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

UL Standard for Safety
for

Circuit Breakers and Circuit-Breaker Enclosures for Use in Hazardous (Classified) Locations, UL 877

Fourth Edition, Dated June 28, 1993

Revisions: This Standard contains revisions through and including July 26, 1996.

A change is indicated by a note following the affected item. The note is preceded and followed by an asterisk.

The new requirements are substantially in accordance with UL's Bulletin on this subject dated March 21, 1996. The bulletin is now obsolete and may be discarded.

The revisions dated July 26, 1996 include a reprinted title page (page 1) for this Standard.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

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that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

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 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:

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UL 877**Standard for****Circuit Breakers and Circuit-Breaker
Enclosures for Use in Hazardous
(Classified) Locations**

First Edition – May, 1973

Second Edition – January, 1976

Third Edition – August, 1985

Fourth Edition**June 28, 1993**

Approval as an American National Standard (ANSI) covers the numbered paragraphs on pages dated June 28, 1993. These pages should not be discarded when revised or additional pages are issued if it is desired to retain the ANSI approved text.

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

Approved as ANSI C33.120-1975, September 25, 1975

Approved as ANSI/UL 877-1985, March 29, 1985

Approved as ANSI/UL 877-1992, August 13, 1992

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.

ISBN 1-55989-305-2**COPYRIGHT © 1974, 1996 UNDERWRITERS LABORATORIES INC.**

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover circuit breakers specifically designed to provide service-entrance, meter-service, or branch-circuit protection for installation and use in hazardous (classified) locations, Class I, Division 1, Groups A, B, C, and D, and Class II, Division 1, Groups E, F, and G, in accordance with the National Electrical Code, NFPA 70.

1.1.1 These requirements also cover explosion-proof electrical equipment for installation and use in Class I, Zone 1, Groups IIA, IIB, IIB plus Hydrogen, and IIC hazardous (classified) locations.

1.1.1 added July 26, 1996

1.2 These requirements cover circuit breakers rated 600 volts, or less.

1.3 These requirements also cover enclosures intended to house a single circuit-breaker mechanism – single or multiple pole, or two single-pole circuit-breaker mechanisms. The mechanisms are not provided with the enclosures.

1.4 These requirements apply to circuit breakers and circuit breaker enclosures for use in hazardous locations under the following atmospheric conditions:

- a) A minimum ambient temperature of minus 25°C (minus 13°F),
- b) An oxygen concentration not greater than 21 percent by volume, and
- c) A nominal barometric pressure of one atmosphere.

1.5 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the acceptable level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard cannot be judged to comply with this standard. Where considered appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

1.5 revised July 13, 1995

2 General

2.1 Terminology

2.1.1 For the purpose of these requirements, the term circuit breaker covers the electrical mechanism together with an enclosure and the term circuit-breaker mechanism covers the electrical mechanisms, only.

2.2 Units of measurement

2.2.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

2.3 Undated references

2.3.1 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.

2.4 Components

2.4.1 Except as indicated in 2.4.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

2.4.2 A component need not comply with a specific requirement that:

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

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

2.4.4 Specific components are recognized as being 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 for which they have been recognized.

2A Class I, Zone, and Group Equivalency

2A.1 Class I, Zone 1, Group IIA

2A.1.1 Explosion-proof electrical equipment intended to be marked in accordance with 24.1.1 shall comply with all the requirements for explosion-proof electrical equipment for use in Class I, Group D hazardous (classified) locations.

2A.1.1 added July 26, 1996

2A.2 Class I, Zone 1, Group IIB

2A.2.1 Explosion-proof electrical equipment intended to be marked in accordance with 24.1.2 shall comply with all the requirements for explosion-proof electrical equipment for use in Class I, Group C hazardous (classified) locations.

2A.2.1 added July 26, 1996

2A.3 Class I, Zone 1, Group IIB plus Hydrogen

2A.3.1 Explosion-proof electrical equipment intended to be marked in accordance with 24.1.3 shall comply with all the requirements for explosion-proof electrical equipment for use in Class I, Group B hazardous (classified) locations.

2A.3.1 added July 26, 1996

2A.4 Class I, Zone 1, Group IIC

2A.4.1 Explosion-proof electrical equipment intended to be marked in accordance with 24.1.4 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.

2A.4.1 added July 26, 1996

CONSTRUCTION

3 General

3.1 These requirements cover both circuit breakers and circuit-breaker enclosures other than as indicated in 24.24.

3.2 Circuit breakers for use in hazardous locations shall also comply with the applicable requirements in the Standard for Molded-Case Circuit Breakers and Circuit-Breaker Enclosures, UL 489.

