal, inch (mm)					
		Uncoated steel		Zinc-coated steel		Copper, brass, or aluminum	
At a point where conduit connection is made		0.032	(0.81)	0.034	(0.86)	0.040	(1.02)
More than 26 inches (660 mm) long	If any wiring device is supported	0.026	(0.66)	0.029	(0.74)	0.032	(0.81)
	If no wiring device is supported	0.020	(0.51)	0.023	(0.58)	0.025	(0.64)
Not more than 26 Inches long	If any wiring device is supported	0.020	(0.51)	0.023	(0.58)	0.025	(0.64)
	If no wiring device is supported	0.016	(0.41)	0.019	(0.48)	0.020	(0.51)

10.2.3 Glass

10.2.3.1 The thickness of a flat panel of glass, smooth or otherwise, shall not be less than specified in Table 10.3. The thickness of a glass lens, glass that is curved or bent, and glass having other shapes shall also not be less than specified in Table 10.3.

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

Table 10.3
Minimum thickness of glass

Exposed area of glass				Minimum thickness of glass					
More Than		Not More Than		Flat		Curved		With Concentric Ribs	
Inch^2	(cm^2)	Inch^2	(cm^2)	Inch	(mm)	Inch	(mm)	Inch	(mm)
0	(0)	150	(968)	0.083	(2.11)	0.083	(2.11)	0.083	(2.11)
150	(968)	500	(3226)	0.10	(2.54)	0.083	(2.11)	0.083	(2.11)
500	(3226)	1100	(7097)	0.14	(3.56)	0.10	(2.54)	0.10	(2.54)

11 Joints in Enclosures for Class I Locations

11.1 General

11.1.1 Joints in an enclosure shall comply with the applicable requirements in 11.1.1 – 11.4.3 and Section 26, Explosion Tests.

Exception: This requirement does not apply to joints that comply with the requirements in Supplement SB, Alternative Joints in Enclosures, and Supplement SC, Alternative Explosion Tests.

11.1.2 A joint in an enclosure shall be of the metal-to-metal, metal-to-glass, metal-to-polymeric, polymeric-to-polymeric, polymeric-to-glass, gasketed metal-to-glass or gasketed polymeric-to-glass type. A joint surface shall have an arithmetical average roughness of not more than 250 microinches (0.0064 mm) in accordance with the Standard for Surface Texture (Surface Roughness, Waviness, and Lay), ANSI/ASME B46.1.

11.1.3 A polymeric-to-polymeric joint shall be of the labyrinth or threaded type.

11.1.4 The determination of the free internal volume shall exclude potting compounds. The free internal volume of a lamp enclosure shall be determined without the lamp installed.

11.1.5 A feeler gauge utilized to measure the clearances specified in these requirements is to be 1/8 to 1/2 inch (3.2 to 12.7 mm) wide, with a 1/2-inch-wide gauge used if possible.

11.1.6 The width of a joint is to be measured with the mating parts in their most unfavorable position.

11.1.7 A joint shall be continuous; that is, it shall not be interrupted by an "O" ring groove or the like.

11.1.8 A gasket may be employed in a metal-to-glass or polymeric-to-glass joint if the gasket complies with the requirements in 11.1.11 – 11.1.13. The maximum clearance between the gasket and the metal, polymeric, or glass shall not be more than that specified in 11.2.1.1, 11.2.2.1 – 11.2.2.3, and 11.3.2 – 11.3.4.

11.1.9 A gasket shall not be employed in a metal-to-metal, metal-to-polymeric, or polymeric-to-polymeric joint, but may be employed adjacent to such a joint if it does not decrease the effectiveness of the joint.

11.1.10 The use of the gasket shall be limited to a joint that will not be disturbed during the installation or intended servicing of the equipment.

11.1.11 The requirement in 11.1.9 applies to a gasket in a metal-to-glass or polymeric-to-glass joint only; it does not apply to other types of gaskets such as those employed in an enclosure for specific environmental conditions. See 8.2.

11.1.12 A gasket shall be:

a) A metal-covered type;

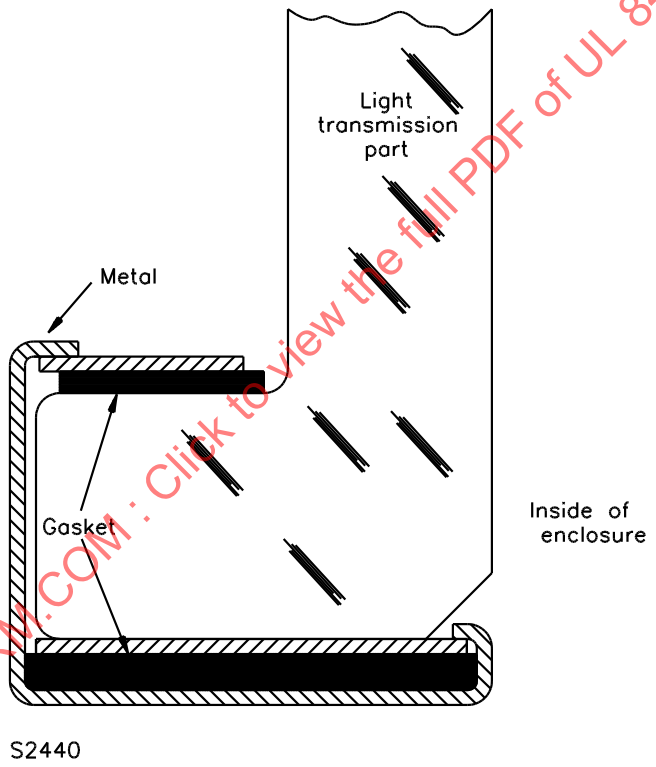
b) Polytetrafluoroethylene; or

c) Other material that has been investigated in accordance with Section SA4.7, Accelerated Air-Oven Aging Test and found acceptable for the application.

11.1.13 A metal-covered gasket between a metal or polymeric part and a glass part shall be mechanically attached to the glass. There shall be no overlapping of the metal covering of the gasket on joint surfaces. An acceptable metal-covered gasket construction is illustrated in Figure 11.1.

Figure 11.1

Metal-covered gasket construction



11.1.14 A material that readily hardens upon aging or adheres to metal surfaces, or both, is not an acceptable gasket material. The attachment of a gasket by an adhesive or a cement is not acceptable.

11.1.15 If a gasket of polytetrafluoroethylene or a material having similar characteristics is used, it shall be installed to reduce the likelihood of cold flow of the gasket material.

11.1.16 A glass part, such as a cylindrical tube for enclosing a fluorescent lamp, may be sealed with a sealing compound that complies with Section 36, Tests For Sealing Compounds, and with other tests covered in this standard, without loosening or cracking. The length of compound seal shall not be less than 5/8 inch (15.9 mm).

11.2 Luminaires for Class I, Groups C and D locations

11.2.1 Straight and rabbet joints – lamp enclosure

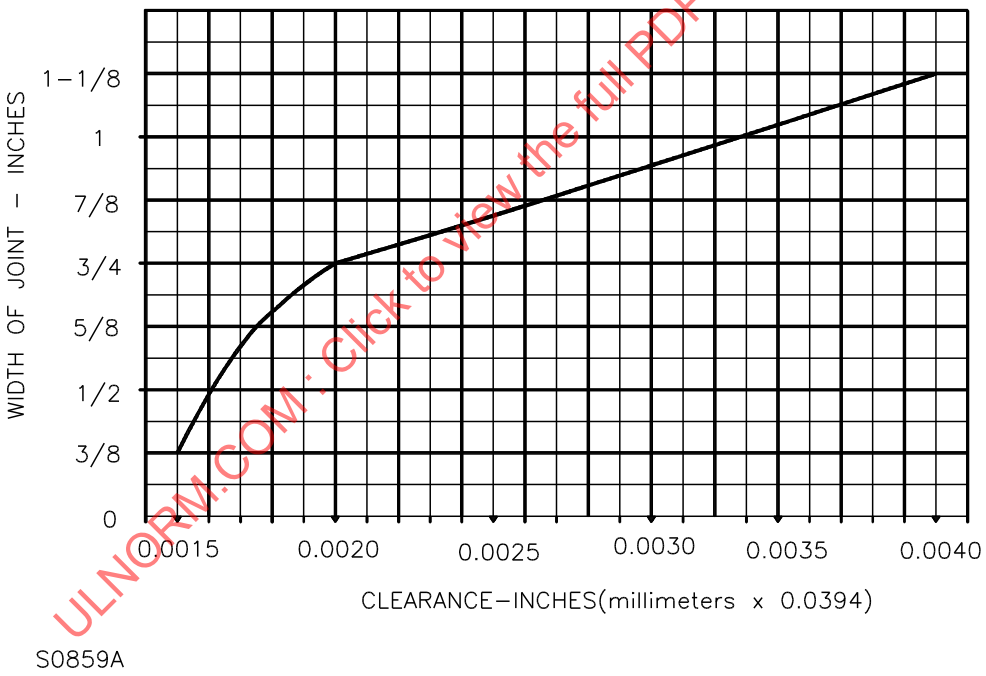
11.2.1.1 The width of a joint and the clearance shall be as shown in Figure 11.2. The joint may be a rabbet construction as illustrated in Figure 11.4 or a straight construction as illustrated in Figure 11.5. For a 3/8 inch (9.50 mm) wide joint the clearance shall be less than 0.0015 inch (0.038 mm) or such that a 0.0015 inch-thick feeler gauge will not enter the required joint width more than 1/8 inch (3.2 mm) at any point.

Exception No. 1: This requirement does not apply to a lamp enclosure having a vented section that complies with the requirements in 11.2.1.2 and 11.2.1.3.

Exception No. 2: This requirement does not apply if the lamp enclosure also serves as an enclosure for other parts. See 11.2.1.4.

Figure 11.2

Relation between clearance and width of joint



(See 11.2.1.1)

11.2.1.2 The lamp enclosure of a lighting luminaire may be provided with a venting section or sections to relieve internal explosion pressures. A joint in a vented enclosure may have a width of joint not less than 1/4 inch (6.4 mm) and a clearance of not more than 0.005 inch (0.13 mm) if the maximum explosion pressure developed during the explosion tests does not exceed 5 psig (34.5 kPa).

11.2.1.3 A venting section shall prevent the propagation of flame.

11.2.1.4 A luminaire enclosure that serves as both a lamp enclosure and an enclosure for other parts (such as a ballast, capacitor, or the like) shall comply with the requirements in 11.2.2.1. A lamp enclosure

is considered separate from another adjacent enclosure in a luminaire if means are provided, such as a seal or the equivalent, to prevent propagation of flame between the enclosures.

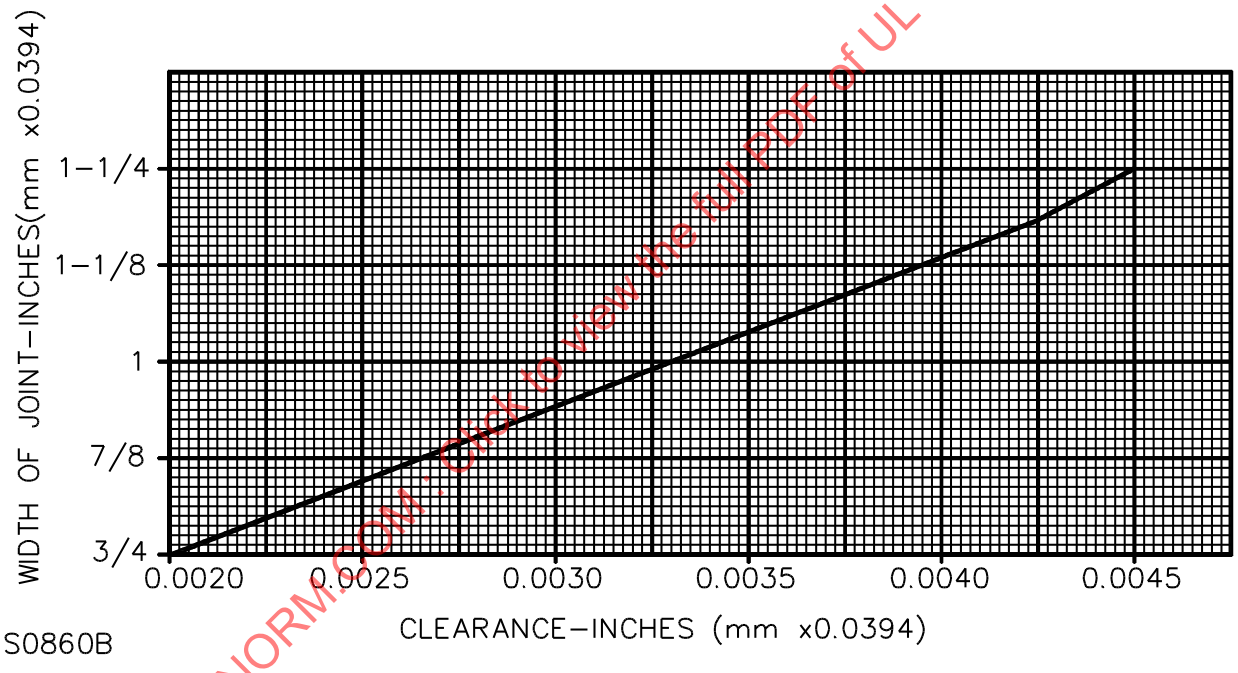
11.2.2 Straight and rabbet joints – enclosures other than lamp enclosures

11.2.2.1 Except as noted in 11.2.2.2 and 11.2.2.3, the width of a joint and the clearance, when assembled, shall be as specified in Figure 11.3, and the width of a joint shall not be less than 3/4 inch (19.1 mm).

11.2.2.2 A rabbet joint may have a diametrical clearance at the axial section of not more than twice the clearance specified in Figure 11.3 if neither the axial nor the radial section of the joint is less than 1/16 inch (1.6 mm) wide.

Figure 11.3

Relation between clearance and width of joint



(See 11.2.2.2 and 11.2.2.3)

11.2.2.3 An enclosure having a free internal volume of 300 cubic inches (4.92 dm^3) or less may have a 1/2-inch (12.7-mm) wide rabbet joint or a 3/8-inch (9.5-mm) wide flat joint if other details comply with (a) or (b), respectively.

a) One-half-inch wide rabbet joint (see Figure 11.4).

1) Neither the axial nor the radial section of the joint is less than 3/64 inch (1.2 mm) wide; and

2) The diametrical clearance of the axial section and the clearance of the radial section of the joint is not more than 0.002 inch (0.05 mm); and

3) The joint width measured from the inside of the enclosure to the nearest edge of each bolt clearance hole and elsewhere is not less than 1/2 inch.

b) Three-eighths-inch wide flat joint (see Figure 11.5).

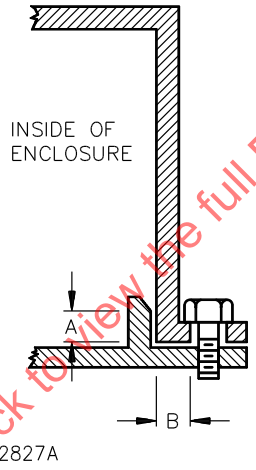
1) The clearance between the joint surfaces is less than 0.0015 inch (0.038 mm) or such that a 0.0015-inch feeler gauge will not enter the required joint width more than 1/8 inch (3.2 mm) at any point, and

2) The thickness of the cover at the joint width is not less than 3/8 inch unless stiffened or reinforced metal of a lesser thickness has been found to be acceptable when judged with respect to its mechanical strength and resistance to opening of the joint clearance under internal pressures, and

3) The joint width measured from the inside of the enclosure to the nearest edge of each bolt clearance hole and elsewhere is not less than 3/8 inch.

Figure 11.4

Rabbet joints



(See 11.2.1.1, 11.2.2.3(a), and 11.3.3)

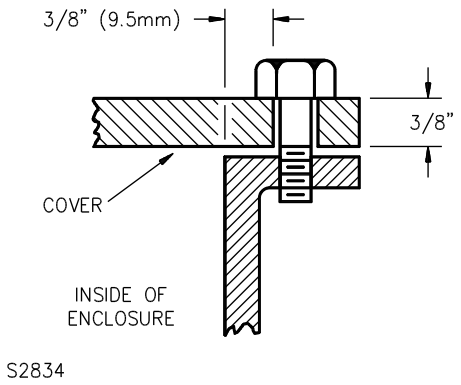
A + B = 3/8 inch (9.5 mm) for Class I, Groups C and D lamp enclosures.

A + B = 1/2 inch (12.7 mm) for Class I, Groups C and D enclosures, other than lamp enclosures, having free internal volume not more than 300 cubic inches (4.92 dm^3).

A + B = 7/8 inch (22.2 mm) for all Class I, Group B enclosures having free internal volume not more than 100 cubic inches (1.64 dm^3).

Figure 11.5

3/8-inch wide flat joint



(See 11.2.2.3(b) and 11.3.2)

11.2.3 Threaded joints

11.2.3.1 The requirements in 11.2.3.2 – 11.2.3.4 apply to all enclosures.

11.2.3.2 A threaded joint shall consist of the number of fully engaged threads specified in Table 11.1, but not less than five. Threads shall not be finer than specified in Table 11.1.

Table 11.1
Thread engagement

Maximum diameter of threaded sections, Inch (mm)	Maximum acceptable number of threads per inch (25.4 mm)	Minimum acceptable number of threads engaged
No Limit	20	5
3/8 (9.5)	24	5
Over 3/8	24	6
Over 3/8	28	7
Over 3/8	32	8

11.2.3.3 The engagement between a threaded shaft and a tapped hole in an enclosure is considered to be a threaded joint.

11.2.3.4 A joint of the serrated type with a thread contour shall not have more than 20 serrations per inch (25.4 mm), and shall have at least five fully engaged and tightly clamped serrations.

