

Australian/New Zealand Standard™

Explosive atmospheres

**Part 1: Equipment protection by
flameproof enclosures ‘d’**



AS/NZS 60079.1:2015

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee EL-014, Equipment for Explosive Atmospheres. It was approved on behalf of the Council of Standards Australia on 20 October 2015 and on behalf of the Council of Standards New Zealand on 22 October 2015.

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This Standard was issued in draft form for comment as DR AS/NZS 60079.1:2015.

Australian/New Zealand Standard™

Explosive atmospheres

Part 1: Equipment protection by flameproof enclosures 'd'

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-014, Equipment for Explosive Atmospheres, to supersede AS/NZS 60079.1:2007.

The objective of this Standard is to set out the requirements for electrical equipment protection by flameproof enclosures ‘d’ for use in explosive gas atmospheres. It specifies requirements for design, construction and testing of electrical equipment and Ex components.

This Standard is identical with, and has been reproduced from IEC 60079-1 Ed.7.0 (2014), *Explosive atmospheres, Part 1: Equipment protection by flameproof enclosures "d"*. Changes to the Standard introduced by this edition are listed in the IEC Foreword.

This Standard is to be read in conjunction with AS/NZS 60079.0, *Explosive atmospheres, Part 0: Equipment—General requirements*.

As this Standard is reproduced from an International Standard, the following applies:

- (a) In the source text ‘this part of IEC 60079’ should read ‘this Australian/New Zealand Standard’.
- (b) A full point substitutes for a comma when referring to a decimal marker.

References to International Standards should be replaced by references to Australian or Australian/New Zealand Standards, as follows:

<i>Reference to International Standard</i>		<i>Australian/New Zealand Standard</i>	
IEC		AS/NZS	
60079	Explosive atmospheres	60079	Explosive atmospheres
60079-0	Part 0: Equipment—General requirements	60079.0	Part 0: Equipment—General requirements
60079-7	Part 7: Equipment protection by increased safety “e”	60079.7	Part 7: Equipment protection by increased safety ‘e’
60079-11	Part 11: Equipment protection by intrinsic safety “i”	60079.11	Part 11: Equipment protection by intrinsic safety ‘i’
60079-15	Part 15: Equipment protection by type of protection “n”	60079.15	Part 15: Equipment protection by type of protection ‘n’

Only normative references that have been adopted as Australian or Australian/New Zealand Standard have been listed.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the annex to which they apply. A ‘normative’ annex is an integral part of a Standard, whereas an ‘informative’ annex is only for information and guidance.

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IEC FOREWORD

The significance of the changes between IEC 60079-1, Edition 7.0 (2014) and IEC 60079-1 Edition 6.0 (2007) (including Corrigendum 1 (2008)), is as listed below:

Explanation of the significance of the changes	Clause	Type		
		Minor and editorial changes	Extension	Major technical changes
Normative references (Removal of the edition date from the reference for IEC 60079-0)	2	X		
Requirements for level of protection "da" (Catalytic sensors of portable combustible gas detectors)	4.2		X	
Requirements for level of protection "dc" (“Enclosed break” devices from IEC 60079-15)	4.4, 15.5	X		
Flameproof joints, General requirements (Documentation clarification and examples of corrosion inhibiting grease)	5.1	X		
Flameproof joints, General requirements (Specific Conditions of Use that joints are not intended to be repaired)	5.1		X	
Flameproof joints, General requirements (Electroplating more than 0,008 mm thick)	5.1		X	
Non-threaded joints, Gap (<i>i</i>) (Intentional gaps between surface for flanged joints)	5.2.2	X		
Serrated joints (Use and test requirements)	5.2.8	X		
Multi-step joints (Not less than 3 adjacent segments and two path changes)	5.2.9		X	
Minimum width of joint and maximum gap for enclosures of groups IIA and IIB (Maximum gaps for flanged, cylindrical or spigot joints of 9,5 mm minimum width and volume greater than 2 000 cm ³)	Table 2		X	
Minimum width of joint and maximum gap for enclosures of groups I, IIA, IIB and IIC (ISO 80000-1 for constructional value rounding)	Table 2, Table 3	X		
Cylindrical threaded joints (ISO 965-1 standard in respect of thread form or quality of fit)	Table 4	X		
Taper threaded joints (External and internal thread construction)	Table 5	X		
Cemented joints (Supplemental mechanical means of securement)	6.1.2			C1
Cemented joints (Evaluation criteria if there is leakage)	6.1.2		X	
Fused glass joints (Glass-to-metal joints)	6.2		X	
Thermal tests of breathing and draining devices (Temperature class based on external surface temperature after the 10 min test period)	10.9.3.2	X		
Test of the ability of the breathing and draining device to withstand pressure (Relocated from before thermal tests to after the non-transmission test)	10.9.3.4	X		

