



UL 60079-1

Underwriters Laboratories Inc. Standard for Safety

Explosive Atmospheres – Part 1: Equipment Protection by Flameproof Enclosures “d”



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

UL Standard for Safety for Explosive Atmospheres – Part 1: Equipment Protection by Flameproof Enclosures “d”, UL 60079-1

Sixth Edition, Dated April 10, 2009

Summary of Topics

The Sixth Edition of ANSI/UL 60079-1, the Standard for Safety for Explosive Atmospheres – Part 1: Equipment Protection by Flameproof Enclosures “d”, UL 60079-1 adopts the Sixth Edition of IEC 60079-1.

The new requirements are substantially in accordance with UL’s Proposal(s) on this subject dated December 28, 2007 and July 11, 2008.

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

Page	Date
1-110	April 10, 2009

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ANSI/ISA 60079-1 (12.22.01)-2009
Sixth Edition



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

Explosive Atmospheres – Part 1: Equipment Protection by Flameproof Enclosures “d”

April 10, 2009



ANSI/UL 60079-1-2009

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This ANSI/UL Standard for Safety consists of the Sixth Edition.

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CONTENTS

General Notes	6
Preface (ISA)	7
National Differences	11
FOREWORD	12
1 Scope	15
2 Normative references	15
3 Terms and definitions	19
4 Equipment grouping and temperature classification	20
5 Flameproof joints	21
5.1 General requirements	21
5.2 Non-threaded joints	22
5.3 Threaded joints	33
5.4 Gaskets (including O-rings)	33
5.5 Equipment using capillaries	38
6 Cemented joints	38
6.1 General	38
6.2 Mechanical strength	38
6.3 Width of cemented joints	38
7 Operating rods	38
8 Supplementary requirements for shafts and bearings	39
8.1 Joints of shafts	39
8.2 Bearings	42
9 Light-transmitting parts	43
10 Breathing and draining devices which form part of a flameproof enclosure	43
10.1 Openings for breathing or draining	43
10.2 Composition limits	44
10.3 Dimensions	44
10.4 Elements with measurable paths	44
10.5 Elements with non-measurable paths	44
10.6 Removable devices	44
10.7 Mounting arrangements of the elements	45
10.8 Mechanical strength	45
10.9 Breathing devices and draining devices when used as Ex components	45
11 Fasteners, associated holes and blanking elements	50
12 Materials and mechanical strength of enclosures – Materials inside the enclosures	55
13 Entries for flameproof enclosures	56
13.1 Cable glands	57
13.2 Conduit sealing devices	58
13.3 Plugs and sockets and cable couplers	59
13.4 Bushings	60
14 Verification and tests	60
15 Type tests	61
15.1 Tests of ability of the enclosure to withstand pressure	61
15.2 Test for non-transmission of an internal ignition	66
15.3 (Reserved for future use)	71
15.4 Tests of flameproof enclosures with breathing and draining devices	71

16	Routine tests	73
17	Switchgear for group I	74
17.1	Means of isolation	74
17.2	Doors or covers	75
18	Lampholders and lamp caps	75
18.1	Device preventing lamps working loose	75
18.2	Holders and caps for lamps with cylindrical caps	76
18.3	Holders for lamps with threaded caps	76
19	Non-metallic enclosures and non-metallic parts of enclosures	76
19.1	(Reserved for future use)	76
19.2	Special constructional requirements	76
19.3	Supplementary requirements for type tests	77
20	Marking	78
20.1	General	78
20.2	Caution and warning markings	78
20.3	Informative markings	79

Annex A (normative) Additional requirements for crimped ribbon elements and multiple screen elements of breathing and draining devices

Annex B (normative) Additional requirements for elements, with non-measurable paths, of breathing and draining devices

B.1	Sintered metal elements	81
B.2	Pressed metal wire elements	81
B.3	Metal foam elements	82

Annex C (normative) Additional requirements for flameproof entry devices

C.1	General	83
C.2	Constructional requirements	83
C.2.1	Sealing methods	83
C.2.2	Threads	85
C.2.3	Constructional requirements for Ex blanking elements	85
C.2.4	Constructional requirements for Ex thread adapters	86
C.3	Type tests	86
C.3.1	Sealing test	86
C.3.2	Test of mechanical strength	88
C.3.3	Type tests for Ex blanking elements	89
C.3.4	Type tests for Ex thread adapters	90

Annex D (normative) Empty flameproof enclosures as Ex components

D.1	General	93
D.2	Introductory remarks	93
D.3	Ex component enclosure requirements	93
D.4	Utilization of an Ex component enclosure certificate to prepare an equipment certificate ...	96
D.4.1	Procedure	96
D.4.2	Application of the schedule of limitations	97

