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Responsible committee: EXL/31 Equipment for explosive atmospheres

Interested committees:

Title: BS EN IEC 60079-1 Explosive atmospheres

Part 1: Equipment protection by flameproof enclosures "d"

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Responsible Committee Secretary: **Mr Christopher Brown (BSI)**Direct tel: **02089967441**E-mail: **christopher.brown@bsigroup.com**

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



31/1704/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:

IEC 60079-1 ED8

DATE OF CIRCULATION:

2023-05-12

CLOSING DATE FOR COMMENTS:

2023-08-04

SUPERSEDES DOCUMENTS:

31/1588/RR

IEC TC 31 : EQUIPMENT FOR EXPLOSIVE ATMOSPHERES

SECRETARIAT:

United Kingdom

SECRETARY:

Mr Tom Stack

OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☐ EMC

☐ ENVIRONMENT

☐ QUALITY ASSURANCE

☐ SAFETY

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Recipients of this document are invited to submit, with their comments, notification of any local regulations or technical reasons that may exist and should be considered should this proposal proceed, recognizing that failure to address such requirements could result in the need for new or existing "In Some Countries" clauses. (SEE AC/22/2007 OR NEW GUIDANCE DOC).

TITLE:

Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures "d"

NOTE FROM TC/SC OFFICERS:

As this is a joint IEC/IEEE Project the documents have been reviewed and approved by the IEEE process.

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 [Ex Equipment and Ex Components electrical equipment](#) with the ~~t~~Type of ~~p~~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.

[ANSI/ASME B1.20.1, Pipe threads, general purpose \(inch\)](#)

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 60086-1, Primary batteries – Part 1: General](#)

IEC 60127 (all parts), *Miniature fuses*

[IEC 60622, Secondary cells and batteries containing alkaline or other non-acid electrolytes – Sealed nickel-cadmium prismatic rechargeable single cells](#)

[IEC 60623, Secondary cells and batteries containing alkaline or other non-acid electrolytes – Vented nickel-cadmium prismatic rechargeable single cells](#)

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

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

[IEC 61960, Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications](#)

[ISO 185, Grey cast irons – Classification](#)

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 2859-1, Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit \(AQL\) for lot-by-lot inspection](#)

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

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

[ISO 80000-1, Quantities and units – Part 1: General](#)

~~[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 ~~that which~~ can ignite an explosive gas atmosphere are placed and which ~~the enclosure is intended to contain~~

a) withstand the pressure developed during an internal explosion of an explosive mixture,

b) and which prevents the transmission of the explosion to the explosive gas atmosphere surrounding the enclosure, and

c) not have external surface temperatures that are capable of igniting a surrounding explosive gas atmosphere

3.2

enclosure volume

total internal volume of the enclosure of flameproof “d” equipment

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.

¹ References in square brackets refer to the bibliography.

3.3**flamepath**

flameproof joint ~~or flamepath~~

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

3.4**length width of flameproof joint**

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 widthlength 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~~ flameproof enclosure has been assembled

~~Note 1 to entry: i_C is the maximum constructional gap, as specified on the schedule drawings.~~

~~Note 2 to entry: i_E is the test gap.~~

~~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 widthlength which prevents any transmission of an explosion during 10 tests made under the conditions specified in ISO/IEC 860079-20-1 [2]

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 can may be rotary or linear or a combination of the two

3.10**pressure-pilingpressure 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****quick-acting 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****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**sealed joint**

place where the corresponding surfaces of two parts of an enclosure, or the conjunction of enclosures, come together and which are sealed by a material intended to prevent the transmission of an internal explosion to the explosive gas atmosphere surrounding the enclosure

~~3.13.14~~**threaded door****threaded 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

a) are intended to close unused entries,

b) are tested separately from the equipment enclosure,

c) have an equipment certificate, and

d) 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.

3.183.15

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 Ex Equipment certificate without the need for repetition of type testing

3.16

containment system

part of the equipment containing the flammable or non-flammable substance that can constitute an internal source of release

Note 1 to entry The requirements for containment systems as part of flameproof enclosures also apply to the use of non-flammable substances, due to risk of increasing the pressure within the flameproof enclosure (see Annex G).

3.17

flammable substance

gases, vapours, liquids or mixtures thereof that are capable of being ignited

3.18

internal source of release

point or location from which a flammable substance in the form of a flammable gas or vapour or liquid may be released into the enclosure such that in the presence of air an explosive gas atmosphere could be formed

4 Level of protection (equipment protection ILevel, EPL)

4.1 General

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

- a) ILevel of protection “da” (EPL “Ma” or “Ga”);
- b) ILevel of protection “db” (EPL “Mb” or “Gb”); or
- c) ILevel of protection “dc” (EPL “Gc”).

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

4.2 Requirements for ILevel of protection “da”

Level of protection “da” is only applicable to catalytic sensors of:

- a) portable, transportable or fixed combustible gas detectors for Group I; and
- b) portable combustible gas detectors for Group II.

NOTE 1 For anticipated applications, these sensors are not intended to be exposed to explosive mixtures of gases or vapours for extended periods of time since alarm actions are intended to mitigate exposure to explosive mixtures upon detection. In typical Group I applications, these sensors and associated detectors are used to monitor for the explosive atmosphere during release or ventilation failure conditions. In a typical Group II application, these sensors and associated detectors are used to verify that an explosive gas atmosphere does not exist in order to permit maintenance activities.

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

- c) the maximum free internal volume shall not exceed 5 cm³;
- d) the electrical conductors into the sensor shall employ a sealed joint, in accordance with Clause 6, directly in the wall of the sensor enclosure;

- e) 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);
- f) 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 2 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.

- g) 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 ILLevel of pPProtection “da”

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

4.3 Requirements for ILLevel of pPProtection “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 ILLevel of pPProtection “dc”

4.4.1 General

~~The requirements for ILLevel of pPProtection “dc” are is only~~ applicable to ~~electrical-e~~ Ex Equipment and Ex ~~e~~Components with electrical switching contacts, with the requirements for Level of Protection “dc” 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 ILLevel of pPProtection “dc” that is intended for connection to field wiring, Clause 13 applies.

NOTE The Schedule Drawings include the manufacturer and model number, along with the electrical ratings and COT range for Level of Protection “dc” equipment.

4.4.2.2 Free internal volume

The free internal volume shall not exceed 20 cm³.

4.4.2.3 Seal protection

Enclosures for ILLevel of pPProtection “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 ILLevel of pPProtection “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.

4.4.2.6 Connection facilities

Equipment shall be provided with connection facilities employing one of the following:

- a) Field wiring connection facilities in accordance with Clause 13 intended to be connected using an appropriate EPL Gc connection method;
- b) Factory wiring connection facilities employing individual conductors (flying leads) intended to be connected using appropriate EPL Gc connection methods; or
- c) Factory wiring connection facilities employing integral terminations intended to be connected using an appropriate EPL Gc connection method (for example, pins soldered to a printed wiring board).

Note The most commonly applied connection means is Type of Protection "e".

4.4.3 ~~Type tests~~Tests for "dc" devices

~~For devices involving IL~~ level of ~~pP~~Protection "dc" ~~equipment, components~~ shall be subjected to the type test specified in 15.5. After the test, the ~~equipment 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 and shall be subjected to the tests specified in Clause 14 through Clause 16 as applicable.

