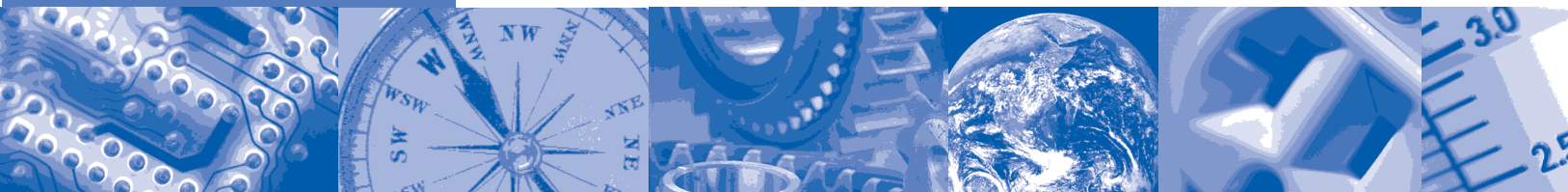


ANSI/ISA-12.22.01-2002 (IEC 60079-1 Mod)

Supersedes ANSI/ISA-12.22.01-1998 (IEC 60079-1 Mod)



Electrical Apparatus for Use in Class I, Zone 1 Hazardous (Classified) Locations Type of Protection — Flameproof "d"



**ISA—The Instrumentation,
Systems, and
Automation Society**

Approved 2 December 2002



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The most recent designation of ANSI/UL 60079-1 and ANSI/ISA-12.22.01-2002 (IEC 60079-1 Mod) as an American National Standard occurred on 2 December 2002.

This ANSI/UL Standard for Safety, which consists of the first edition is under continuous maintenance, whereby each revision is ANSI approved upon publication. Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Written comments are to be sent to the UL-RTP Standards Department, 12 Laboratory Drive, Research Triangle Park, NC 27709.

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**ISA — The Instrumentation, Systems,
and Automation Society**
ANSI/ISA – 12.22.01-2002
First Edition

Underwriters Laboratories Inc.
ANSI/UL 60079-1
First Edition



**ISA—The Instrumentation, Systems,
and Automation Society**



**Electrical Apparatus for Use in Class I, Zone 1 Hazardous
(Classified) Locations: Type of Protection -
Flameproof “d”**

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General Notes

This is the common ISA and UL Standard for Electrical apparatus for explosive gas atmospheres – Part 1: Flameproof enclosures "d". It is the first edition of ANSI/ISA-12.22.01-2002 (IEC 60079-1 Mod) [formerly ANSI/ISA-12.22.01-1998 (IEC 60079-1 Mod)] and the first edition of UL 60079-1. The ISA suffix "Mod" indicates the document is a modification of the IEC document and includes U.S. deviations encompassing both additions and deletions of information.

ANSI/ISA-12.22.01-2002 (IEC 60079-1 Mod) and UL 60079-1 contain identical requirements, and identical publication dates. The presentation and format of the standards material may differ between the two published standards.

This common Standard was prepared by ISA — The Instrumentation, Systems, and Automation Society and Underwriters Laboratories Inc. (UL).

Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

Level of harmonization

This standard adopts the IEC text with deviations.

The requirements are presented in different formats. The ISA version of the standard illustrates the national differences from the IEC text through the use of legislative text (strike-out and underline). The UL version of the standard illustrates national differences immediately following the IEC text. National differences between the UL version and the ISA version shall be word for word except for editorial changes.

Interpretations

The interpretation by the SDO of an identical or equivalent standard shall be based on the literal text to determine compliance with the standard in accordance with the procedural rules of the SDO. If more than one interpretation of the literal text has been identified, a revision shall be proposed as soon as possible to each of the SDOs to more accurately reflect the intent.

UL Effective Date

As of 2 December 2002 all products Listed or Recognized by UL must comply with the requirements in this Standard.

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Preface (ISA)

This ISA standard is based on IEC Publication 60079-1. It is the intention of the ISA SP12 Committee to develop an ANSI Standard that is harmonized with IEC 60079-1 to the fullest extent possible.