Annex E (normative) Cells and batteries used in flameproof “d” enclosures

E.1	Introductory remarks	98
E.2	Acceptable electrochemical systems	98
E.3	General requirements for cells (or batteries) inside flameproof enclosures	99
E.4	Arrangement of safety devices	99
E.4.1	Prevention of excessive temperature and cell damage	99
E.4.2	Prevention of cell polarity reversal or reverse charging by another cell in the same battery	100
E.4.3	Prevention of inadvertent charging of a battery by other voltage sources in the enclosure	101
E.5	Recharging of secondary cells inside flameproof enclosures	102
E.6	Rating of protection diodes and reliability of protection devices	103

Annex F (informative) Mechanical properties for screws and nuts**Annex G (informative) Introduction of an alternative risk assessment method encompassing “equipment protection levels” for Ex equipment**

G.0	Introduction	105
G.1	Historical background	105
G.2	General	106
G.2.1	Coal mining (group I)	106
G.2.2	Gases (group II)	106
G.2.3	Dusts (group III)	107
G.3	Risk of ignition protection afforded	108
G.4	Implementation	108

Bibliography

General Notes

This is the common ISA and UL standard for Explosive Atmospheres – Part 1: Equipment Protection by Flameproof Enclosures “d”. It is the sixth edition of ANSI/ISA-60079-1 (superceding ANSI/ISA-12.22.01-2002 (IEC 60079-1 Mod)) and the Sixth edition of ANSI/UL 60079-1. The document is a modification of the IEC document and includes U.S. deviations encompassing both additions and deletions of information.

ANSI/ISA-60079-1 and ANSI/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.

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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.

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UL Effective Date

The requirements in this standard are effective April 10, 2009.

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This ISA standard is based on IEC Publication 60079-1. It is the intention of the ISA12 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-60079-1. The document is a modification of the IEC document and includes U.S. deviations encompassing both additions and deletions of information.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

EXPLOSIVE ATMOSPHERES – Part 1: Equipment Protection by Flameproof Enclosures “d”

FOREWORD

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International Standard IEC 60079-1 has been prepared by IEC technical committee 31: Equipment for explosive atmospheres.

This sixth edition cancels and replaces the fifth edition published in 2003 and constitutes a technical revision.

This edition contains the following significant technical changes with regard to the previous edition:

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- a) revisions to Clause 5 regarding markings and conditions of safe use when a dimension of a flameproof joint is other than the relevant minimum or maximum;
- b) revisions to Table 1 regarding maximum gap for flanged, cylindrical or spigot joints;
- c) revisions to Table 4 regarding requirements for taper threaded joints;
- d) revisions to Clause 10 regarding volume restrictions and test conditions associated with breathing and draining devices;
- e) revisions to Clause 11 regarding requirements for fasteners, associated holes and blanking elements;
- f) revisions to Clause 12 regarding material restrictions associated with zinc and zinc alloys;
- g) revisions to Table 5 regarding conditions for the determination of maximum surface temperatures;
- h) revisions to Clause 15 regarding the determination of explosion pressure (reference pressure);
- i) revisions to Table 6 regarding the reduction in length of a threaded joint for non-transmission testing;
- j) revisions to Table 7 regarding the test factors to increase pressure or test gap (i_E);
- k) revisions to Table 8 regarding the minimum distance of obstructions from flange openings;
- l) revisions to Clause 19 regarding tests for flameproofness;
- m) revisions to Clause 20 regarding a tabulated collection of marking requirements;
- n) revisions to Annex C regarding additional requirements for flameproof entry devices;
- o) revisions to Annex D regarding empty flameproof enclosures as Ex components;
- p) addition of a new Annex F regarding mechanical properties for screws and nuts; and
- q) addition of a new Annex G regarding equipment protection levels for Ex equipment.

The text of this standard is based on the following documents:

FDIS	Report on voting
31/680/FDIS	31/692/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This standard is to be read in conjunction with IEC 60079-0:2004, *Electrical apparatus for explosive gas atmospheres – Part 0: General requirements*.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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A list of all parts of IEC 60079 series, under the general title Explosive atmospheres can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the new edition.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

Explosive Atmospheres – Part 1: Equipment Protection by Flameproof Enclosures “d”

1 Scope

This part of IEC 60079 contains specific requirements for the construction and testing of electrical equipment with the type of protection flameproof enclosure “d”, intended for use in explosive gas atmospheres.

This standard supplements and modifies the general requirements of IEC 60079-0. Where a requirement of this standard conflicts with a requirement of IEC 60079-0, the requirement of this standard will take precedence.

NOTE Equipment protection by flameproof enclosures “d” provides Equipment Protection Level (EPL) Gb. For further information, see Annex G.