A material that hardens after the joint is assembled (for example, a locking compound on threaded joints) shall not be used on a joint that is intended to be serviced.

NOTE Care should be exercised when thread locking compound for fasteners is used to secure joints such that the compound does not wick onto flamepath surfaces.

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):

- a) the minimum length of the flameproof joint as stated by the documentation is greater than the relevant minimum; or
- b) the maximum gap of the flameproof joint as stated by the documentation is less than the relevant maximum; or

- 274 c) the minimum number of threads engaged for the flameproof joint as stated by the
275 documentation is more than the relevant minimum;

276 NOTE ~~4~~ IEC 60079-0 defines the documentation as the documents that give a full and correct specification of the
277 explosion safety aspects of the [electrical-Ex Equipment and Ex Component equipment](#).

278 the ~~equipment certificate~~[Ex Equipment certificate](#) number shall include the "X" suffix in accordance
279 with the marking requirements of IEC 60079-0 and the ~~sS~~[Specific eC](#)onditions of ~~uU~~[Use](#) listed on the
280 certificate ~~and in the instructions~~ shall detail one of the following:

- 281 d) dimensions of the flameproof joints shall be detailed; or
282 e) specific drawing referenced that details the dimensions of the flameproof joints; or
283 f) specific guidance noted to contact the original manufacturer for information on the
284 dimensions of the flameproof joints; or
285 g) specific indication that the flameproof joints are not intended to be repaired.

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

288 The surface of joints may be protected against corrosion.

289 Coating with paint or powder-coat finish is not permitted. Other coating material may be used if
290 the material and application procedure have been shown not to adversely affect the flameproof
291 properties of the joint. [If the other coating material is non-metallic type, see Clause 19.](#)

292 Corrosion inhibiting grease, such as petrolatum or soap-thickened mineral oils, may be applied to
293 joint surfaces before assembly. The grease, if applied, shall be of a type that does not harden
294 because of ageing, does not contain an evaporating solvent, and does not cause corrosion of the
295 joint surfaces. Verification of suitability shall be in accordance with the grease manufacturer's
296 specifications.

297 Joint surfaces may be electroplated. The metal plating, if applied, shall be in accordance with the
298 following:

- 299 h) if not more than 0,008 mm thick, no additional consideration is necessary; [or](#)
300 i) if more than 0,008 mm thick, then the maximum gap without the plating shall still be in
301 accordance with the applicable joint requirements, and shall be tested for flame transmission
302 based on the gap dimension that would exist without the plating.

303 Where equipment is rated for a specific gas and a specific equipment group (for example, IIB +
304 H₂), the enclosure shall comply with:

- 305 j) the requirements for the equipment group of the specific gas, and
306 k) [the requirements for the lower equipment group.](#)

307 5.2 Non-threaded joints

308 5.2.1 [WidthLength](#) of joints (L)

309 The [widthlength](#) of joints shall not be less than the minimum values given in Table 2 and Table 3.

310 The [widthlength](#) of joints for cylindrical metallic parts press-fitted into the walls of a metallic
311 flameproof enclosure of a volume not greater than 2 000 cm³ may be reduced to 5 mm, if

- 312 a) the design does not rely only on an interference fit to prevent the part being displaced during
313 the type tests of Clause 15,

- b) the assembly meets the impact test requirements of IEC 60079-0, taking the worst-case interference fit tolerances into account, and
- c) the external diameter of the press-fitted part, where the [widthlength](#) 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 [widthlength](#) of joint requirements of Table 2 or Table 3 apply.

5.2.2 Gap (i)

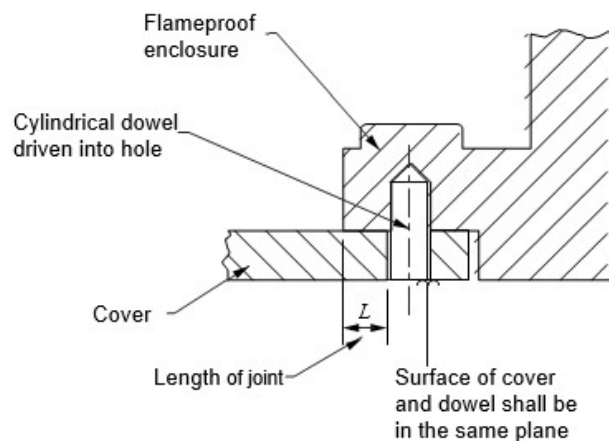
The gap, if one exists, between the surfaces of a joint shall nowhere exceed the maximum values given in Table 2 and Table 3.

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 [3]. 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.



IEC 1933/14

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

5.2.3 Spigot joints

For the ~~calculation determination~~ of the [widthlength](#) L of spigot joints, ~~one of the following shall be taken into account: the sum of the lengths of the plane part of the joint (dimension c in Figure 2) and of the cylindrical part of the joint (dimension d in Figure 2) and the plane part (see Figure 2a).~~ In this case, the gap shall not be less than the minimum ~~nowhere exceed the maximum~~ values given in Table 2 and Table 3, as applicable. ~~;-or~~

Regarding these dimensions

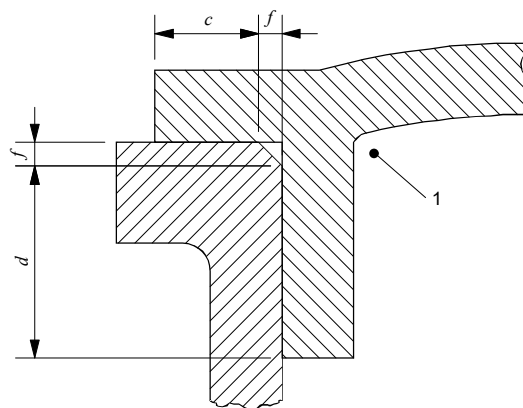
- a) the length of the plane part of the joint shall not be less than 6 mm;

- b) the length of the cylindrical part of the joint shall not be less than 0.5 times the required minimum length of joint L in accordance with Table 2 and Table 3, as applicable; and
- c) the length of the chamfer between the plane and cylindrical parts of the joint (dimension f in Figure 2) shall not be greater than 1 mm.
- a) the cylindrical part only (see Figure 2b). In this case, the plane part need not comply with the requirements of Table 2 and Table 3.

The gaps of the plane and cylindrical parts of the joint shall not exceed the maximum values given in Table 2 and Table 3, as applicable.

NOTE 1 For gaskets, see also 5.4.

Joint designs that are similar to a spigot joint (see Figure 3), but where the plane part or chamfer of the joint do not meet the dimensional requirements for spigot joints, shall comply with 5.2.4 for cylindrical joints.



IEC 1900/14

Figure 2a — Cylindrical part and plane part

Key

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

c plane part of the joint $\geq 6,0 \text{ mm}$ (IIC)
 $\geq 3,0 \text{ mm}$ (I, IIA, IIB)

d cylindrical part of the joint $\geq 0,50 L$ (IIC)

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

1 interior of enclosure

Figure 2 – Example of Spigot joints

5.2.4 Cylindrical joints

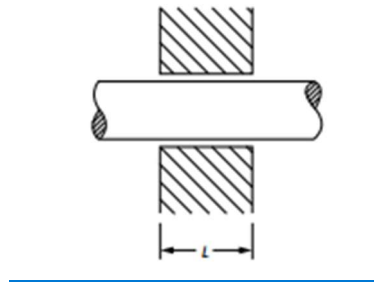
Length L of cylindrical part of the joint (see Figure 3) shall not be less than the minimum values given in Table 2 and Table 3, as applicable.