Explanation of the significance of the changes	Clause	Type		
		Minor and editorial changes	Extension	Major technical changes
Ex component certificate (Service temperature range for non-metallic enclosures per IEC 60079-0)	10.9.4	X		
Fasteners and openings (Relocation of blanking element content to 13.8 and C.2.3)	11	X		
Fasteners and openings, Property class or yield stress (Certificate specific condition of use)	11.3	X		
Fasteners and openings (Openings in the wall of the enclosure)	11.8	X		
Materials (Material limitation in acetylene atmospheres)	12.8			C2
Entries for flameproof enclosures, General (Metric and NPT threaded entries)	13.1	X		
Entries for flameproof enclosures, General (Group I non-threaded joints)	13.1		X	
Entries for flameproof enclosures, Non-threaded holes (Group I application)	13.3		X	
Entries for flameproof enclosures, Cable glands (Group I application)	13.4		X	
Cable glands, Conduit sealing devices (Documentation to facilitate mounting)	13.4,13.5	X		
Plugs and sockets and cable couplers (Load requirement for arc-quenching test)	13.6.4			C3
Bushings (Documentation to facilitate mounting)	13.7	X		
Blanking elements (Relocated from Clause 11)	13.8	X		
Verification and tests (Maximum surface temperature conditions)	Table 6	X		
Type tests (Sequence and number of samples for tests)	15	X		
Determination of explosion pressure, General (Devices that can cause turbulence)	15.2.2.2	X		
Determination of explosion pressure, General (Number of tests for Group IIC)	15.2.2.2	X		
Determination of explosion pressure, General (Pressure pilling for Group IIB)	15.2.2.4	X		
Determination of explosion pressure, General (Equipment marked for a single gas)	15.2.2.5	X		
Overpressure test, General (Low ambient overpressure tests not required)	15.2.3	X		
Overpressure test – First method (static) (3 times option when routine batch testing)	15.2.3.2		X	

Explanation of the significance of the changes	Clause	Type		
		Minor and editorial changes	Extension	Major technical changes
Overpressure test – First method (static) <i>(Adjustment for low ambient due to small size of equipment)</i>	15.2.3.2		X	
Overpressure test – Second method (dynamic) <i>(Number of tests to be made)</i>	15.2.3.3	X		
Test for non-transmission of an internal ignition <i>(Clarification regarding grease)</i>	15.3	X		
Reduction in length of a threaded joint for non-transmission test <i>(ISO 965-1 and 965-3 standards in respect of thread form and quality of fit)</i>	Table 9	X		
Test factors to increase pressure or test gap <i>(Group IIC adjustments for elevated ambients)</i>	Table 10	X		
Test for non-transmission of an internal ignition, Groups I, IIA and IIB <i>(Number of tests to be made)</i>	15.3.2.3	X		
Test for non-transmission of an internal ignition, Group IIC testing by increased gap <i>(Number of tests to be made)</i>	15.3.3.2	X		
Test for non-transmission of an internal ignition, Group IIC <i>(Oxygen enrichment of test gases)</i>	15.3.3.4		X	
Thermal tests of enclosures with breathing and draining devices <i>(Temperature class based on external surface temperature after the 10 min test period)</i>	15.4.3.1	X		
Tests for “dc” devices <i>(“Enclosed break” devices from IEC 60079-15)</i>	15.5		X	
Routine tests, General <i>(Adjustment for low ambient due to small size of equipment)</i>	16.1.2		X	
Routine tests, General <i>(Options when second method is chosen)</i>	16.1.3	X		
Routine tests, General <i>(Welded joint inspection options)</i>	16.3		X	
Routine tests, General <i>(Allowance for batch testing)</i>	16.6		X	
Switchgear for Group I <i>(Clarifying need for compliance with EPL Mb types of protection)</i>	17.2.2, 17.2.3	X		
Non-metallic enclosures and non-metallic parts of enclosures, General <i>(Exception for cemented joints)</i>	19.1	X		
Non-metallic enclosures and non-metallic parts of enclosures, Resistance to tracking and creepage distances <i>(Reference to both IEC 60079-7 and or IEC 60079-15)</i>	19.2		X	
Non-metallic enclosures and non-metallic parts of enclosures, Requirements for type tests <i>(Clarification of test sequence)</i>	19.3	X		

