

Subject 823

March 30, 2007

SUMMARY OF TOPICS

The following changes in requirements are being proposed:

1. Revision to the requirements for NPT male threads to harmonize with the requirements in UL 1203

2. Addition of requirements for supplemental external grounding or bonding terminals

STP BALLOTS DUE: May 14, 2007

COMMENTS DUE: May 14, 2007

For your convenience in review, proposed additions to existing requirements are shown underlined and proposed deletions are shown ~~lined-out~~.

1. Revision to the requirements for NPT male threads to harmonize with the requirements in UL 1203

RATIONALE

Proposal submitted by: Donald Ankele, Underwriters Laboratories Inc.

The intent of the 9th Edition UL 823 was to harmonize completely with UL 1203 for construction and performance requirements were no technical differences should exist. However, a comment made to UL 1203 during the comment resolution process regarding harmonizing NPT male threads with UL 60079-1 was accepted, but this comment was not simultaneously proposed to UL 823. UL proposes to revise UL 823 to include the wording found in the 4th Edition UL 1203.

PROPOSAL

1.2 These requirements also cover explosion-proof electrical equipment for installation and use in Class I, Zone 1, Groups IIA, IIB and IIC hazardous (classified) locations and dust-ignition-proof equipment for use in Zone 20, 21, and 22 locations.

11.7.1.6 Tapered threaded joints shall comply with Table 11.1.

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Table 11.1
Tapered threaded joints

<u>Pitch</u>	$\geq 0.9 \text{ mm}$
<u>Threads provided on each part</u>	$\geq 5^b$
<u>Threads engaged</u>	$\geq c$
<u>On male threaded fittings with a shoulder or interruption, a thread length not less than the L4 dimension defined by ANSI/ASME B1.20.1 shall be provided between the face of the shoulder and the end of the fitting thread.</u>	
^a Internal and external thread shall have the same nominal size, cone angle and thread form.	
^b Threads shall conform to NPT requirements of ANSI/ASME B1.20.1, and shall be made up wrench tight.	
^c Adjustment of gauging practices is required to achieve the required engagement of threads. See Section 14.	
<u>Note: Gauging of female threads in IEC 60079-1 is flush to +2 turns of the plug gauge.</u>	

14.1.2 NPT threaded entries shall be permitted and shall use a modified National Standard Pipe Taper (NPT) thread with thread form per ANSI/ASME B1.20.1. Entries shall not be smaller than trade size 1/2 nor larger than trade size 6. Factory-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 to +1 turns described in ANSI/ASME B1.20.1. NPT supply connection entry threads shall be provided with not less than 5 full threads. The thread form shall comply with 14.1.4. Factory NPT threaded assemblies shall be made up with not less than 4-1/2 threads engagement upon assembly. Supply connection threads shall comply with Section 33, Explosion Tests.

14.1.4 Where a conduit stop (also known as an integral bushing) is not provided, the inner end of the entry shall be smooth and well-rounded. The dimensions of a conduit stop, if provided, shall be as shown in Table 14.1. 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 not less than five full threads of engagement with a conduit or fitting gauging at L1-1 (1 turn large). NPT Threaded entries shall conform to ANSI/ASME B1.20.1 except that entries shall gauge with +1/2 to +3-1/2 turns beyond the L-1 gauging notch in lieu of the ±1 turns described in ANSI/ASME B1.20.1.

14.1.9 When an integral conduit stop is provided in a conduit opening of an enclosure for Class I, Group C or D locations, the threads are to be either of the straight type or tapered 3/4 inch per foot (62.5 mm/m). NPS threaded entries may be provided for an enclosure for Group C or D locations and shall use a National Standard Pipe Straight (NPS) thread per ANSI/ASME B1.20.1 and shall include an integral bushing and shall provide five full threads. The dimensions of the integral bushing shall be as shown in Table 14.2.

14.1.14 All male NPT threaded fittings having a shoulder or other interruption that can interfere with thread engagement shall have a threaded length not less than the L4 dimension shown in accordance with ANSI/ASME B1.20.1 when measured from the end of the fitting thread to the face of a shoulder or to an interruption.

14.1.15 Male NPT threaded fittings made from all metals except stainless steel, shall gauge ±1 turn of the ring gauge from being flush with the end of the thread in accordance with ANSI/ASME B1.20.1.

14.1.16 Male NPT threaded fittings made from stainless steel shall use a modified National Standard Pipe Taper (NPT). The pipe thread form shall comply with the Standard for Pipe Threads, ANSI/ASME B1.20.1, except that entries shall gauge with $+1\frac{1}{2}$ to $+3\frac{1}{2}$ turns beyond the L-1 gauging notch in lieu of the ± 1 turns described in ANSI/ASME B1.20.1.

A conduit hub not integrally cast with an enclosure shall:

- a) Have a wall thickness before threading of 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 Secureness of Conduit Hubs Test, Section 36.