The gap shall not exceed the maximum values given in Table 2 and Table 3, as applicable. The gap is the maximum difference between the diameters of the two parts of the joint.

Operating rods shall also comply with Clause 7.

Cylindrical joints for shaft glands of rotating electric machines with sleeve bearings or rolling-element bearings shall also comply with Clause 8.

370 NOTE For gaskets, see also 5.4.



1

L

IEC 1901/14

Key

L minimum length of joint

1 interior of enclosure

Figure 3 – Examples of Cylindrical joints

371 **5.2.45.2.5 Holes in joint surfaces**

372 **5.2.4.15.2.5.1 General**

373 Where a flanged plane joint, or the plane part of a spigot joint (see 5.2.5.4), or a partial cylindrical
374 surface (see 5.2.6) of a joint (see 5.2.7) is interrupted by holes intended for the passage of
375 threaded fasteners for assembling the parts of a flameproof enclosure, the distance l to the edge
376 of the hole shall be equal to or greater than

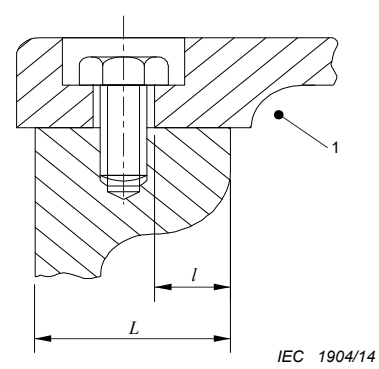
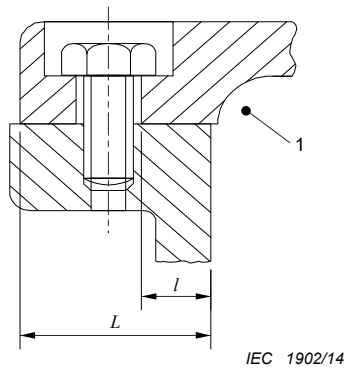
- 377 a) 6 mm when the width/length of joint L is less than 12,5 mm;
378 b) 8 mm when the width/length of joint L is equal to or greater than 12,5 mm but less than 25 mm;
379 or
380 c) 9 mm when the width/length of joint L is equal to or greater than 25 mm.

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

382 The distance l is determined as follows.

383 **5.2.4.25.2.5.2 Flanged joints with holes outside the enclosure (see Figure 4 ~~Figure 3~~ and**
384 **Figure 5 ~~Figure 5~~)**

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



Key

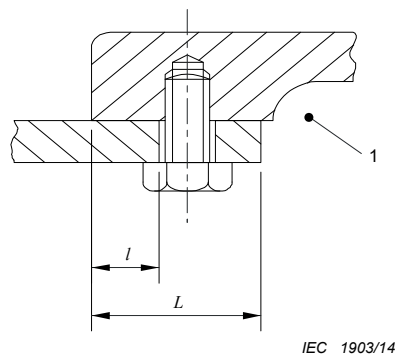
1 interior of enclosure

Figure 43 – Holes in surfaces of flanged joints, example 1

Figure 5 – Holes in surfaces of flanged joints, example 2

386 **5.2.4.35.2.5.3** Flanged joints with holes inside the enclosure (see [Figure 6](#)~~Figure 4~~)

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



Key

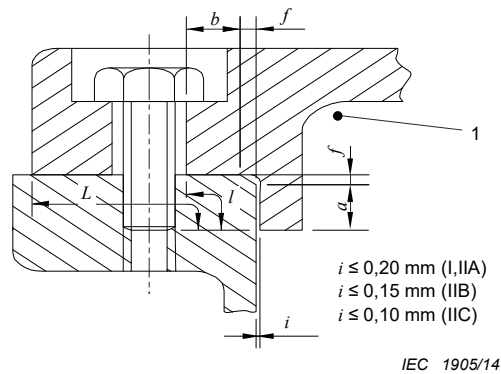
1 interior of enclosure

Figure 64 – Holes in surfaces of flanged joints, example 2

388 **5.2.4.45.2.5.4** Spigot joints where, to the edges of the holes, the joint consists of a
389 cylindrical part and a plane part (see [Figure 7](#)~~Figure 6~~)

390 The distance l is defined as follows:

- 391 a) the sum of the [width/length](#) a of the cylindrical part and the [width/length](#) b of the plane part, if f
392 is less than or equal to 1 mm and if the gap of the cylindrical part is less than or equal to
393 0,2 mm for [electrical](#) equipment of Groups I and IIA, 0,15 mm for [electrical](#) equipment of
394 Group IIB, or 0,1 mm for [electrical](#) equipment of Group IIC (reduced gap); or
- 395 b) the [width/length](#) b of the plane part alone, if either of the above-mentioned conditions is not
396 met.



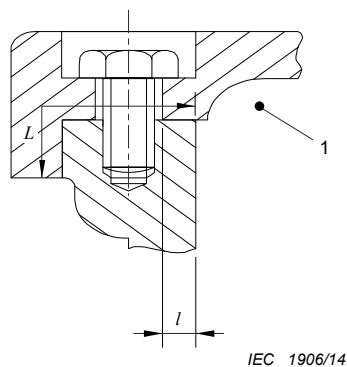
Key

1 interior of enclosure

Figure 76 – Holes in surfaces of spigot joints, example 1

5.2.4.55.2.5.5 Spigot joints where, to the edges of the holes, the joint consists only of the plane part (see Figure 8 **Figure 7** and Figure 9 **Figure 8**), in so far as **flanged plane** joints are permitted (see 5.2.8)

The distance l is the **widthlength** of the plane part between the inside of the enclosure and a hole, where the hole is outside the enclosure (see Figure 8 **Figure 7**), or between a hole and the outside of the enclosure where the hole is inside the enclosure (see Figure 9 **Figure 8**).



Key

1 interior of enclosure

Figure 87 – Holes in surfaces of spigot joints, example 2

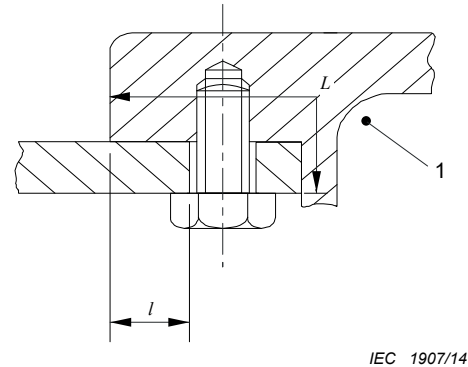


Figure 98 – Holes in surfaces of spigot joints, example 3

5.2.55.2.6 Conical joints

Where joints include conical surfaces, the **widthlength** 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

409 through the conical part. For ~~electrical~~ equipment of Group IIC, the cone angle shall not exceed
410 5°.