This preface is included for informational purposes and is not part of ANSI/ISA-12.22.01-2002 (IEC 60079-1 Mod). The suffix "Mod" indicates the document is a modification of the IEC document and includes U.S. deviations encompassing both additions and deletions of information.

The standards referenced within this document may contain provisions which, through reference in this text, constitute requirements of this document. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this document are encouraged to investigate the possibility of applying the most recent editions of the standards indicated within this document. Members of IEC and ISO maintain registers of currently valid International Standards. ANSI maintain registers of currently valid U.S. National Standards.

This document has been prepared as part of the service of ISA—The Instrumentation, Systems, and Automation Society—toward a goal of uniformity in the field of instrumentation. To be of real value, this document should not be static but should be subject to periodic review. Toward this end, the Society welcomes all comments and criticisms and asks that they be addressed to the Secretary, Standards and Practices Board; ISA; 67 Alexander Drive; P. O. Box 12277; Research Triangle Park, NC 27709; Telephone (919) 549-8411; Fax (919) 549-8288; E-mail: standards@isa.org.

The ISA Standards and Practices Department is aware of the growing need for attention to the metric system of units in general, and the International System of Units (SI) in particular, in the preparation of instrumentation standards. The Department is further aware of the benefits to USA users of ISA standards of incorporating suitable references to the SI (and the metric system) in their business and professional dealings with other countries. Toward this end, this Department will endeavor to introduce SI-acceptable metric units in all new and revised standards, recommended practices, and technical reports to the greatest extent possible. *Standard for Use of the International System of Units (SI): The Modern Metric System*, published by the American Society for Testing & Materials as IEEE/ASTM SI 10-97, and future revisions, will be the reference guide for definitions, symbols, abbreviations, and conversion factors.

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Foreword (UL)

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 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 or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the 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 does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this 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.

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National Differences

GENERAL

In the UL publication of this standard, National Differences from the text of International Electrotechnical Commission (IEC) Publication 60079-1, Electrical apparatus for explosive gas atmospheres – Part 1: Flameproof enclosures "d", copyright 2001, are indicated by notations (differences) and are presented in bold text. The national difference type is included in the body.

In the ISA publication of this standard, National Differences are presented using legislative text (strike-out and underline). The national difference type is identified in an informative annex.

There are five types of National Differences as noted below. The standard may not include all types of these National Differences.

NOTE The UL printed standard includes the national difference types within the body of the text. The ISA printed standard includes the national difference types in an annex at the back of the standard.

DR – These are National Differences based on the National Electrical Code (NEC) and other U.S. Regulatory Requirements.

D1 – These are National Differences based on **basic safety principles and requirements**, elimination of which would compromise safety for U.S. consumers and users of products.

D2 – These are National Differences based on **safety practices**. These are differences for IEC requirements that may be acceptable, but adopting the IEC requirements would require considerable retesting or redesign on the manufacturer's part.

DC – These are National Differences based on the **component standards** and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – These are National Differences based on **editorial comments or corrections**.

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Contents

General Notes	5
Preface (ISA)	7
Foreword (UL)	11
National Differences	13
Foreword (ISA)	17
1 Scope	19
2 ~~Normative~~ References	19
3 Definitions	20
4 Apparatus grouping and temperature classification	22
5 Flameproof joints	22
6 Cemented joints	33
7 Operating rods	33
8 Supplementary requirements for shafts and bearings	34
9 Light-transmitting parts	36
10 Breathing and draining devices which form part of a flameproof enclosure	36
11 Fasteners, associated holes and closing devices	42
12 Materials and mechanical strength of enclosures; materials inside the enclosures	45
13 Entries for flameproof enclosures	45
14 Verification and tests	48
15 Type tests	49
16 Routine tests	58
17 ~~Switchgear for Group I~~	59
18 Lampholders and lampcaps	60
19 Non-metallic enclosures and non-metallic parts of enclosures	61
Annex A (normative) — Additional requirements for crimped ribbon elements of breathing and draining devices	65