~~14.1.17 A conduit hub not integrally cast with an enclosure shall:~~

- ~~a) Have a wall thickness before threading of 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 Secureness of Conduit Hubs Test, Section 36.~~

2. Addition of requirements for supplemental external grounding or bonding terminals

RATIONALE

Proposal submitted by: Donald Ankele, Underwriters Laboratories Inc.

This proposal adds new paragraphs 18.7, 18.7.1 and 55.26 that is similar to that found in the 4th Edition UL 60079-0, and is proposed to harmonize with other UL Hazardous Locations standards in order to eliminate differences in requirements where none should exist.

PROPOSAL

18.7 Supplemental external grounding or bonding terminal.

18.7.1 When provided, supplemental earthing or bonding connection facilities on the outside of a heater shall provide effective connection of a conductor with a cross-sectional area of at least 4 mm² (10 AWG). Effective connection shall be verified by compliance with the Pullout and Secureness tests in UL 486E. The terminal shall be marked in accordance with 55.26.

55.26 If a supplementary external grounding or bonding terminal is provided on the outside of a heater, and is identified by being either colored green or by being marked G, GR, Ground, Grounding, Protective Earth, PE, or $\oplus$; the instructions provided with the equipment shall indicate that the internal grounding terminal shall be used for the equipment grounding connection and that the external terminal is for a supplementary bonding connection where local codes or authorities permit or require such connection.

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UL 823

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Electric Heaters For Use In Hazardous (Classified) Locations

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Underwriters Laboratories Inc. (UL)
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Northbrook, IL 60062-2096

UL Standard for Safety for Electric Heaters For Use in Hazardous (Classified) Locations, UL 823

Ninth Edition, Dated October 20, 2006

Summary of Topics

This new edition of ANSI/UL 823 includes Division 1 requirements for construction and performance found in UL 1203.

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

Future Effective Dates	References
December 30, 2010	Paragraphs 14.1.14, 14.1.15, and 14.1.16

The new requirements are substantially in accordance with UL's Proposal(s) on this subject dated January 6, 2006 and May 26, 2006.

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New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing, Recognition, and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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This Standard consists of pages dated as shown in the following checklist:

Page	Date
1-78	October 20, 2006
SA1-SA12	October 20, 2006
SB1-SB6	October 20, 2006
SR1-SR2	October 20, 2006

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UL 823



ANSI/UL 823-2006

Standard for Electric Heaters For Use in Hazardous (Classified) Locations

The First and Second editions were titled Electric Heaters for Use in Hazardous Locations, Class I, Groups C and D, Class II, Groups E, F, and G. The Third through fifth editions were titled Electric Heaters For Use In Hazardous Locations, Class I, Groups A, B, C, and D, and Class II, Groups E, F, and G.

First Edition – September, 1965
Second Edition – January, 1969
Third Edition – June, 1971
Fourth Edition – May, 1972
Fifth Edition – July, 1977
Sixth Edition – October, 1985
Seventh Edition – February, 1991
Eighth Edition – October, 1995

Ninth Edition

October 20, 2006

The most recent designation of ANSI/UL 823 as an American National Standard (ANSI) occurred on September 6, 2006.

This ANSI/UL Standard for Safety, which consists of the Ninth edition is under continuous maintenance, whereby each revision is ANSI approved upon publication.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements. Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <http://csds.ul.com>.

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INTRODUCTION

1 Scope

1.1 These requirements cover explosion-proof, dust-ignition-proof and dust-tight portable and fixed electric heaters 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 explosion-proof electrical equipment for installation and use in Class I, Zone 1, Groups IIA, IIB and IIC hazardous (classified) locations.

1.3 These requirements also cover explosion-proof electrical equipment that has been investigated for use in one or more specific gas or vapor atmospheres with or without additional Class I Groups. See 55.4.

1.4 These requirements cover electric air heaters, electric hot-water or steam radiators, and electric hot plates rated 600 volts or less.

1.5 These requirements also cover paint heaters, rated 600 volts or less, for use at pressures not exceeding 100 psig (690 kPa). Paint heaters operating at more than 100 psig may be investigated in accordance with these requirements and any additional requirements judged to be necessary.

1.6 These requirements do not cover medical equipment.

1.7 These requirements cover heaters for use only under the following atmospheric conditions:

- a) A minimum ambient temperature of minus 50°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 An electric heater for use in hazardous locations shall also comply with the applicable requirements for a similar product for use in ordinary locations.

2.2 An electric heater for Class III locations shall comply with requirements for Class II, Group G, except that an enclosure for Class III, Division 2 shall be of the type described in 45.3.

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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 are 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 Enclosure Types

6.1 A heater that is marked enclosure Type 7 shall comply with the applicable requirements for Class I. A heater that is marked enclosure Type 9 shall comply with the applicable requirements for Class II.

6.2 An enclosure that is intended for use in other environmental conditions shall also comply with the applicable requirements for each enclosure type, for example Type 3, 4X, or 6, specified in the Standard for Enclosures for Electrical Equipment, UL 50.