Explanation of the significance of the changes	Clause	Type		
		Minor and editorial changes	Extension	Major technical changes
Instructions (Indication that repair of flamepaths is not intended)	21		X	
Bushings (Documentation regarding numbers of cores)	C.2.1.4	X		
Bushings (Criteria for non-transmission test)	C.2.1.4	X		
Bushings (Evaluation criteria if there is leakage)	C.2.1.4		X	
Flameproof joints, Threaded joints (Requirement options)	C.2.2.1	X		
Flameproof joints, Non-threaded joints (Group I application)	C.2.2.2		X	
Constructional requirements for Ex blanking elements (Relocated from Clause 11)	C.2.3.1	X		
Constructional requirements for Ex blanking elements (Metric and NPT Ex blanking elements)	C.2.3.2, C.2.3.3	X		
Constructional requirements for Ex blanking elements (Group I non-threaded construction)	C.2.3.4		X	
Sealing test, General (Allowance for re-tightening)	C.3.1.1	X		
Cable glands and conduit sealing devices with sealing ring (Mandrel to be corrosion-resistant metal)	C.3.1.2	X		
Type tests for Ex blanking elements, Torque test (Test-block to be steel)	C.3.3.1	X		
Tightening torque values (Addition of < 16 mm thread size)	Table C.1		X	
Tightening torque values (Addition of NPT thread sizes)	Table C.2		X	
Ex component enclosure requirements (Markings content)	D.3.8			C4
Ex component enclosure requirements (Certificate content)	D.3.10		X	
Utilization of an Ex component enclosure certificate to prepare an equipment certificate, Procedure (Devices that can create significant turbulence)	D.4.1		X	
Acceptable primary cells (Addition of Type B cells)	Table E.1		X	
Acceptable primary cells (Removal of Type T cells)	Table E.1			C5
Acceptable secondary cells (Addition of Lithium type cells)	Table E.2		X	
Prevention of excessive temperature and cell damage (Application of IEC 60079-11 requirement)	E.4.1.2	X		

Explanation of the significance of the changes	Clause	Type		
		Minor and editorial changes	Extension	Major technical changes
Prevention of inadvertent charging of a battery by other voltage sources in the enclosure <i>(Construction not requiring additional protection)</i>	E.4.3		X	
Recharging of secondary cells inside flameproof enclosures <i>(Additional battery options)</i>	E.5.1		X	
Introduction of an alternative risk assessment method encompassing equipment protection levels' for Ex equipment <i>(Removal of previous Informative Annex)</i>	Annex G	X		
Additional requirements for Flameproof enclosures with an internal source of release (containment system) <i>(Addition of new Normative Annex)</i>	Annex G		X	
Requirements for machines with flameproof "d" enclosures fed from converters <i>(Addition of new Normative Annex)</i>	Annex H		X	

NOTE The technical changes referred to include the significance of technical changes in the revised IEC Standard, but they do not form an exhaustive list of all modifications from the previous version. More guidance can be found by referring to the Redline Version of the standard.

Explanations:

A) Definitions

Minor and editorial changes

Clarification
decrease of technical requirements
minor technical change
editorial corrections

These are changes which modify requirements in an editorial or a minor technical way. They include changes of the wording to clarify technical requirements without any technical change, or a reduction in level of existing requirement.