Annex B (normative) — Additional requirements for elements, with non-measurable paths, of breathing and draining devices	67
~~Annex C (normative) — Additional requirements for flameproof cable entries.....~~	~~69~~
Annex D (informative) — United States major deviations.....	73
Annex E (informative) — Editorial differences between ANSI/UL 60079-1 and ANSI/ISA-12.22.01-2002 (IEC 60079-1 Mod).....	75
Annex F (informative) — National differences types noted in ANSI/UL 60079-1	83

Foreword (ISA)

All text of IEC 60079-1:2000 is included. U.S. National Deviations are shown by ~~strikeout~~ through text deleted and underline under text added. Tables, or portions of tables, that are to be deleted are shown as shaded; figures to be deleted are marked with the overlay "X." There are six annexes in this standard. Annexes A, B, and C are normative and are considered part of this standard. Annexes D, E, and F are informative and are not considered part of this standard.

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1 Scope

This ~~part of IEC 60079 standard~~ contains the specific requirements for the construction and testing of electrical apparatus with type of protection flameproof enclosure "d", intended for use in Class I, Zone 1 potentially explosive gas atmospheres. In addition, flameproof enclosures shall comply with the applicable requirements of ANSI/ISA-12.00.01-2002 (IEC 60079-0 Mod).

2 Normative References

The following ~~normative~~ documents may contain provisions which, through reference in this text, constitute provisions of this ~~part of IEC 60079 standard~~. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this ~~part of IEC 60079 standard~~ are encouraged to investigate the possibility of applying the most recent editions of the ~~normative~~ documents indicated below. For undated references, the latest edition of the ~~normative~~ document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards. ANSI maintains registers of currently valid U.S. National Standards.

IEC 60061 (all parts)	Lamp caps and holders together with gauges for the control of interchangeability and safety
~~IEC 60079-0:1998~~	~~Electrical apparatus for explosive gas atmospheres — Part 0: General requirements~~
<u>ANSI/ISA-12.00.01-2002 (IEC 60079-0 Mod)</u>	<u>Electrical Apparatus for Use in Class I, Zones 0 & 1, Hazardous (Classified) Locations - <i>General Requirements</i>.</u>
IEC 60079-1A:1975	Electrical apparatus for explosive gas atmospheres – Part 1: Construction and verification test of flameproof enclosures of electrical apparatus - First supplement: Appendix D: Method of test for ascertainment of maximum experimental safe gap
~~IEC 60079-7:1990~~	~~Electrical apparatus for explosive gas atmospheres — Part 7: Increased safety "e"~~
<u>ANSI/ISA-12.16.01-2002 (IEC 60079-7 Mod)</u>	<u>Electrical Apparatus for Use in Class I, Zone 1, Hazardous (Classified) Locations Type of Protection - <i>Increased Safety "e"</i>.</u>
~~IEC 60079-11:1999~~	~~Electrical apparatus for explosive gas atmospheres — Part 11: Intrinsic safety "i"~~
<u>ISA-12.02.01 (IEC 60079-11 Mod)</u>	<u>Electrical Apparatus for Use in Class I, Zones 0, 1, & 2, Hazardous (Classified) Locations Type of Protection – <i>Intrinsic Safety "i"</i></u>
~~IEC 60112:1979~~	~~Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions~~
IEC 60529:1989	Degrees of protection provided by enclosures (IP Code)
IEC 60707:1981	Methods of test for the determination of the flammability of solid electrical insulating materials when exposed to an igniting source
ISO 31-0:1992	Quantities and units – Part 0: General principles
ISO 185:1988	Grey cast iron — Classification

ISO 965-1:1980	ISO general purpose metric screw threads – Tolerances – Part 1: Principles and basic data
ISO 965-3:1980	ISO general purpose metric screw threads – Tolerances – Part 3: Deviations for constructional threads
ISO 1210:1982	Plastics – Determination of the burning behaviour of horizontal and vertical specimens in contact with a small-flame ignition source
ISO 2738:1987	Permeable sintered metal materials – Determination of density, oil content, and open porosity
ISO 4003:1977	Permeable sintered metal materials – Determination of bubble test pore size
ISO 4022:1987	Permeable sintered metal materials – Determination of fluid permeability
ISO 6892:1984	Metallic materials – Tensile testing
<u>ANSI/ASME B1.20.1</u>	<u>Pipe Threads, General Purpose (Inch)</u>
<u>ANSI/ASME B46.1</u>	<u>Standard for Surface Texture.</u>
<u>ANSI/UL 94</u>	<u>Tests for Flammability of Plastic Materials for Parts in Devices and Appliances</u>