11.2.4 Labyrinth joints

11.2.4.1 Joints of the labyrinth type shall be tested in accordance with the requirements in 25.13.

11.2.5 Bolts in joint width

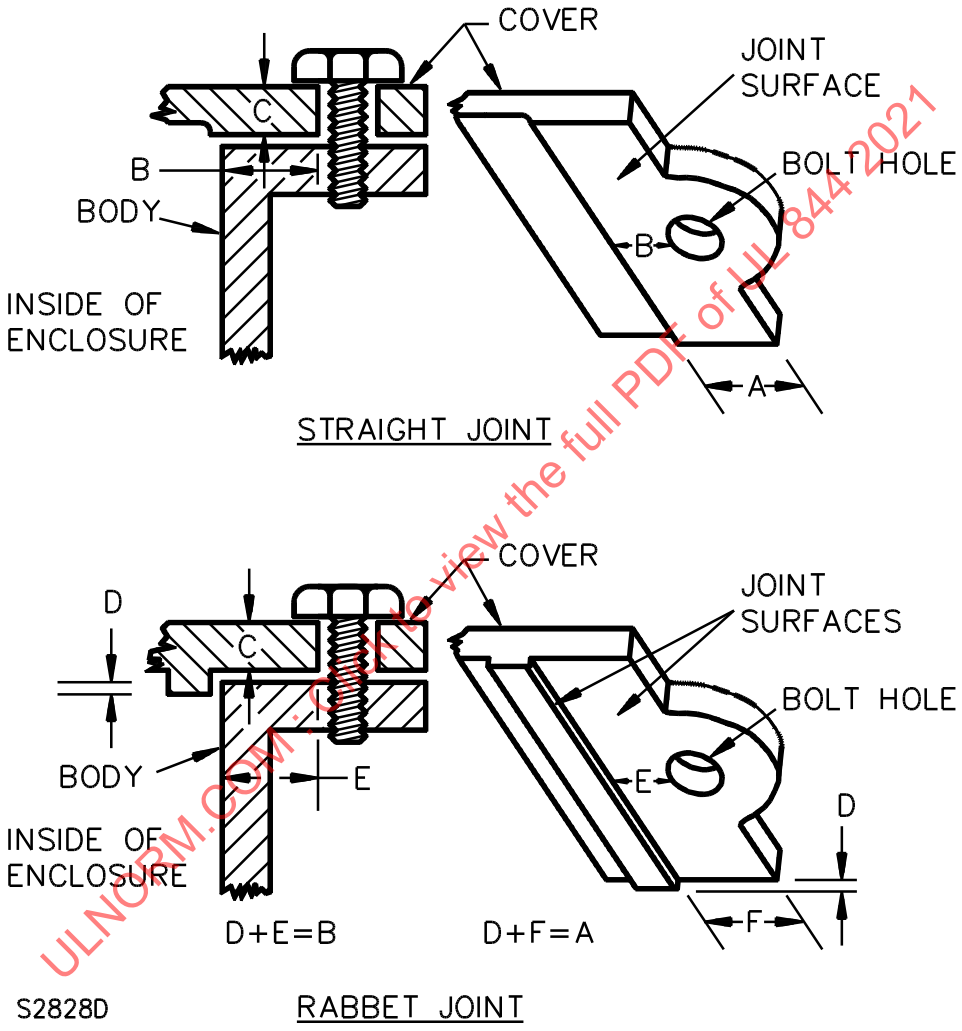
11.2.5.1 The requirements in 11.2.5.2 and 11.2.5.3 apply to all enclosures.

11.2.5.2 A bolt may be located in a 3/4-inch (19.1-mm) or wider joint if the distance from the inside of the enclosure to the nearest edge of the clearance hole for the bolt is not less than 1/2 inch (12.7 mm) and the

diametrical clearance between the bolt and the clearance hole is not more than 0.045 inch (1.14 mm) measured over the shank or the major diameter of the threads, for a length of not less than one-half the required width of joint specified in Figure 11.2 and Figure 11.3. The bolt may be provided with a lock washer. If the bolts or screws for fastening a cover each engage at least five full threads in a tapped hole in the enclosure, the holes need not be bottomed. See Figure 11.6.

Figure 11.6

Bolts in joint width



(See 11.2.5.2 and 11.2.5.3)

A = Required minimum width of joint (see Figure 11.2 and Figure 11.3)

B = Minimum distance from inside enclosure to bolt clearance hole

C = 1/2 of required minimum width of joint

D = One part of rabbet joint

E = Second part of rabbet joint to bolt clearance hole

F = Second part of rabbet joint elsewhere

11.2.5.3 The requirements in 11.2.5.2 apply, in general, to ordinary round machine screws. Screws that form their own machine-type thread and that have been investigated for securing enclosure parts may also be located in the joint width if they comply with the requirements in 11.2.5.2 except for measurement of the bolt clearance. In determining the clearance between a thread-forming screw and its clearance hole, the bolt dimension to be used is the minimum dimension of the cross section over the threads.

11.3 Luminaires for Class I, Group B locations

11.3.1 The requirements in 11.3.2 – 11.3.6 apply to lamp enclosures and enclosures other than lamp enclosures.

11.3.2 The width of a joint in an enclosure having a free internal volume of 30 cubic inches (492 cm^3) or less shall not be less than 3/8 inch (9.5 mm). At a bolt hole, the width shall be measured from the inside edge to the nearest edge of the bolt clearance holes. The thickness at the joint flange shall not be less than 3/8 inch. The clearance between joint surfaces shall be less than 0.0015 inch (0.038 mm) or such that a 0.0015-inch feeler gauge will not enter the required joint width more than 1/8 inch (3.2 mm) at any point. See Figure 11.5.

11.3.3 The width of a joint in an enclosure having a free internal volume of more than 30 cubic inches (492 cm^3) but not more than 100 cubic inches (1640 cm^3) shall not be less than 5/8 inch (25.9 mm). At a bolt hole, the width shall be measured from the inside edge to the nearest edge of the bolt clearance hole. The clearance between joint surfaces shall be less than 0.0015 inch (0.038 mm) or such that a 0.0015-inch feeler gauge will not enter the required joint width more than 1/8 inch (3.2 mm) at any point. A rabbet joint in an enclosure shall have a total joint width of not less than 7/8 inch (22.2 mm) with neither section of the joint being less than 3/8 inch (9.5 mm) wide. The diametrical clearance at an axial section of the joint shall not be more than 0.0025 inch (0.064 mm), and the clearance at a radial or clamped section of the joint shall not be more than 0.0015 inch. See Figure 11.4.

11.3.4 The width of a joint in an enclosure having a free internal volume of more than 100 cubic inches (1640 cm^3) but not more than 350 cubic inches (5740 cm^3) shall not be less than 1 inch (25.4 mm). At a bolt hole, the width shall be measured from the inside edge to the nearest edge of the bolt clearance hole. The clearance between the joint surfaces shall not be more than 0.0015 inch (0.038 mm).

11.3.5 Except for a conduit connection and a joint having tapered threads, a threaded joint in an enclosure shall have at least eight fully engaged threads with a Class 1 fit, at least seven with a Class 2 fit, or at least six with a Class 3 fit. See the Standard for Unified inch Screw Threads (UN and UNR Thread Form), ANSI/ASME B1.1. A threaded joint in an enclosure having tapered threads shall fully engage at least five threads. Threads shall not be finer than 20 threads per inch (25.4 mm).

11.3.6 A joint of the serrated type with a thread contour shall not have more than 20 serrations per inch (25.4 mm) and shall have at least five fully engaged and tightly clamped serrations.

11.4 Luminaires for Class I, Group A locations

11.4.1 The requirements in 11.4.2 and 11.4.3 apply to lamp enclosures and enclosures other than lamp enclosures.

11.4.2 Except for a conduit connection and a joint having tapered threads, a threaded joint in an enclosure shall have at least eight fully engaged threads with a Class 1 fit, at least seven with a Class 2 fit, or at least six with a Class 3 fit. See the Standard for Unified inch Screw Threads (UN and UNR Thread Form), ANSI/ASME B1.1. A threaded joint in an enclosure having tapered threads shall fully engage at least five threads. Threads shall not be finer than 20 threads per inch (25.4 mm).

11.4.3 A joint of the serrated type with a thread contour shall not have more than 20 serrations per inch (25.4 mm) and shall have at least five fully engaged and tightly clamped serrations.

12 Joints in Enclosures for Class II, Groups E, F, and G Locations

12.1 A joint in an enclosure shall be of the metal-to-metal, metal-to-glass, metal-to-polymeric, polymeric-to-polymeric, or polymeric-to-glass type. A joint surface shall have an arithmetical average roughness not more than 250 microinches (0.0064 mm) in accordance with the Standard for Surface Texture (Surface Roughness, Waviness, and Lay), ANSI/ASME B46.1.

12.2 The width of a joint measured from the inside of an enclosure to the outside shall not be less than 3/16 inch (4.8 mm). The clearance between the joint surfaces shall not be more than 0.002 inch (0.50 mm) for a 3/16-inch (4.8-mm) wide joint and not more than 0.003 inch (0.08 mm) for a 1/4-inch (6.4-mm) wide joint. These specified widths shall also be provided between the inside of the enclosure and the nearest edge of each bolt hole.

Exception: A luminaire with joints having both larger clearances and greater widths than those specified may be accepted for test.

12.3 If a gasket is used in a joint, it shall be formed of polytetrafluoroethylene (also see 11.1.14) or material having similar characteristics. The gasket may be of plant-fiber sheet packing material if the surface temperature to which the gasket is exposed does not exceed 90°C (194°F). The gasket material shall be mechanically attached and protected from abuse. The width of gasket contact shall not be less than 3/16 inch (4.8 mm) at all points around the joint. A gasket that is secured in a joint not intended to be opened after the luminaire is assembled is considered mechanically attached.

Exception: The gasket may be attached by an adhesive or cement if aging tests on the construction show that the means of attachment does not deteriorate. See Supplement SA4.7.

12.4 A material that upon aging readily hardens or adheres to metal surfaces, or both, is not an acceptable gasket material. See Supplement SA4.7 for the investigation of elastomeric gaskets.

12.5 A threaded joint shall consist of at least three threads fully engaged. A screw shall not have more than 32 threads per inch (25.4 mm).

12.6 The engagement between a threaded shaft and a tapped hole in an enclosure is considered to be a threaded joint.

12.7 A luminaire may have a combination joint consisting of two sections, such as a threaded section and a gasketed glass-to-metal section. Neither section considered alone need comply with the requirements specified in 12.2, 12.3, or 12.5. A threaded section shall have at least two threads fully engaged. A straight (flat or cylindrical) section shall have at least 1/8 inch (3.2 mm) width and not more than 0.002 inch (0.005 mm) clearance. A gasketed section shall have at least 1/8 inch width of gasket contact at all points around the joint.

13 Holes in Enclosure

13.1 Luminaires for Class I locations

13.1.1 A metal pin or a part press-fitted through the wall of an enclosure shall engage for at least 3/8 inch (9.5 mm). Such a part shall be secured against removal by welding, peening, or the equivalent.

13.1.2 Holes in an enclosure for securing a part shall:

a) Be bottomed;

b) Be closed by welding of the part in place; or

c) Have the screws securing the part engaged for at least five full threads and the screws shall be secured against removal. If a self-tapping screw is used, it shall have a minimum of five full threads engaged when seated. A screw shall not have more than 32 threads per inch (25.4 mm).

13.1.3 Unless the attachment complies with the requirements in 13.1.1 or 13.1.2, holes in an enclosure for attachment of a nameplate shall be bottomed. The remaining thickness at the bottomed hole shall be sufficient to withstand the Hydrostatic Pressure Test, Section 28, but shall not be less than 1/16 inch (1.6 mm).

13.1.4 A tapped hole shall not be provided in a sintered-metal part that is employed as a venting section of an enclosure.

13.2 Luminaires for Class II locations

13.2.1 A metal pin or a part press-fitted through the wall of an electrical enclosure shall engage for at least 3/16 inch (4.8 mm). Such a part shall be secured against removal by welding, peening, or the equivalent.

13.2.2 Holes in an enclosure for securing a part shall:

a) Be bottomed;

b) Be closed by welding of the part in place; or

c) Have the screws securing the part engaged for at least three full threads and the screws shall be secured against removal. If a self-tapping screw is used, it shall have a minimum of three full threads engaged when seated. A screw shall not have more than 32 threads per inch (25.4 mm).

13.2.3 Unless the attachment complies with the requirements in 13.2.1 or 13.2.2, holes in an enclosure for attachment of a nameplate shall be bottomed. The remaining thickness at the bottomed hole shall not be less than 1/16 inch (1.6 mm).

13.2.4 A tapped hole shall not be provided in a sintered-metal part that is employed as a venting section of an enclosure.

14 Shaft Openings

14.1 General

14.1.1 A shaft opening in an enclosure shall be of the metal-to-metal type for Class I locations and of the metal-to-metal or metal-to-polymeric type for Class II locations. See 11.1.1 for roughness requirements of the metal surfaces forming the path.

14.2 Luminaires for Class I locations

14.2.1 Except as noted in 14.2.2, a shaft opening in an enclosure shall have a length of path of not less than 1 inch (25.4 mm). The diametrical clearance between the shaft and its opening in the enclosure shall be as specified in Figure 11.3. The diametrical clearance of a path longer than 1-1/4 inches (31.8 mm) shall not be more than 0.0045 inch (0.114 mm).

14.2.2 A shaft opening in an enclosure provided with a venting section (see 11.2.1.2) shall have a length of path not less than 1/4 inch (6.4 mm) with a diametrical clearance of not more than 0.005 inch (0.13 mm) if the maximum explosion pressure developed during explosion tests does not exceed 5 psig (34.5 kPa).

14.3 Luminaires for Class II locations

14.3.1 A shaft opening in an enclosure shall have a length of path of not less than 1/2 inch (12.7 mm). The diametrical clearance between the shaft and the shaft opening shall not be more than 0.005 inch (0.13 mm) for a 1/2-inch (12.7-mm) length of path, 0.008 inch (0.20 mm) for a 1-inch (25.4-mm) length of path, and 0.011 inch (0.28 mm) for a 1-1/2-inch (38.1-mm) length of path, with intermediate values proportional.

15 Guards of Luminaires for Classes I and II Locations

15.1 A guard, if used, shall be attached to the luminaire so that its position is maintained.

16 Nonmetallic External Parts

16.1 A nonmetallic external part, such as a guard or a reflector, shall be subjected to the Test for Accumulation of Static Electricity, Section 35.4.

17 Supply Connections

17.1 Luminaires for Class I locations

17.1.1 A luminaire shall have provision for connection to threaded rigid metal conduit or other wiring methods in accordance with Article 501 in the National Electrical Code, NFPA 70.

17.1.2 Except as noted in 17.1.3, the conduit hub of a luminaire intended to be supported by conduit shall be provided with a setscrew to secure the luminaire to the conduit. The setscrew shall be located to the outside of five full threads of the supply opening.

17.1.3 The requirement in 17.1.2 applies to a luminaire, such as the pendent type, that has one conduit hub and can turn on the supporting conduit. It does not apply to a luminaire, such as a fluorescent type, that is suspended at two or more points and that cannot turn on the supporting conduit.

17.1.4 An outlet or terminal box in which connections to the power-supply circuit will be made shall be located so that, after the luminaire has been installed as intended, the connections will be readily accessible for inspection without the disconnection of any portion of the wiring.

17.1.5 The leads or conductors shall be securely held and tightly sealed where they pass into the lamp chamber. If a sealing compound or cement is used, it shall comply with the Tests On Sealing Compounds, Section 36 and be at least 5/8 inch (15.9 mm) deep. The sealing compound shall neither flow nor creep at the operating temperature of the lighting unit. A sealing compound that softens upon the application of heat shall have a softening point of not less than 93°C (200°F).

17.1.6 The softening point of a sealing compound is to be determined in accordance with the Standard Test Method for Softening Point By Ring-and-Ball Apparatus, ASTM E28.

17.1.7 A seal provided between the lamp enclosure and the wiring compartment shall comply with the Tests On Sealing Compounds, Section 36.

17.1.8 A conduit opening shall be provided with at least five full threads.

17.1.9 Each conduit opening shall be provided with:

a) A smooth and well-rounded integral conduit stop, having a throat or inner diameter as specified in Table 17.1;

b) A smooth and well-rounded inner end as shown in Figure 17.1; or

c) Threads not exceeding the maximum number specified in Table 17.2 for the conduit size.

Exception: The opening need not comply with this requirement if instructions are provided in accordance with 74.27.

Figure 17.1

Conduit opening without conduit stop

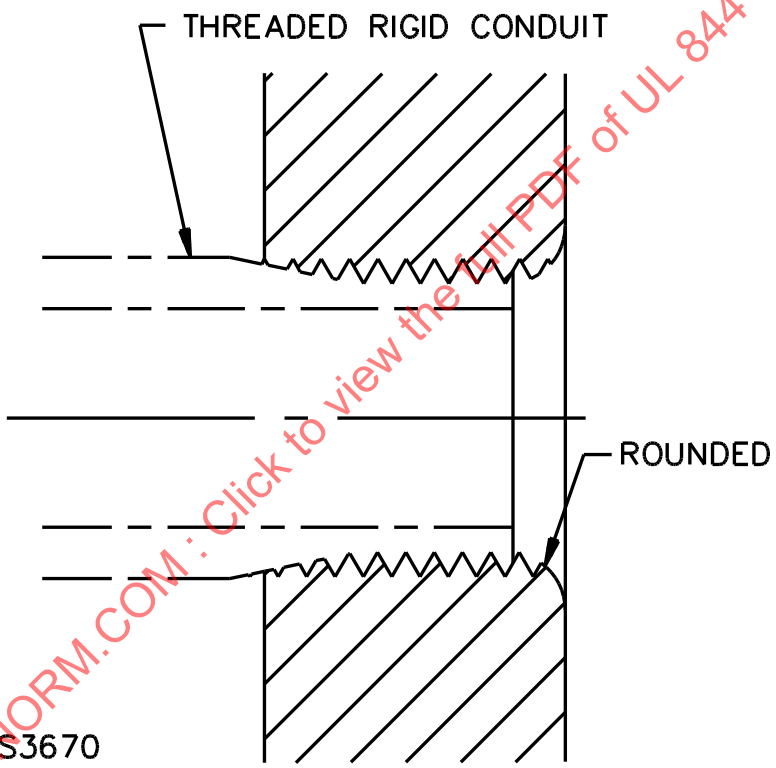


Table 17.1
Throat diameter of conduit stop

Trade size of conduit,		Throat diameter of conduit stop, Inches (mm)			
Inches	(mm O.D.)	Minimum		Maximum	
1/2	(21.3)	0.560	(14.22)	0.622	(15.80)
3/4	(26.7)	0.742	(18.85)	0.824	(20.93)
1	(33.4)	0.944	(23.98)	1.049	(26.64)
1-1/4	(42.4)	1.242	(31.55)	1.380	(35.05)
1-1/2	(48.3)	1.449	(36.80)	1.610	(40.89)

Table 17.1 Continued on Next Page

Table 17.1 Continued

Trade size of conduit,		Throat diameter of conduit stop, Inches (mm)			
Inches	(mm O.D.)	Minimum		Maximum	
2	(60.3)	1.860	(47.24)	2.067	(52.50)
2-1/2	(73.0)	2.222	(56.44)	2.469	(62.71)
3	(88.9)	2.761	(70.13)	3.068	(77.93)
3-1/2	(101.6)	3.193	(81.10)	3.548	(90.12)
4	(114.3)	3.623	(92.02)	4.026	(102.26)
5	(141.3)	4.542	(115.37)	5.047	(128.19)
6	(168.3)	5.458	(138.63)	6.065	(154.05)

Table 17.2
Number of threads in a conduit opening without an integral stop

Trade size of conduit, Inches (mm OD)		Number of threads per inch (25.4 mm)	Maximum number of threads
1/2	(21.3)	14	6
3/4	(26.7)	14	6
1	(33.4)	11-1/2	6
1-1/4	(42.2)	11-1/2	6
1-1/2	(48.3)	11-1/2	7
2	(60.3)	11-1/2	7
2-1/2	(73.0)	8	7
3	(88.9)	8	8
3-1/2	(101.6)	8	8
4	(114.3)	8	9
5	(141.3)	8	9
6	(168.3)	8	9

17.1.10 If a luminaire has a single hub and the wiring compartment of the luminaire would not be expected to be used for through wiring during installation, the throat diameter for conduit sizes greater than 1/2-inch trade size (21.3 mm OD) may be less than that specified in Table 17.1 but not less than 0.560 inch (14.22 mm).