Extension

addition of technical options

These are changes which add new or modify existing technical requirements, in a way that new options are given, but without increasing requirements for equipment that was fully compliant with the previous standard. Therefore, these will not have to be considered for products in conformity with the preceding edition.

Major technical changes

addition of technical requirements
increase of technical requirements

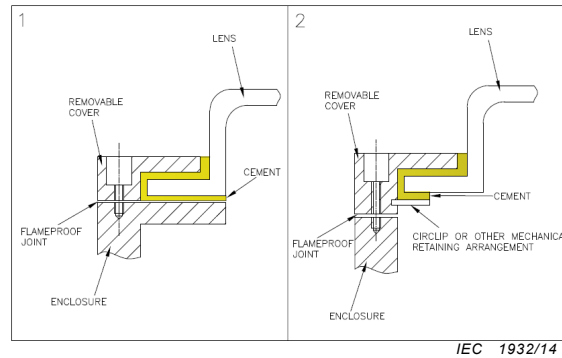
These are changes to technical requirements (addition, increase of the level or removal) made in a way that a product in conformity with the preceding edition will not always be able to fulfil the requirements given in the later edition. These changes have to be considered for products in conformity with the preceding edition. For these changes additional information is provided in clause B) below.

NOTE These changes represent current technological knowledge. However, these changes should not normally have an influence on equipment already placed on the market.

B) Information about the background of 'Major Technical Changes'

C1 – Supplemental mechanical means of securing the cemented joint shall not be defeated by the opening of doors or covers that are intended to be opened during

installation or maintenance. For example, in the images below for a luminaire incorporating a cemented joint between the lens and the enclosure cover, the construction shown in the second image would be in accordance with this requirement, while the construction shown in the first image would not.



- C2 – Addition of material limitations of enclosures of equipment and enclosures of Ex components for external mounting, if constructed of copper or copper alloys, when used in explosive gas atmospheres containing acetylene (12.8).
- C3 – Addition of power factor requirement for evaluating the ability of a plug and socket to remain flameproof during the arc-quenching period while opening a test circuit (13.6.4).
- C4 – Addition of marking requirements for Ex component enclosures, in addition to the requirements for marking of Ex components given in IEC 60079-0 (D.3.8).
- C5 – Removal of Type T cells as acceptable primary cells (Table E.1).

AUSTRALIAN/NEW ZEALAND STANDARD

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.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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, *Explosive atmospheres – Part 0: Equipment – General requirements*

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 60079-15, *Explosive atmospheres – Part 15: Equipment protection by type of protection "n"*

IEC 60127 (all parts), *Miniature fuses*

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

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

ISO 2738, *Sintered metal materials, excluding hardmetals – Permeable sintered metal materials – Determination of density, oil content and open porosity*

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

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

ANSI/ASME B1.20.1, *Pipe threads, general purpose (inch)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60079-0 as well as the following apply.

NOTE Additional definitions applicable to explosive atmospheres can be found in IEC 60050-426 [1]¹.

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

Note 1 to entry: For enclosures in which the contents are essential in service, the volume to be considered is the remaining free volume.

Note 2 to entry: 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 1 to entry: 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 1 to entry: 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)

MESG

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 60079-20-1 [2]

¹ References in square brackets refer to the bibliography.

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

Note 1 to entry: The device is arranged so that the operation has two stages:

- one for locking or unlocking, and
- 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 equipment blanking element**

threaded blanking elements for Group I or II, and non-threaded blanking elements for Group I, that

- are intended to close unused entries,
- are tested separately from the equipment enclosure,
- have an equipment certificate, and
- are intended to be fitted to the equipment enclosure without further consideration

Note 1 to entry: This does not preclude a component certificate for Ex component blanking elements in accordance with IEC 60079-0. Examples of blanking elements are shown in Figure C.1.

Note 2 to entry: Non-threaded blanking elements are not equipment for Group II applications.

3.17**Ex equipment 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 1 to entry: This does not preclude a component certificate for Ex component thread adapters in accordance with IEC 60079-0. Examples of thread adapters are shown in Figure C.3.