1DV.1 DR Modification of Clause 1 first paragraph to replace as follows:

This standard contains specific requirements for the construction and testing of electrical equipment with the type of protection flameproof enclosure “d”, intended for use in Class I, Zone 1, explosive gas atmospheres.

1DV.2 DR Addition of 1DV.2.1 and 1DV.2.2 to Clause 1:

1DV.2.1 The U.S. version of IEC 60079-1 does not include requirements for Group I electrical apparatus. Requirements for Group I electrical apparatus included in this document are to be considered omitted in all instances where they appear.

1DV.2.2 Where references are made to other IEC 60079 standards, the referenced requirements found in these standards shall apply as modified by any applicable U.S. National Differences.

2 Normative references

2DV.1 DR Modification of the Title in Clause 2:

Delete “Normative”.

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60061 (all parts),
Lamp caps and holders together with gauges for the control of interchangeability and safety

IEC 60079-0:2004,
Electrical apparatus for explosive gas atmospheres – Part 0: General requirements

IEC 60079-1-1,
Electrical apparatus for explosive gas atmospheres – Part 1-1: Flameproof enclosures “d” – Method of test for ascertainment of maximum experimental safe gap

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IEC 60079-7,
Explosive atmospheres – Part 7: Equipment protection by increased safety “e”

IEC 60079-11,
Explosive atmospheres – Part 11: Equipment protection by intrinsic safety “i”

IEC 60079-14:2002,
Electrical apparatus for explosive gas atmospheres – Part 14: Electrical installations in hazardous areas (other than mines)

IEC 60086-1:2000,
Primary batteries – Part 1: General

IEC 60112,
Method for the determination of the proof and the comparative tracking indices of solid insulating materials

IEC 60127 (all parts),
Miniature fuses

IEC 60529:1989,
Degrees of protection provided by enclosures (IP Code)

IEC 60623:2001,
Secondary cells and batteries containing alkaline or other non-acid electrolytes – Vented nickel-cadmium prismatic rechargeable single cells

IEC 60662:1980,
High-pressure sodium vapour lamps

IEC 60695-11-10,
Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods

IEC 61951-1:2003,
Secondary cells and batteries containing alkaline or other non-acid electrolytes – Portable sealed rechargeable single cells – Part 1: Nickel-cadmium

IEC 61951-2:2003,
Secondary cells and batteries containing alkaline or other non-acid electrolytes – Portable sealed rechargeable single cells – Part 2: Nickel-metal hydride

ISO 185:1988,
Grey cast iron – Classification

ISO 965-1:1998,
ISO general-purpose metric screw threads – Tolerances – Part 1: Principles and basic data

ISO 965-3:1998,
ISO general-purpose metric screw threads – Tolerances – Part 3: Deviations for constructional threads

ISO 2738:1999,
Sintered metal materials, excluding hard metals – Permeable sintered metal materials – Determination of density, oil content and open porosity

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ISO 3864: 1984,
Safety colours and safety signs

ISO 4003:1977,
Permeable sintered metal materials – Determination of bubble test pore size

ISO 4022:1987,
Permeable sintered metal materials – Determination of fluid permeability

ANSI/ASME B1.20.1-1983 (R2001),
Pipe threads, general purpose (inch)

2DV.2 DR Modification of Clause 2 to replace with the following:

IEC 60061 (all parts),
Lamp caps and holders together with gauges for the control of interchangeability and safety

IEC 60079-1-1:2002,
Electrical apparatus for explosive gas atmospheres – Part 1-1: Flameproof enclosures “d” – Method of test for ascertainment of maximum experimental safe gap

IEC 60079-14:2002,
Electrical apparatus for explosive gas atmospheres – Part 14: Electrical installations in hazardous areas (other than mines)

IEC 60086-1:2000,
Primary batteries – Part 1: General

IEC 60112,
Method for the determination of the proof and the comparative tracking indices of solid insulating materials

IEC 60127 (all parts),
Miniature fuses

IEC 60529:1989,
Degrees of protection provided by enclosures (IP Code)

IEC 60623:2001,
Secondary cells and batteries containing alkaline or other non-acid electrolytes – Vented nickel-cadmium prismatic rechargeable single cells

IEC 60662:1980,
High-pressure sodium vapour lamps

IEC 60695-11-10,
Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods

IEC 61951-1:2003,
Secondary cells and batteries containing alkaline or other non-acid electrolytes – Portable sealed rechargeable single cells – Part 1: Nickel-cadmium

IEC 61951-2:2003,
Secondary cells and batteries containing alkaline or other non-acid electrolytes – Portable sealed rechargeable single cells – Part 2: Nickel-metal hydride