4 Enclosure Material

4.1 The enclosure of a circuit breaker shall be made of ferrous alloys, copper, brass, bronze, or aluminum or its alloys containing not less than 80 percent aluminum or shall be made of acceptable nonmetallic material. A metal such as zinc or magnesium, or their alloys, is not acceptable.

4.2 Copper shall not be used for the enclosure of a circuit breaker for use in Class I, Group A locations. A copper alloy may be used for an enclosure if:

- a) It is coated with tin, nickel, or other acceptable coating, or
- b) The copper content of the alloy is not more than 30 percent.

4.3 Among the factors that are taken into consideration when determining the acceptability of a nonmetallic material are:

- a) Mechanical strength,
- b) Resistance to impact,
- c) Moisture-absorptive properties,

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A not-for-profit organization dedicated to public safety
and committed to quality service

July 13, 1995

Revision pages for

Standard for

Circuit Breakers and Circuit-Breaker Enclosures For Use in Hazardous (Classified) Locations,

UL 877, Fourth Edition

Attached to this transmittal notice is a revision of the Fourth edition of UL 877.

A CHANGE ON A PAGE DATED JULY 13, 1995 IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM, PRECEDED AND FOLLOWED BY AN ASTERISK.

THESE NEW AND REVISED REQUIREMENTS ARE NOW IN EFFECT EXCEPT FOR PARAGRAPHS 10.1.1.1, 10.1.2, 10.1.7, 10.2.2, 10.2.5, 10.2.5.1, 24.29, TABLE 10.2, AND FIGURE 10.1, WHICH BECOME EFFECTIVE JULY 16, 1997 AS INDICATED IN THE SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM. TO RETAIN THE REQUIREMENTS IN EFFECT UNTIL JULY 16, 1997, DO NOT DISCARD THE PREVIOUS PAGES CONTAINING THE REQUIREMENTS SPECIFIED ABOVE UNTIL THIS FUTURE EFFECTIVE DATE.

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

The new and revised requirements are substantially in accordance with UL's bulletin on this subject dated October 28, 1994. The bulletin is now obsolete and may be discarded.

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Revised and/or additional pages may be issued from time to time.

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With the inclusion of the accompanying material, the standard consists of pages dated as shown in the following checklist:

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1.5 revised July 13, 1995

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2.4.4 Specific components are recognized as being 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 for which they have been recognized.

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4.2 Copper shall not be used for the enclosure of a circuit breaker for use in Class I, Group A locations. A copper alloy may be used for an enclosure if:

- a) It is coated with tin, nickel, or other acceptable coating, or
- b) The copper content of the alloy is not more than 30 percent.

4.3 Among the factors that are taken into consideration when determining the acceptability of a nonmetallic material are:

- a) Mechanical strength,
- b) Resistance to impact,
- c) Moisture-absorptive properties,

- d) Resistance to fungus,
- e) Combustibility,
- f) Resistance to repeated explosions,
- g) Resistance to solvents as covered by the hazardous location group or groups under consideration,
- h) Resistance to accumulation of electrostatic charges, and
- i) Resistance to distortion and creep at temperatures to which the material may be subjected under all conditions of use.

All of these factors are to be considered with respect to thermal aging.

5 Enclosure Thickness

5.1 The thickness of a metal enclosure wall shall not be less than specified in Table 5.1.

Exception: An enclosure of die-cast or permanent-mold aluminum may have a wall thickness of not less than 3/32 inch (2.4 mm), provided that:

- a) *The free internal volume of the enclosure is less than 30 cubic inches (0.5 dm³);*
- b) *Insulated conductors are clamped or routed so that they cannot contact the enclosure; and*
- c) *All uninsulated live parts are separated from the enclosure by an insulating barrier at least 0.028 inch (0.70 mm) thick secured in place. In determining the acceptability of the insulating material, consideration is to be given to:*
 - 1) *Moisture absorptive properties,*
 - 2) *Combustibility,*
 - 3) *Resistance to distortion at temperatures to which it may be subjected, and*
 - 4) *Thermal aging.*

Table 5.1
Thickness of metal for enclosure

Maximum enclosure dimension		Minimum acceptable thickness, Inch ^a		
Length or diameter in inches ^a	Area of any one surface in square inches ^b	Cast brass, bronze, copper, or malleable iron	Cast iron or aluminum	Sheet steel
22	480	0.093	0.125	0.067
30	620	0.093	0.125	0.093
60	1500	0.125	0.187	0.125
Over 60	Over 1500	0.187	0.250	0.187

^a 1 inch = 25.4 mm.

^b 1 square inch = 645 mm².

5.2 A machined or a threaded joint in the walls of a cast-metal enclosure shall have at least the thickness specified in Table 5.1 through the overlap.