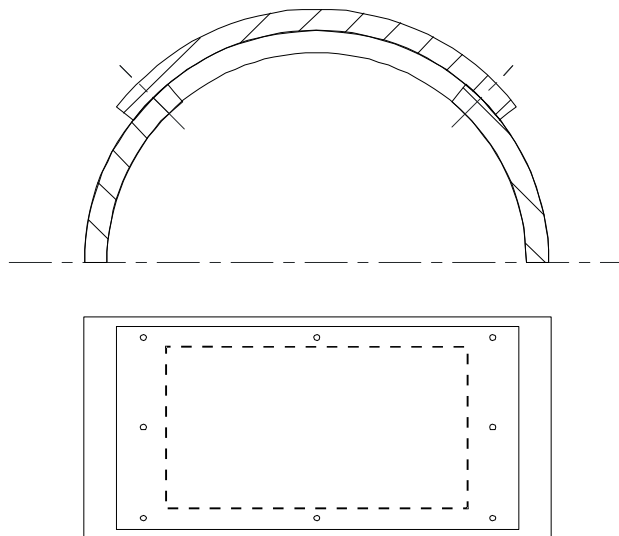
411 NOTE The cone angle is taken to be the angle between the major axis of the cone and the surface of the cone.

412 ~~5.2.6~~5.2.7 Joints with partial cylindrical surfaces (not permitted for Group IIC)

413 There shall be no intentional gap between the two parts (see 9a).

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

415 The diameters of the cylindrical surfaces of the two parts forming the flameproof joint, and their
416 tolerances, shall ensure compliance with the relevant requirements for the gap of a cylindrical joint
417 as given in Table 2.



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418

419 **Figure 109a – Example of a joint with partial cylindrical surfaces**

419

420 **Figure 9—Examples of joint constructions**

420

421 ~~5.2.75~~5.2.8 Flanged joints for acetylene atmospheres

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

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

427 ~~Additionally, Alternatively, for volumes greater than 500 cm³, all of the following conditions shall~~
428 ~~be met:~~

- 429 ~~e)d)~~ gap i and length L in accordance with Table 3; and
- 430 ~~d)e)~~ a maximum prospective short circuit current of 10 000 rms symmetrical amperes.

431 NOTE Limiting the maximum prospective short circuit current to 10 000 rms symmetrical amperes limits the production
432 of carbon particles that could be expelled through a flanged joint with a dynamically increased gap due to the reaction
433 of the enclosure flange from a combination of the arc-rupturing pressure and exploding gas pressure. See Figure 11.

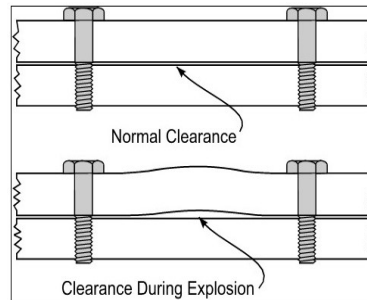


Figure 11 – Example of a flanged joint with a dynamically increased gap

5.2.85.2.9 Serrated joints

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

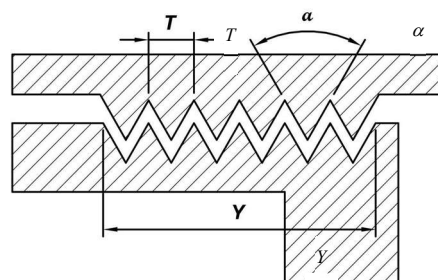
- a) at least five fully engaged serrations,
- b) a pitch greater than or equal to 1,25 mm, and
- c) an included angle of $60^\circ (\pm 5^\circ)$.

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 Table 2 or Table 3 for a flanged joint of the same length (determined by multiplying the pitch by the number of serrations), the "Specific eConditions of uUse" requirements of 5.1 apply.

See [Figure 12](#) [Figure-9b](#).



$$Y \geq 5T$$

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

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

$$\alpha = 60^\circ (\pm 5^\circ)$$

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Figure 12b – Example of serrated joint

Figure 9 – Examples of joint constructions

5.2.95.2.10 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 Table 2 or Table 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~~Ex Equipment certificate number shall include the "X" suffix in accordance with the marking requirements of IEC 60079-0 and the ~~s~~Specific ~~e~~Conditions of ~~u~~Use listed on the certificate shall detail 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; or
- d) 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).

5.2.11 Other joints

Joints that incorporate flamepaths not addressed elsewhere in this standard shall comply with the following requirements

- a) the joint shall consist of not less than 2 adjacent parts of the joint where the path changes direction not less than by $90^\circ \pm 5^\circ$; and
- b) For the calculation of the length L of the joint, the sum of the lengths of the two parts of the joint shall not be less than the minimum value for spigot joints given in Table 2 and Table 3, as applicable.

Regarding these dimensions

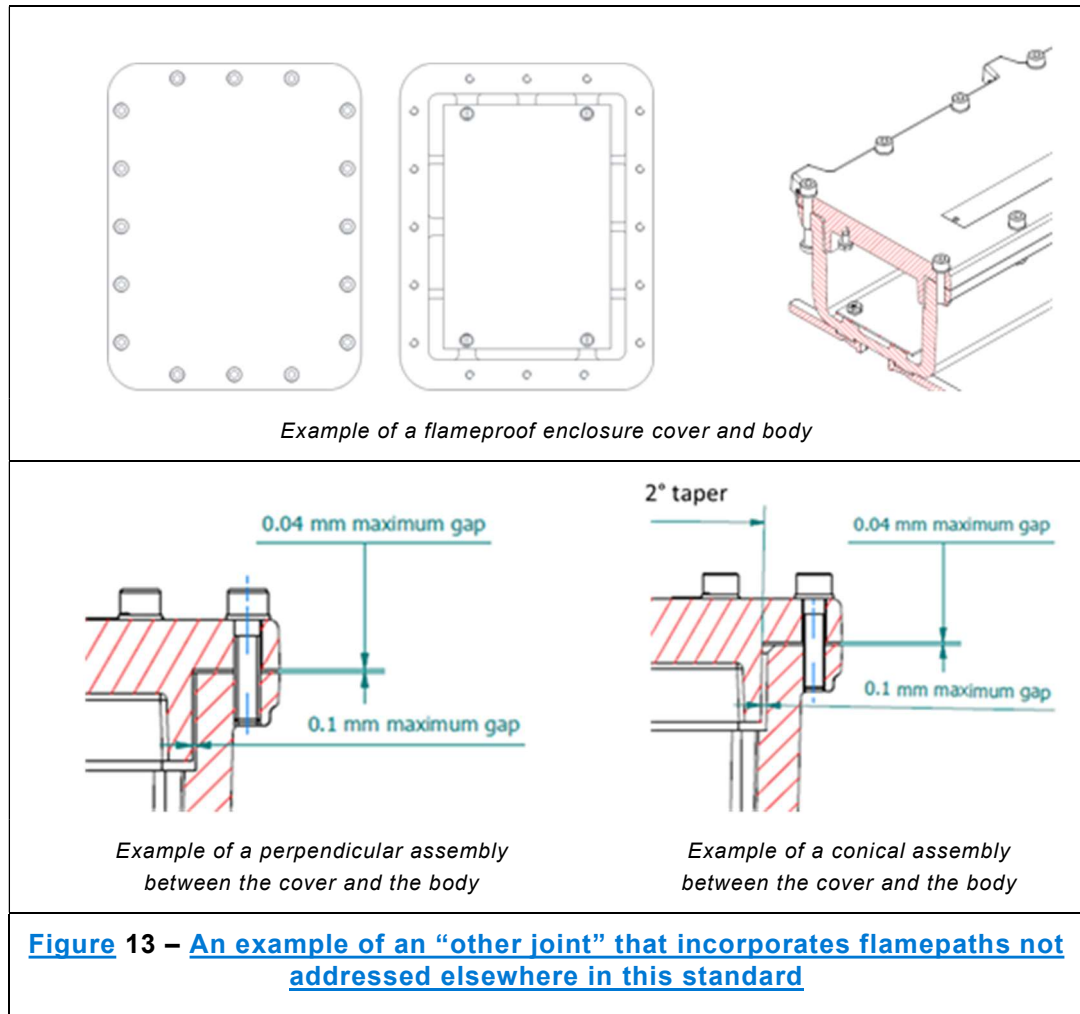
- c) the length of the flanged part of the joint shall not be less than 6 mm;
- d) the length of the adjacent part of the joint within the enclosure shall not be less than 0.5 the required minimum length of joint L in accordance with the spigot joint dimensions given in Table 2 and Table 3, as applicable; and
- e) the length of the chamfer between these adjacent parts of the joint shall not be greater than 1 mm.