ISO 185:1988,
Grey cast iron – Classification

ISO 965-1:1998,
ISO general-purpose metric screw threads – Tolerances – Part 1: Principles and basic data

ISO 965-3:1998,
ISO general-purpose metric screw threads – Tolerances – Part 3: Deviations for constructional threads

ISO 2738:1999,
Sintered metal materials, excluding hard metals – Permeable sintered metal materials – Determination of density, oil content and open porosity

ISO 3864: 1984,
Safety colours and safety signs

ISO 4003:1977,
Permeable sintered metal materials – Determination of bubble test pore size

ISO 4022:1987,
Permeable sintered metal materials – Determination of fluid permeability

ANSI/ASME B1.20.1-1983 (R2001),
Pipe threads, general purpose (inch)

ANSI/ASME B46.1,
Standard for Surface Texture

UL 94
Tests for Flammability of Plastic Material for Part in Devices and Appliances

UL 2225
Metal-Clad Cables and Cable-Sealing Fittings for use in Hazardous (Classified) Locations

UL 60079-0
Electrical Apparatus for Explosive Gas Atmospheres – Part 0: General Requirements

UL 60079-7
Electrical Apparatus for Explosive Gas Atmospheres – Part 7: Increased Safety “e”

UL 60079-11
Electrical Apparatus for Explosive Gas Atmospheres – Part 11: Intrinsic Safety “i”

3 Terms and definitions

For the purposes of this document, the following terms and definitions, in addition to those given in IEC 60079-0, apply.

NOTE Additional definitions applicable to explosive atmospheres can be found in IEC 60050-426.

3.1 flameproof enclosure “d” enclosure in which the parts which can ignite an explosive gas 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 gas 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 luminaries, the volume is determined without lamps fitted.

3.3 flameproof joint or flamepath place where the corresponding surfaces of two parts of an enclosure, or the conjunction of enclosures, come together and which prevents the transmission of an internal explosion to the explosive gas 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

NOTE This definition does not apply to threaded joints.

3.5 distance l shortest path through a flameproof joint, when the width of the flameproof 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

NOTE 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 (for an explosive mixture) MESH maximum gap of a joint of 25 mm in width which prevents any transmission of an explosion during 10 tests made under the conditions specified in IEC 60079-1-1

3.7DV DE Modification of Clause 3.7 to add NOTE as follows:

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 precompressed, 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:

- one for locking or unlocking,
- 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** device which permits an exchange between the atmosphere within an enclosure and the surrounding atmosphere and which maintains the integrity of the type of protection

3.15 **draining device** device which permits liquids to flow out from an enclosure and which maintains the integrity of the type of protection

3.16 **Ex blanking element** threaded blanking element tested separately from the equipment enclosure but having an equipment certificate and which is intended to be fitted to the equipment enclosure without further consideration

NOTE 1 This does not preclude a component certificate for blanking elements in accordance with IEC 60079-0. Examples of blanking elements are shown in Figure 22.

NOTE 2 Non-threaded blanking elements are not equipment.

3.16DV DR Modification of Clause 3.16 Note 1 as follows:

Delete last sentence.

3.17 **Ex thread adapter** thread adapter tested separately from the enclosure but having an equipment certificate and which is intended to be fitted to the equipment enclosure without further consideration

NOTE This does not preclude a component certificate for thread adapters in accordance with IEC 60079-0. Examples of thread adapters are shown in Figure C.2.

3.18 **Ex component enclosure** empty flameproof enclosure provided with an Ex component certificate, without the internal equipment being defined, so as to enable the empty enclosure to be made available for incorporation into an equipment certificate without the need for repetition of type testing

4 Equipment grouping and temperature classification

The equipment grouping and temperature classification defined in IEC 60079-0 for the use of electrical equipment in explosive gas atmospheres apply to flameproof enclosures. The subdivisions A, B and C for electrical equipment of Group II also apply.

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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.

The dimensions given in 5.2 to 5.5 inclusive specify the minimum or maximum values that may be applied to the essential parameters of flamepaths. In instances where a dimension of a flameproof joint is other than the relevant minimum or maximum (for example, in order to comply with the test for non-transmission of an internal ignition), the equipment shall be marked "X" according to 29.2 item i) of IEC 60079-0 and the specific conditions of use on the certificate shall be in accordance with one of the following:

- a) dimensions of the flameproof joints shall be detailed; or
- b) specific drawing referenced that details the dimensions of the flameproof joints; or
- c) specific guidance noted to contact the original manufacturer for information on the dimensions of the flameproof joints.

5.1DV DR Modification of Clause 5.1 third paragraph as follows:

Delete "X" before "according" and replace "specific conditions of use on the certificate" with "instructions provided".