3 Definitions

For the purpose of this standard, the following definitions, in addition to those given in ~~IEC 60079-0~~ ANSI/ISA-12.00.01-2002 (IEC 60079-0 Mod), apply.

3.1 flameproof enclosure "d":

an enclosure in which the parts which can ignite an explosive atmosphere are placed and which can withstand the pressure developed during an internal explosion of an explosive mixture, and which prevents the transmission of the explosion to the explosive atmosphere surrounding the enclosure.

3.2 volume:

total internal volume of the enclosure. However, for enclosures in which the contents are essential in service, the volume to be considered is the remaining free volume.

NOTE For luminaires, the volume is determined without lamps fitted.

3.3 flameproof joint:

place where corresponding surfaces of two parts of an enclosure come together, or the conjunction of enclosures, and which prevents the transmission of an internal explosion to the explosive atmosphere surrounding the enclosure.

3.4 width of flameproof joint (L):

shortest path through a flameproof joint from the inside to the outside of an enclosure.

3.5 distance (l):

shortest path through a flameproof joint, when the width of the joint L is interrupted by holes intended for the passage of fasteners for assembling the parts of the flameproof enclosure.

3.6 gap of flameproof joint (*i*):

distance between the corresponding surfaces of a flameproof joint when the electrical apparatus enclosure has been assembled. For cylindrical surfaces, forming cylindrical joints, the gap is the difference between the diameters of the bore and the cylindrical component.

3.7 maximum experimental safe gap (MESG) (for an explosive mixture):

maximum gap of a joint of 25 mm width which prevents any transmission of an explosion in 10 tests made under the conditions specified in IEC 60079-1A.

NOTE ANSI/NFPA 497 defines Maximum Experimental Safe Gap (MESG) as the maximum clearance between two parallel metal surfaces which has been found, under specified test conditions, to prevent an explosion in a test chamber from being propagated to a secondary chamber containing the same gas or vapor at the same concentration.

3.8 shaft:

part of circular cross section used for the transmission of rotary movement.

3.9 operating rod:

part used for the transmission of control movements which may be rotary or linear or a combination of the two.

3.10 pressure-piling:

results of an ignition, in a compartment or subdivision of an enclosure, of a gas mixture pre-compressed for example due to a primary ignition in another compartment or subdivision.

3.11 quick-acting door or cover:

door or cover provided with a device which permits opening or closing by a simple operation, such as the movement of a lever or the rotation of a wheel. The device is arranged so that the operation has two stages:

a) one for locking or unlocking; and

b) another for opening or closing.

3.12 door or cover fixed by threaded fasteners:

door or cover the opening or closing of which requires the manipulation of one or more threaded fasteners (screws, studs, bolts or nuts).

3.13 threaded door or cover:

door or cover which is assembled to a flameproof enclosure by a threaded flameproof joint.

3.14 breathing device:

integral or separable part of a flameproof enclosure designed to permit exchange between the atmosphere inside the enclosure and the surrounding atmosphere.

3.15 draining device:

integral or separable part of a flameproof enclosure designed to permit water formed by condensation to escape from the enclosure.

3.16 factory sealed:

a construction where components capable of initiating an internal explosion due to arcing, sparking, or thermal effects under normal conditions are isolated from the wiring system by means of factory installed flameproof seal or joint.

4 Apparatus grouping and temperature classification

The apparatus grouping and temperature classification defined in ~~IEC 60079-0~~ ANSI/ISA-12.00.01-2002 (IEC 60079-0 Mod) for the use of electrical apparatus in potentially explosive atmospheres apply to flameproof enclosures. The subdivisions A, B, C for electrical apparatus of Group II also apply.