The gaps of these adjacent parts of the joint shall not exceed the maximum value given for spigot joints in Table 2 and Table 3, as applicable.

Joint designs that are similar to a spigot joint (see Figure 2), but where the flanged part or chamfer of the joint do not meet the dimensional requirements of 5.2.10, the adjacent parts of the joint within the enclosure shall comply with the spigot joint requirements of Table 2 and Table 3, as applicable.

See Figure 13 for just one example of an "other joint" that incorporates flamepaths not addressed elsewhere in this standard.

NOTE For gaskets, see also 5.4.



498
499

Table 2 – Minimum widthlength of joints and maximum gaps for enclosures to be used in of Groups I, IIA and IIB

Type of joint		Minimum <u>widthlength</u> of joint L ^b mm	Maximum gap ^{a, b} mm														
			For a volume cm^3 $10 < V \leq 100$			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

^a Constructional values rounded according to ISO 80000-1 [3] should be taken into consideration when determining the maximum gap.

^b For volume $\leq 10 \text{ cm}^3$, the construction requirements of this table do not apply.

NOTE In Edition 7.0 of this edition of IEC 60079-1:2014, 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 widthlength 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 NFPA 70 [4] US Class I, Division 1 explosion-proof gap dimensions documented in ANSI/UL 1203 [5].

500

Table 3 – Minimum widthlength of joints and maximum gaps for enclosures to be used in Group IIC enclosures

Type of joint		Minimum <u>widthlength</u> of joint L_d mm	Maximum gap ^d mm			
			For a volume cm^3 $10 < V \leq 100$	For a volume cm^3 $100 < V \leq 500$	For a volume cm^3 $500 < V \leq 2\,000$	For a volume cm^3 $V > 2\,000$
Flanged joints ^a		6	0,10	–	–	–
		9,5	0,10	0,10	–	–
		15,8	0,10	0,10	0,04	–
		25	0,10	0,10	0,04	0,04
Spigot joints (Figure 2a)	$e \geq 6 \text{ mm}$	12,5	0,15	0,15	0,15	–
	$d \geq 0,5 L$	25	0,18 ^b	0,18 ^b	0,18 ^b	0,18 ^b
	$L = e + d$	40	0,20 ^c	0,20 ^c	0,20 ^c	0,20 ^c
	$f \leq 1 \text{ mm}$					
Cylindrical joints <u>Spigot joints</u> (Figure 3a)		6	0,10	–	–	–
		9,5	0,10	0,10	–	–
		12,5	0,15	0,15	0,15	–
		25	0,15	0,15	0,15	0,15
Cylindrical joints for shaft glands of rotating electrical machines with rolling element bearings		40	0,20	0,20	0,20	0,20
		6	0,15	–	–	–
		9,5	0,15	0,15	–	–
		12,5	0,25	0,25	0,25	–
		25	0,25	0,25	0,25	0,25
		40	0,30	0,30	0,30	0,30
^a Flanged joints are permitted for explosive mixtures of acetylene and air only in accordance with 5.2.8. ^b Maximum gap of cylindrical part increased to 0,20 mm if $f < 0,5 \text{ mm}$. ^c Maximum gap of cylindrical part increased to 0,25 mm if $f < 0,5 \text{ mm}$. ^d For volume $\leq 10 \text{ cm}^3$, the construction requirements of this table do not apply.						
The constructional values rounded according to ISO 80000-1 should be taken into consideration when determining the maximum gap.						

5.3 Threaded joints

Threaded joints shall comply with the requirements given in Table 4 or Table 5.

Table 4 – Cylindrical threaded joints

Pitch	≥ 0,7 mm ^a
Thread form and quality of fit	Medium or fine tolerance quality according to ISO 965-1 and ISO 965-3 ^b
Threads engaged	≥ 5
Depth of engagement	
- Volume ≤ 100 cm ³	≥ 5 mm
- Volume >100 cm ³	≥ 8 mm
^a Where the pitch exceeds 2 mm, special manufacturing precautions may be necessary (for example, more threads engaged) to ensure that the electrical equipment can pass the test for non-transmission of an internal ignition which is prescribed in 15.3.	
^b Cylindrical threaded joints which do not conform with ISO 965-1 and ISO 965-3 in respect of thread form or quality of fit are permitted if the test for non-transmission of an internal ignition, prescribed in 15.3, is passed, when the widthlength of the threaded joint specified by the manufacturer is reduced by the amount specified in Table 9.	

Table 5 – Taper threaded joints ^{a, c}

Threads provided on each part	≥ 5 ^b
^a Internal and external thread shall have the same nominal size.	
^b Threads shall conform to the NPT requirements of ANSI/ASME B1.20.1 and shall be made-up wrench tight. External threaded parts shall be provided with: 1) an effective thread length not less than the "L2" dimension; and 2) if a shoulder is provided, a length not less than the "L4" dimension between the face of the shoulder and end of the thread. Internal threads shall gauge at "flush" to "2 turns large" using an L1 plug-gauge.	
^c Where the tapered threaded joint consists of both the internal and external threaded parts with at least 4,5 fully engaged threads, the requirements of footnote b in this table need not be applied.	
NOTE See Annex C for tapered thread requirements applicable to flameproof entry devices.	

5.4 Gaskets (including O-rings)

If a gasket of compressible or elastic material is used, for example, to protect against the ingress of moisture or dust or against leakage of a liquid, it shall ~~be applied as a supplement, that is to say~~ neither be taken into account in the determination of the [widthlength](#) of the flameproof joint nor interrupt it.

[NOTE This standard does not require flameproof enclosures to have a degree of ingress protection \(IP Code\).](#)

The gasket shall ~~then~~ be mounted [such so](#) that

- a) the permissible gap and [widthlength](#) of flanged joints or the plane part of a spigot joint are maintained, and
- b) the minimum [widthlength](#) of joint of a cylindrical joint or the cylindrical part of a spigot joint are maintained before and after compression.

These requirements do not apply to cable glands (see 13.3 [and](#) C.2.1.1) or to joints which contain a sealing gasket of metal or of a non-flammable compressible material with a metallic sheath. Such a sealing gasket contributes to the explosion protection, and in this case the gap between each

522 surface of the plane part shall be measured after compression. The minimum [widthlength](#) of the
523 cylindrical part shall be maintained before and after compression.