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7 Class I, Zone and Group Equivalency

7.1 Class I, Zone 1, Group IIA

7.1.1 Explosion-proof electrical equipment intended to be marked in accordance with 55.2 shall comply with all the requirements for explosion-proof electrical equipment for use in Class I, Group D hazardous (classified) locations.

7.2 Class I, Zone 1, Group IIB

7.2.1 Explosion-proof electrical equipment intended to be marked in accordance with 55.3 shall comply with all the requirements for explosion-proof electrical equipment for use in Class I, Group C hazardous (classified) locations.

7.3 Class I, Zone 1, Group IIC

7.3.1 Explosion-proof electrical equipment intended to be marked in accordance with 55.5 shall comply with all the requirements for explosion-proof electrical equipment for use in both Class I, Group A and Class I, Group B hazardous (classified) locations.

7.4 Zone 20, Zone 21, and Zone 22

7.4.1 Dust-ignition-proof electric heaters intended to be marked Zone 20 and 21 in accordance with 55.8 shall comply with all the requirements for dust-ignition-proof electrical equipment for use in Class II, Division 1 hazardous (classified) locations.

7.4.2 Dusttight electric heaters intended to be marked Zone 22 in accordance with 55.9 shall comply with all the requirements for Dusttight electric heaters for use in Class II, Division 2 hazardous (classified) locations.

8 Glossary

8.1 For the purpose of this Standard, the following definitions apply.

8.2 AXIAL JOINT SECTION – The portion of a flat, labyrinth, or rabbet joint that is parallel to the axis of the parts forming the joint.

8.3 CEMENTED JOINT – A joint which relies upon a cement or other similar compound to prevent the propagation of an explosion to a surrounding atmosphere by filling all voids between the mating parts forming the joint, such that no flamepath exists. Intended for joints which are not disturbed after assembly. See 11.2.

8.4 CLEARANCE, AXIAL – The clearance between parts forming the axial joint section.

8.5 CLEARANCE, DIAMETRICAL – The clearance between two parts measured as the difference in the diameters.

8.6 CLEARANCE, RADIAL – The clearance between parts forming the joint section radiating from the axis or center.

8.7 FLAMEPATH – The joint formed upon assembly of parts that are intended to arrest the flame and vent hot gases produced when an ignition of an explosive atmosphere takes place within an explosion-proof enclosure.

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8.8 INTERNAL LENGTH OF JOINT – The distance from the innermost point to the outermost point of the joint formed upon assembly of the parts comprising that joint.

8.9 LABYRINTH JOINT – A joint consisting of an arrangement of mating steps, grooves or collars consisting of two or more axial sections having one radial section between each axial section, or two or more radial sections with one axial section between each radial section, whereby the flame path changes direction more than twice.

8.10 RABBET JOINT – A rabbet joint consists of an axial section and a radial section that form a right angle, whereby the flamepath must change direction. A rabbet joint is also known as a spigot joint.

8.11 RADIAL JOINT SECTION – The portion of the joint that is perpendicular to the axis of the parts forming the joint.

8.12 SEALED JOINT – A joint where a sealing material applied to a joint surface does not increase the maximum clearance between joint surfaces beyond the dimensions specified in this Standard. See 11.3.1 and 19.4.

8.13 SHAFT PATH – A path formed upon assembly of a shaft and shaft opening in an enclosure.

8.14 STRAIGHT OR FLAT JOINT – A joint where, upon assembly of the parts forming the joint, a straight flame path in a single plane is formed.

8.15 TEST FACTOR – A factor of safety imposed upon a test condition.

8.16 THREADED JOINT – A joint formed upon assembly of two mating threaded sections.

CONSTRUCTION – ALL HEATERS

9 General

9.1 A portable heater shall be of the hand-held type or shall be mounted on a movable base or stand with or without casters or wheels.

10 Enclosure

10.1 Enclosure

10.1.1 The enclosure housing the electrical components, such as heater elements, switches, and thermostats, shall be made of iron, steel, copper, brass, bronze, aluminum, or an alloy containing not less than 80 percent aluminum, or shall be made of nonmetallic material which complies with the requirements in Section 32, Non-Metallic Enclosure Materials Tests. A metal such as zinc or magnesium or their alloys shall not be used.

10.1.2 Copper shall not be used for the enclosure of an electric heater for use in Class I, Group A locations. A copper alloy shall not be used for an enclosure unless it is coated with tin, nickel, or other acceptable coating, or unless the copper content of the alloy is not more than 30 percent.

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10.2 Thickness

10.2.1 Except as indicated in 10.2.2 and 10.2.3, the thickness of enclosure walls shall not be less than specified in Table 10.1.