6 Joints in Enclosures

6.1 General

6.1.1 A joint in an enclosure shall be of the metal-to-metal, metal-to-polymeric, or polymeric-to-polymeric 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 B46.1-1985.

6.1.2 A polymeric-to-polymeric joint shall be a labyrinth or threaded type.

6.1.3 The free-internal volume is considered to be the total internal volume of an electrical enclosure minus the volume of internal components. Potting compounds are not considered in the determination of the free-internal volume.

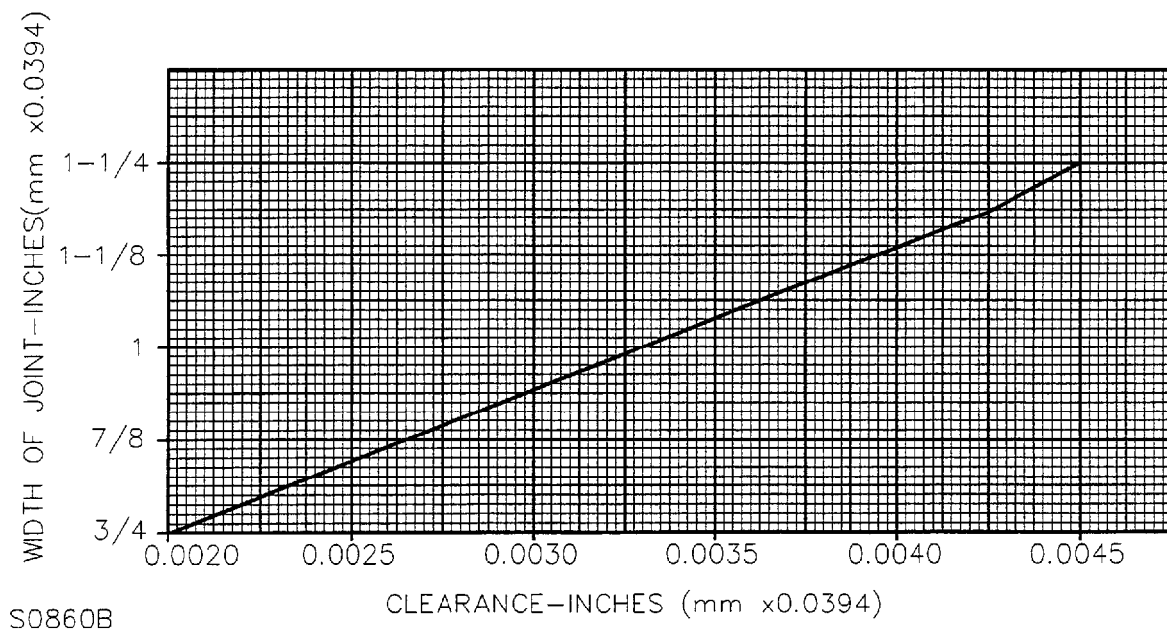
6.1.4 A feeler gauge utilized to measure the clearances specified in these requirements is to be 1/8 to 1/2 inch (3.2 to 12.7 mm) wide, with a 1/2-inch-wide gauge used, if possible. The width of a joint is to be measured with the cover in the most unfavorable position.

6.2 Class I, Groups C and D locations

6.2.1 Flat and rabbet joints

6.2.1.1 Except as indicated in 6.2.1.2, 6.2.1.3, and 6.2.3.1, the width of a joint and the clearance, when assembled, shall be as specified in Figure 6.1 and the width of joint shall not be less than 3/4 inch (19.1 mm).

Figure 6.1
Relation between clearance and width of joint



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6.2.1.2 A rabbet joint may have a diametrical clearance at the axial section of not more than twice the clearance specified in Figure 6.1 if neither the axial nor the radial section of the joint is less than 1/16 inch (1.6 mm) wide.

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

a) One-half-inch wide rabbet joint (see Figure 6.2):

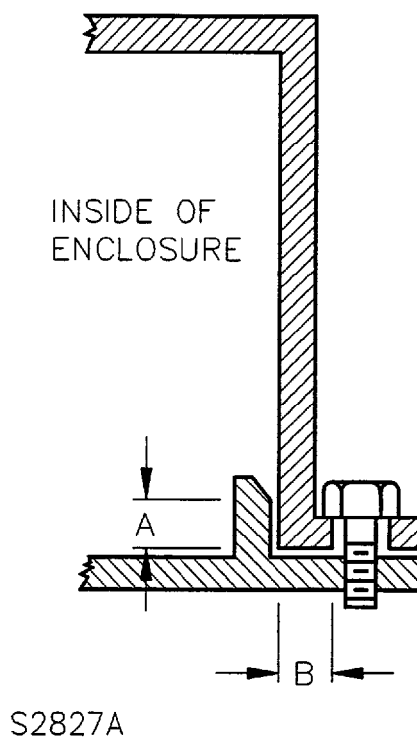
- 1) Neither the axial nor the radial section of the joint is less than 3/64 inch (1.2 mm) wide,
- 2) The diametrical clearance of the axial section and the clearance of the radial section of the joint is not more than 0.002 inch (0.05 mm), and
- 3) The joint width measured from the inside of the enclosure 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 6.3):