524 See [Figure 1440](#) to [46](#).

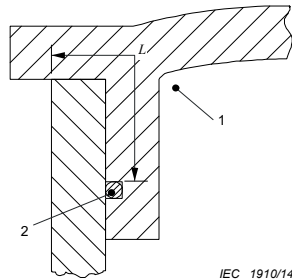


Figure 1440 – Illustration of the requirements concerning gaskets – Example 1

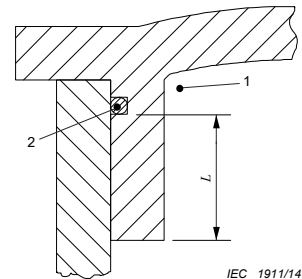


Figure 1541 – Illustration of the requirements concerning gaskets – Example 2

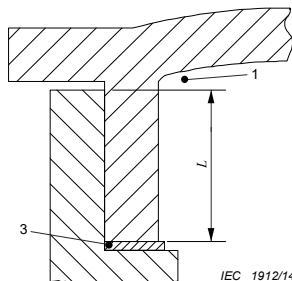


Figure 1642 – Illustration of the requirements concerning gaskets – Example 3

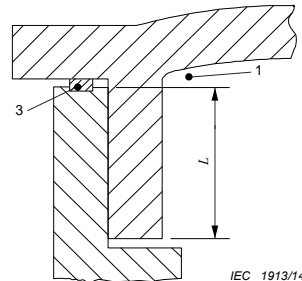


Figure 1743 – Illustration of the requirements concerning gaskets – Example 4

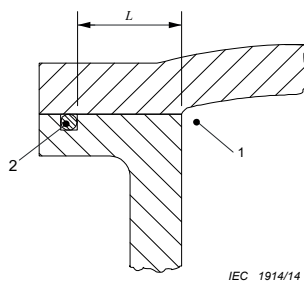


Figure 1844 – Illustration of the requirements concerning gaskets – Example 5

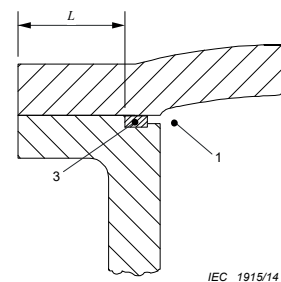
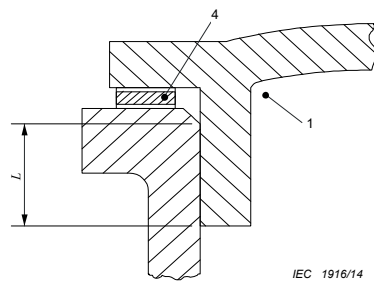


Figure 1945 – Illustration of the requirements concerning gaskets – Example 6



Key

- 1 interior of enclosure
- 2 O-ring
- 3 gasket
- 4 metallic or metal sheath gasket

Figure 2016 – Illustration of the requirements concerning gaskets – Example 7

Figure 16 – Illustration of the requirements concerning gaskets – Example 7

5.5 Equipment using capillaries

The capillaries shall either comply with the gap dimensions given in Table 2 or Table 3 for cylindrical joints using 0 as the diameter of the inner part, or when the capillaries do not conform to the gaps given in these tables, the equipment shall be evaluated in accordance with the test for non-transmission of an internal ignition given in 15.3.

6 Sealed joints

6.1 Cemented joints

6.1.1 General

Parts of a flameproof enclosure may be cemented either directly into the wall of the enclosure so as to form with the latter an inseparable assembly, or into a metallic frame such that the assembly can be replaced as a unit without damaging the cement.

The material, preparation, application, and curing conditions (such as time, temperature, etc.) of the cementing shall be included in documentation prepared in accordance with IEC 60079-0.

An unaltered sample of the cemented joint assembly representative of production shall be used for evaluation and testing purposes. To facilitate retention of the cement while curing, a cemented joint may incorporate an additional material at one or both ends. If such additional material is incorporated, it shall be removed or the sealing properties of the additional material shall be rendered ineffective so as to test only the effectiveness of the cemented joint seal.

NOTE An example of rendering the sealing properties ineffective would be the replacement of the production material with wax, or other low temperature material whose sealing properties would degrade during thermal conditioning.

A flameproof joint in accordance with Clause 5, which also incorporates cement, and which is tested without the cement in accordance with 15.3, does not need to fulfill the requirements of Clause 6.

6.1.2 Mechanical strength

Cemented joints are only intended to ensure the sealing of the flameproof enclosure of which they form a part. Arrangements shall be made in the construction so that the mechanical strength of the assembly does not depend upon the adhesion of the cement alone.

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.

Cemented joints in accordance with 6.1.1 shall be subjected to the following tests:

- a) Two samples ~~representative of production~~ shall be subjected to an overpressure test with water in accordance with 15.2.3.2. The test is considered satisfactory if blotting paper, placed under each sample under test, is free from any trace of leakage.
- b) Either the same two samples from a) above, or a separate set of samples, shall be subjected to the tests of enclosures in IEC 60079-0, as applicable. Subsequent to this conditioning, the samples shall be subjected to an overpressure test with water in accordance with 15.2.3.2. The test is considered satisfactory if blotting paper, placed under each sample under test, is free from any trace of leakage.

NOTE The tests of enclosures in IEC 60079-0 permit the tests to be conducted on either a set of two samples or a set of four samples, with the difference being the number of tests conducted on each sample.

Alternatively, the tests in item a) above need not be performed prior to the tests of b) above, provided that there is no leakage after the tests of b) above.

If there is any leakage on the blotting paper as a result of the test on the samples from ~~Item 2) of 6.1.2 b) above~~, the cemented joint involves undefined leakage paths through the joint. Therefore, then the cemented joint for one sample that leaks after being subjected to the tests of enclosures and ~~hydraulic~~ overpressure testing above shall be subjected to the following tests:

- c) the flame erosion test in 19.4 is to be performed at room ambient temperature and but with no modifications to the cemented joints of the test samples, followed by
- d) the test for non-transmission in 15.3.2.1, or the test for non-transmission in 15.3.3.3 or 15.3.3.4, as applicable for the equipment group, is to be performed with consideration of the maximum ambient temperature in accordance with 15.3.1 and with no further modifications to the cemented joints of the test sample.

The cemented joint is judged satisfactory if this test for non-transmission is satisfactory.

Routine overpressure testing of cemented joints (per Clause 16) shall be performed whenever 1,5 times or 3 times the reference pressure is necessary to comply with 6.1.2a).

6.1.3 Length Width of cemented joints

The shortest path through a cemented joint from the inside to the outside of a flameproof enclosure of volume V shall be

- a) $\geq 3 \text{ mm}$ if $V \leq 10 \text{ cm}^3$;
- b) $\geq 6 \text{ mm}$ if $10 \text{ cm}^3 < V \leq 100 \text{ cm}^3$ or
- c) $\geq 10 \text{ mm}$ if $V > 100 \text{ cm}^3$.

For constructions incorporating an additional material at one or both ends to facilitate retention of the cement while curing, this additional material shall neither be taken into account in the determination of the length of the cement of the cemented joint nor interrupt it.

6.2 Fused glass joints

6.2.1 General

Fused glass joints are glass-to-metal joints formed by the application of molten glass into a metal frame that results in either a chemical or physical bond between the glass and the metal frame.

6.2.2 WidthLength of fused glass joints

The shortest path along through a fused glass joint from the inside to the outside of a flameproof enclosure shall be ≥ 3 mm.