17.1.11 If an integral conduit stop is provided in a conduit opening of an enclosure for Class I, Group A or B locations, the threads shall be tapered 3/4 inch per foot (62.5 mm/m).

17.1.12 If an integral conduit stop is provided in a conduit opening of an enclosure for Class I, Group C or D locations, the threads may be of the straight type or tapered 3/4 inch per foot (62.5 mm/m).

17.1.13 If an integral conduit stop is not provided in a conduit opening, the threads shall be tapered 3/4 inch per foot (62.5 mm/m).

17.1.14 Entries shall use a modified National Standard Pipe Taper (NPT) or National Standard Pipe Straight (NPS) thread. The pipe thread form shall comply with the Standard for Pipe Threads, ANSI/ASME B1.20.1. Entries shall not be smaller than trade size 1/2 nor larger than trade size 6 and shall provide for five full threads of engagement with a conduit or fitting gauging at L1-1. NPT threaded entries shall

conform to ANSI/ASME B1.20.1 except that entries shall gauge from flush to +3-1/2 turns beyond the L-1 gauging notch in lieu of the ±1 turns described in ANSI/ASME B1.20.1.

17.1.15 Metric threaded entries shall comply with the requirements in 11.2.3.1 – 11.2.3.4, Threaded Joints and Explosion Tests, Section 26. Means shall be provided to minimize abrasion to conductor insulation.

17.1.16 Metric threaded entries shall have a permanent marking near the supply connection opening in accordance with 74.28.

Exception: Luminaires which use a thread type other than NPT or NPS are not required to have the marking in 74.28 when they are provided with an adapter to NPT or NPS thread form. The adapter shall comply with the applicable construction and performance requirements in this Standard and the Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations UL 1203, Part VIII.

17.1.17 All openings for connection to conduit, except those necessary for installation, shall be furnished with metal plugs engaging at least five full threads.

17.1.18 A conduit hub not integrally cast with an enclosure, shall:

a) Have a wall thickness before threading not less than that of the corresponding trade-size conduit;

b) Not depend on friction alone to prevent it from turning; and

c) Comply with the Tests for Secureness of Conduit Hubs, Section 32.

17.2 Luminaires for Class II locations

17.2.1 A luminaire shall have provision for connection to threaded rigid metal conduit or other wiring methods in accordance with Article 502 in the National Electrical Code, NFPA 70.

17.2.2 Except as noted in 17.2.3, the conduit hub of a luminaire intended to be supported by conduit shall be provided with a setscrew to secure the luminaire to the conduit. The setscrew shall be located to the outside of 3-1/2 threads of the supply opening.

17.2.3 The requirement in 17.2.2 applies to a luminaire, such as the pendent type, that has one conduit hub and can turn on the supporting conduit. It does not apply to a luminaire, such as a fluorescent type, that is suspended at two or more points and cannot turn on the supporting conduit.

17.2.4 Each conduit opening shall comply with the requirements in 17.1.9, 17.1.10, 17.1.13, 17.1.15, 17.1.16, and 17.1.18.

17.2.5 Entries shall use a modified National Standard Pipe Taper (NPT) or National Standard Pipe Straight (NPS) thread. The pipe thread form shall comply with the Standard for Pipe Threads, ANSI/ASME B1.20.1. Entries shall not be smaller than trade size 1/2 nor larger than trade size 6 and shall provide for 3-1/2 full threads of engagement with a conduit or fitting gauging at L1-1. NPT threaded entries shall conform to ANSI/ASME B1.20.1 except that entries shall gauge from flush to +3-1/2 turns beyond the L-1 gauging notch in lieu of the ±1 turns described in ANSI/ASME B1.20.1.

17.2.6 Metric threaded entries shall comply with the requirements in 12.5 and the Dust Penetration Test, Section 29. Means shall be provided to minimize abrasion to conductor insulation.

17.2.7 If an integral conduit stop is provided in a conduit opening, the threads may be of the straight type or tapered 3/4 inch per foot (62.5 mm/m).

17.2.8 If an integral conduit stop is not provided in a conduit opening, the threads shall be tapered 3/4 inch per foot (62.5 mm/m).

17.2.9 All openings for connection to conduit, except those necessary for installation, shall be furnished with metal plugs engaging at least three full threads.

17.2.10 A conduit hub not integrally cast with an enclosure shall:

a) Have a wall thickness before threading not less than that of the corresponding trade-size conduit;

b) Not depend upon friction alone to prevent it from turning; and

c) Comply with the Test for Secureness of Conduit Hubs, Section 32.

17.3 Leads

17.3.1 A lead that is intended for field-wiring connection shall have a minimum length as specified in (a) – (c), as applicable:

a) If connections are intended to be made within the luminaire enclosure – 6 inches (152.4 mm);

b) If connections are not intended to be made within the luminaire enclosure – 18 inches (457.2 mm); or

c) 24 inches (610 mm) plus the distance between the sealing fitting and the luminaire enclosure that is specified in the marking when connections are not intended to be made within an outlet box or within the luminaire enclosure, and the luminaire is intended to have a sealing fitting installed.

18 Disconnecting Means

18.1 A luminaire may be provided with means to automatically disconnect the lampholder from the supply circuit when the globe assembly is unscrewed from the conduit-connected enclosure.

18.2 The disconnecting means shall disconnect all connections to the lampholder and shall be acceptable for the controlled load.

18.3 All live parts that are not disconnected from the circuit shall be enclosed in an explosion-proof or a dust-ignition-proof enclosure.

19 Protection Against Corrosion

19.1 All ferrous-metal parts shall be protected against corrosion, except at joint surfaces, shaft openings, and conduit threads, by zinc or cadmium coating, plating, enameling, painting, varnishing, or lacquering. Joint surfaces and conduit threads may be electroplated with zinc or cadmium. For luminaires for Class II locations, the metal surfaces of a gasketed joint that is not directly accessible from outside the luminaire after the luminaire is assembled may be coated with porcelain enamel.

Exception: Protection against corrosion need not be provided for a stainless steel part.

19.2 Brass, copper, or lead-alloy (terne) are not acceptable for coating a ferrous-metal part as a protection against corrosion.

19.3 An enclosure of ferrous metal other than stainless steel shall be subjected to the Rust-Resistance Test, Section 31.

20 Materials Applied to Joint Surfaces

20.1 Paint or a sealing material shall not be applied to the contacting surfaces of a joint.

Exception No. 1: This requirement does not apply to sealing material that is applied to the contacting surfaces of a joint that is not intended to be and is not required to be opened to install or service the equipment. The application of the material shall not increase the maximum clearance between joint surfaces beyond the dimensions specified in this Standard and complies with the requirements in 26.19.

Exception No. 2: For a luminaire for Class II locations, in a joint that may be opened after the luminaire is assembled, the joint surface against which a gasket bears may be provided with a thin and uniform coating of paint if aging and compression tests show that the paint does not adhere to the gasket material and does not peel off the joint surface. See Supplement SA.

Exception No. 3: For a luminaire for Class II locations, a gasketed joint not intended to be opened after the luminaire is assembled and provided with means such as welding, riveting, upset screw threads, or the equivalent to reduce the likelihood that the joint will be opened, may have metal joint surfaces that have a thin and uniform coating of paint if the paint and the gasket material are acceptable for the temperature at the joint surface. See Sections SA3, SA4, and SA6 of Supplement SA.

Exception No. 4: A threaded joint surface or a threaded opening for conduit may be provided with a metallic paint or other noninsulating coating if the paint or coating is acceptable for the temperature at the threaded metal surface and if the joint surface or opening with the paint or coating applied:

a) For Class I locations, prevents the passage of flame, hot particles, or sparks capable of igniting the surrounding atmosphere during the explosion tests. See 26.10.

b) For Class I and Class II locations, complies with the requirements specified in the Electrical-Resistance Test, Section 34.

Exception No. 5: A threaded joint surface or a threaded opening for conduit may be provided with a nonmetallic paint or other insulating coating if the construction complies with the requirements specified in Exception No. 3 and if an acceptable means of bonding is provided to maintain grounding continuity for all exposed dead metal parts of the luminaire. In determining the acceptability of the means of bonding, consideration is to be given to the effects of the environmental conditions.

20.2 Corrosion-inhibiting grease such as petrolatum or soap-thickened mineral oil may be applied to the metal joint surfaces before assembly. The grease shall be of a type that does not harden because of aging, does not contain an evaporating solvent, and does not cause corrosion of the metal surfaces.

20.3 A corrosion inhibiting, non-drying, thickened mineral oil-based sealant that does not contain metal particles shall be permitted to be applied to threaded joints.

21 Fuses

21.1 Fuses provided in a luminaire for Class I locations shall comply with Tests on Luminaires with Fuses, Section 27.

21.2 Unless provided with a factory seal, a luminaire for Class I locations having fuses shall be marked in accordance with 74.3(p).

22 Grounding and Bonding

22.1 All exposed dead metal parts of a luminaire shall be electrically connected together.

Exception: This requirement does not apply to a part that is not likely to become energized.

22.2 A non-metallic enclosure shall be provided with means for maintaining continuity between grounded rigid metal conduit and dead metal parts within the enclosure.

22.3 All luminaires shall have provision for grounding all noncurrent carrying metal parts that are exposed, or that are capable of being contacted by persons during normal operation or adjustment of the equipment and that are capable of becoming energized, in accordance with the requirements in the Standard for Luminaires, UL 1598.

22.4 A supplemental external bonding terminal provided on the luminaire shall have a terminal that is not identified as being intended for connection of the luminaire grounding conductor by being:

a) Colored green;

b) Marked with the letter or word "G", "GR", "GRD", or "GROUND"; or

c) Marked with the following grounding-terminal symbol: ⏚

Exception: The external bonding terminal shall not be identified as an equipment grounding terminal unless instructions are included with the equipment indicating that the internal grounding terminal shall be used as the equipment grounding means and that the external terminal is only a supplemental bonding connection where local authorities permit or require such a connection.

23 Porosity in Enclosure Materials

23.1 Porosity not in a joint surface shall not be more than 3/32 inch (2.4 mm) wide and shall not be more than 1/16 inch (1.6 mm) deep. The minimum thickness of the wall from the bottom of a hole to the opposite surface shall not be less than 1/8 inch (3.2 mm), and shall not be affected by porosity holes.

23.2 Porosity in the joint surface greater than 1/64 inch (0.4 mm) wide shall be included in the measurement of the joint width. Holes in the joint surface shall not be more than 1/16 inch (1.6 mm) wide and shall not be more than 1/16 inch (1.6 mm) deep, and the specified minimum width of the joint, not including the holes, shall be provided.

24 Luminaires for Wet Locations

24.1 A luminaire that is marked "Suitable for Wet Locations " or "Suitable for Locations Having Deposits of Readily Combustible Paint Residues" shall be subjected to the Thermal Shock Test, Section 30, and:

a) For other than a recessed luminaire which can be mounted in the ground or below grade level, comply with the requirements for a Type 3, 3S, 4, 4X, 6, or 6P enclosure, as specified in the Standard for Enclosures for Electrical Equipment, Non-Environmental Considerations, UL 50; or

b) For a recessed luminaire which can be mounted in the ground or below grade level, comply with the requirements for a Type 6 or 6P enclosure as specified in the Standard for Enclosures for Electrical Equipment, Non-Environmental Considerations, UL 50; or

c) Comply with the requirements for wet locations luminaires in the Standard for Luminaires, UL 1598, except that no water shall enter the enclosure.

24.2 A gasket provided to exclude water shall be in addition to, but not in place of, the joints specified elsewhere in this standard.

24.3 A fluorescent luminaire marked in accordance with 24.1, intended for outdoor installation, and not provided with Class P thermally protected ballast equipment shall be marked as specified in 74.3(i).

PERFORMANCE

25 Temperature Test

25.1 When tested under the applicable conditions described in 25.3 – 25.25, a luminaire shall not attain a temperature on the exterior of the enclosure higher than specified in Table 25.1. For a luminaire subject to deposits of combustible-paint residues, see 25.26 – 25.28.

Table 25.1
Exterior surface temperature limits

luminaire for use in:	Maximum temperature	
	°C	°F
Class I, Groups A, B, C, D	a	a
Class I, Group C – Surgical Type luminaire only	160	320
Class II, Groups E, F	200	392
Class II, Group G	165	329

[a] Operating temperature or class marked on luminaire.

25.2 The exterior surface temperature of a luminaire intended for use where Class I and Class II conditions may exist simultaneously shall not exceed:

a) 165°C (329°F) for a luminaire for Class I and Class II, Group G, Groups F and G, or Groups E, F, and G; or

b) 200°C (392°F) for a luminaire for Class I and Class II, Group E, Group F, or Groups E and F.

25.3 Except as noted in 25.4, the operating temperature or temperature code shall be based on operation in a 40°C (104°F) ambient. If the temperature class is provided in lieu of the operating temperature, it shall be in accordance with Table 74.1.

25.4 For a luminaire marked for use in an elevated ambient, the operating temperature or temperature class shall be based on operation in the elevated ambient for which the luminaire is marked.

25.5 An incandescent lamp luminaire is to be operated at rated maximum wattage. The test is to be continued until equilibrium temperatures are attained.

25.6 Except as noted in 25.7 and 25.8, an electric-discharge lamp luminaire is to be operated at the voltage and the frequency specified for the control equipment until equilibrium temperatures are obtained. Also see 25.13 and 25.14.

25.7 A high-intensity-discharge lamp luminaire employing a self-ballasted lamp shall be operated at rated lamp wattage.

25.8 A high-intensity-discharge lamp luminaire is to be operated as described in 25.9 – 25.12.

25.9 A high-intensity-discharge lamp luminaire shall be provided with a nominal system consisting of ballast, capacitor (if required), and lamp. The nominal system is to be determined by a test, with components installed in the luminaire as intended, conducted at a 25 ±5°C (77 ±9°F) temperature in accordance with 25.10.

Exception: This requirement does not apply to a luminaire employing a self-ballasted lamp.

25.10 For a luminaire employing a high-intensity-discharge lamp other than the self-ballasted type, a ballast and capacitor (if required) together with the appropriate lamp are to be energized at rated ballast voltage until the lamp voltage stabilizes. A nominal system is considered to exist when the lamp wattage is within ±5 percent of its nominal value. If the application of rated ballast voltage does not result in a nominal system, the input voltage to the ballast may be increased, with the concurrence of those concerned, to a value greater than the rated ballast voltage to bring the lamp wattage up to within 5 percent of its nominal value.

25.11 The nominal system of a luminaire employing both a high-intensity-discharge lamp and an incandescent lamp, which may operate at the same time, shall be determined in accordance with 25.9 and 25.10.

25.12 A stabilized sinusoidal voltage supply shall be provided, and the voltage is to be adjusted to the rated voltage of a separate ballast of a high-intensity-discharge lamp. For a combination high-intensity-discharge lamp and incandescent lamp luminaire or self-ballasted high-intensity-discharge lamp luminaire, rated voltage is to be applied to the ballast and the incandescent lamp or a self-ballasted lamp is to be operated as described in 25.5 or 25.7, as appropriate.

25.13 An electric-discharge-lamp luminaire, other than one employing a self-ballasted lamp, is to be operated under the abnormal conditions specified in 25.14 unless:

a) Class P thermally-protected ballast equipment is used; or

b) The ballast is remote from the luminaire.

25.14 For a fluorescent-lamp luminaire, the abnormal conditions are to be the same as those used to investigate a Class P thermally-protected ballast. For an electric-discharge-lamp luminaire of other than the fluorescent-lamp type, the abnormal conditions are to be short-circuiting of the lamp terminals.

25.15 The luminaire is to be mounted as intended in a room that has provisions for maintaining the intended ambient temperature. The air flow in the test room shall not exceed 30 feet per minute (0.15 m/s). Temperature variations of not more than 5°C (9°F) from the intended ambient are to be added to or subtracted from the observed temperature reading.

Exception: Temperature variations of more than 5°C (9°F) may be added to the observed temperature reading as necessary, if agreeable to those concerned.

25.16 The temperature of a ballast of a high-intensity-discharge lamp luminaire, other than a remote ballast, shall be measured by the change-of-resistance method. Thermocouples are to be used for measuring the temperature of other parts of a luminaire.

25.17 Except as noted in 25.18, a temperature test to determine external temperatures shall be conducted at an ambient of 40°C (104°F).

25.18 In determining operating temperatures of a luminaire that is marked for use in an elevated ambient, the test is to be conducted at the elevated ambient for which the luminaire is marked.

25.19 Except as noted in 25.20, to determine compliance with ordinary location requirements, temperatures of internal components such as ballasts, lampholders, and lead wires are to be based on tests conducted at a 25°C (77°F) ambient. See 74.21.

25.20 In determining internal temperatures of a luminaire intended for use in an elevated ambient, the test is to be conducted at the elevated ambient.

25.21 In conducting the temperature tests, consideration is to be given to the heat transmission of a color-corrective glass cylinder and to the effect of other components, such as a colored globe, a reflector, or a guard, if provided.

25.22 A luminaire for Class II, Group E locations only is to be blanketed with magnesium dust (see 29.5) during the test.

25.23 A luminaire for Class II, Groups E and F; Groups E and G; Groups E, F, and G; Group F; Group G; or Groups F and G locations is to be blanketed with grain dust (see 29.4) during the test.

25.24 With reference to 25.22 and 25.23, the luminaire is to be installed in a test chamber as described in 29.2 and is to be exposed to the circulating dust-air atmosphere until the dust blanket is stabilized. The dust-circulation equipment is then to be de-energized and the luminaire is to be operated until equilibrium temperatures are attained.

25.25 For a lighting luminaire intended and marked for use where Class I and Class II conditions may exist simultaneously, the marked operating temperature or temperature code shall be based on the temperature attained during the test with dust blanket.

25.26 When coated with paint as specified in 25.28, the exterior surface of an enclosure for a luminaire intended for use where subject to deposits of combustible-paint residues shall not attain a temperature higher than 105°C (221°F) when tested at 40°C (104°F) or the rated ambient temperature if higher than 40°C.