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 Level of protection (equipment protection level, EPL)**4.1 General**

Electrical equipment with flameproof enclosure “d” shall be one of the following:

- level of protection “da” (EPL “Ma” or “Ga”);
- level of protection “db” (EPL “Mb” or “Gb”); or
- level of protection “dc” (EPL “Gc”).

The requirements of this standard shall apply to all levels of protection unless otherwise stated.

4.2 Requirements for level of protection “da”

Level of protection “da” is only applicable to catalytic sensors of portable combustible gas detectors.

The following are the additional specific requirements for level of protection “da” that modify or supplement the requirements of this standard:

- the maximum free internal volume shall not exceed 5 cm³;
- the electrical conductors into the sensor shall employ a sealed joint, in accordance with Clause 6, directly in the wall of the enclosure;
- the breathing device of the sensor shall comply with Clause 10, and shall be bonded to the wall of the enclosure so as to eliminate any gaps (such as cementing per 6.1 or sinter bonding) or shall be press-fitted to the wall of the enclosure with supplemental mechanical means of securing (such as swaging);
- supplied by a circuit of Level of Protection “ia”, with a maximum dissipated power limited to 3,3 W for Group I and 1,3 W for Group II; and

NOTE Catalytic elements operate normally at a high temperature. If the power dissipation is increased beyond normal operating levels, the element fails to an open circuit. Therefore, the required power limitation provides a limitation of the external surface temperature.

- the non-transmission tests of 15.3 or 15.4.4 (if applicable) are modified to increase the number of non-transmission tests as shown in Table 1.

Table 1 – Number of non-transmission tests for level of protection “da”

Equipment group	Number of non-transmission tests
I	50
IIA	50
IIB	50
IIC	50 hydrogen and 50 acetylene

4.3 Requirements for level of protection “db”

Other than specific requirements for level of protection “da” and “dc”, all other requirements of this standard shall apply to level of protection “db”.

4.4 Requirements for level of protection “dc”

4.4.1 General

The requirements for level of protection “dc” are applicable to electrical equipment and Ex components with electrical switching contacts and are found in 4.4.2 through 4.4.3.

4.4.2 Construction of “dc” devices

4.4.2.1 General

The requirements of 4.4.2.2 through 4.4.2.5 replace those of Clause 5 through Clause 13. For equipment in level of protection “dc” that is intended for connection to field wiring, Clause 13 applies.

4.4.2.2 Free internal volume

The free internal volume shall not exceed 20 cm³.

4.4.2.3 Seal protection

Enclosures for level of protection “dc” that do not serve as the external equipment enclosure shall be capable of withstanding normal handling and assembly operations without damage to seals. When the enclosure for level of protection “dc” also serves as the external equipment enclosures, the enclosure requirements of IEC 60079-0 apply.

4.4.2.4 Continuous operating temperature (COT) requirements

Poured seals and encapsulating compounds shall have a continuous operating temperature (COT) range that includes a minimum temperature that is below, or equal to, the minimum service temperature and a maximum temperature that is at least 10 K above the maximum service temperature.

4.4.2.5 Ratings

Devices shall be limited to a maximum rating of 690 V a.c., r.m.s. or d.c. and 16 A a.c. r.m.s. or dc.

4.4.3 Tests for “dc” devices

For devices involving level of protection “dc”, components shall be subjected to the type test specified in 15.5. After the test, the device or component shall show no visible signs of damage, no external ignition shall occur, and there shall be no failure to clear the arc when the switch contacts are opened

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 specify the essential parameters of flamepaths. In instances where any of the following apply (for example, in order to comply with the test for non-transmission of an internal ignition):

- the minimum length of the flameproof joint as stated by the documentation is greater than the relevant minimum; or
- the maximum gap of the flameproof joint as stated by the documentation is less than the relevant maximum; or
- the minimum number of threads engaged for the flameproof joint as stated by the documentation is more than the relevant minimum;

NOTE 1 IEC 60079-0 defines the documentation as the documents that give a full and correct specification of the explosion safety aspects of the electrical equipment.

the equipment certificate number shall include the "X" suffix in accordance with the marking requirements of IEC 60079-0 and the specific conditions of use listed on the certificate and in the instructions shall detail one of the following:

- dimensions of the flameproof joints shall be detailed; or
- specific drawing referenced that details the dimensions of the flameproof joints; or
- specific guidance noted to contact the original manufacturer for information on the dimensions of the flameproof joints; or
- specific indication that the flameproof joints are not intended to be repaired.