Table 10.1
Thickness of metal for enclosure

Maximum enclosure dimensions				Minimum thickness, inch (mm)			
Length or diameter,		Area of any one		Cast brass,		Cast iron and	
inches	(m)	square	(m ²)	bronze, copper, of		aluminum	Sheet steel
		inches		malleable iron			
22	(0.56)	480	(0.31)	0.093	(2.36)	0.125	(3.18)
30	(0.76)	620	(0.40)	0.093	(2.36)	0.125	(3.18)
60	(1.52)	1500	(0.97)	0.125	(3.18)	0.187	(4.75)
Over 60	(over 1.52)	Over 1500	(over 0.97)	0.187	(4.66)	0.250	(6.55)
						0.067	(1.70)
						0.093	(2.36)
						0.125	(3.18)
						0.187	(4.66)

10.2.2 A heating element shall be permitted to have a sheath thickness less than 3/32 inch (2.4 mm) if the element:

- a) Is cast in metal, with the cast metal not less than 1/8 inch (3.2 mm) thick over the sheath; or
- b) Complies with the Dielectric Voltage-Withstand Test, Section 29, and the manufacturing and production tests specified in 51.1(c).

10.2.3 A sheet-metal enclosure of a heater for use in Class II locations shall be permitted to have a thickness not less than specified in Table 10.2 if the heater is intended only for:

- a) Ceiling mounting and is marked in accordance with 55.16; or
- b) Wall mounting, complies with the requirements in 29.3 and 29.4, and is marked in accordance with 55.17.

Table 10.2
Thickness of sheet metal for Class II locations

Specific construction ^a		Minimum thickness of sheet metal, inch (mm)		
		Uncoated steel	Zinc-coated steel	Copper, brass, or aluminum
At Openings for Conduit		0.032 (0.81)	0.034 (0.86)	0.040 (1.02)
Length more than 26 inches (660 mm)	Component Support	0.026 (0.66)	0.029 (0.74)	0.032 (0.81)
	No Component Support	0.020 (0.51)	0.023 (0.58)	0.025 (0.64)
Length not more than 26 inches	Component Support	0.020 (0.51)	0.023 (0.58)	0.025 (0.64)
	No Component Support	0.016 (0.41)	0.019 (0.48)	0.020 (0.51)

NOTE – This table applies only to heaters as described in 10.2.3 and 39.2.2.1.

^a A component refers to an electrical device, such as a lampholder, switch, and the like.

10.2.4 Table 10.2 applies to any single surface of a single flat sheet. Rigid members consisting of 1/2 by 1/2 inch (12.7 by 12.7 mm), 90-degree angle strips formed of sheet steel not less than 0.032 inch (0.81 mm) thick, or flat steel bars not less than 3/8 inch (9.5 mm) thick shall be permitted to be used to reinforce and divide a large area into sections for which thinner metal shall be permitted to be used. Such reinforcement, unless along the longer dimensions of the surface, is to be additionally secured to the adjacent sides of the enclosure. A single piece of sheet metal that is corner-bent to form an angle of not more than 120 degrees is considered to be reinforced along the bend, and its thickness shall be permitted to be based on the length of the largest flat surface involved.

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

11 Joints in Enclosures

11.1 General

11.1.1 Joints in an enclosure shall comply with the applicable requirements in 11.1.2 – 11.7.3.1, and Section 33, Explosion Tests.

Exception: This requirement does not apply to joints that comply with the requirements in Supplement SA, Alternative Joints in Enclosures, and Supplement SB, 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, or polymeric-to-glass type. The 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, ANSI/ASME B46.1.

11.2 Cemented joints

11.2.1 When a part that is not intended to be removed after assembly, and that is not required to be opened to install or service the equipment is sealed with a sealing compound, the sealing compound shall:

- a) For Class I equipment, resist solvent action in compliance with 32.5, Tests on sealing compounds;
- b) Resist moisture in compliance with UL 1203, High Humidity Tests; and
- c) Comply with the requirements of 29.2, Impact test, without loosening or cracking, or showing other signs of deterioration.

11.2.2 The length of the compound seal shall be either the minimum length of joint required for an unsealed joint, or 5/8 inch (15.9 mm), whichever is less.

11.2.3 The cement shall contain no voids between the mating parts forming the joint.

11.2.4 The cement shall not be relied upon for mechanical security of the joint.

11.3 Joints with flamepaths Class I, Groups A, B, C, and D

11.3.1 A sealing material applied to a joint surface in accordance with Exception No. 1 to 21.3 shall not increase the maximum clearance between joint surfaces beyond the dimensions specified in this Standard.

11.3.2 A polymeric-to-polymeric joint shall be of the labyrinth or threaded type, and shall comply with the requirements in Section 32, Non-Metallic Enclosure Materials Tests.

11.3.3 The free-internal volume is determined to be the total internal volume of an electrical enclosure minus the volume of internal components. The volume of potting compounds is not used in the determination of the free-internal volume.

Exception No. 1: Potting compounds used for factory-installed lead wire seals, coil encapsulation, or coilinsulation are to be used in the determination of the free-internal volume.