6.3 Welded or brazed joints

Joints may be made by welding or brazing (for example, e.g. eutectic methods using filler metal, including silver solder, with a melting point at or above 450 °C, see ISO 857-2 [6]).

NOTE 1 Eutectic methods involve the joining of two or more components, normally metallic, employing a binary or ternary alloy system which solidifies at a constant temperature which is lower than the beginning of solidification of any of the components being joined.

Low temperature solder alloys (e.g. solder alloys with a melting point below 450 °C), such as lead/tin composites, are not acceptable.

NOTE 2 It is not a requirement of this standard that the melting point of solder alloys be verified.

7 Operating rods

Where an operating rod passes through the wall of a flameproof enclosure, the following requirements shall be met:

- a) if the diameter of the operating rod exceeds the minimum widthlength of the joint specified in Table 2 and Table 3, the widthlength of the joint shall be at least equal to this diameter but without, however, having to exceed 25 mm; and
- b) if the diametrical clearance is liable to be enlarged as a result of wear in normal service, appropriate arrangements shall be made to facilitate a return to the original state, for example, by means of a replaceable bushing. Alternatively, gap enlargement due to wear may be prevented by the use of bearings complying with Clause 8.

8 Supplementary requirements for electric machines shafts and bearings

8.1 Joints of shafts

8.1.1 General

Flameproof joints of shafts of rotating-electrical machines shall be arranged so as not to be subject to wear in normal service.

The flameproof joint may be

- a) a cylindrical joint (see Figure 21~~Figure 17~~);
- b) a labyrinth joint (see Figure 22~~Figure 18~~); or
- c) a joint with a floating gland (see Figure 23~~Figure 19~~).

8.1.2 Cylindrical joints

Where a cylindrical joint contains grooves for the retention of grease, the region containing the grooves shall neither be taken into account when determining the widthlength of a flameproof joint nor interrupt it (see Figure 21~~Figure 17~~).

The minimum radial clearance k (see Figure 24~~Figure 20~~) of shafts of rotating-electrical machines shall not be less than 0,05 mm.

8.1.3 Labyrinth joints

Labyrinth joints which do not comply with the requirements of Table 2 and Table 3 may nevertheless be considered as complying with the requirements of this standard if the tests specified in [Clauses 14 through Clause 16](#) are satisfied.

The minimum radial clearance k (see [Figure 24](#) ~~Figure 20~~) of shafts of ~~rotating~~ electrical machines shall not be less than 0,05 mm.

8.1.4 Joints with floating glands

The determination of the maximum degree of float of the gland shall take account of the clearance in the bearing and the permissible wear of the bearing as specified by the manufacturer. The gland may move freely radially with the shaft and axially on the shaft but the gland shall remain concentric with the shaft. A device shall prevent rotation of the gland (see [Figure 23](#) ~~Figure 19~~).

Floating glands are not permitted for ~~electrical~~ equipment of Group IIC.

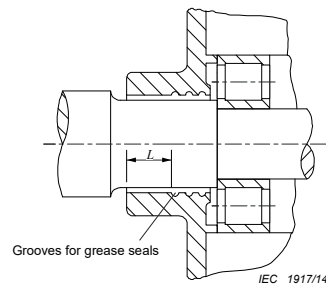


Figure 21 – Example of cylindrical joint for shaft of rotating electric machine

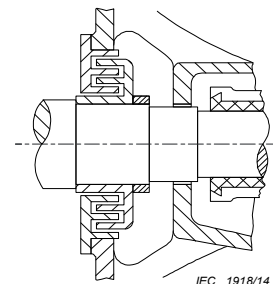
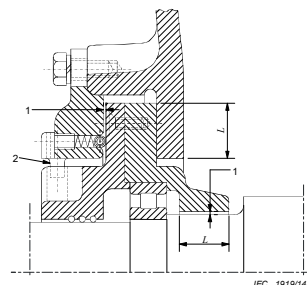


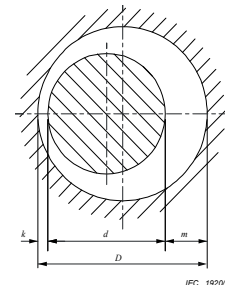
Figure 22 – Example of labyrinth joint for shaft of rotating electric machine



Key

- 1 gap
- 2 stop to prevent rotation of gland

Figure 23 – Example of joint with floating gland for shaft of rotating electric machine



Key

- k minimum radial clearance permissible without rubbing
- m maximal radial clearance taking k into account
- $D-d$ diametrical clearance

Figure 24 – Joints of shaft glands of electric machines

8.2 Bearings

8.2.1 Sleeve bearings

A flameproof joint of a shaft gland associated with a sleeve bearing shall be provided in addition to the joint of the sleeve bearing itself and shall have a [width/length](#) of joint at least equal to the diameter of the shaft but not exceeding 25 mm.

If a cylindrical or labyrinth flameproof joint is used in a rotating ~~electrical machine~~electric machine with sleeve bearings, at least one face of the joint shall be of non-sparking metal (for example, ~~leaded~~ brass) whenever the air gap between stator and rotor is greater than the minimum radial clearance k (see Figure 24) specified by the manufacturer. The minimum thickness of the non-sparking metal shall be greater than the air gap.

Sleeve bearings are not permitted for rotating ~~electrical machine~~electric machines of Group IIC.

8.2.2 Rolling-element bearings

In shaft glands equipped with rolling-element bearings, the maximum radial clearance m (see Figure 24) shall not exceed two-thirds of the maximum gap permitted for such glands in Table 2 and Table 3.

NOTE 1 It is acknowledged that, with assemblies, all parts will not exist in their worst case dimensions simultaneously. A statistical treatment of the tolerances, such as "RMS", can be required for m and k verification.

NOTE 2 It is not a requirement of this standard that the manufacturer's m and k calculations be verified. Neither is it a requirement of this standard that m and k be verified by measurement.

8.3 Embedded temperature detectors

When an embedded temperature detector (ETD) is applied in electric machines with a rated voltage exceeding 1 kV, the ETD and its connecting leads shall be located in or adjacent to an earthed area. A means of satisfying this requirement is to locate the ETD between two winding layers, each of which is bound by a conductive covering prior to insertion in the slots. The ETD connecting leads could be routed adjacent to the core end immediately upon leaving the slot and routed to the terminal box avoiding any winding connections.

9 Light-transmitting parts

For light-transmitting parts of other than glass, the requirements in Clause 19 of this standard apply.

When glass serves as the light-transmitting part, the specification for the glass shall include the following:

- a) the name of the glass manufacturer;
- b) the type designation of the glass; and
- c) material treatments such as chemical toughening, tempering, annealing, thermal conditioning

NOTE It is not a requirement of this standard that conformity to the manufacturer's material treatment specifications of the glass be verified.

~~NOTE Mountings of light-transmitting parts, of any material that produces internal mechanical stress in those parts, can result in failure of the light-transmitting part.~~

10 Breathing and draining devices which form part of a flameproof enclosure

10.1 General

Breathing and draining devices shall incorporate permeable elements which can withstand the pressure created by an internal explosion in the enclosure to which they are fitted, and which shall prevent the transmission of the explosion to the explosive atmosphere surrounding the enclosure.

They shall also withstand the dynamic effects of explosions within the flameproof enclosure without permanent distortion or damage which would impair their flame-arresting properties. They are not intended to withstand continuous burning on their surfaces.