5 Flameproof joints

5.1 General requirements

All flameproof joints, whether permanently closed or designed to be opened from time to time, shall comply, in the absence of pressure, with the appropriate requirements of Clause 5.

The design of joints shall be appropriate to the mechanical constraints applied to them.

NOTE The values given in Clause 5 constitute the necessary conditions. Additional measures may be necessary in order to pass the non-transmission test of 15.2.

The surface of joints may be protected against corrosion.

Coating with paint or powder-coat finish is not permitted. Other coating material may be used if the material and application procedure have been shown not to adversely affect the flameproof properties of the joint.

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

Joint surfaces may be electroplated. The metal plating shall not be more than 0.008 mm thick.

5.2 Non-threaded joints

5.2.1 Width of joints (L)

The width of joints shall not be less than the minimum values given in Tables 1 and 2. The width of joints for cylindrical metallic parts press-fitted into the walls of a metallic flameproof enclosure of volume not greater than 2000 cm³ may be reduced to 5 mm, if

- the design does not rely only on an interference fit to prevent the part being displaced during the type tests of Clause 15;~~and~~
- the assembly meets the impact test requirements of ~~IEC 60079-0~~ ANSI/ISA-12.00.01-2002 (IEC 60079-0 Mod), taking the worst case interference fit tolerances into account; and
- the external diameter of the press-fitted part, where the width of the joint is measured, does not exceed 60 mm.

NOTE Press-fit parts have the diameter of the hole smaller than the outside diameter of the inserted part such that the parts are assembled using an interference fit.

5.2.2 Gap (i)

The gap, if one exists, between the surfaces of a joint shall nowhere exceed the maximum values given in Tables 1 and 2.

The surfaces of joints shall be such that their average roughness R_a (ISO 468) does not exceed $6.3 \mu\text{m}$ (250 microinches in accordance with ANSI/ASME B46.1).

For flanged joints there shall be no intentional gap between the surfaces, except for quick-acting doors or covers.

For electrical apparatus of Group I, it shall be possible to check, directly or indirectly, the gaps of flanged joints of covers and doors designed to be opened from time to time. Figure 1 shows an example of construction for indirect checking of a flameproof joint.

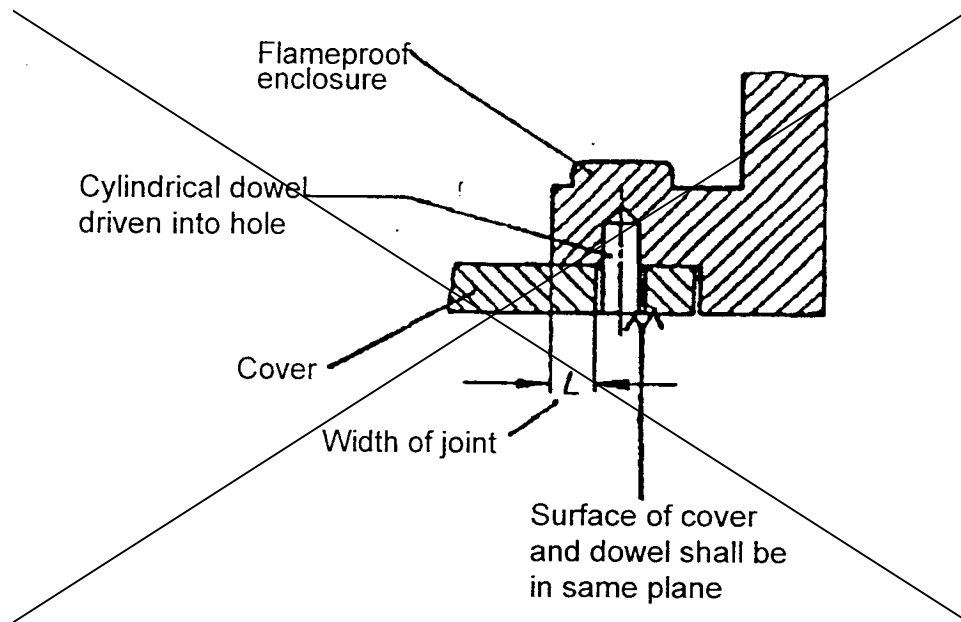


Figure 1 — Example of construction for indirect checking of a flanged Group I flameproof joint