Exception No. 2: Potting compounds are to be used in determining the free-internal volume when the compounds:

- a) Have been investigated to determine that they will withstand exposure to the flammable vapors involved in that they will remain in place inside the enclosure; and*
- b) Are free of voids.*

11.3.4 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 preferred. The width of the joint is to be measured with the parts forming the joint assembled in the most unfavorable position.

11.3.5 A gasket shall not be employed in a metal-to-metal, metal-to-polymeric, or polymeric-to-polymeric joint. A gasket that is adjacent to a joint and does not increase the clearance, nor decrease the length of the joint specified in this Standard for the Group and type of joint, meets the intent of this requirement.

11.3.6 A gasket functioning as an active member in the flamepath is not prohibited from being employed in a metal-to-glass or polymeric-to-glass joint when the gasket complies with the requirements in 11.3.7 – 11.3.10. The maximum clearance between the gasket and the metal, polymeric, or glass shall not be more than that specified in this Standard for the Group and type of joint.

11.3.7 The use of a gasket functioning as an active member in the flamepath shall be limited to a joint that is not disturbed during the installation or intended servicing of the equipment.

11.3.8 A gasket functioning as an active member in the flamepath shall be a metal-covered type formed from polytetrafluoroethylene, or other material that has been investigated and found capable of being used for the application. A metal-covered gasket in a metal-to-glass or polymeric-to-glass joint shall be mechanically attached to the glass. There shall be no overlapping of the metal covering the gasket on the joint surfaces. A gasket in a metal-to-glass joint shall be subjected to tests to determine the effects of solvent vapors, heat, aging, compression, distortion under conditions of use, and cold flow or creep when the gasket is of the elastomeric or thermoplastic type. The means of securing the gasket to the cover or enclosure, the gasket construction, and the gasket material are to be investigated in determining the tests to be conducted.

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11.3.9 When a gasket of polytetrafluoroethylene or similar material is used, it shall be installed in such a manner as to reduce the occurrence of cold flow of the gasket material. The means of securing the gasket to the cover or enclosure, the gasket construction, and the gasket material are to be investigated in determining the tests to be conducted.

11.3.10 A material that upon aging readily hardens or adheres to a joint surface, or both, is not to be used as a gasket material. A gasket which is attached by an adhesive or a cement does not comply with this Standard.

11.3.11 A joint of the labyrinth type shall comply with the requirements in 33.13.

11.3.12 A labyrinth joint shall consist of not less than 3 adjacent segments where the path changes direction not less than 2 times.

11.4 Class I, Groups C and D locations

11.4.1 General

11.4.1.1 Except as indicated in 11.4.1.2 – 11.4.1.5 and 11.4.2.1, the width of a joint and the clearance, when assembled, shall be as specified in Figure 11.1. The width of the joint shall not be less than 3/4 inch (19.1 mm).

11.4.1.2 A rabbet joint is not prohibited from having a diametrical clearance at the axial section of not more than twice the clearance specified in Figure 11.1 when neither the axial nor the radial section of the joint is less than 1/16 inch (1.6 mm) wide.

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Figure 11.1
Relation between clearance and width of joint



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11.4.1.3 An enclosure having a free-internal volume of not more than 300 cubic inches (4.92 dm³) is not prohibited from having a 1/2 inch (12.7 mm) wide rabbet joint or a 3/8 inch (9.5 mm) wide flat joint when details comply with (a) or (b), respectively.

a) One-half-inch-wide rabbet joint (see Figure 11.2).

- 1) Neither the axial nor the radial section of the joint is less than 3/64 inch (1.2 mm) wide;
- 2) The diametrical clearance of the axial section and the clearance of the radial section 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 (12.7 mm).

b) Three-eighths-inch-wide flat joint (see Figure 11.3).

- 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 joint more than 1/8 inch (3.2 mm) at any point;
- 2) The thickness of the cover at the joint width is not less than 3/8 inch (9.5 mm), unless stiffened or reinforced material less thick has been found to be capable of being used when judged with respect to opening of joint clearance under internal pressures; and

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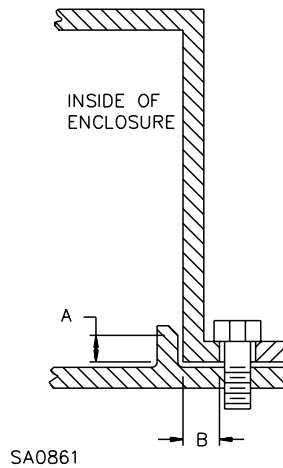


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- 3) The joint width measured from the inside of the enclosure to the nearest edge of each bolt clearance hole is not less than 3/8 inch (9.5 mm).