Exception: The exterior surface of an enclosure may exceed 105°C (221°F) but shall not exceed 150°C (302°F) if there is no apparent change in the paint coating, such as discoloration, after not less than 36 hours of continuous luminaire operation.

25.27 When coated with paint as described in 25.28, the luminaire shall comply with the applicable temperature requirements for unclassified (ordinary) location luminaires when tested at a 25°C (77°F) ambient, or at rated ambient temperature if higher than 25°C. See 25.19 and 25.20.

25.28 With reference to 25.26, the heated parts of a luminaire, including the lamp housing, are to have three coats of either a white nitrocellulose-base paint (containing at least 10 percent by weight of nitrocellulose) or a white acrylic enamel applied with a brush and allowed to dry between each coat. The final coat is to be allowed to dry before the temperature test is conducted.

26 Explosion Tests

26.1 Equipment for use in Class I locations shall comply with the applicable requirements in Section 11, Joints in Enclosures for Class I Locations, and 26.2 – 26.18.

Exception: This requirement does not apply to equipment for use in Class I locations that comply with the requirements in Supplement SB, Alternative Joints in Enclosures, and Supplement SC, Alternative Explosion Tests.

26.2 The enclosure of a luminaire for use in Class I locations shall be tested in the presence of specific gas- or vapor-air mixtures over the range of flammable or explosive concentrations of the gas- or vapor-air mixture to determine:

a) The maximum explosion-pressure effects; and

b) The maximum propagation effects.

26.3 During the explosion tests described in 26.3 – 26.11:

a) The enclosure shall prevent the passage of flame to the surrounding atmosphere and sparks capable of igniting the surrounding atmosphere;

b) The enclosure shall not burst or its joints become loosened; and

c) There shall be no mechanical damage, other than breakage of the lamp, to the electrical components.

26.4 A series of at least 15 tests is to be conducted on each enclosure subjected to explosion tests.

26.5 Lengths of conduit as specified in Table 26.1 are to be connected to an enclosure in which field-wiring connections are intended to be made.

Table 26.1
Lengths of rigid metal conduit for explosion tests

Class I hazardous location groups	Conduit trade size, inch	Conduit length	
		Feet	(m)
A[a], B[a], C[a]	Less than 2	5, 10, and 15	(1.52, 3.05, and 4.57)
D	Less than 2	2	(0.61)
A[a], B[a], C[a], D[a]	2 and larger	1.5	(0.46)

[a] A luminaire may be tested with shorter lengths of conduit if it is intended to have a sealing fitting attached to conduit sizes less than 2 inches, lengths less than 18 inches, or both, and the valve is marked as specified in 74.29.

26.6 Any gasket provided in addition to a required joint is to be removed for the explosion tests.

26.7 For the explosion tests, the enclosure is to be installed in a test chamber that has inlet and outlet connections to the lines carrying the explosive mixture. The enclosure to be tested is to be tapped with threaded holes for connection to the inlet or outlet lines carrying the explosive mixture, attachment of explosion-pressure recording devices, and insertion of a spark plug for ignition. The length of conduit attached to a wiring compartment is to be used for inlet or outlet connection to the lines carrying the explosive mixture. A spark plug is to be located in the length of conduit at a distance of about 4 inches (102 mm) from the outer end of the conduit. The explosive mixture is to be prepared by auxiliary equipment capable of maintaining predetermined concentrations of the mixture.

26.8 The explosive mixture is to be allowed to flow into the enclosure being subjected to explosion tests and into the test chamber until all of the original air has been displaced. Samples are to be taken for analyses from the test chamber, within the enclosures subjected to tests, and the line carrying the explosive mixture. The mixture within the enclosure being tested is then to be ignited by a spark plug.

26.9 Electronic waveforms recorded from pressure sensing devices are to be smoothed using either a 2-kilohertz filter or a computer simulation of a 2-kilohertz filter.

26.10 If a luminaire is intended to be provided with a paint or other coating on a threaded joint surface or on threads of an opening for conduit, the explosion tests are also to be conducted on a sample provided with such coating. See 20.1, Exception No. 4, Item (a).

26.11 An enclosure of a luminaire for Class I, Group A or B locations, or both, that has flat or rabbet-type joints is to be tested with the joints reduced to 75 percent of the total joint width to be used and with the joints shimmed to give a clearance of 50 percent greater than the clearance to be used.

26.12 An enclosure of a luminaire for Class I, Group A or B locations, or both, that has threaded joints, is to be tested with a threaded engagement of 75 percent of the total number of engaging threads to be provided in production. The lateral clearance at the threaded joint is to be the maximum obtainable in production luminaires, including maximum manufacturing tolerances.

26.13 An enclosure of a luminaire for Class I, Group A or B locations, or both, that has a free internal volume greater than 30 cubic inches (492 cm^3) and that has a shaft passing through the enclosure is to be tested with the metal-to-metal shaft path reduced to 75 percent of the total path length.

26.14 Except for a surgical type, a lighting luminaire provided with a venting section – see 11.2.1.2 – is to be subjected to an additional series of ten explosion tests with 75 percent of the venting area sealed.

26.15 An enclosure of a luminaire that has a labyrinth joint is to be tested with the joint width reduced to 75 percent and the joint clearance increased by 50 percent.

26.16 A threaded polymeric-to-polymeric joint is to be tested with the threaded engagement of 75 percent of the total number of engaging threads to be provided in production.

26.17 The explosive mixtures to be used in the explosion tests are as specified in Table 26.2.

Table 26.2
Explosive mixtures for explosion test

Class I hazardous location group	Material	Flammable range, percent by volume
A	Acetylene	5.0 – 20.0
B	Hydrogen	15.1 – 35.0
C	Ethylene	4.0 – 9.0
D	Propane	3.0 – 7.0

26.18 For explosion-proof equipment specified and marked for use at ambient temperatures lower than minus 25°C (minus 13°F), the explosion tests shall be determined by one of the following methods:

a) For explosion-proof equipment specified and marked for use at ambient temperatures lower than minus 25°C (minus 13°F), the explosion tests shall be performed at the minimum ambient specified, ±5°C (±9°F) degrees. When the ambient specified is such that common materials within the Group are not flammable, a test temperature shall be specified that represents the minimum temperature at which the test gasses shown in Table 28.1 remain gasses, or

b) For equipment for use in Group C or D classified locations, rated not less than minus 60°C (minus 76°F), not subject to pressure piling, and determined to comply with the flame propagation requirements in 26.3, the equipment shall alternatively be subjected to the hydrostatic pressure test using the test factors for low ambient rated equipment found in Table 28.1, based upon room ambient explosion pressure tests, or

c) The reference pressure shall be determined at room ambient temperature using the defined test mixture(s), but at increased pressure. The absolute pressure of the test mixture (P) shall be calculated by the following formula, using T_a in °C:

$$P = 100[293 / T_a, \min + 273)] \ (kPa)$$

or

$$P = 14.6959[293 / T_a, \min = 273)] \ (psi)$$

26.18A.1 For explosion-proof equipment specified and marked for use at ambient temperatures greater than 60°C (140°F), in addition to the tests of 26.18, flame propagation tests shall be conducted under one of the following conditions:

1) At a temperature not less than the specified maximum ambient temperature; or

2) At normal ambient temperature using the defined test mixture at increased pressure according to the factors in Table 26.18A; or

3) At normal atmospheric pressure and temperature, but with the test gap increased by the factors noted in Table 26.18A.

These tests are in addition to the explosion tests required to determine compliance with 26.2(b) and 26.3(a).

26.18A.1.1 All test sample joints are to be based upon the manufacturers maximum specified gap, and tested with the minimum specified joint length. Specially prepared test samples having modified joint lengths, gaps and engagements shall be employed. For Groups A, B, or A and B, test factors per 26.11 through 26.16 are also required to be introduced into the test pressure or test gap in addition to the test factors above.

Table 26.18A
Test factors to increase pressure or joint test gap

Temperature up to °C	Groups A & B 27.5% H2 7.5% C2H2	Group C 37% H2	Group D 55% H2
60	1.00	1.00	1.00
70	1.11	1.04	1.05
80	1.13	1.05	1.06
90	1.15	1.06	1.07
100	1.16	1.06	1.08
110	1.18	1.07	1.09
120	1.20	1.08	1.10
130	1.22	1.09	1.11

26.19 When a sealing material is applied to a joint surface in accordance with Exception No. 1 to 20.1, the explosion tests are to be conducted both with and without the sealing material in place.

27 Tests on Luminaires with Fuses

27.1 A luminaire for Class I locations having fuses shall be subjected to overload and short-circuit tests on the fuses to determine adverse effects caused by opening of the fuses in explosive gas- or vapor-air mixtures.

Exception: A luminaire having cartridge fuses filled with noncombustible granular material need not be subjected to the additional overload and short-circuit tests, if the luminaire is marked in accordance with the requirements in 74.25.

28 Hydrostatic Pressure Test

28.1 The enclosure of a luminaire for Class I locations that is subjected to explosion tests shall withstand for 10 seconds, without rupture or permanent distortion, an internal hydrostatic pressure in accordance with Table 28.1 based on the maximum pressure obtained in the explosion tests on the enclosure.

Exception No. 1: The hydrostatic pressure test is not required to be performed when material strength calculations indicate a factor of safety based on the maximum internal explosion pressure. The safety factor shall be as specified in Table 28.1.

Exception No. 2: When the production-line hydrostatic pressure test specified in Section 73, Hydrostatic Pressure Test, is conducted, the pressure for the hydrostatic test is not required to exceed:

a) 2.25 times the maximum internal explosion pressure, and more than 345 kPa (50 psig) when the maximum pressure rise takes place in more than 5 milliseconds; or

b) 3 times the maximum internal explosion pressure, and more than 345 kPa (50 psig), when the maximum pressure rise takes place in less than 5 milliseconds.

28.2 The hydrostatic test pressure for an enclosure of a luminaire with a venting section is to be based on the maximum explosion pressure obtained with 75 percent of the vented area sealed if this series of explosion tests is required by 26.14.

Table 28.1
Safety factors for determining the strength of an enclosure

Enclosure material or part	Test factor for hydrostatic pressure test for ambient to minus 25°C[b]	Test factor for hydrostatic pressure test for ambient to C[a]			Test factor for calculations to
		Minus 40°C	Minus 50°C	Minus 60°C	Minus 25°C
Cast metal	4	6	6	6.5	5
Non-metallic other than glass	4	c	c	c	4
Glass	4	6	6	6.5	c
Fabricated steel and aluminum	3[d]	4.5	4.5	4.8	4
Cover bolts or screws	3	4	4.5	4.8	3

[a] For equipment in accordance with 26.18, where the equipment is not subject to pressure piling.

[b] Applies to equipment tested in accordance with 26.18A.1 (1) and (3).

[c] Undefined.

[d] The enclosure shall withstand a hydrostatic pressure of at least twice the maximum internal explosion pressure without permanent distortion and at least three times the maximum internal explosion pressure without rupture.

28.3 A conduit seal in factory-sealed equipment shall withstand for 10 seconds, without rupture or permanent distortion, a hydrostatic test pressure of four times the maximum explosion pressure obtained on each side of the seal. When excessive leakage results in the inability of the test apparatus to maintain the required pressure in a test of a seal for 2.0 inch (60.3 mm OD) or larger trade-size conduit with wires sealed in place, equipment with a seal but without wires is to be used.

Exception: Equipment having a factory-installed conduit seal that is not subjected to explosion tests on the conduit side of the seal shall withstand without rupture or permanent distortion the applicable hydrostatic test pressure specified in Table 28.2.

Table 28.2
Hydrostatic pressures for factory-installed conduit seals

Conduit trade size		Required hydrostatic pressure for Class I hazardous locations psig (MPa)			
inches	(mm OD)	Group A	Group B	Group C	Group D
1/2 – 2	(21.3 – 60.3)	6000 (41.4)	6000 (41.4)	1200 (8.3)	600 (4.1)
2-1/2 – 6	(73.0 – 177.8)	4000 (27.6)	4000 (27.6)	1200 (8.3)	600 (4.1)

28.4 The hydrostatic test pressure for an enclosure with a venting section is to be based on the maximum explosion pressure obtained with 75 percent of the vented section sealed.

28.5 The hydrostatic pressure is to be applied at a rate of 100 – 600 psig (690 – 4137 kPa) per minute until the required internal pressure is reached. Gaskets or other means are not prohibited from being used to prevent leakage of water during application of pressure.

29 Dust-Penetration Test

29.1 An enclosure of a luminaire for Class II locations shall be exposed for at least six heating and cooling cycles and for at least 30 hours to a circulating dust-air atmosphere to determine that the luminaire is dust-ignition-proof with regard to exclusion of dust. There shall be no entrance of the dust into the device as determined by visual examination following the test described in 29.2. Also see Compression Set, Section SA5 of Supplement SA.

29.2 The luminaire is to be installed in a test chamber to permit free circulation of the dust-air mixture around the luminaire. The test chamber is to be provided with a cover and with dust-air-inlet and -outlet connections. The luminaire is to be exposed to the dust-air atmosphere that is to be produced by auxiliary apparatus and introduced into the test chamber.

29.3 The tests are to be conducted at an ambient temperature of 10 – 40°C (50 – 104°F) and a relative humidity of 40 – 60 percent.

29.4 Grain dust consisting of wheat or corn dust, or both, that has passed through a U.S.A. Standard 150-micron (100-mesh) wire cloth is to be used for the dust-air atmosphere if the luminaire is for Class II, Group F, Group G, or Groups F and G locations.

29.5 Magnesium dust, all of which has passed through a U.S.A. Standard 250-micron (60-mesh) wire cloth, 66 percent of which has passed through a 150-micron (100-mesh) wire cloth, and 22 percent of which has passed through a 75-micron (200-mesh) wire cloth, is to be used for the dust-air atmosphere if the luminaire is for Class II, Group E, Groups E and F, Groups E and G, or Groups E, F, and G locations.

29.6 The wire cloth specified in 28.4 and 28.5 is to conform to the dimensional requirements for Specification for Wire-Cloth Sieves for Testing Purposes, ASTM E11.

29A Dust-Penetration Test

29A.1 A luminaire enclosure having joints in compliance with 12.1 – 12.7 shall be permitted to be subjected to the test of 29A.2 following any Aging Tests of 11.1.12 item c) or Section 37, as are applicable.

29A.2 The luminaire enclosure shall first be subjected to the Pressure Test of 29A.3 followed by the Dust Exclusion Test of 29A.4.

29A.3 Pressure Test - A positive internal pressure of at least 4 ± 0.4 kPa shall be applied to the luminaire enclosure for $60\ ^{+10}_{0}$ s. Any breathing or draining device may be sealed for this test if the pressure cannot be maintained. Any seals of the breathing or draining device shall be removed and the sample shall be subjected to the Dust Exclusion Test in the condition it is in after the completion of this test.

29A.4 Following the Pressure Test of 29A.3, the Dust Exclusion Test shall be performed in accordance with ANSI/IEC 60529 for IP 6X, except that the level of depression shall be increased to at least 4 kPa for a period of at least 8 h. There shall be no entrance of the dust into the luminaire enclosure as determined by visual examination following the test.

30 Thermal Shock Test

30.1 A luminaire that is marked "Suitable for Wet Locations " is to be operated under the conditions of the temperature test (see Section 25) until equilibrium temperatures are reached. Approximately 1-3/4 ounces (0.052 L) of ice water at a temperature not greater than 1.1°C (34°F) is then to be splashed against the area of the light transmission part having the highest temperature. There shall be no cracking or breaking of the light transmission part as a result of the test.

31 Rust-Resistance Test

31.1 An enclosure of ferrous metal other than stainless steel shall show no visible rust at the conclusion of the test specified in 31.2.

Exception No. 1: Locations where protection is impractical, such as sliding surfaces of hinges, need not comply with this requirement.

Exception No. 2: Joint surfaces, conduit threads, shafts, and the like, need not comply with this requirement.

31.2 The enclosure or representative parts of the enclosure are to be subjected to a salt spray (fog) in accordance with the Standard Test Method of Salt Spray (Fog) Testing, ASTM B117 employing a 5 percent by weight salt solution for 24 hours. At the end of the test, the specimens are to be removed from the chamber, washed in clean running water not warmer than 100°F (37.8°C) to remove all salt deposits from the surface, and dried immediately. Corrosion products, other than rust, may be removed by light brushing if required to observe corrosion of the underlying surface.

32 Test for Secureness of Conduit Hubs

32.1 General

32.1.1 A conduit hub in a polymeric enclosure or a hub not integrally cast with a metal enclosure shall withstand the torque specified in Table 32.1 applied to a short length of rigid conduit threaded into the hub

of the enclosure in the intended manner, without turning in the enclosure and without stripping of any threads.

Table 32.1
Torque

Trade size of conduit, inches	Torque, pound-inches (N·m)	
1/2 and 3/4	800	(90.4)
1, 1-1/4, and 1-1/2	1000	(112.9)
2 and larger	1600	(180.8)

32.1.2 A conduit hub in a polymeric enclosure shall not pull apart or otherwise be damaged, such as cracked or broken, when subjected to the pullout and bending tests described in 32.2.1 and 32.3.1.

32.2 Pullout

32.2.1 A length of rigid conduit is to be installed as intended in the conduit hub. A pulling force of 200 pounds (890 N) is to be applied for 5 minutes in a direction parallel to the conduit.

32.3 Bending

32.3.1 A length of rigid metal conduit at least 1 foot (305 mm) long of the intended size is to be installed in a conduit hub. The enclosure is to be securely mounted as intended in service, but positioned so that the installed conduit extends in a horizontal plane. A weight is to be suspended from the end of the conduit to produce the bending moment specified in Table 32.2. The magnitude of the weight is to be determined from the equation:

$$W = \frac{M - 0.5CL}{L}$$

In which:

W is the weight, in pounds, to be hung at the end of the conduit;

L is the length of the conduit, in inches, from the wall of the enclosure to the point at which the weight is suspended;

C is the weight of the conduit in pounds; and

M is the bending moment required, in pound-inches.

For the SI system of units, the equation is

$$W = \frac{0.1M - 4.9CL}{L}$$

in which:

W and C are measured in kilograms,

M is in newton-meters, and

L is in meters

Table 32.2
Bending moment

Normal mounting plane of enclosure surface[a]	Conduit trade size, inches	Bending moment, pound-inches[b] (N·m)
Horizontal	All	300 (33.9)
Vertical	1/2 – 3/4	300
	1 and larger	600 (67.8)

[a] If the enclosure surface may be installed in either a horizontal or a vertical plane, the vertical bending moment value is to be used.

[b] The test procedure may be terminated prior to attaining the values specified if the deflection of the conduit exceeds 10 inches (255 mm) for a 10-foot (3.05 m) length of conduit.