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 may be applied to joint surfaces before assembly. The grease, if applied, shall be of a type that does not harden because of ageing, does not contain an evaporating solvent, and does not cause corrosion of the joint surfaces. Verification of suitability shall be in accordance with the grease manufacturer's specifications.

Joint surfaces may be electroplated. The metal plating, if applied, 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 a volume not greater than 2 000 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, 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.

5.2.2 Gap (l)

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 (derived from ISO 468) does not exceed 6,3 μm .

5.2.2DV.1 DR Modification of Clause 5.2.2 second paragraph by replacing with the following:

The surfaces of joints shall be such that their average roughness R_a (derived from ISO 468) does not exceed 6,3 μm (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 equipment 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.

5.2.2DV.2 DR Modification of Clause 5.2.2, fourth paragraph to delete:

This paragraph does not apply.

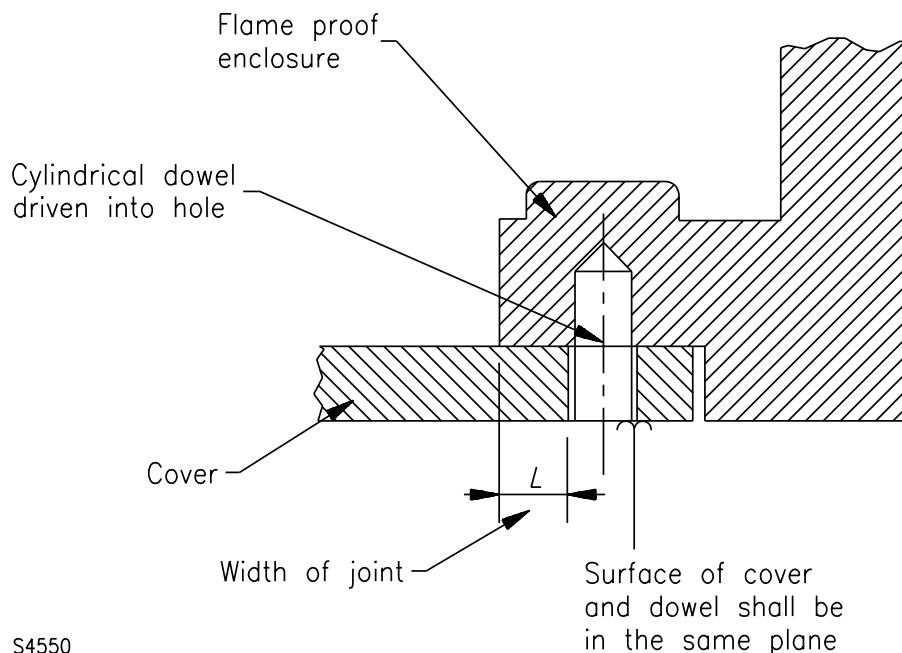


Figure 1 – Example of construction for indirect checking of a flanged group I flameproof joint

Figure 1DV.1 DC Delete Figure 1:

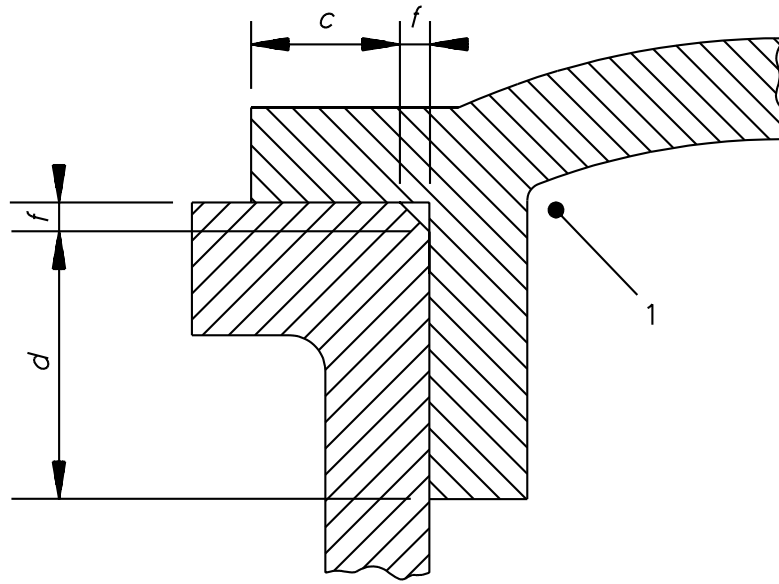
This Figure does not apply.

5.2.3 Spigot joints

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

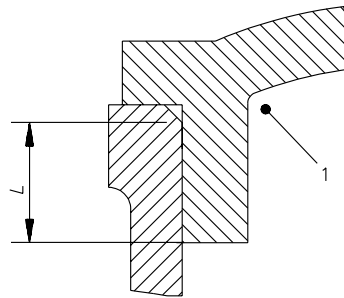
- the cylindrical part and the plane part (see Figure 2a). In this case, the gap shall nowhere exceed the maximum values given in Tables 1 and 2;
- the cylindrical part only (see Figure 2b). In this case, the plane part need not comply with the requirements of Tables 1 and 2.