Figure 11.2
Rabbet joint

See 11.4.1.3(a) and 11.5.1.2

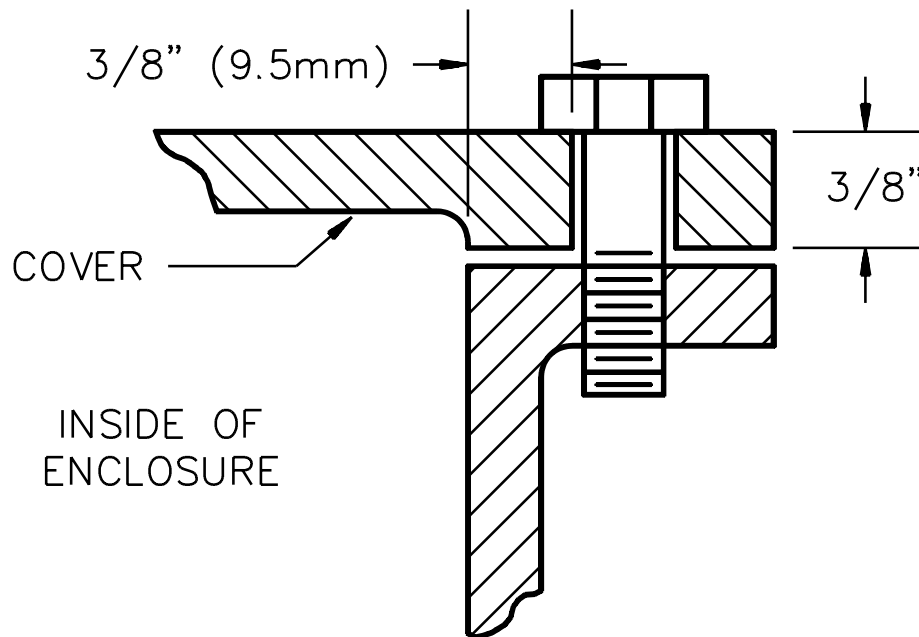


$A + B = 1/2$ inch (12.7 mm) for Class I, Groups C and D enclosures having free internal volume not more than 300 cubic inches (4.92 dm³)

$A + B = 7/8$ inch (22.2 mm) for Class I, Group B enclosures having free internal volume not more than 100 cubic inches (1.64 dm³)

Figure 11.3
3/8-inch (9.5-mm) wide flat joint

(See 11.4.1.3(b) and 11.5.1.1)



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11.4.1.4 The width of a joint in an enclosure having a free internal volume of not more than 6 cubic inches (0.1 dm³) shall not be less than 1/4 inch (6.4 mm). For an enclosure for Group C locations, the clearance between the joint surfaces shall not be more than 0.004 inch (0.10 mm). For an enclosure for Group D locations, the clearance between the joint surfaces shall not be more than 0.006 inch (0.15 mm).

11.4.1.5 An enclosure is not prohibited from having a venting section to relieve internal explosion pressures. A joint in a vented enclosure is not prohibited from having a width of not less than 1/4 inch (6.4 mm), and a clearance of not more than 0.005 inch (0.13 mm), when the maximum explosion pressure developed during the explosion tests does not exceed 5 psig (34.5 kPa). A venting section shall afford protection against propagation of flame.

11.4.1.6 A 3/4 inch (19.1 mm) or wider joint shall not have an interruption, such as a groove for an O-ring, unless:

- a) The interruption has a maximum cross-sectional area of 0.05 inch² (32.3 mm²);
- b) The joint width from the inside of the enclosure to the inner edge of the interruption is more than 1/2 inch (12.7 mm); and
- c) The balance of the required minimum joint width is provided from the outer edge of the interruption, to the outside of the enclosure.

11.4.2 Labyrinth joints, Groups A, B, C, and D

11.4.2.1 A joint of the labyrinth type shall comply with the requirements in 33.25.

11.4.2.2 A labyrinth joint shall consist of not less than 3 adjacent segments where the path changes direction not less than 2 times.

11.4.3 Bolts in joint width

11.4.3.1 A bolt is not prohibited from being located in a 3/4 inch (19.1 mm) or wider joint when 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 11.1. The distance from inside the enclosure to the edge of the nearest clearance hole is measured with the cover in the most unfavorable position. See 11.4.3.4 and Figure 11.4.