33 Vibration Test

33.1 A luminaire assembly intended for use where subject to vibration (for example, a luminaire supported by conduit trunnion, or pole) is to be subjected for 35 hours to the vibration test described in 33.2 – 33.5. There shall be no damage to the joints or other explosion-proof or dust-ignition-proof features of construction.

33.2 A luminaire, complete with reflector and guard attached, is to be mounted in its intended mounting position for the test with the threaded hub connected to the lower end of a vertical length of threaded rigid conduit, 26-1/2 inches (673 mm) long, the upper end of which is to be screwed into a threaded hub of a rigidly mounted frame. The size of the vertical conduit is to correspond to the smallest size of threaded conduit hub that may be provided on the luminaire. Among the factors to be taken into consideration during selection of samples are:

a) Luminaire size and mass;

b) Mounting;

c) Globes, refractors, and similar optics;

d) Reflectors; and

e) Options such as alternative guards.

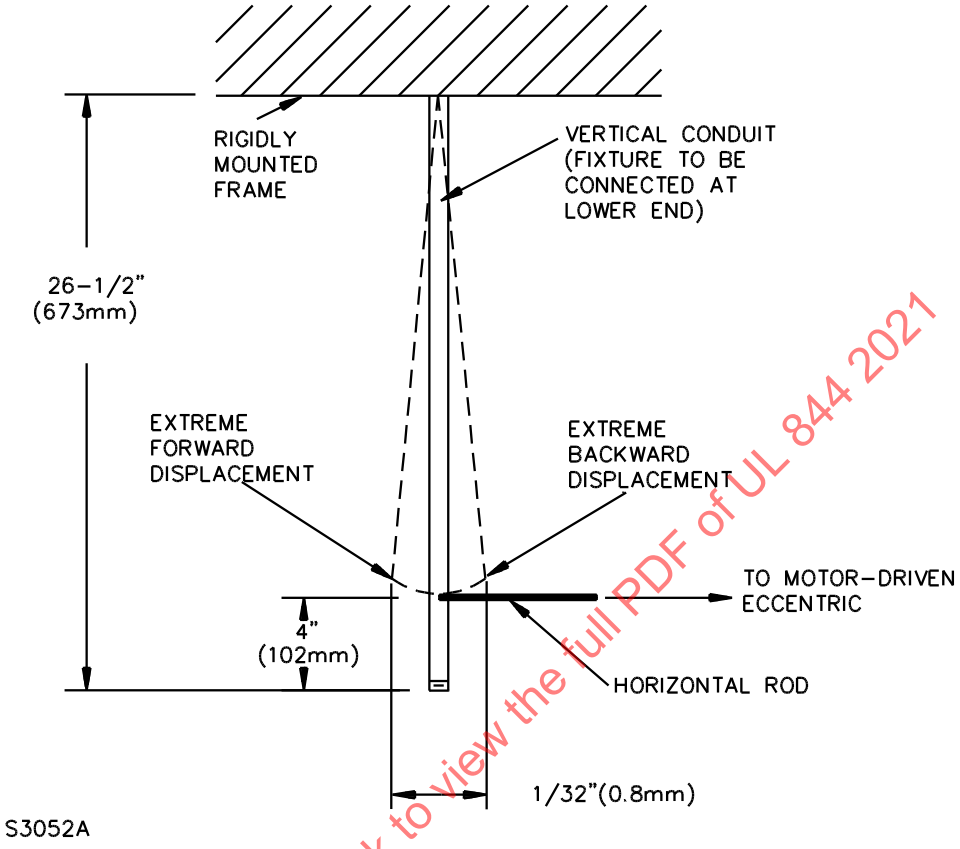
33.3 A horizontal rod is to be securely fastened to the vertical conduit at a point 4 inches (102 mm) above the lower end of the conduit in order to transmit a vibratory motion to the conduit from a motor-driven eccentric. The horizontal movement in each direction of motion as illustrated in Figure 33.1 is to be 1/32 inch (0.8 mm) at a frequency of 2000 cycles per minute. The total travel for each complete cycle is to be 1/16 inch (1.6 mm). The vibration test setup for luminaires intended for stanchion, yoke, or trunnion mounting is illustrated in Figure 33.2.

33.4 If several reflectors are provided, the one with the largest diameter is to be attached to the luminaire.

33.5 If the luminaire, such as a fluorescent lamp luminaire, has two threaded conduit hubs for conduit suspension, only one of the hubs is to be connected to the vibration machine; the other hub is to be connected to a vertical length of conduit in the normal manner.

Figure 33.1

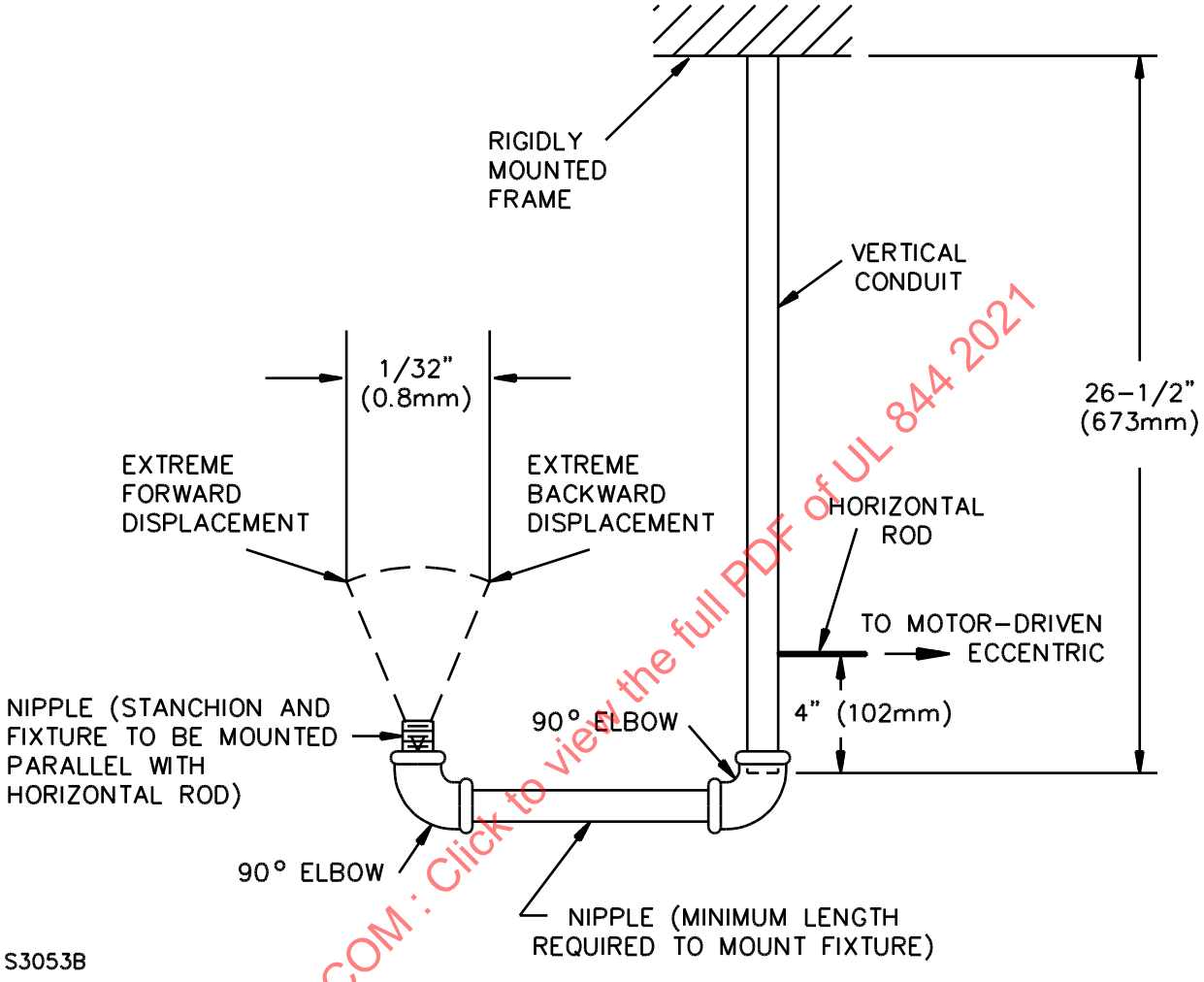
Illustration of vibration test displacement



(See 32.3)

Figure 33.2

Vibration test setup for stanchion, yoke, or trunnion mounted luminaires



34 Electrical Resistance Test

34.1 The resistance of the grounding path at threaded joint surfaces or a threaded conduit opening on which a metallic paint or non-insulating coating has been applied shall not exceed 0.003 ohm.

34.2 A direct or alternating current of 50 amperes is to be passed between the two points specified in 34.3 and the resulting drop in potential is to be measured between these points. The resistance in ohms is to be determined by dividing the drop in potential in volts by the current in amperes passing between the two points.

34.3 For threaded joint surfaces, the voltage drop is to be measured between two points, one on each of the two parts of the equipment that comprise the joint. For a conduit opening, the voltage drop is to be measured between two points, one on the equipment adjacent to the opening and the other on a length of conduit connected to the opening, and located 1/16 inch (1.6 mm) from the equipment.

35 Non-Metallic Enclosure Materials Tests – Class I

35.1 General

35.1.1 Non-metallic materials shall comply with the requirements in either 35.2 or 35.3, and shall comply with the requirements in 35.4.

35.1.2 Non-metallic electrical enclosures shall comply with the requirements in the Standard for Enclosures for Electrical Equipment, Non-Environmental Considerations, UL 50 Polymeric Enclosures/Parts, Polymeric Enclosure Rigid Metallic Conduit Connection Test and Polymeric Enclosure Bonding Test.

35.2 Chemical compatibility by material samples

35.2.1 Samples with like dimensions are to be prepared according to the requirements in Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics, ANSI/ASTM D256, and Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials, ANSI/ASTM D790.

35.2.2 The values for the following physical properties are to be determined using as-received specimens and specimens that have been subjected to chemical exposure. A set of five as-received specimens each shall be tested to determine the as-received values:

a) Resistance to impact in accordance with Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics, ANSI/ASTM D256;

b) Flexural properties in accordance with Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials, ANSI/ASTM D790; and

c) Changes in weight and dimensions.

35.2.3 For each of the following test chemicals, a set of three sets of 5 samples [5 specimens each for 35.2.2 (a) – (c)] shall be exposed to a 100 percent saturated vapor in air of the chemical at 20°C to 25°C (68°F to 77°F) for a period of 7 days:

a) Acetic Acid (Glacial);

b) Acetone;

c) Ammonium Hydroxide (20% by weight);

d) ASTM reference fuel C;

e) Diethyl Ether;

f) Ethyl Acetate;

g) Ethylene Dichloride;

h) Furfural;

i) n-Hexane;

j) Methyl Ethyl Ketone;

k) Methanol;

l) 2-Nitropropane; and

m) Toluene.

Exception: The manufacturer is not prohibited from marking specific chemical atmospheres in which the product is to be used and test for those chemical exposures only.

35.2.4 The physical property values after chemical exposure shall not be less than 85 percent of the values determined using as-received samples for 35.2.2 (a) and (b).

Exception: A material that has values less than 85 percent and not less than 50 percent of the as-received values meets the intent of this requirement when it complies with the explosion and hydrostatic tests conducted on the complete sample subjected to the chemical exposure.

35.2.5 With regard to 35.2.2(c), shrinkage or weight loss shall not exceed 1 percent.

Exception: A material whose shrinkage or weight loss exceeds 1 percent of the as-received values meets the intent of this requirement when it complies with the explosion and hydrostatic tests conducted on the complete sample subjected to the chemical exposure.

35.2.6 A set of three complete enclosure samples shall be subjected to the following tests:

a) Accelerated aging as specified in 35.3.3; and

b) Flamepath erosion test as specified in 35.3.5.

35.3 Chemical compatibility by complete end product tests

35.3.1 Sixteen (16) complete samples are to be tested as specified in 35.3.2 – 35.4.3.5.

35.3.2 For each of the following test chemicals, one enclosure shall be exposed to a 100 percent saturated vapor in air of the chemical at 20°C to 25°C (68°F to 77°F) for a period of 7 days:

a) Acetic Acid (Glacial);

b) Acetone;

c) Ammonium Hydroxide (20% by weight);

d) ASTM reference fuel C;

e) Diethyl Ether;

f) Ethyl Acetate;

g) Ethylene Dichloride;

h) Furfural;

i) n-Hexane;

j) Methyl Ethyl Ketone;

k) Methanol;

l) 2-Nitropropane; and

m) Toluene.

Exception: The manufacturer is not prohibited from having an enclosure evaluated, and marked only for specific chemical atmospheres for which the product is intended.

35.3.3 Three separate enclosure samples are to be conditioned in an oven at a temperature (T_2) and for a length of time (D) determined in accordance with the following:

$$D = \frac{18262.5}{2^{(\Delta T/10)}}$$

$$T_2 = T_1 + 10\left(\frac{In\frac{18262.5}{D}}{In\ 2}\right)$$

in which:

D is the test time in days;

T_1 is the maximum temperature in °C obtained on the enclosure in a temperature test under normal operating conditions;

T_2 is the test oven temperature in °C;

ΔT is T_2 minus T_1.

Hygroscopic materials (most notably nylons) are not prohibited from being rehydrated in an ambient of 50 ±10 percent Relative Humidity, 23 ±3°C (73 ±5.5°F) for 48 hours prior to materials testing. Either the test time in days (D) or the test temperature (T_2) is to be selected by the manufacturer based upon the aging properties of the material. The number of days (D) selected shall not be less than 30.

Exception: Aging less than 30 days, for polymers with known aging behavior (such as having an assigned Relative Temperature Index, RTI), meets the intent of this requirement. However, no test temperature shall be greater than 50°C (122°F) above the maximum temperature used to establish the RTI.

35.3.4 The three samples subjected to the accelerated aging test of 35.3.3 and each of the samples subjected to the solvent vapor exposure tests shall be individually subjected to the Hydrostatic Pressure Test, Section 28, based on the test pressure obtained during the explosion pressure tests conducted as described in Explosion Tests, Section 26.

35.3.5 Samples subjected to the solvent vapor exposure test of 35.3.2 or accelerated aging test of 35.3.3, shall exhibit no visual erosion of any flamepath when subjected to 100 additional flame propagation tests using the test method from Explosion Tests, Section 26.

35.4 Test for Accumulation of Static Electricity

35.4.1 General

35.4.1.1 A nonmetallic external part with an area greater than 15.5 in^2 (100 cm^2) shall comply with either the requirements in 35.4.2 or 35.4.3.

35.4.2 Method A

35.4.2.1 Any non-metallic surface with area greater than 15.5 in^2 (100 cm^2) shall have a surface resistivity of 1 GΩ or less at 23°C (73°F) and 50 percent relative humidity as defined by the material specifications or as determined by the test in 35.4.2.2.

35.4.2.2 The resistance is to be tested on the enclosure or on parts of the enclosure. Two parallel electrodes 0.04 inch (1 mm) in width, 4 inches (100 mm) in length, 0.4 inch (10 mm) apart are to be centered on a 6 by 2.4 inch (150 mm by 60 mm) sample. The sample is to be cleaned with distilled water, then with isopropyl alcohol, then once more with distilled water before being dried. Untouched by bare hands, it is to be conditioned for 24 hours at 23°C (73°F) and 50 percent relative humidity. The test is to be carried out under the same conditions. A direct voltage of 500 ±10 Vdc is to be applied for one minute. The resistance is the quotient of the direct voltage applied at the electrodes to the total current flowing between them when the direct voltage has been applied for one minute.

35.4.3 Method B

35.4.3.1 A nonmetallic external part with an area greater than 15.5 in^2 (100 cm^2) shall be subjected to the test specified in 35.4.3.2 – 35.4.3.5.

35.4.3.2 No sparks shall be observed when a grounded metal sphere is brought into gradual contact with the nonmetallic part, mounted as intended, after it has been electrostatically charged.

35.4.3.3 Three samples of the part are to be conditioned for at least 48 hours at a relative humidity of 25 ±10 percent.

35.4.3.4 Immediately after removal from the low-humidity chamber, the samples are to be supported by means of insulators in a room having a relative humidity not more then 35 percent and having all sources of light, other than electrical sparks, eliminated. An electrostatic charge is to be sprayed on non-conductive parts of the product using a Van de Graaf generator limited to 5000 volts.

35.4.3.5 A 3/8 inch (9.5 mm) diameter grounded metal sphere is to be brought into gradual contact with the non-conductive area of the sample.

36 Tests on Sealing Compounds

36.1 A sealing compound used in Class I equipment shall be subjected to the tests described in 36.2 – 36.7 to determine its resistance to chemicals.

36.2 The resistance to crushing of the sealing compound is to be determined on as-received specimens and specimens exposed to chemical vapors. The crushing force after exposure is to be at least 85 percent of the value determined using as-received samples. In addition, changes in dimensions and weight after

exposure are to be determined. Shrinkage or loss of weight of more than 1 percent or an increase in weight or swelling that changes the intended properties of the sealing compound does not meet the intent of the requirement. See 36.8.

36.3 Cylindrical specimens 1/2 inch (12.7 mm) in diameter and 3/4 inch (19.1 mm) long are to be used for the tests. At least 81 specimens are required – six for each chemical and three for as-received tests. The samples shall be of uniform size and shape, having both ends perpendicular to the side of the cylinder.

36.4 The specimens are to be exposed for 168 hours (7 days) to saturated vapors in air of the chemicals specified in 35.2.3.

36.5 During and after the exposure, the specimens are to be observed for discoloration, swelling, crazing, cracking, leaching, or dissolving.

36.6 After the exposure, three specimens from each chemical exposure are to be weighed and measured immediately after removal from the chemical vapor.

36.7 The other three exposed specimens and the as-received specimens are to be placed between two parallel plates and crushed with a compression-testing machine having a crosshead speed of 0.1 inch (2.54 mm) per minute. The load is to be applied perpendicular to the axis of the cylindrical specimens and the compressive force required to crack and break the specimens is to be recorded.

36.8 As an alternative, tests to determine resistance of the sealing compound to chemicals shall be conducted on a complete sample that incorporates the sealing compound as intended in the final assembly, without cable or conductors. These tests are to consist of explosion and hydrostatic pressure tests in accordance with Explosion Tests, Section 26 and Hydrostatic Pressure Test, Section 28 on the complete sample after the sample has been exposed to the chemicals specified in 35.3.2. There shall be no flame propagation, rupture, cracking, breakage, or other damage to the sealing compound.

37 Non-Metallic Enclosure Tests – Class II

37.1 An enclosure made of a non-metallic material shall be subjected to tests to determine that it is equivalent to comparable metal enclosures that have been found suitable for use in Class II hazardous locations.