NOTE 2 IEC 60079-0 permits the use of an advisory marking on the equipment as an alternative for the requirements for the "X" marking.

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.

Corrosion inhibiting grease, such as petrolatum or soap-thickened mineral oils, 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 be in accordance with the following:

- if not more than 0,008 mm thick, no additional consideration is necessary;
- if more than 0,008 mm thick, then the maximum gap without the plating shall still be in accordance with the applicable joint requirements, and shall be tested for flame transmission based on the gap dimension that would exist without the plating.

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 2 and 3.

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,
- 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.

NOTE There is no prohibition of press-fit combinations of other than metallic parts into metallic flameproof enclosures. In these other combinations, the minimum width of joint requirements of Tables 2 or 3 apply.

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 2 and 3.

The surfaces of joints shall be such that their average roughness R_a does not exceed 6,3 μm .

NOTE Average roughness is derived from ISO 468. Determination can be made by visual comparison to a reference plate.

For flanged joints of other than quick-acting doors or covers, there shall be no intentional gap between the surfaces other than that created by the flatness tolerances of the mating parts.

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.

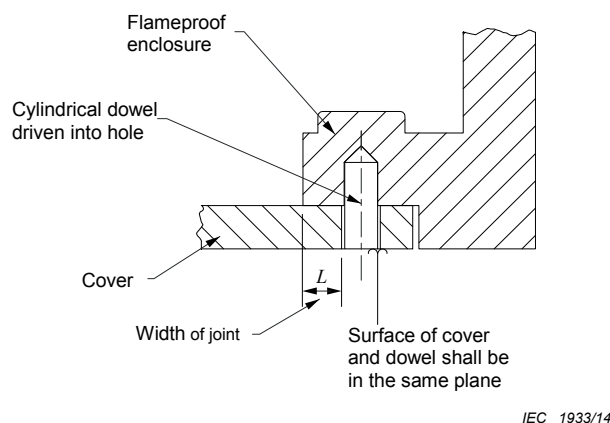


Figure 1 – Example of construction for indirect checking of a flanged Group I flameproof joint

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 2 and 3; or
- the cylindrical part only (see Figure 2b). In this case, the plane part need not comply with the requirements of Tables 2 and 3.

NOTE For gaskets, see also 5.4.

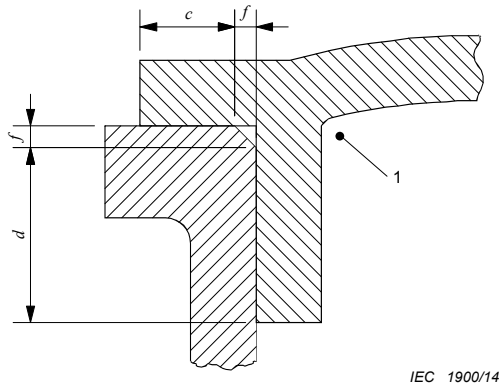


Figure 2a – Cylindrical part and plane part

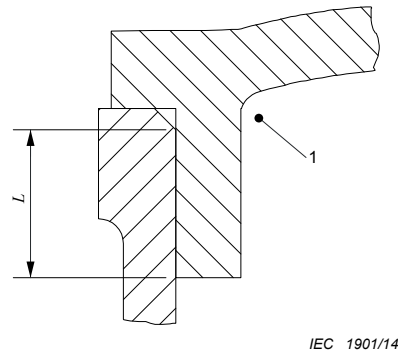


Figure 2b – Cylindrical part only

Key

$$L = c + d \text{ (I, IIA, IIB, IIC)}$$

$$c \geq 6,0 \text{ mm (IIC)}$$

$$\geq 3,0 \text{ mm (I, IIA, IIB)}$$

$$d \geq 0,50 L \text{ (IIC)}$$

$$f \leq 1,0 \text{ mm (I, IIA, IIB, IIC)}$$

1 interior of enclosure

Figure 2 – Spigot joints

5.2.4 Holes in joint surfaces

5.2.4.1 General

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.