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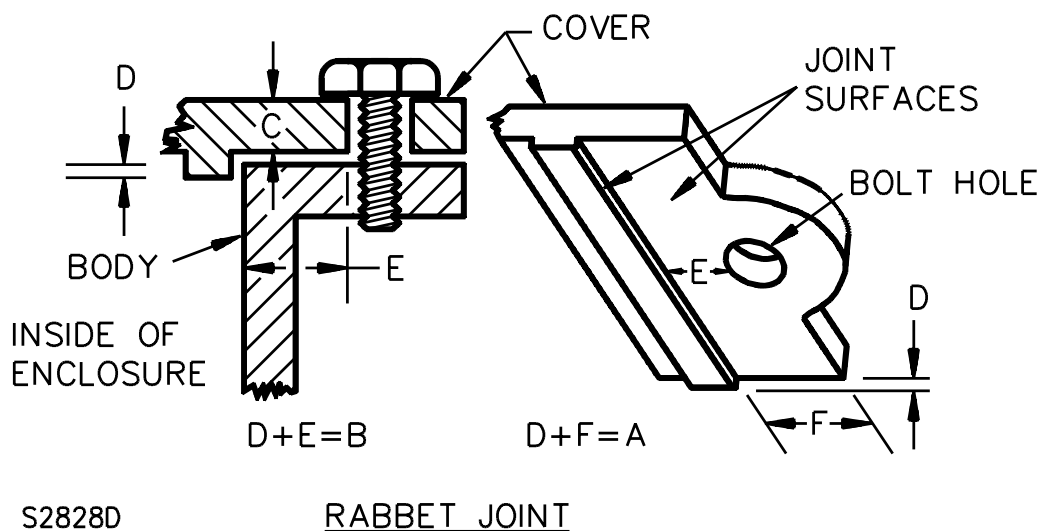
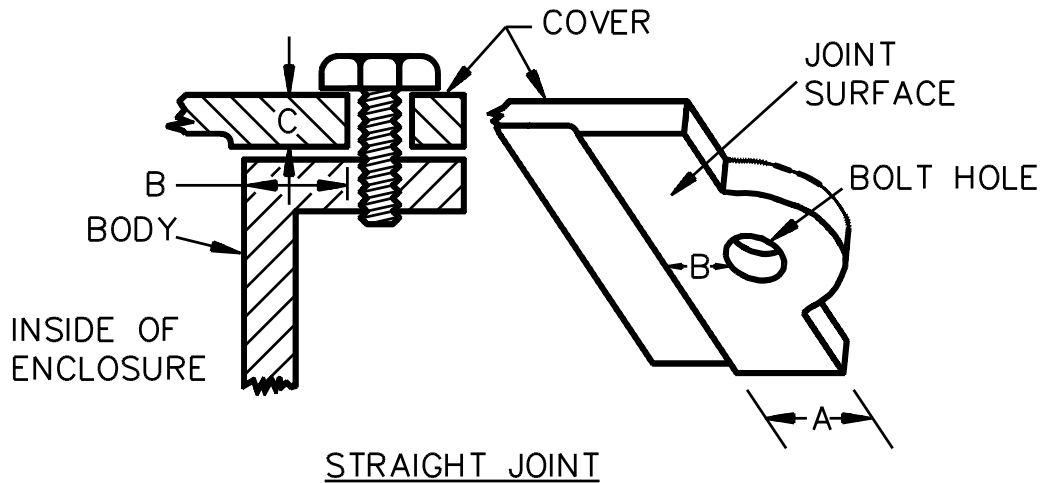
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Figure 11.4
Bolts in joint width
 (See 11.4.3.1 and 11.5.2.2)



A = Required minimum width of joint (see Figure 11.1)

B = Minimum distance from inside enclosure to bolt clearance hole

C = One-half 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

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11.4.3.2 All bolt holes in a joint width shall be bottomed or the bolts or screws for fastening a cover shall each engage at least five full threads in a tapped hole.

11.4.3.3 A bolt in a joint width is not prohibited from being provided with a lock washer.

11.4.3.4 The requirements in 11.4.3.1 and 11.4.3.2 apply, in general, to machine screws having a round cross section. Screws that form their own machine-type thread and have been investigated for securing enclosure parts are not prohibited from being located in the joint width when they comply with the requirements in 11.4.3.1 and 11.4.3.2, 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.

11.5 Class I, Group B locations

11.5.1 General

11.5.1.1 The width of a joint in an enclosure having a free internal volume of not more than 30 cubic inches (0.5 dm^3) 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 hole. The cover thickness at the joint flange shall not be less than $3/8$ inch. The clearance between the 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 joint more than $1/8$ inch (3.2 mm) at any point. See Figure 11.3.

Exception: For an enclosure having a free internal volume of not more than 6 cubic inches (0.1 dm^3), the clearance between the joint surfaces is not prohibited from being not more than 0.004 inch (0.10 mm), and the cover thickness at the joint flange is not prohibited from being less than $3/8$ inch .

11.5.1.2 The width of a joint in an enclosure having a free internal volume of more than 30 cubic inches (0.5 dm^3) and not more than 100 cubic inches (1.6 dm^3) shall not be less than $5/8$ inch (15.9 mm). At a bolt hole, the width is to be measured from the inside edge to the nearest edge of the bolt clearance hole. The clearance between the 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 joint more than $1/8$ inch (3.2 mm) at any point. A rabbet joint shall have a total width of not less than $7/8$ inch (22.2 mm), with neither section of joint being less than $3/8$ inch (9.5 mm) wide. The diametrical clearance at the axial section of joint shall not be more than 0.0025 inch (0.064 mm), and the clearance at the radial or clamped section of joint shall not be more than 0.0015 inch. See Figure 11.2.

11.5.1.3 The width of a joint in an enclosure having a free internal volume of more than 100 cubic inches (1.64 dm^3) and not more than 350 cubic inches (5.7 dm^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).