NOTE For gaskets, see also 5.4.



S4551A

Figure 2a – Cylindrical part and plane part



S4551B

Figure 2b – Cylindrical part only

Key

- L $c + d$ (I, IIA, IIB, IIC)
- c $\geq 6,0$ mm (IIC)
 $\geq 3,0$ mm (I, IIA, IIB)
- d $\geq 0,50 L$ (IIC)
- f $\leq 1,0$ mm (I, IIA, IIB, IIC)
- 1 interior of enclosure

Figure 2 – Spigot joints

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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

- 6 mm when the width of joint L is less than 12,5 mm,
- 8 mm when the width of joint L is equal to or greater than 12,5 mm but less than 25 mm,
- 9 mm when the width of joint L is equal to or greater than 25 mm.

NOTE The requirements for clearance holes of fasteners are specified in IEC 60079-0.

The distance l is determined as follows.

5.2.4.1 Flanged joints with holes outside the enclosure (see Figures 3 and 5)

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

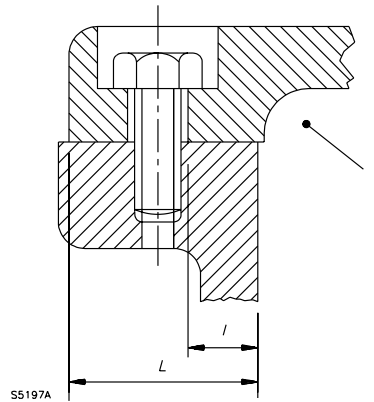
5.2.4.2 Flanged joints with holes inside the enclosure (see Figure 4)

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 6)

The distance l is defined as follows:

- 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 equipment of groups I and IIA, 0,15 mm for electrical equipment of group IIB, or 0,1 mm for electrical equipment of group IIC (reduced gap); or
- the width b of the plane part alone, if either of the above-mentioned conditions is not met.



$i \leq 0,20 \text{ mm (I, IIA)}$

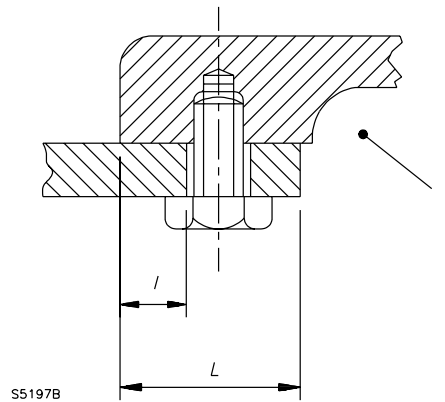
$i \leq 0,15 \text{ mm (IIB)}$

$i \leq 0,10 \text{ mm (IIC)}$

Key

1 interior of enclosure

Figure 3 – Holes in surfaces of flanged joints



$i \leq 0,20 \text{ mm (I, IIA)}$

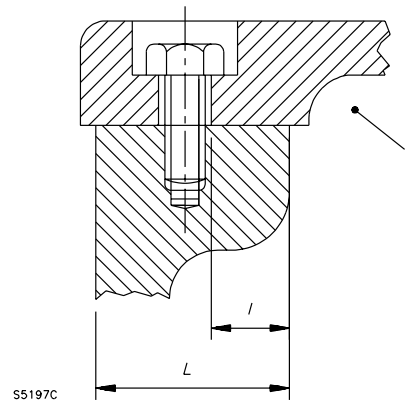
$i \leq 0,15 \text{ m (IIB)}$

$i \leq 0,10 \text{ mm (IIC)}$

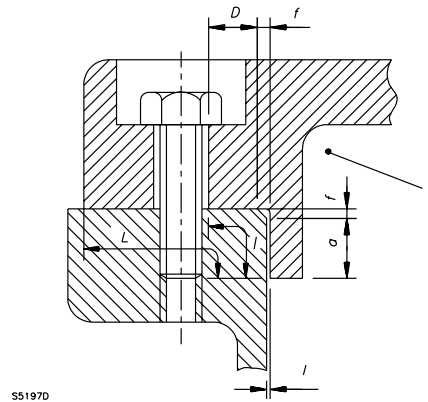
Key

1 interior of enclosure

Figure 4 – Holes in surfaces of flanged joints


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

1 interior of enclosure

Figure 5 – Holes in surfaces of flanged joints
 $i \leq 0,20 \text{ mm (I, IIA)}$
 $i \leq 0,15 \text{ mm (IIB)}$
 $i \leq 0,10 \text{ mm (IIC)}$
Key