5.2.3 Spigot (rabbet) joints

For the determination of the width L of spigot joints the following shall be taken into account:

- Either the cylindrical part and the plane part (see Figure 2) (the gap if one exists, between the surfaces of the joint shall nowhere exceed the maximum values given in Tables 1 and 2.)
- Or the cylindrical part only (see Figure 3) (in this case the plane part need not comply with the requirements of Tables 1 and 2.)

NOTE For gaskets see also 5.4.

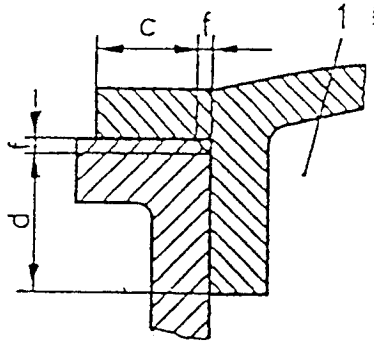


Figure 2

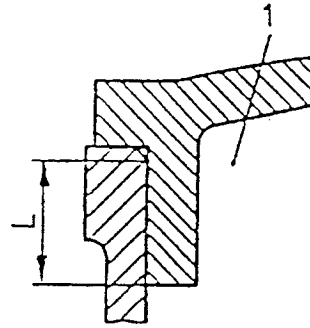


Figure 3

$$\begin{aligned}
 L &= c + d \text{ (I, IIA, IIB, IIC)} \\
 c &\geq 6,0 \text{ mm (IIC)} \\
 &\geq 3,0 \text{ mm (I, IIA, IIB)} \\
 d &\geq 0,50 L \text{ (IIC)} \\
 f &\leq 1,0 \text{ mm (I, IIA, IIB, IIC)}
 \end{aligned}$$

1 Interior of enclosure

Figure 2 and 3 — Spigot joints

5.2.4 Holes in joint surfaces

Where a plane joint or the plane part or partial cylindrical surface (see 5.2.6) of a joint is interrupted by holes intended for the passage of threaded fasteners for assembling the parts of a flameproof enclosure, the distance l to the edge of the hole shall be equal to or greater than

- a) 6 mm when the width of joint L is less than 12.5 mm;
- b) 8 mm when the width of joint L is equal to or greater than 12.5 mm but less than 25 mm; or
- c) 9 mm when the width of joint L is equal to or greater than 25 mm.

The distance l is determined as follows.

5.2.4.1 Flanged joints with holes outside the enclosure (see Figures 4 and 6)

The distance l is measured between each hole and the inside of the enclosure.

5.2.4.2 Flanged joints with holes inside the enclosure (see Figure 5)

The distance l is measured between each hole and the outside of the enclosure.

5.2.4.3 Spigot joints where, to the edges of the holes, the joint consists of a cylindrical part and a plane part (see Figure 7)

The distance l is

- a) the sum of the width a of the cylindrical part and the width b of the plane part, if f is less than or equal to 1 mm and if the gap of the cylindrical part is less than or equal to 0.2 mm for electrical apparatus of Groups I and IIA, 0.15 mm for electrical apparatus of Group IIB, or 0.1 mm for electrical apparatus of Group IIC (reduced gap); or
- b) the width b of the plane part alone, if either of the above-mentioned conditions is not met.