11.5.2 Bolts in joint width

11.5.2.1 A bolt is not prohibited from being located in the joint width of an enclosure having a free internal volume (air volume) of more than 100 and not more than 350 cubic inches (1.6 – 5.7 dm³) when it complies with the requirements in 11.5.2.2 and 11.5.2.3.

11.5.2.2 A bolt is not prohibited from being located in a 1 inch (25.4 mm) or wider joint when the distance from the inside of the enclosure to the nearest edge of the clearance hole for the bolt is not less than 55/64 inch (21.8 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. The distance from inside the enclosure to the edge of the nearest clearance hole is measured with the cover in the most unfavorable position. See 11.5.2.5 and Figure 11.4.

11.5.2.3 All bolt holes in a joint width shall be bottomed or the bolts or screws for fastening a cover shall each engage at least five full threads in a tapped hole.

11.5.2.4 A bolt in a joint width is not prohibited from being provided with a lock washer.

11.5.2.5 The requirements in 11.5.2.1 – 11.5.2.3 apply, in general, to machine screws having a round cross section. Screws that form their own machine-type thread and have been investigated for securing enclosure parts are not prohibited from being located in the joint width when they comply with the requirements in 11.5.2.1 – 11.5.2.3, 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.

11.6 Class I, Group A locations

11.6.1 Except for a conduit connection and a joint having tapered threads, a threaded joint in an enclosure shall have at least:

- a) Eight fully engaged threads with a Class 1 fit;
- b) Seven threads with a Class 2 fit; or
- c) Six threads with a Class 3 fit.

11.6.2 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 (per 25.4 mm).

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

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11.7 Threaded joints

11.7.1 General – Class I, Groups A, B, C, and D

11.7.1.1 The thread pitch in threaded joints shall not be finer than 32 threads per inch (0.79 mm pitch).

11.7.1.2 A joint of the serrated type with thread contour shall not have more than 20 serrations per inch (1.27 mm pitch) and shall have not less than 5 fully engaged and tightly clamped serrations.

11.7.1.3 All unused threaded openings through the walls of an explosion-proof enclosure shall be closed by a device or a threaded plug. The joint formed, upon assembly, shall comply with 11.7.2.1.

11.7.1.4 For joints formed by a screw in a through hole securing a part, the screw shall be secured against removal by a lock nut, a lock washer, peening, staking, welding, or other mechanical means.

11.7.1.5 A thread locking compound shall be subjected to a special investigation.

11.7.2 Class I, Groups A and B

11.7.2.1 A threaded joint shall comply with the following:

- a) For standard tapered pipe threads, not less than 5 fully engaged threads shall be provided; or
- b) For parallel threads not finer than 20 threads per inch (1.27 mm pitch) the minimum number of threads required shall be not less than specified in Table 11.1 for the class of fit; or
- c) For parallel threads not finer than 32 threads per inch (0.79 mm pitch) and tested as described in Section 33, Explosion Tests, the minimum number of threads required shall be not less than specified in Table 11.2.

Table 11.1
Number of threads versus class of fit

Minimum number of fully engaged threads	Class of fit	
	ANSI ^a	ISO ^b
6	3	(5H/4h)
7	2	(6H/6h)
8	1	(7H/7h)

^aSee the Standard for Unified Inch Screw Threads (UN and UNR Thread Form), ANSI/ASME B1.1.

^bSee the Standard for General Purpose Metric Screw Threads – Tolerances – Part 1, ISO 965-1 and the Standard for General Purpose Metric Screw Threads – Tolerances – Part 3, ISO 965-3.

Table 11.2
Threads required based upon enclosure volume

Free internal volume of enclosure	Minimum number of fully engaged threads	Minimum length of thread engagement
$\leq 6.1 \text{ inch}^3 (\leq 100 \text{ cm}^3)$	5	0.25 inch (6 mm)
$> 6.1 \text{ inch}^3 (> 100 \text{ cm}^3)$	6	0.3125 inch (8 mm)

11.7.3 Class I, Groups C and D

11.7.3.1 A threaded joint shall be made up with the number of fully engaged threads specified in Table 11.3. Threads shall not be finer than specified in Table 11.3.

Table 11.3
Thread engagement

Maximum diameter of threaded sections, inch (mm)	Maximum number of threads per inch (per 25.4 mm)	Minimum 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

11.8 Shaft Openings

11.8.1 General

11.8.1.1 A shaft opening in an enclosure shall be of the metal-to-metal type. See 11.1.2 regarding the roughness of the surfaces forming the shaft path joints.

11.8.1.2 The requirements in 11.8.2.1 – 11.8.3.5.2 apply to shaft openings in electrical enclosures for Class I, Groups C and D locations.

11.8.1.3 Equipment for Class I, Group A or B locations having a free internal volume of 30 cubic inches (0.5 dm^3) or less and a shaft that rotates at less than 100 rpm shall comply with the requirements in 11.8.2.1.

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