37.2 A non-metallic enclosure shall comply with the requirements in 35.3.3, Accelerated Aging Tests, 35.4, Tests for Accumulation of Static Electricity, and the Standard for Enclosures for Electrical Equipment, Non-Environmental Considerations, UL 50.

37.3 A non-metallic enclosure shall be such that the minimum widths of joints or shaft openings do not decrease nor the maximum clearances increase beyond those specified, under all conditions of use. In addition, tests shall show that no other adverse effects are expected to occur such as loosening of parts, reduction in electrical spacings, ignition of the material from an electrical arc, or accumulation of electrostatic charges.

37.4 Consideration is to be given to all variations in chemical composition, color percentage mix, or molecular weight.

37.5 Prior to the test of SA5.3, diffusers, globes, refractors, lenses and similar optics that are made from polymeric material shall be permitted to be subjected to short term-aging using the formula found in SA5.3 when all of the following applies:

a) The polymeric material which forms the optic portion shall conform with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B with an established RTI value, and used within this rating;

b) The polymeric material which forms the optic portion forms a part of a gasketed metal to polymeric joint;

c) Air temperature is conducted measuring the lens internal service temperature, in addition to all gasket internal service temperatures; and

d) The maximum internal service temperature is used in the aging formula in SA5.3.

For luminaires with a gasketed joint that is intended to be opened, the luminaire shall be opened and re-closed in accordance with the manufacturer's instructions prior to being subjected to the Dust-Penetration Test, Section 29 or 29A.

38 Leakage Test on Factory-Installed Conduit Seals

38.1 A factory-installed conduit seal shall not provide for the passage of more than 0.007 cubic foot (0.20 dm^3) of air per hour at a pressure of 6 inches (152 mm) of water.

38.2 The test is to be conducted with wires sealed in place, using the maximum number and size of wires and wire insulation for which the seal is intended.

PART II – LUMINAIRES FOR CLASS I, DIVISION 2, GROUPS A, B, C, AND D LOCATIONS

GENERAL

39 Details

39.1 Other than as noted in 39.2, a luminaire for use in Class I, Division 2 locations shall comply with the requirements for a luminaire for use in unclassified (ordinary) locations and with the requirements in Sections 40 – 42.

39.2 A luminaire for use in Class I, Division 2 locations, but requiring Division 1 constructional features, shall comply with the appropriate requirements for a Division 1 luminaire.

CONSTRUCTION

40 Enclosure

40.1 General

40.1.1 The electrical components shall be totally enclosed to prevent the escape of sparks or other hot particles.

40.1.2 The enclosure shall be formed and assembled so that it will have the strength and rigidity necessary to resist the abuses to which it is likely to be subjected without increasing the risk of fire due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects.

40.2 Supply connections

40.2.1 A luminaire shall have provision for connection to threaded rigid metal conduit or other wiring methods in accordance with Article 501 in the National Electrical Code, NFPA 70.

40.2.2 Each conduit opening shall comply with the requirements in 17.1.9, 17.1.10, 17.1.13, 17.1.15, 17.1.16, 17.2.2, and 17.2.3.

40.2.3 If an integral conduit stop is provided in a conduit opening, the threads may be of the straight type or tapered 3/4 inch per foot (62.5 mm/m).

40.2.4 If an integral conduit stop is not provided in a conduit opening, the threads shall be tapered 3/4 inch per foot (62.5 mm/m).

40.2.5 A conduit opening shall be provided with not less than 3-1/2 threads.

40.2.6 All openings for connection to conduit, except those necessary for installation, shall be furnished with metal plugs engaging at least three full threads.

40.3 Luminaires for wet locations

40.3.1 A luminaire for Class I, Division 2 locations marked "Suitable for Wet Locations" shall comply with the requirements in Luminaires for Wet Locations, Section 24.

40.4 Protection against corrosion

40.4.1 All ferrous-metal parts shall be protected against corrosion by zinc or cadmium coating, plating, enameling, painting, varnishing, or lacquering. A luminaire shall also comply with the requirements in 19.2 and 19.3.

Exception: Protection against corrosion need not be provided for stainless steel parts.

41 Arcing and Sparking Parts

41.1 An arcing or sparking part – such as a switch, a circuit breaker, a starter, a fuse, or the like – shall be housed in an enclosure complying with the requirements for an enclosure for use in Class I, Division 1 locations unless:

a) The part is a ballast marked "Type HL" in accordance with the requirements in the Standard for Fluorescent-Lamp Ballasts, UL 935.

b) The part is a cartridge fuse used as supplementary protection and the luminaire is marked in accordance with the requirements in 74.24.

c) The part is a ballast having a thermal protector which is fully submerged in a potting compound, or

d) The part complies with the requirements in the Standard for Nonincendive Electrical Equipment For Use In Class I and II, Division 2, and Class III , Divisions 1 and 2 Hazardous (Classified) Locations, ANSI/ISA-12.12.01.

PERFORMANCE

42 Temperature Test

Note: For the purposes of determination of the operating temperature or temperature code, the methodology is identical to the methodology for the normal temperature test in the Standard for Luminaires, UL 1598.

42.1 A luminaire shall be tested under the conditions described in 42.5 – 42.16.

42.2 Except as noted in 42.4, the operating temperature or temperature class is to be based on operation in a 40°C (104°F) ambient. If the temperature class is provided in lieu of the temperature, it shall be as specified in Table 74.1.

42.3 For a luminaire intended and marked for use where Class I and Class II conditions may exist simultaneously, the marked operating temperature or temperature code shall be based on the temperature attained during the test with dust blanket. See 25.25 and 74.15.

42.4 For a luminaire marked for use in an elevated ambient, the operating temperature or temperature class shall be based on operation in the elevated ambient for which the luminaire is marked.

42.5 Temperatures are to be measured on all parts of the luminaire including the lamp.

42.6 An incandescent-lamp luminaire is to be operated at rated maximum wattage. The test is to be continued until equilibrium temperatures are attained.

42.7 Except as noted in 42.8, an electric-discharge lamp luminaire is to be operated at the voltage and the frequency specified for the control equipment until equilibrium temperatures are attained.

42.8 A high-intensity-discharge lamp luminaire employing a self-ballasted lamp is to be operated at rated lamp wattage.

42.9 A high-intensity-discharge lamp luminaire is to be operated as described in 25.9 – 25.12.

42.10 The luminaire is to be mounted as intended in a room that has provisions for maintaining the intended ambient temperature. The air flow in the test room is not to exceed 30 feet per minute (0.15 m/s). Temperature variations of not more than 5°C (9°F) from the intended ambient are to be added to or subtracted from the observed temperature readings.

Exception: Temperature variations of more than 5°C (9°F) may be added to the observed temperature reading, as necessary, if agreeable to those concerned.

42.11 The temperature on a ballast of a luminaire is to be measured by the change-of-resistance method. Thermocouples are to be used for measuring the temperature of other parts of a luminaire.

42.12 Except as noted in 42.13, a temperature test to determine operating temperatures is to be conducted at an ambient of 40°C (104°F).

42.13 To determine operating temperatures of a luminaire that is marked for use in an elevated ambient, the test is to be conducted at the elevated ambient for which the luminaire is marked.

42.14 Except as noted in 42.15, to determine compliance with ordinary location requirements, temperatures of internal components such as ballasts, lampholders, and lead wires are to be based on tests conducted at a 25°C (77°F) ambient. See 74.21.

42.15 To determine temperatures of internal components of a luminaire intended for use in an elevated ambient, the test is to be conducted at the elevated ambient.

42.16 In conducting the temperature tests, consideration is to be given to the heat transmission of a color-corrective glass cylinder and to the effect of other components such as a colored globe, a reflector, or a guard, if provided.

PART III– LUMINAIRES FOR CLASS II, DIVISION 2, GROUPS F AND G AND CLASS III LOCATIONS

GENERAL

43 Details

43.1 A luminaire for Class II, Division 2, Group F, Group G, Groups F and G or Class III locations shall comply with the requirements for a luminaire for use in unclassified locations and with the requirements in Sections 44 – 49.

CONSTRUCTION

44 Enclosure

44.1 Electrical components shall be totally enclosed to exclude the entrance of dust and to prevent the escape of sparks or other hot particles.

44.2 An enclosure that is of the gasketed type and is intended to exclude the entrance of dust shall be tested as described in Temperature Test, Section 48 and in Dusttight Enclosure Test, Section 49. A gasket shall comply with the requirements in 12.3 and 12.4. The width of joints and the maximum joint clearances are not specified.

44.3 A gasket that is employed to make an enclosure dust-tight shall be mechanically secured or captive if it is at a joint that is opened for wiring or for maintenance such as relamping.

44.4 The enclosure shall comply with the requirements in Section 40, Enclosure.

45 Supply Connections

45.1 A luminaire shall have provision for connection of rigid metal conduit or other wiring methods in accordance with Article 502 for Class II and Article 503 for Class III locations in the National Electrical Code, NFPA 70.

45.2 A conduit opening having an integral conduit stop shall be provided with at least five full threads.

45.3 A conduit opening having an integral conduit stop shall be provided with at least five full threads.

a) A smooth and well-rounded integral conduit stop, having a throat or inner diameter as specified in Table 17.1;

b) A smooth and well-rounded inner end as shown in Figure 17.1; or

c) Threads not exceeding the maximum number specified in Table 17.2 for the conduit size.

Exception: The opening need not comply with this requirement if instructions are provided in accordance with 74.27.

45.4 If an integral conduit stop is provided, it shall be smooth and well-rounded, having a throat or inner diameter as specified in Table 17.1, except as noted in 45.5.

45.5 If a luminaire has a single hub and the wiring compartment of the luminaire would not be expected to be used for through wiring during installation, the throat diameter for conduit sizes greater than 1/2-inch trade size (21.3 mm OD) may be less than that specified in Table 17.1 but not less than 0.560 inch (14.22 mm).

45.6 If an integral conduit stop is provided in a conduit opening, the threads may be of the straight type or tapered 3/4 inch per foot (62.5 mm/m).

45.7 If an integral conduit stop is not provided in a conduit opening, the threads shall be tapered 3/4 inch per foot (62.5 mm/m).

45.8 If the threads for the connection of conduit are tapped all the way through a hole in an enclosure wall, there shall not be less than 3-1/2 full threads.

45.9 All openings for connection to conduit, except those necessary for installation, shall be furnished with metal plugs engaging at least three full threads.

45.10 A conduit hub not integrally cast with an enclosure shall:

a) Have a wall thickness before threading not less than that of the corresponding trade-size conduit;

b) Not depend upon friction alone to prevent it from turning; and

c) Comply with the Test for Secureness of Conduit Hubs, Section .

45.11 Except as noted in 45.12, the conduit hub of a luminaire intended to be supported by conduit shall be provided with a setscrew to secure the luminaire to the conduit

45.12 The requirement in 45.11 applies to a luminaire, such as a pendant type, that has one conduit hub and can turn on the supporting conduit. The requirement does not apply to a luminaire, such as a fluorescent type, that is suspended at two or more points and cannot turn on the supporting conduit.

46 Control Devices

46.1 A control device such as a switch, a circuit breaker, a starter, a fuse, a ballast, and the like, shall be mounted within an enclosure that will exclude dust. See 44.1.

47 Protection Against Corrosion

47.1 All ferrous metal parts shall be protected against corrosion by zinc or cadmium coating, plating, enameling, painting, varnishing, or lacquering. A luminaire shall also comply with the requirements in 19.2 and 19.3.

Exception: Protection against corrosion need not be provided for a stainless steel part.

PERFORMANCE

48 Temperature Test

48.1 A luminaire shall be tested under conditions described in 48.2 – 48.16, and the temperatures shall not exceed 165°C (329°F).

48.2 The maximum temperature specified in 48.1 applies to the exterior of the luminaire.

48.3 Except as noted in 48.4, the operating temperature or temperature class is to be based on operation in a 40°C (104°F) ambient. If the temperature class is provided in lieu of the operating temperature, it shall be as specified in Table 74.1. See 74.11.

48.4 For a luminaire marked for use in an elevated ambient, the operating temperature or temperature class shall be based on operation in the elevated ambient for which the luminaire is marked.

48.5 An incandescent lamp luminaire is to be operated at rated maximum wattage. The test is to be continued until equilibrium temperatures are attained.

48.6 Except as noted in 48.7, an electric-discharge-lamp luminaire is to be operated at the voltage and the frequency specified for the control equipment until equilibrium temperatures are attained.

48.7 A high-intensity-discharge lamp luminaire employing a self-ballasted lamp is to be operated at rated lamp wattage.

48.8 A high-intensity-discharge lamp luminaire is to be operated as described in 25.9 – 25.12.

48.9 The luminaire is to be mounted as intended in a room that has provisions for maintaining the intended ambient temperature. The air flow in the test room is not to exceed 30 feet per minute (0.15 m/s). Temperature variations of not more than 5°C (9°F) from the intended ambient are to be added to or subtracted from the observed temperature reading.

Exception: Temperature variations of more than 5°C (9°F) may be added to the observed temperature reading, as necessary, if agreeable to those concerned.

48.10 The temperature of a ballast, if provided as part of the luminaire, is to be measured by means of the change-of-resistance method. Thermocouples are to be used for measuring the temperature of other parts of a luminaire.

48.11 Except as noted in 48.12, a temperature test to determine operating temperatures is to be conducted at an ambient of 40°C (104°F).

48.12 In determining operating temperatures of a luminaire that is marked for use in an elevated ambient, the test is to be conducted at the elevated ambient for which the luminaire is marked.

48.13 Except as noted in 48.15, to determine compliance with unclassified (ordinary) location requirements, temperatures of internal components such as ballasts, lampholders, and lead wires are to be based on tests conducted at 25°C (77°F) ambient. See 74.21.

48.14 To determine compliance with unclassified (ordinary) location requirements, internal temperatures of a luminaire intended for use in an elevated ambient, the test is to be conducted at the elevated ambient.

48.15 In conducting the temperature test, consideration is to be given to the heat transmission of a color-corrective glass cylinder and to the effect of other components such as a colored globe, a reflector, and a guard, if provided.

48.16 The luminaire is to be operated in air as described in 48.9 until temperatures are constant. The luminaire is then to be blanketed with grain dust as described in 25.23 and again operated until temperatures are constant. The maximum temperature to be used for determining compliance with the requirement in 48.1 and the marked operating temperature or temperature code, is to be calculated using the formula:

$$T = T_1 + \frac{T_2 - T_1}{2}$$

in which:

T is the calculated maximum temperature,

T_1 is the maximum temperature in air, and

T_2 is the maximum temperature with dust blanket.

49 Dusttight Enclosure Test

49.1 General

49.1.1 The enclosure is to be sprayed with atomized water and no water shall enter the enclosure.

49.1.2 A nozzle that produces a round pattern 3 – 4 inches (76 – 102 mm) in diameter, measured 12 inches (305 mm) from the nozzle, is to be used. The air pressure is to be 30 psi (207 kPa). The water is to be supplied by a suction feed with a siphon height of 4 – 8 inches (102 – 204 mm). Not less than 5 fluid ounces per linear foot (485 mL/m) of test length of the enclosure under test is to be applied at a rate of 3 gallons (11 L) per hour. The nozzle is to be held 12 – 15 inches (305 – 381 mm) from the enclosure, and the spray of water is to be directed at all points of potential dust entry, such as seams, joints, external operating mechanisms, and the like. A conduit may be installed to equalize the internal and external pressures, but is not to serve as a drain.

PART IV – PORTABLE LUMINAIRES

GENERAL

50 Details

50.1 These requirements cover portable luminaries for indoor use in hazardous (classified) locations, Class I, Division 1, Groups A, B, C and D, and Class II, Division 1, Groups F and G, in accordance with the National Electrical Code, NFPA 70.

50.2 Except as modified by this Part, portable luminaries shall also comply with the applicable requirements in Parts I, V and VI of this Standard.

51 Protection of Glass Parts

51.1 A substantial external guard, rim, or bosses shall protect glass parts of the lamp enclosure against damage upon overturning or dropping the lighting unit.

52 Seal Between Lamp and Terminal Compartments

52.1 A lead wire or conductor shall be securely held and tightly fitted where it extends through the wall between the lamp and terminal compartments. If a sealing compound or cement is used, it shall provide and maintain a tight fit, neither soften nor crack under service conditions, and not be less than 5/8 inch (15.9 mm) deep. The sealing compound shall neither flow nor creep at the operating temperature of the lighting unit. A sealing compound that softens upon the application of heat shall have a softening point of not less than 93°C (200°F) in accordance with the Standard Test Method for Softening Point by Ring-and-Ball Apparatus, ASTM E28. A seal provided between the lamp enclosure and the terminal compartment shall comply with the Tests For Sealing Compounds, Section 36.

53 Supply Connections

53.1 Cords, plugs, and provision for connection

53.1.1 A portable luminaire shall have provision for connection of an extra hard usage flexible cord as defined in Article 400 of the National Electrical Code, NFPA 70, with a grounding conductor. The construction of the terminal enclosure shall enable the cord to be readily replaced.

53.1.2 A surgical type luminaire shall have a cord and an attachment plug installed on the unit. The cord shall be an extra hard usage flexible cord as defined in Article 400 of the National Electrical Code, NFPA 70, and the plug shall be acceptable for at least the same hazardous locations as the unit and be of the configuration specified for use in hospital operating rooms.

53.1.3 The surface of the insulation of the equipment-grounding conductor of a power-supply cord shall be green with or without one or more yellow stripes and no other conductor shall be so identified. The equipment-grounding conductor shall be connected to the grounding terminal by means other than solder.

53.1.4 A portable luminaire other than the surgical type may be provided without a cord, an attachment plug, or both, if marked in accordance with 74.30(d). If provided, the cord shall be an extra hard usage flexible cord as defined in Article 400 of the National Electrical Code, NFPA 70, and the plug shall be a 3-wire grounding type and acceptable for at least the same hazardous locations as the unit. The cord and the plug or the cord alone may be installed on the luminaire during manufacture. See 74.30(d).

54 Terminal enclosure

54.1 Class I

54.1.1 If each terminal is of a type that permits turning of a screw end, a head (wire-binding screw), or a nut in contact with strands of the cord conductor, the terminal enclosure shall comply with the requirements specified in the Explosion Tests, Section 26, and the Hydrostatic Pressure Test, Section 28, and have joints in accordance with 11.1 – 11.4.3. The terminal enclosure shall be made of metal at least 1/8 inch (3.2 mm) thick.

54.1.2 If each terminal is of a type that provides a spacing of not less than 3/16 inch (4.8 mm) between terminals, is insulated, and does not have a screw end or head (wire-binding screws) or a nut in contact with strands of the cord conductor, the terminals shall be enclosed, but the explosion-proof construction specified in 54.1.1 need not be provided. The entrance for the power-supply cord may be closed with a molded-rubber or -neoprene bushing complying with 63.1 – 63.3.