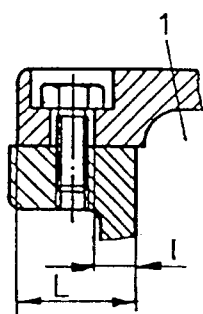


Figure 4

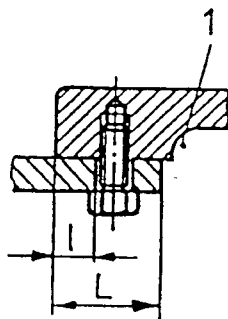


Figure 5

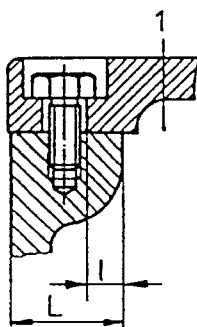


Figure 6

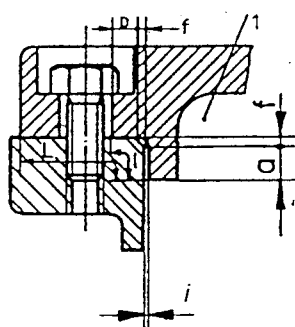


Figure 7

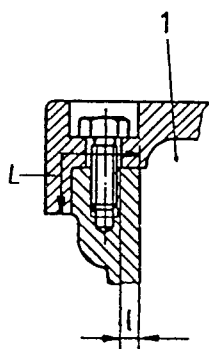
 $i \leq 0,20 \text{ mm (I, IIA)}$
 $i \leq 0,15 \text{ mm (IIB)}$
 $i \leq 0,10 \text{ mm (IIC)}$


Figure 8

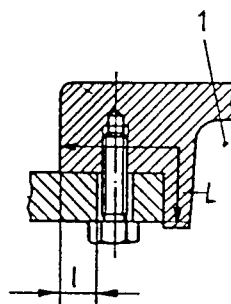


Figure 9

1. Interior of enclosure

Figure 4, 5, 6 — Holes in surfaces of flanged joints

Figure 7, 8, 9 — Holes in surfaces of spigot joints

5.2.4.4 Spigot joints where, to the edges of the holes, the joint consists only of the plane part (see Figures 8 and 9), in so far as plane joints are permitted (see 5.2.7)

The distance l is the width of the plane part between the inside of the enclosure and a hole, where the hole is outside the enclosure (see Figure 8), or between a hole and the outside of the enclosure where the hole is inside the enclosure (see Figure 9).

5.2.5 Conical joints

Where joints include conical surfaces, the width of joint, and the gap normal to the joint surfaces shall comply with the relevant values in Tables 1 and 2. The gap shall be uniform through the conical part. For electrical apparatus of Group IIC, the cone angle shall not exceed 5° .

NOTE The cone angle is taken to be the angle between the vertical axis of the cone and the surface of the cone.

5.2.6 Joints with partial cylindrical surfaces (not permitted for Group IIC)

There shall be no intentional gap between the two parts (see Figure 10).

The width of the joint shall comply with the requirements of Table 1.

The diameters of the cylindrical surfaces of the two parts forming the flameproof joint, and their tolerances, shall ensure compliance with the relevant requirements for the gap of a cylindrical joint as given in Table 1.

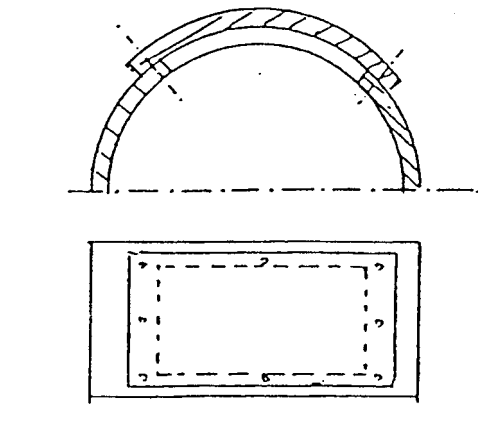


Figure 10 — Example for a joint with partial cylindrical surfaces

5.2.7 Additional requirements for joints of electrical apparatus of Group IIC

Flanged joints are not permitted for electrical apparatus of Group IIC intended for use in potentially explosive atmospheres containing acetylene except if the gap is $\leq 0.04 \text{ mm}$ for $L \geq 9.5 \text{ mm}$ up to 500 cm^3 .

5.2.8 Serrated joints

Serrated joints need not comply with the requirements of Tables 1 and 2 but shall have

- a) at least five fully engaged serrations; ~~and~~