- 1) The clearance between the joint surfaces is less than 0.0015 inch (0.038 mm) or such that an 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 unless stiffened or reinforced metal of a lesser thickness has been found to be acceptable when judged with respect 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 is not less than $3/8$ inch.

Figure 6.2
Rabbet joint



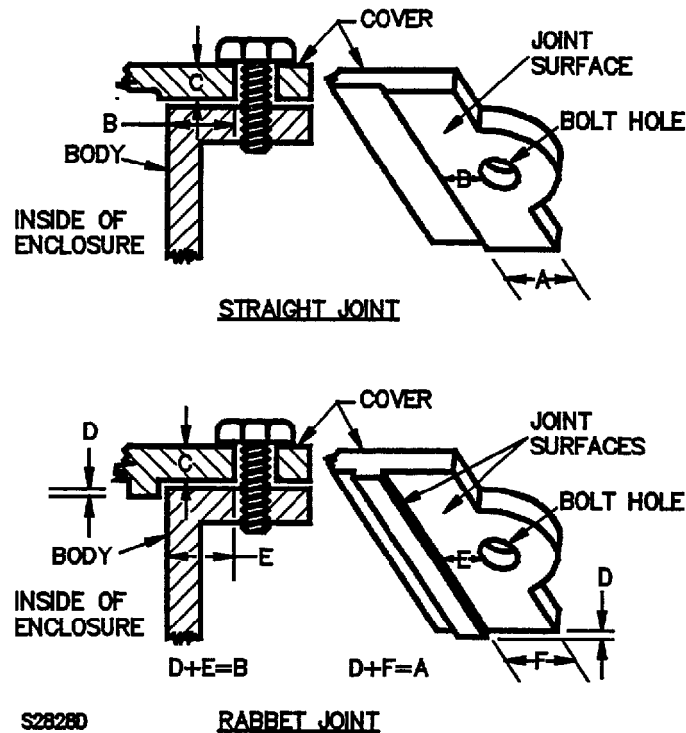
(See 6.2.1.3(a) and 6.3.2)

$A + B = 1/2$ inch (12.7 mm) for Class 1, 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 1, Group B enclosures having free internal volume not more than 100 cubic inches (1.64 dm³).

Figure 6.2 revised July 13, 1995

Figure 6.4
Bolts in joint width



(See 6.2.4.1 and 6.2.4.2)

- A = Required minimum width of joints (see Figure 6.1)
- 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

6.3 Class I, Group B locations

6.3.1 The width of a joint in an enclosure having a free internal volume of not more than 30 cubic inches (0.5 dm³) 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 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 joint more than 1/8 inch (3.2 mm) at any point. See Figure 6.3.

6.3.2 The width of a joint in an enclosure having a free internal volume of more than 30 cubic inches (0.5 dm^3) but 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 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 joint more than $1/8$ inch (3.2 mm) at any point. A rabbet joint 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 the axial section of the joint shall not be more than 0.0025 inch (0.064 mm), and the clearance at the radial or clamped section of the joint shall not be more than 0.0015 inch. See Figure 6.2.

6.3.3 The width of a joint in an enclosure having a free internal volume of more than 100 cubic inches (1.6 dm^3) but 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).

6.3.4 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, seven threads with a Class 2 fit, or six threads with a Class 3 fit. 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).

6.3.4 revised July 13, 1995

6.3.5 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.

6.3.5 revised July 13, 1995

6.4 Class I, Group A locations

6.4.1 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, seven threads with a Class 2 fit, or six threads with a Class 3 fit. 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).

6.4.1 revised July 13, 1995

6.4.2 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.

6.4.2 revised July 13, 1995

6.5 Class II, Groups E, F, and G locations

6.5.1 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 (0.05 mm) for a $3/16$ -inch 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 be provided between the inside of the enclosure and the nearest edge of each bolt hole. The width of joint is to be measured with the cover in the most unfavorable position. See 6.1.1 for the roughness of joint surface requirements.

6.5.2 If a gasket is used in a joint, it shall be formed of polytetrafluoroethylene, plant-fiber sheet-packing material, or a material having similar characteristics. 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.

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.