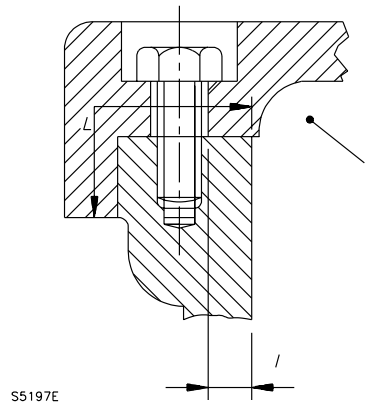
1 interior of enclosure

Figure 6 – Holes in surfaces of spigot joints

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$i \leq 0,20 \text{ mm}$ (I, IIA)

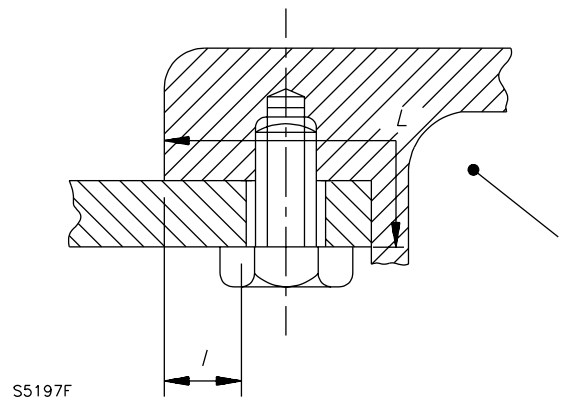
$i \leq 0,15 \text{ mm}$ (IIB)

$i \leq 0,10 \text{ mm}$ (IIC)

Key

1 interior of enclosure

Figure 7 – Holes in surfaces of spigot joints



$i \leq 0,20 \text{ mm}$ (I, IIA)

$i \leq 0,15 \text{ mm}$ (IIB)

$i \leq 0,10 \text{ mm}$ (IIC)

Key

1 interior of enclosure

Figure 8 – Holes in surfaces of spigot joints

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5.2.4.4 Spigot joints where, to the edges of the holes, the joint consists only of the plane part (see Figures 7 and 8), 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 7), or between a hole and the outside of the enclosure where the hole is inside the enclosure (see Figure 8).

5.2.5 Conical joints

Where joints include conical surfaces, the width of the 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 equipment of Group IIC, the cone angle shall not exceed 5° .

NOTE The cone angle is taken to be the angle between the major 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 9a).

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.

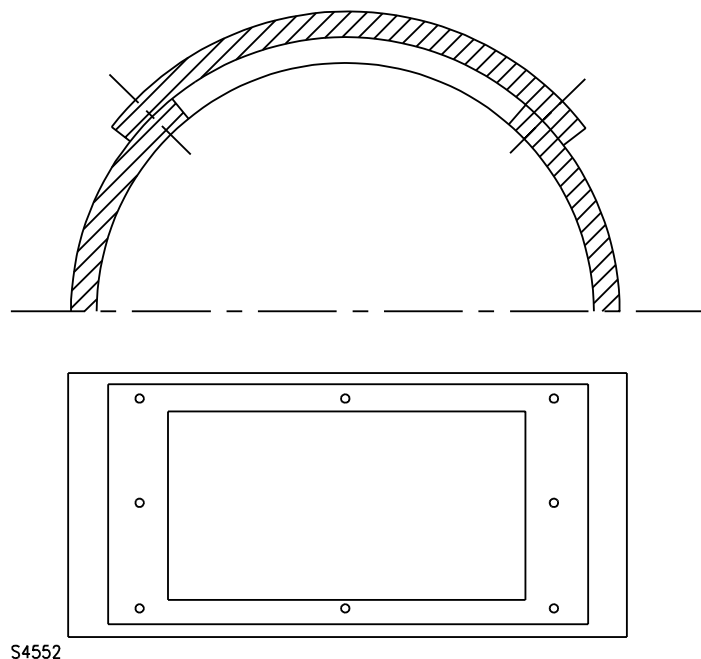


Figure 9a — Example for a joint with partial cylindrical surfaces

5.2.7 Flanged joints for acetylene atmospheres

Flanged joints are only permitted for electrical equipment of group IIC intended for use in explosive gas atmospheres containing acetylene provided all of the following conditions are met:

- a) gap $i \leq 0,04$ mm;
- b) width $L \geq 9,5$ mm; and
- c) volume ≤ 500 cm³.