54.2 Class II

54.2.1 If each terminal is of a type that permits turning of a screw end, a head (wire-binding screw), or a nut in contact with strands of the cord conductor, the terminal enclosure shall comply with the

requirements specified in the Dust Penetration Test, Section 29 and have joints in accordance with 12.1 – 12.7. Cast-metal parts of the enclosure shall be at least 1/8 inch (3.2 mm) thick.

54.2.2 If each terminal is of a type that provides a spacing of not less than 3/16 inch (4.8 mm) between terminals, is insulated, and does not have a screw end, a head (wire-binding screw), or a nut in contact with strands of the cord conductor, the terminals shall be enclosed, but the dust ignition-proof construction specified in 54.2.1 need not be provided. The entrance for the power-supply cord may be closed with a molded-rubber or -neoprene bushing complying with 63.1 – 63.3.

55 Cord Clamp and Strain Relief

55.1 A positive mechanical cord clamp shall be provided that enables the flexible supply cord to be readily replaced and does not permit strain at cord connections within the terminal enclosure when tested as specified in the Strain-Relief Test, Section 65. If the cord clamp is threaded to the terminal enclosure, it shall form a tight engagement or shall be secured against turning or loosening by means of a setscrew or the equivalent. The clamp shall be smooth and free from sharp edges that can damage the flexible cord.

56 Attachment of Parts

56.1 A threaded joint entering an explosion-proof and dust-ignition-proof lamp and terminal enclosure of a portable luminaire shall be secured against loosening by setscrews or the equivalent.

57 Hook and Handle

57.1 A lighting unit shall be provided with a hook, unless mounted on a base or stand, and shall be provided with a handle or the equivalent.

58 Casters and Wheels

58.1 Casters, wheels, or both provided on the floor-borne assembly of a portable luminaire shall be of metal or shall be electrically conductive rubber casters or metal wheels with electrically conductive tires.

59 External Metal Parts

59.1 Other than as noted in 59.2, all external metal parts of a portable luminaire, including its base or stand, that may be struck by or strike against foreign objects shall be made of nonsparking material such as brass or aluminum.

59.2 The external parts of the base of a mobile surgical luminaire that may strike vertical objects shall be made of nonsparking material such as brass or aluminum.

60 Switches

60.1 A switch provided in a surgical luminaire shall be 2-pole and shall have a current rating not less than the maximum current that it controls

60.2 Other than as noted in 60.3, a switch for the control of an incandescent lamp or lamps shall be acceptable for the control of tungsten filament lamps.

60.3 A switch need not comply with the requirement in 60.2 if:

a) It is rated 3 amperes or more alternating current or 6 amperes or more direct current and is used only for the control of a single candelabra-base lamp.

b) The current rating of the switch is not less than the value specified in Table 60.1 and the lighting unit is marked in accordance with 74.30(d).

Table 60.1
Switch ratings

Lampholder	Minimum acceptable current rating of switch in amperes per lampholder	
	AC	DC
Candelabra	3.6	6
Intermediate	3.6	6
Medium	12	20
Mogul	24	40

61 Spacings

61.1 Other than as noted in 61.2 and 61.3, the spacing between uninsulated live parts of opposite polarity, and between uninsulated live parts and metal that may be grounded shall not be less than 1/4 inch (6.4 mm) through air or 3/8 inch (9.5 mm) over surface.

Exception: The spacings specified do not apply between uninsulated live parts of a wiring device, such as a lampholder, and dead metal that is part of the wiring device (including mounting screws, rivets, yokes, clamps, and the like), or between such live parts and that part of the dead metal surface of the portable lamp on which the device is mounted in its intended manner.

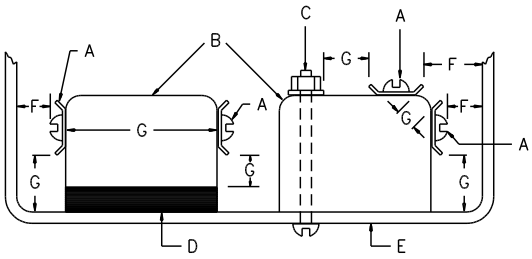
61.2 If a barrier or liner of insulating material is used to provide spacings, it shall be of material acceptable for the application and not less than 0.028 inch (0.711 mm) thick.

Exception: A barrier that is securely held in place and not exposed or otherwise subject to mechanical damage after installation may be less than 0.028 inch (0.711 mm) but not less than 0.013 inch (0.330 mm) thick.

61.3 Some examples of the spacings referred to in the Exception to 61.1 are illustrated in Figure 61.1.

Figure 61.1

Component spacings



SM100

A) Uninsulated live parts of a wiring device.

B) Insulating material of a wiring device.

C) Mounting screw of a wiring device.

D) Dead metal part of a wiring device.

E) Dead metal part of a portable lamp.

F) Spacings to which 61.1 applies.

G) Spacings to which 61.1 does not apply.

PERFORMANCE

62 Temperature Test

62.1 When operated continuously as described in 62.3, temperatures obtained on a portable luminaire shall:

a) Not exceed a 30°C (54°F) rise on the exterior of the handle or a 20°C (36°F) rise on the insulation and jacket of the connection cord. Consideration is to be given to a greater than 20°C (36°F) rise on the insulation and jacket if the cord is rated higher than 60°C (140°F) and if the section of cord having a rise greater than 20°C (36°F) is within an enclosure. The temperatures on the components and wiring within the portable lighting unit shall not exceed their acceptable temperature limits. When the device is for Class II, Groups F and G locations, the temperature rises are to be determined with the unit covered with grain dust.

b) Not exceed a 65°C (117°F) rise on the surface of an unpainted pine board on which the lighting unit may be laid or on which the light from the lighting unit may shine. The surface of the unpainted pine board is to be positioned horizontally or vertically as made possible by the guard, base, or stand of the lighting unit to result in the most light absorption from the device.

c) Not exceed 200°C (392°F) for Class II, Group F, on the exterior of the portable luminaire.

d) Not exceed 165°C (329°F) for Class II, Group G on the exterior of the portable luminaire.

e) Not exceed 200°C (392°F) at a 40°C (104°F) ambient on the exterior of a portable luminaire intended for use where Class I, and Class II, Group F conditions may exist simultaneously.

f) Not exceed 165°C (329°F) at a 40°C (104°F) ambient on the exterior of a portable luminaire. intended for use where Class I, and Class II, Group F, Group G, or Groups F and G conditions may exist simultaneously.

62.2 When determining the maximum temperatures specified in 62.1 (c) – (f), the lighting unit is to be blanketed with grain dust. During the test the dust shall not char or ignite.

62.3 An incandescent portable luminaire is to be operated at rated maximum voltage or higher if necessary to obtain rated maximum wattage. A portable luminaire employing an electric-discharge-lamp is to be operated at the voltage specified for the control equipment.

62.4 Temperatures are to be measured by means of 20 AWG (0.05 mm^2) iron-constantan thermocouples. The lighting unit is to be operated continuously in various positions at rated lamp or ballast voltage with a lamp of maximum wattage, until constant equilibrium temperatures are attained.

62.5 In conducting the temperature tests, consideration is to be given to the heat transmission of color-corrective glass cylinders employed in portable luminaires intended for use in surgical applications. Additional tests may be required.

63 Accelerated Aging Test of Bushing

63.1 A molded-rubber bushing provided at the cord entrance to the terminal enclosure shall not have a change in hardness of more than five Type A durometer units as a result of exposure in an air oven for 70 hours at 100 ± 2°C (212 ± 3.6°F).

63.2 When possible, the complete molded-rubber bushing is to be tested. The hardness of the rubber is to be determined as the average of five readings with a gauge, such as a Rex hardness gauge or Shore durometer. The bushing is then to be exposed in an air oven for 70 hours at 100 ±2°C (212 ± 3.6°F).

63.3 The bushing or specimen is to be removed from the oven and then cooled at room temperature for at least 4 hours. The hardness is to be determined again as the average of five readings. The difference between the original average hardness reading and the average reading taken after exposure in an air oven is the change in hardness.

64 Thread-Wear Test

64.1 A threaded joint between a metal and a nonmetallic part of the lamp and terminal enclosures that may be disturbed during intended maintenance or use of the luminaire shall not show appreciable wear of threads on the nonmetallic part, and shall freely engage with a close fit, after 1000 cycles of assembly and disassembly.

65 Strain-Relief Test

65.1 The strain relief at the point of supply cord entry into the terminal enclosure of the luminaire shall be subjected to the strain-relief test described in 65.2 and 65.3. As a result of the test, there shall not be:

a) A displacement of 3/32 inch (2.4 mm) or more of the conductors, conductor insulation, or outer jacket of the flexible cord;

b) Any damage to the cord insulation, such as a cut, rip, or tear; or

c) Any damage to the portable lighting unit that could adversely affect compliance with the requirements in this standard.

65.2 The portable luminaire is to be tested with each size and type of flexible cord as marked on the unit in accordance with 74.30(b). The cord is to be cut cleanly at a right angle to its major axis and installed in the enclosure under test so that the end of the jacket is located in its intended position as if the conductors were to be connected to the terminals. However, there is to be no stripping of insulation and no connection to terminals. The flush position of conductor, insulation, fillers, and jacket is intended to provide an indicating means of cord displacement after application of the test force.

65.3 The luminaire, and transformer or ballast enclosure, if provided, is to be mounted in a fixed position and a direct pull is to be applied to the external extension of the cord. The strain relief at each point of supply cord entry into an enclosure shall withstand a direct pull of:

a) For the luminaire terminal enclosure, 90 pounds-force (400 N) for 1 minute; and

b) For a transformer or ballast enclosure, 30 pounds-force (133 N) for 1 minute.

66 Rough-Usage Test

66.1 The lamp and terminal enclosures and the cord clamp of a portable luminaire not provided with a base or stand shall not be impaired nor shall threaded engagements be loosened during the rough-usage test described in 66.2.

66.2 The luminaire is to be suspended in a vertical position, with the cord clamp up, by a short loop formed from a heavy solid wire. The power-supply cord is to be removed from the lighting unit and one end of the wire loop is to be connected to the lighting unit at its cord clamp. The other end of the wire loop is to be extended through a screw eye secured to a solidly mounted vertical board, 2 inches (50.8 mm) thick. The free end of the lighting unit is to be pulled away from the board and allowed to swing back against the board (or a wooden block secured to the board) for 9000 times at a rate of about 50 times per minute. The horizontal swing distance at the threaded joint for relamping is to be about 6 inches (152 mm).

67 Drop Test

67.1 The lamp and terminal enclosures and the cord clamp of a portable luminaire that can be dropped while it is handled shall not be impaired when the luminaire is dropped onto a concrete floor ten times from a height of 3 feet (0.9 m).

67.2 For the first five drops, the luminaire, with cord connected as in service, is to fall freely in a manner that would normally be the case if the luminaire were to fall from a horizontal platform to the floor. In the remaining 5 drops, the luminaire with cord is to be held at various angles about 3 feet (0.9 m) above the concrete floor and dropped.

68 Impact Test

68.1 If a portable luminaire is other than the surgical type, for use in Class I locations, and of a type that would not be subjected to a drop or overturning test, there shall be no loosening of assembly or damage to the glass parts when subjected to an impact of 5 foot-pounds (6.8 J) as described in 38.2.

68.2 A 2 inch (50.8 mm) diameter steel ball weighing approximately 1.18 pounds (0.53 kg) is to be dropped vertically from a distance of 50-3/4 inches (1.3 m) on the glass part. The steel ball is to be dropped once at the center and once at the side of the glass part while the glass part is secured to the lamp enclosure of the luminaire unit as intended.

69 Overturning Test

69.1 A luminaire having a base or stand shall be subjected to an overturning test, unless it is provided with a substantial base without a stand, or intended to be used as a surgical light in a hospital operating room. The lamp and terminal enclosures and cord clamp shall not be impaired upon overturning the luminaire on a concrete floor ten times in various positions of adjustment.

70 Stability Test

70.1 A portable luminaire having a base or stand shall not overturn from the intended operating position when:

a) Tilted 20 degrees from its vertical centerline; or

b) Placed on a horizontal floor and a direct horizontal pull of 12 pounds (53.3 N) is applied to the lighting unit at 4 feet (1.2 m) above the floor, or at the maximum height of the luminaire if less than 4 feet (1.2 m).

70.2 The stability of a portable luminaire having a base or stand is to be determined with the luminaire adjusted to the most unstable condition likely to be encountered in its intended use, including swiveling and blocking of the casters and wheels with a 3/8 inch (9.5 mm) square rod.

71 Resistance Test

71.1 The resistance of the grounding path between the grounding member of the attachment plug or the grounding terminal of the cord connector and exposed dead metal parts of the luminaire, excluding the resistance of the grounding conductor of the flexible cord, shall not exceed 0.1 ohm.

71.2 The resistance may be determined by any convenient method except that if unacceptable results are recorded, either a direct- or alternating-current of 15 amperes is to be passed from the grounding terminal to all exposed dead metal parts, and the resulting drop in potential is to be measured between these two points. The resistance in ohms is to be determined by dividing the drop in potential in volts by the current in amperes passing between the two points.

PART V – MANUFACTURING AND PRODUCTION TESTS

72 Bonding Test on Portable Luminaires

72.1 The manufacturer shall determine by a routine production-line test that the grounding member of the attachment plug, when provided, or the grounding conductor of the supply cord is electrically connected to dead metal parts of portable luminaires.

73 Hydrostatic Pressure Test

73.1 When the hydrostatic pressure test specified in Hydrostatic Pressure Test, Section 28 is conducted in accordance with the Exception No. 2 to 28.1, each explosion-proof electrical enclosure shall withstand without rupture or permanent distortion, as a routine production-line test, the hydrostatic pressure specified in 73.2.

73.2 The hydrostatic pressure within each enclosure is to be raised to 1.5 times the maximum explosion pressure, and more than 50 psig (345 kPa). The pressure is to be applied for more than 10 seconds and less than 1 minute.

PART VI – MARKING

74 Details

74.1 These marking requirements apply to the luminaires covered in Parts I, II, III and IV of this standard. All markings shall be legible and prominent.

74.2 A luminaire intended for use in more than one class, group, or division of hazardous locations may require multiple markings appropriate for each use. For example, a luminaire for use in both Class I, Division 2 only, and Class II, Divisions 1 and 2 may require more than one temperature class marking. The hazardous locations division need not be marked on the luminaire if the luminaire is suitable for Division 1 locations.

74.3 Each luminaire shall be marked with the following:

a) The manufacturer's name, identifying symbol, or other descriptive marking by which the organization responsible for the product may be identified.

b) A distinctive catalog designation to specifically identify the luminaire.

c) Maximum voltage.

d) Lamp type and maximum lamp wattage, if an incandescent lamp or a high-intensity discharge lamp is employed.

e) An indication that the luminaire is suitable for a self-ballasted high-intensity-discharge lamp, if the luminaire has been investigated for use with such a lamp.

f) Frequency and ampere ratings, if an electric-discharge lamp other than a self-ballasted type is employed.

g) An incandescent lamp luminaire of a self-ballasted high-intensity-discharge lamp that is intended for use only on an alternating-current circuit shall be marked with the term "AC " or other designation for alternating current, followed by the word "only."

h) "CAUTION – Use of a lamp rated more than _____ watts may result in a fire hazard," if a switch is employed in a surgical luminaire. The marking shall be readily visible and permanent, in letters not less than 1/8 inch (3.2 mm) high. The maximum value to be inserted in the marking is 75 for candelabra and intermediate lampholders, 300 for medium lampholders, and 750 for mogul lampholders. If this marking is used, it may be considered to satisfy the marking requirement in (d).

i) A fluorescent luminaire marked "Suitable for wet locations," intended for outdoor installation, and not provided with Class P thermally-protected ballast equipment shall also be marked "For outdoor use only."

Exception: A fluorescent luminaire with a simple reactance ballast.

j) Relamping instructions.

Exception: Relamping instructions need not be provided if the method of relamping is obvious and it is unlikely that the luminaire would be disassembled for relamping at a joint other than the joint intended for that purpose.

k) Mounting position limitations, if required, for example, "For vertical mounting, lamp base up, only."

l) Designation of the hazardous location in which the luminaire is intended to be used: for example, "Class, Group." In addition, a product for Division 2 only shall bear the wording: "Division 2," for example, "Class ____, Division 2, Group ____ "

Exception: A luminaire for Class I, Division 2 locations only need not be marked to identify the hazardous location group.

m) A cautionary statement for a luminaire for use in Class I, Divisions 1 and 2, Class II, Division 1, or Class II, Division 2 locations consisting of the word "CAUTION" and the following or the

equivalent wording: "To reduce the risk of ignition of hazardous atmospheres, disconnect the luminaire from the supply circuit before opening. Keep tightly closed when in operation." This marking shall also be provided on all covers for inspection or servicing of the luminaire that are removable after the luminaire is installed. For a luminaire with disconnecting means as described in Disconnecting Means, Section 18, the cautionary statement shall clearly indicate the necessary precautions. For such a luminaire, the cautionary statement may consist of the word "CAUTION" and the following or equivalent wording: "To reduce the risk of ignition of hazardous atmospheres, disconnect from the supply before opening compartment other than lamp chamber. Keep tightly closed when in operation."

n) Maximum operating temperature or temperature class as specified in Table 74.1 if the operating temperature exceeds 100°C (212°F). The operating temperature or temperature class shall be located near the marking required by (l).

o) If applicable, information regarding the use of external reflectors and the different operating temperatures obtained using different external reflectors.

Exception: If the luminaire is marked to indicate the maximum of the temperatures obtained using different external reflectors, the operating temperature information pertaining to the use of each of the external reflectors need not be provided. However, the marking shall specify all external reflectors that can be used with the luminaire.

p) A cautionary statement for a luminaire, such as an incandescent luminaire, that is intended for use in Class II, Division 1 locations or paint application areas (see 7.1), and that can have exterior surface temperatures exceeding the marked operating temperature if equipped with a lamp of a wattage higher than the rated luminaire wattage: "WARNING " and the following or equivalent wording: "Risk of fire or explosion – Use lamp rated ____ W or less." This marking shall be permanent and shall be located where readily visible during relamping.

q) Maximum ambient temperature for which the luminaire is acceptable. The marked ambient temperature shall be 25°C (77°F) or, if applicable, an elevated ambient temperature as indicated by 25.4, 42.4, or 48.5.

r) A cautionary statement for a luminaire for use with low-pressure sodium lamps in Division 2 locations consisting of the word "CAUTION" and the following or equivalent wording: "Sodium could ignite if lamp is broken during relamping. To reduce the risk of fire or explosion, make sure that the area is dry and the atmosphere is free of ignitable gases or vapors before relamping. Disconnect the luminaire from the supply circuit before opening. Keep tightly closed when in operation."