5.2.4.2 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.

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

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

5.2.4.4 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.

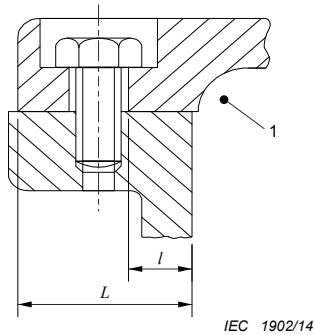


Figure 3 – Holes in surfaces of flanged joints, example 1

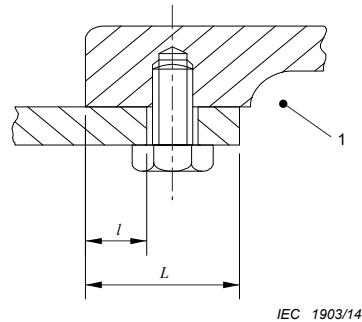


Figure 4 – Holes in surfaces of flanged joints, example 2

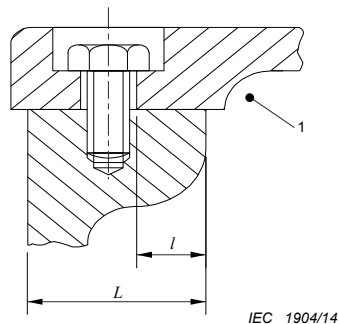


Figure 5 – Holes in surfaces of flanged joints, example 3

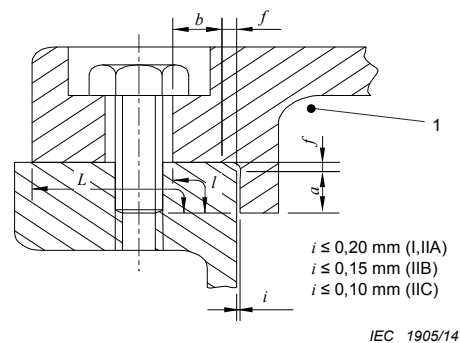


Figure 6 – Holes in surfaces of spigot joints, example 1

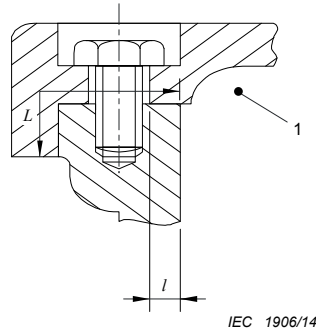


Figure 7 – Holes in surfaces of spigot joints, example 2

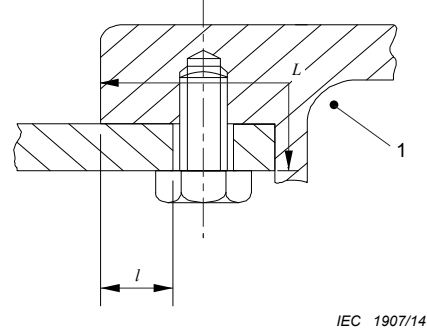


Figure 8 – Holes in surfaces of spigot joints, example 3

Key

1 interior of enclosure

5.2.4.5 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 Table 2 and Table 3. The gap shall be uniform through the conical part. For electrical equipment of Group IIC, the cone angle shall not exceed 5°.

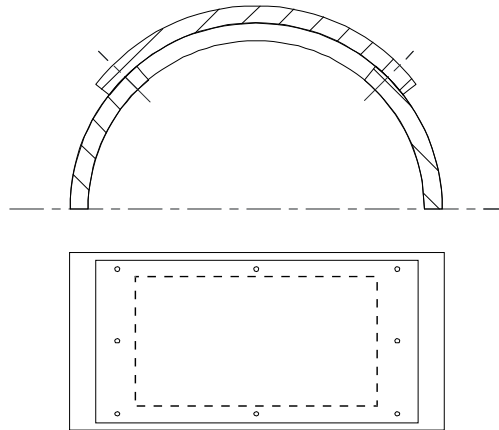
NOTE The cone angle is taken to be the angle between the major axis of the cone and the surface of the cone.