5.2.8 Serrated joints

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

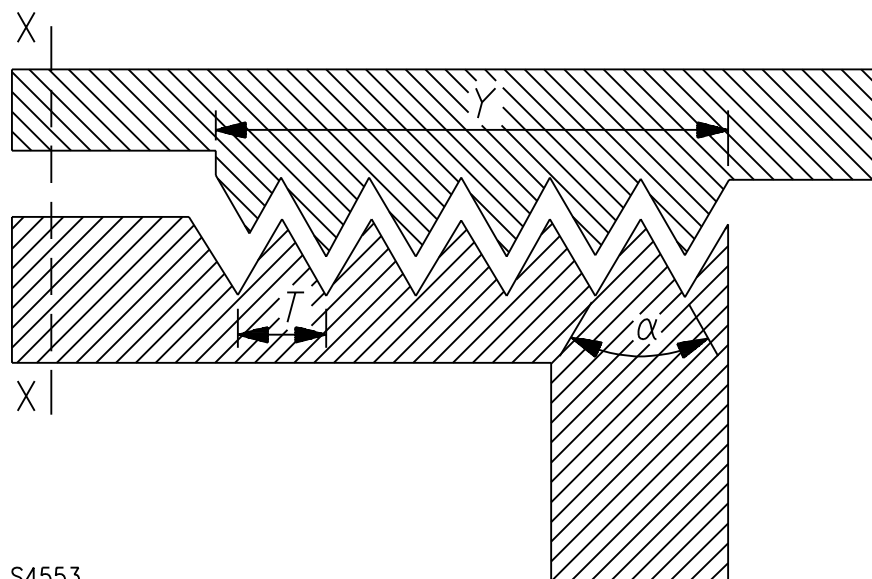
- a) at least five fully engaged serrations,
- b) a pitch greater than or equal to 1,25 mm, and
- c) an included angle of 60° ($\pm 5^\circ$).

Serrated joints shall not be used for moving parts.

Serrated joints shall satisfy the test requirements of 15.2, with the test gap, i_E , between the mating serrations as specified in 15.2, based on the manufacturer's maximum constructional gap, i_C .

If the manufacturer's maximum constructional gap is different to that shown in Tables 1 or 2 for a flanged joint of the same length (determined by multiplying the pitch by the number of serrations), the "conditions of use" requirements of 5.1 apply.

See Figure 9b.



$$Y \geq 5T$$

$$\text{Test length} = \frac{Y}{1,5}$$

$$T \geq 1,25\text{mm}$$

$$\alpha = 60^\circ$$

S4553

Figure 9b – Example of serrated joint

Table 1 – Minimum width of joint and maximum gap for enclosures of groups I, IIA, and IIB

Type of joint		Minimum width of joint L mm	Maximum gap mm											
			for volume (cm ³) V ≤ 100			for volume (cm ³) 100 < V ≤ 500			for volume (cm ³) 500 < V ≤ 2 000			for volume (cm ³) V > 2 000		
			I	IIA	IIB	I	IIA	IIB	I	IIA	IIB	I	IIA	IIB
Flanged, cylindrical or spigot joints		6	0,30	0,30	0,20	–	–	–	–	–	–	–	–	–
		9,5	0,35	0,30	0,20	0,35	0,30	0,20	0,08	0,08	0,08	–	–	–
		12,5	0,40	0,30	0,20	0,40	0,30	0,20	0,40	0,30	0,20	0,40	0,20	0,15
		25	0,50	0,40	0,20	0,50	0,40	0,20	0,50	0,40	0,20	0,50	0,40	0,20
Cylindrical joints for shaft glands of rotating electrical machines with	Sleeve bearings	6	0,30	0,30	0,20	–	–	–	–	–	–	–	–	–
		9,5	0,35	0,30	0,20	0,35	0,30	0,20	–	–	–	–	–	–
		12,5	0,40	0,35	0,25	0,40	0,30	0,20	0,40	0,30	0,20	0,40	0,20	–
		25	0,50	0,40	0,30	0,50	0,40	0,25	0,50	0,40	0,25	0,50	0,40	0,20
		40	0,60	0,50	0,40	0,60	0,50	0,30	0,60	0,50	0,30	0,60	0,50	0,25
	Rolling-element bearings	6	0,45	0,45	0,30	–	–	–	–	–	–	–	–	–
		9,5	0,50	0,45	0,35	0,50	0,40	0,25	–	–	–	–	–	–
		12,5	0,60	0,50	0,40	0,60	0,45	0,30	0,60	0,45	0,30	0,60	0,30	0,20
		25	0,75	0,60	0,45	0,75	0,60	0,40	0,75	0,60	0,40	0,75	0,60	0,30
		40	0,80	0,75	0,60	0,80	0,75	0,45	0,80	0,75	0,45	0,80	0,75	0,40

NOTE Constructional values rounded according to ISO 31-0 should be taken when determining the maximum gap.