74.4 In addition to, or as an alternative to, the marking requirement in 74.3(l), a luminaire that has been investigated and found to comply with the requirements for Class I, Division 1, Group D locations may additionally or alternatively be marked Class I, Zone 1, Group IIA.

74.5 In addition to, or as an alternative to, the marking requirement in 74.3(l), a luminaire that has been investigated and found to comply with the requirements for Class I, Division 1, Group C locations may additionally or alternatively be marked Class I, Zone 1, Group IIB.

74.6 In addition to, or as an alternative to, the marking requirement in 74.3(l), a luminaire that has been investigated and found to comply with the requirements for Class I, Division 1, Group B locations may be marked Class I, Zone 1, Group IIB plus Hydrogen.

74.7 In addition to, or as an alternative to, the marking requirement in 74.3(l), a luminaire that has been investigated and found to comply with the requirements for both Class I, Division 1, Group A, and Class I, Division 1, Group B locations may additionally or alternatively be marked Class I, Zone 1, Group IIC.

74.8 In addition to, or as an alternative to, the marking requirement in 74.3(l), a luminaire that has been investigated and found to comply with the requirements for Class I, Division 2, Group D locations may additionally or alternatively be marked Class I, Zone 2, Group IIA.

74.9 In addition to, or as an alternative to, the marking requirement in 74.3(l), a luminaire that has been investigated and found to comply with the requirements for Class I, Division 2, Group C locations may additionally or alternatively be marked Class I, Zone 2, Group IIB.

74.10 In addition to, or as an alternative to, the marking requirement in 74.3(l), a luminaire that has been investigated and found to comply with the requirements for Class I, Division 2, Group B locations may be marked Class I, Zone 2, Group IIB plus Hydrogen.

74.11 In addition to, or as an alternative to, the marking requirement in 74.3(l), a luminaire that has been investigated and found to comply with the requirements for both Class I, Division 2, Group A, and Class I, Division 2, Group B locations may additionally or alternatively be marked Class I, Zone 2, Group IIC.

74.12 A luminaire marked Group IIB may also be marked Group IIA.

74.13 A luminaire marked Group IIC may also be marked Group IIA, Group IIB, or both Group IIA and Group IIB.

Table 74.1
Temperature marking

Maximum operating temperature[a]		Temperature class
°C	(°F)	
450	(842)	T1
300	(572)	T2
280	(536)	T2A
260	(500)	T2B
230	(446)	T2C
215	(419)	T2D
200	(392)	T3
180	(356)	T3A
165	(329)	T3B
160	(320)	T3C
135	(275)	T4
120	(248)	T4A
100	(212)	T5
85	(185)	T6

[a] Based on a 40°C (104°F) ambient.

74.14 In addition to, or as an alternative to, the marking requirement in 74.3(l), a luminaire that has been investigated and found to comply with the requirements for Class II, Division 1, Group E, F or G locations may additionally or alternatively be marked Zone 20, 21, or 22.

74.15 In addition to, or as an alternative to, the marking requirement in 74.3(l), a luminaire that has been investigated and found to comply with the requirements for Class II, Division 2, Group F or G locations may additionally or alternatively be marked Zone 22.

74.16 With reference to 74.3(n), the operating temperature or temperature class shall not identify a temperature less than the maximum operating temperature.

74.17 Except as noted in 74.18 and 74.22, the operating temperature, if marked in lieu of the temperature class, shall be one of the temperatures specified in Table 74.1.

74.18 The marked operating temperature need not be one of the temperatures specified in Table 74.1 on a luminaire for Class I, Division 1 or Class I, Division 2 locations if:

a) The luminaire is marked to indicate that it is for use only in a specific gas or vapor atmosphere;

b) The specific gas or vapor is identified in the marking;

c) The ignition temperature of the specified gas or vapor is more than 5°C (9°F) below the next higher temperature specified in Table 74.1; and

d) The exposed surface temperature and marked operating temperature do not exceed the ignition temperature of the specific gas or vapor.

74.19 The location and the method of the markings on the luminaire shall be as specified in Table 74.2.

Exception: The markings required in accordance with 74.20 and 74.28 need not comply with the requirements specified in Table 74.2.

Table 74.2
Marking locations and methods

Class and division	Location	Method[a]
Class I, Division 1	Outside of the luminaire enclosure; shall be visible after installation of the luminaire.	Permanently attached metal nameplate; debossed; or molded in the enclosure.
Class I, Division 2	Same as Class I, Division 1 or inside of the luminaire enclosure if readily visible through the light transmission part or by opening a door or removing a cover after installation of the luminaire.	Same as Class I, Division 1, or die-stamped, paint stenciled, indelibly-stamped lettering or adhesive-backed pressure-sensitive labels that comply with the Standard for Marking and Labeling Systems, UL 969.
Class II, Division 1 and 2	Same as Class I, Division 1 or inside of the luminaire enclosure if readily visible through the light transmission part.	Same as Class I, Division 2.

[a] If it is specified that marking may be located on the inside of the luminaire enclosure, the marking may be on a paper label.

74.20 If space is not available on a luminaire for all of the markings required – for example, a luminaire intended for use with or without reflectors, for use with several different types or sizes of lamps, for use under different conditions, or a luminaire for which much information regarding conditions of use and corresponding operating temperatures is required – some of this information may be on an instruction sheet packed with the luminaire if:

a) As much of this information is on the luminaire as is practical, based on available space on the luminaire;

b) All cautionary and warning statements required are on the luminaire; and

c) Reference is made on the luminaire to the additional information packed with the luminaire.

74.21 A luminaire that has been investigated and found acceptable for exposure to Class I and Class II location conditions at the same time shall be marked with the following or equivalent wording: "Suitable for simultaneous use in Class I, Group __ and Class II, Group __ locations " together with the operating temperature or temperature class. The operating temperature shall not exceed the appropriate limit specified in 25.2(a), 25.2(b), or 48.1. This marking shall be located near the marking required by 74.3 (l) and (n).

74.22 In addition to the temperatures specified in Table 74.1, a luminaire for Class I, Division 2 locations only may be marked with an operating temperature of 325°C (617°F), 350°C (662°F), or any operating temperature exceeding 450°C (842°F).

74.23 Except for a fluorescent lamp luminaire in which each ballast is of the Class P thermally-protected type or as noted in 74.24, there shall be no marking on the luminaire, the carton or container in which it is shipped, or on material attached to or shipped with the luminaire to indicate or imply that protection or a protective device is provided in the luminaire or ballast.

74.24 With reference to the requirement in 74.23, a luminaire in which a ballast is associated with a replaceable fuse in a fuseholder external to the ballast, the carton or container for such a luminaire and material attached to or shipped with the luminaire may be marked:

a) To indicate the presence of the fuse;

b) With information on fuse replacement; or

c) With both markings.

74.25 A luminaire intended for use where subject to deposits of combustible-paint residues shall be marked: "Suitable for Locations Having Deposits of Readily Combustible-Paint Residues."

74.26 A luminaire may be marked with one or more enclosure type designations – see Enclosure Types, Section 8.

74.27 If any point within a terminal box or wiring compartment of a permanently connected luminaire in which the power-supply conductors are intended to be connected, including such conductors themselves, attains a temperature greater than 60°C (140°F) during the temperature test, the luminaire shall be permanently marked "For supply connection, use wires rated for at least_____°C (°F)" or with an equivalent statement. The temperature value shall be in accordance with the Standard for Luminaries, UL 1598. This statement shall be located at or near the point where the supply connections are to be made, and shall be clearly visible both during and after installation of the luminaire.

74.28 A luminaire that has been investigated and found to be acceptable for use in an elevated ambient as mentioned in 25.4, 42.4, or 48.5 may be marked: "This luminaire is acceptable for operation in ambient conditions not exceeding ____ °C (____ °F)," or equivalent wording. This marking may be on the luminaire or on an instruction sheet packed with the luminaire.

74.29 The marking specified in 74.27 shall comply with the marking requirements in the Standard for Luminaires, UL 1598.

74.30 A luminaire that employs a cartridge fuse in accordance with 41.1(b) shall be marked, at a location visible when the fuse is being replaced, with the following or equivalent statement: "Replace only with fuse having the same voltage and current rating as the existing fuse. Fuse is for supplementary protection only."

Exception: The luminaire need not be marked if the fuse is enclosed within a ballast.

74.31 A luminaire that employs a cartridge fuse filled with noncombustible granular material in accordance with the exception to 27.1 shall be marked, at a location visible when the fuse is being replaced, with the word "CAUTION " and the following or equivalent statement: "Risk of Ignition of Hazardous Atmospheres – Replace only with x fuse having the same voltage and current rating as the existing fuse." The manufacturer is to insert identification of the fuse filled with noncombustible granular material in the space marked "x ".

74.32 If a manufacturer produces luminaires at more than one factory, each luminaire shall have a distinctive marking by which the luminaire may be identified as the product of a particular factory.

74.33 In accordance with the Exceptions to 17.1.9 and 45.3, instructions to install a fitting providing a smooth, rounded inlet hole shall be provided if a conduit opening is not:

a) Provided with a conduit stop;

b) Well-rounded; or

c) Threaded as specified in Table 17.2.

74.34 Equipment having metric supply connection openings in accordance with 17.2.6 shall have a permanent marking which includes the supply connection thread size, type, and class of fit.

74.35 A luminaire intended to have a sealing fitting installed in accordance with note (a) to Table 26.1 shall be permanently marked where it will be readily visible during and after installation with the word: "WARNING" and the following equivalent wording: "To prevent ignition of Group ___ atmospheres conduit runs must have a sealing fitting connected within ___ inches of the luminaire."

74.36 Additionally, portable luminaries shall be provided with the following:

a) If it is necessary to use a flexible cord rated over 60°C (140°F), the marking shall specify the required temperature rating of the cord.

b) A portable luminaire shall be provided with marking instructions regarding power-supply-cord replacement. They shall include the following or equivalent information: "For replacement purpose use ___ AWG, Type ___ power-supply cord only." These instructions shall be legible and permanent. They may appear on a paper label if located within the terminal compartment and protected from mechanical damage.

c) A lighting unit that is produced without the flexible power-supply cord, an attachment plug, or both attached shall be provided with instructions regarding the installation of these components. These instructions shall include all required information regarding an acceptable cord and attachment plug that must be provided. These instructions shall be either a part of the permanent markings, or on a removable tag or an instruction sheet provided with the lighting unit.

d) If a switch as specified in 60.3(b) and in Table 60.1 is employed, the portable luminaire shall be marked "Use of a lamp rated more than ___ watts may result in risk of fire." The marking shall be clearly visible, permanent, and in letters not less than 1/8 inch (3.2 mm) high. The value to be inserted in the marking is 75 for candelabra and intermediate lampholders, 250 for medium lampholders, and 500 for mogul lampholders.

e) Each lighting unit employing a packing gland requiring dismantling during cord replacement shall be provided with an instruction sheet covering the intended assembly of the packing gland to the lighting unit.

75 Installation Instructions

75.1 General

75.1.1 Luminaires shall be provided with documentation that includes all the instructional material required by this standard.

75.2 Electronic medium for required instructions

75.2.1 The required instructional material of this standard may be provided additionally or alternatively by electronic media under the following conditions:

a) Where all required instructional material is provided by electronic media, there shall be marking on the apparatus that contains the international symbol ⚠ (Reference No. 0434B of ISO 7000), along with the document number, revision level and location of the electronic documentation (e.g. URL, QRcode).

b) Where only some of the required instructional material is provided by electronic media and some is printed:

1) there shall be marking on the apparatus that contains the international symbol ⚠ (Reference No. 0434B of ISO 7000), along with the document number, revision level and location of the electronic documentation (e.g. URL, QRcode); and

2) the printed instructions provided with the apparatus shall clearly identify that additional information is available electronically, along with the document number, revision level and location of this electronic documentation (e.g. URL, QRcode).

Exception: For small electrical apparatus where some or all of the instructional material is to be provided by electronic media, and where there is limited space for both the international symbol ⚠ (Reference No. 0434B of ISO 7000) and the document number, revision level and location of the electronic documentation (e.g. URL, QRcode):

a) the international symbol ⚠ (Reference No. 0434B of ISO 7000) shall be marked on the apparatus; and

b) printed instructions shall be provided with the apparatus that, as a minimum, indicates the document number, revision level and location of the electronic documentation (e.g. URL, QRcode).

NOTE When electronic documentation is referenced either on the device or on the printed instructions, the location given can be the specific location for the required instructions (e.g. direct link to the specific instructions), or can be a more general location. (e.g. the URL for the overall manufacturer's website). It is the manufacturer's responsibility to assure that the location of the required instructions is accessible by the user.

75.2.2 Where a QRcode is used to provide the required instructional material, and the QRcode contains all required instructional material (as opposed to merely referencing a URL that contains required instructional material), a document number and revision level need not be indicated.

75.2.3 Where some or all of the required instructional material is provided by electronic media, the required instructional material shall be available in printed format upon request of the user.

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SUPPLEMENT SA – INVESTIGATION OF ELASTOMERIC GASKETS

SA1 Scope

SA1.1 This outline is for use as a guide in the investigation of elastomeric gaskets intended for use in luminaires for Class II, Division 1, hazardous (classified) locations. It is to be used to evaluate performance and determine acceptability of constructions in which the gasket may or may not be secured by an adhesive and the joint surfaces may or may not be painted.

SA2 General

SA2.1 The investigation is to include:

a) A review of information regarding properties of the gasket material;

b) A test to determine that the gasket will not adhere to the joint surfaces after aging;

c) Determining if compression set of the gasket (or alternative conditioning) would adversely affect the integrity of the dusttight joint; and

d) An identification test for follow-up purposes.

SA3 Physical Properties

SA3.1 Information relating to physical properties of the gasket material is to be reviewed to confirm that the material is acceptable for use at the temperature to which it will be subjected in service.

SA4 Accelerated Air-Oven Aging Test

SA4.1 The accelerated air-oven aging is intended to determine if a gasket material will transfer or adhere to the joint surfaces. The results are to be used in determining compliance with the requirements in the exception to 12.3, 12.4, and Exception Nos. 1 and 2 to 20.1 in this standard.

SA4.2 The maximum temperature at the gasketed joint is to be determined by testing the luminaire in air (that is, without dust blanket) at an ambient temperature of 40°C (104°F) or at rated ambient, whichever is higher.

SA4.3 The parameters for the accelerated air-oven aging are to be calculated using the maximum temperature measured at the gasketed joint. The calculations are to be based on testing for 50 years. For the purpose of calculations, the accelerated-aging period may be halved for each 10°C (18°F) increase in test temperature.

SA4.4 The test time and test temperature are to be calculated using the following formula:

a) For test time:

$$D = \frac{18262.5}{2^{(\Delta T/10)}}$$

b) For test temperature

$$T_2 = T_1 + 10\left(\frac{In\frac{18262.5}{D}}{In\ 2}\right)$$

in which:

D is the number of days for air-oven aging;

T_1 is the maximum temperature in degrees C at the gasketed joint, see SA4.2;

T_2 is the air-oven aging test temperature in degrees C; and

ΔT is $T_2 - T_1$.

See SA4.5.

SA4.5 For the calculation described in SA4.4, either the test time (D) or the test temperature (T_2) is to be selected by the luminaire manufacturer.

SA4.6 Two samples of the luminaire housing with the gasketed joint assembly representative of production units are to be subjected to the air-oven aging. A third sample is to be provided for use as a control (as-received) sample for comparison with the samples subjected to the oven aging.

SA4.7 At the completion of the test, the samples are to be removed from the oven and allowed to cool to room temperature. The force required to separate the enclosure parts at the gasketed joint is then to be measured using tensile equipment employing a cross-head speed of 0.1 inch per minute (2.5 mm/min.) The force to separate the parts shall not exceed 100 pounds (44.8 N).

SA4.8 The samples subjected to the oven aging are also to be visually examined – see SA4.9.

SA4.9 Among the factors that are to be taken into consideration when determining the acceptability of a gasketed assembly after oven aging are:

a) Deterioration of the materials used in the joint assembly;

b) Transfer of gasket material to a joint surface;

c) Transfer of paint to a gasket;

d) Peeling off of paint from a painted joint surface;

e) Effectiveness of an adhesive used to secure a gasket;

f) The force required to separate a luminire at a gasketed joint – see SA4.7; and

g) Other results that may impair the dusttight construction of the luminaire.

SA5 Compression Set

SA5.1 General

SA5.1.1 It shall be determined whether compression set of a gasket may adversely affect the dusttightness of a gasketed joint by:

a) Determining the percentage compression set as described in SA5.2.1 – SA5.2.4; or

b) Conditioning a sample luminaire and then subjecting it to a dust-penetration test as described in SA5.3.1 – SA5.3.3.

SA5.2 Compression set determination

SA5.2.1 The percentage compression set shall be determined as described in SA5.2.2 or SA5.2.3 and shall not exceed 25 percent.

SA5.2.2 The percentage compression set of closed-cell expanded rubber or open-cell sponge rubber is to be determined in accordance with Compression Set Under Constant Deflection in the Standard Specification for Flexible Cellular Materials– Sponge or Expanded Rubber, ASTM D1056. The test time and temperature are to be determined using the formulae specified in SA5.3.2.

SA5.2.3 The percentage compression set of an elastomeric material other than expanded or sponge rubber is to be determined by Method B of the Standard Test Methods for Rubber Property – Compression Set, ASTM D395. The test time and temperature are to be determined using the formulae specified in SA5.3.2.

SA5.2.4 The compression set is to be calculated using the following formula:

$$C = \frac{(t_o - t_1)}{(t_o - t_s)} \times 100$$

in which:

C is the compression set in percent;

t_o is the original thickness in inches;

t_1 is the thickness in inches after the specified recovery period; and

t_s is the thickness in inches of the spacer bar; that is the thickness of the compressed gasket.

SA5.3 Dust penetration

SA5.3.1 A sample luminaire shall be conditioned as described in SA5.3.2 and then subjected to the Dust-Penetration Test, Section 29.

SA5.3.2 The luminaire assembled with all components required for conducting the dust-penetration test is to be conditioned in an air oven. The time and temperature for the conditioning are to be determined using the following formula:

$$D = \frac{90}{2^{(x-1)}}$$

$$T_2 = T_1 + 10(X - 1)$$

in which:

D is the number of days for air-oven aging.

T_1 is the maximum temperature in degrees C at the gasketed joint – see SA4.2;

T_2 is the air-oven aging test temperature in degrees C; and

X is any number from 1 to 5 selected by the luminaire manufacturer. The same value is to be used in both equations.

SA5.3.3 After conditioning, the luminaire is to be cooled to room temperature, and then, without disturbing the gasketed joints in the assembly, the luminaire is to be subjected to the dust-penetration test.

SA6 Identification

SA6.1 The gasket material and the adhesive, if used, shall be subjected to qualitative pyrolytic-gas chromatographic analysis for follow-up identification purposes.