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).

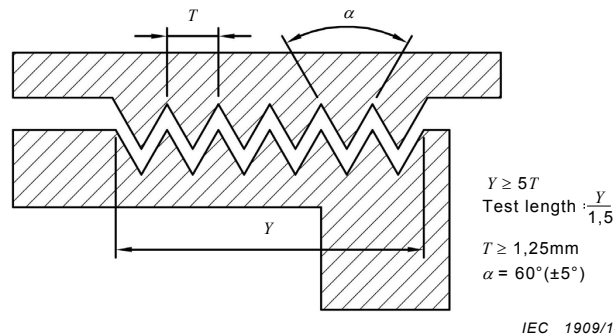
The width of the joint shall comply with the requirements of Table 2.

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 2.



IEC 1908/14

Figure 9a – Example of a joint with partial cylindrical surfaces



IEC 1909/14

Figure 9b – Example of serrated joint

Figure 9 – Examples of joint constructions

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:

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

5.2.8 Serrated joints

Serrated joints need not comply with the requirements of Tables 2 and 3 but shall have

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

Serrated joints shall only be used for joints that are fixed in place during operation.

Serrated joints shall satisfy the test requirements of 15.3, with a) the test gap, i_E , between the mating serrations as specified in 15.3, based on the manufacturer's maximum constructional gap, i_C , and b) the test length reduced to $Y / 1,5$.

If the manufacturer's maximum constructional gap is different to that shown in Tables 2 or 3 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.

5.2.9 Multi-step joints

A multi-step joint shall consist of not less than 3 adjacent segments where the path changes direction not less than two times by $90^\circ \pm 5^\circ$.

Multi-step joints need not comply with the requirements of Tables 2 or 3 but shall satisfy the test requirements of 15.3 with the test length of each segment reduced to not more than 75 % of the manufacturer's specified design minimum lengths.

For flameproof enclosures that incorporate multi-step joints, the equipment certificate number shall include the "X" suffix in accordance with the marking requirements of IEC 60079-0 and the specific conditions of use listed on the certificate shall detail one of the following:

- dimensions of the flameproof joints shall be detailed; or
- specific drawing referenced that details the dimensions of the flameproof joints; or
- specific guidance noted to contact the original manufacturer for information on the dimensions of the flameproof joints; or
- specific indication that the flameproof joints are not intended to be repaired.

NOTE 1 IEC 60079-0 permits the use of an advisory marking on the equipment as an alternative for the requirements for the "X" marking.

NOTE 2 Multi-step joints are distinct from labyrinth joints on rotating shafts as addressed in this standard (see 8.1.3).

Table 2 – 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 a volume cm^3 $V \leq 100$			For a volume cm^3 $100 < V \leq 500$			For a volume cm^3 $500 < V \leq 2\,000$			For a volume cm^3 $2\,000 < V \leq 5\,750$			For a volume cm^3 $V > 5\,750$		
			I	IIA	IIB	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	–	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	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	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	–	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	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	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	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	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	0,80	0,75	0,40
Constructional values rounded according to ISO 80000-1 [3] should be taken into consideration when determining the maximum gap.																	
NOTE In this edition of IEC 60079-1, two new columns were introduced into Table 2 that subdivided the previous single " $V > 2\,000$ " column into a " $2\,000 < V < 5\,750$ " column and a " $V > 5\,750$ " column. This subdivision was made to introduce maximum gap dimensions for flanged, cylindrical or spigot joints with minimum width of joint L of 9,5 mm where none existed previously. Specifically, it introduced the values "0,08" for Groups IIA and IIB when volume is " $2\,000 < V < 5\,750$ " and "0,08" for Group IIA when volume is " $V > 5\,750$ ". These maximum gap values and the associated volume subdivisions are based on historic US Class I, Division 1 explosion-proof gap dimensions documented in ANSI/UL 1203 [4].																	