These requirements apply equally to devices for the transmission of sound but do not cover devices for

- a) relief of pressure in the event of internal explosion, [or](#)
- [b\)](#) use with pressure lines containing gas which is capable of forming an explosive mixture with air and is at a pressure in excess of 1,1 times atmospheric pressure. [Additional requirements for pressure lines as a containment system are given in Annex G.](#)

10.2 Openings for breathing or draining

The openings for breathing or draining shall not be produced by deliberate enlargement of gaps of flanged joints.

NOTE Environmental contaminants (such as from the accumulation of dust or paint) can cause breathing and draining devices to become inoperative in service.

10.3 Composition limits

The composition limits of the materials used in the device shall be specified either directly or by reference to an existing applicable specification.

The elements of breathing or draining devices for use in an explosive gas atmosphere containing acetylene shall comprise not more than 60 % of copper by mass to limit acetylide formation.

10.4 Dimensions

The dimensions of the breathing and draining devices and their component parts shall be specified.

10.5 Elements with measurable paths

Interstices and measurable lengths of path need not comply with the values given in Table 2 and Table 3, provided that the elements pass the tests of Clauses 14 through 16.

Additional requirements for crimped ribbon elements and multiple screen elements are given in 0.

10.6 Elements with non-measurable paths

Where the paths through the elements are not measurable (for example, sintered metal elements), the element shall comply with the relevant requirements of Annex B.

The elements are classified according to their ~~density as well as their~~ pore size in accordance with the standard methods for the particular material and the particular manufacturing methods (see Annex B).

10.7 Removable devices

10.7.1 General

If a device can be dismantled, it shall be designed to avoid reduction or enlargement of the openings during re-assembly.

10.7.2 Mounting arrangements of the elements

The breathing and draining elements [of the removable device](#) shall be sintered, or fixed by other suitable methods:

- a) either directly into the enclosure to form an integral part of the enclosure; or
- b) in a suitable mounting component, which is clamped or screwed into the enclosure so that it is replaceable as a unit.

Alternatively, the element can be mounted, for example press-fitted in accordance with 5.2.1, so as to form a flameproof joint. In this case, the appropriate requirements of Clause 5 shall be applied, with the exception that the surface roughness of the element need not comply with 5.2.2, if the element arrangement passes the type test in [Clauses](#) 14 through [Clause](#) 16.

If necessary, a clamping ring or similar means can be used to maintain the integrity of the enclosure. The breathing or draining element can be mounted

- c) either from within, in which case the accessibility of screws and clamping ring shall be possible only from the inside; or
- d) from outside the enclosure, in which case the fasteners shall comply with Clause 11.

10.8 Mechanical strength

The device and its guard, if any, shall, when mounted normally, pass the test for resistance to impact of IEC 60079-0.

10.9 Breathing devices and draining devices when used as Ex [C](#) components

10.9.1 General

In addition to 10.1 through 10.8 ~~10.7~~ inclusive, the following requirements shall apply to breathing and draining devices which are evaluated as Ex [C](#) components.

[The Schedule of Limitations listed on the Ex Component certificate and in the instructions shall include at least the following:](#)

- a) [the maximum recorded surface temperature obtained during the type test corrected to 40 °C, or to the higher marked ambient temperature;](#)
- b) [service temperature range for non-metallic enclosures and non-metallic parts of enclosures;](#)
- c) [the maximum permitted enclosure volume \(based on the thermal test\) if greater than 2,5 l;](#)
- d) [for devices suitable for reference pressures greater than 2 000 kPa for Group II or 1 333 kPa for Group I, the reference pressure for which these devices are suitable; and](#)
- e) [special mounting instructions \(such as special orientations for draining\), if any.](#)

10.9.2 Mounting arrangements of the elements and components

The breathing and draining elements shall be sintered or cemented in accordance with Clause 6, or fixed by other methods into a suitable mounting part to form the mounting component.

The mounting component is secured by clamping or by fasteners or screwed into the enclosure as a replaceable unit complying with the relevant requirements of [Clauses](#) 5 and [Clause](#) 6 and, where appropriate, Clause 11.

10.9.3 Type tests for breathing and draining devices used as Ex components

10.9.3.1 General

Attachment of the sample device under test shall be made on the end of the test rig enclosure in the same manner as it would normally be mounted on a flameproof enclosure. The test shall be performed on the sample after the impact test of 10.8 and in accordance with 10.9.3.2 ~~through to~~ 10.9.3.4.

The impact test may be performed on the sample, separate from the test enclosure, when it is mounted on a plate that forms the end part of the test rig enclosure.

For devices with non-measurable paths, the maximum bubble test pore size of the sample shall be not less than 85 % of the specified maximum bubble test pore size. See B.1.2.

10.9.3.2 Thermal tests

10.9.3.2.1 General

After the bubble test in 10.9.3, breathing and draining devices as Ex components shall be subjected to the thermal tests based on the maximum intended flameproof enclosure volume, but no less than the volume of the test rig in [Figure 2524](#).

NOTE When using the test rig in [Figure 2524](#), the maximum volume is approximately 2,5 l.

~~Breathing and draining devices intended for multiple use in any single flameproof enclosure shall be tested additionally with the enclosure.~~

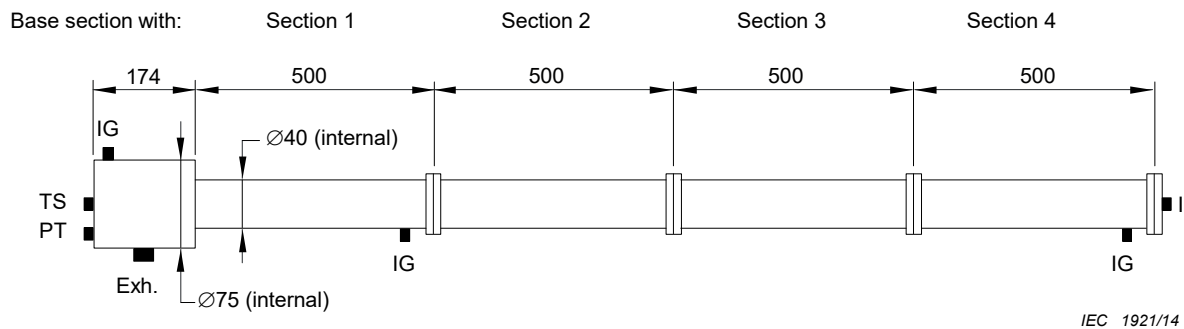
10.9.3.2.2 Test procedure

For enclosure volumes of less than or equal to 2,5 l, the test rig assembly with all four sections, as shown in [Figure 2524](#), shall be used, and the test procedure shall be carried out as follows:

- a) the position of the ignition source shall be at the enclosure inlet and 50 mm from the inside of the end-plate housing the device and the results observed;
- b) the test mixtures shall be as for 15.4.3.1, as appropriate;
- c) the temperature of the external surface of the device shall be monitored during tests;
- d) any device shall be operated as specified by the manufacturer's documentation. After each of five tests, the explosive mixture shall be maintained external to the device for a sufficient time to allow any continuous burning on the face of the device to become evident, for at least 10 min, so as to increase the temperature of the external surface of the device or to make temperature transfer to the outer face possible; and

NOTE The temperature of the external surface after the 10 min test period is used in determining the temperature class in accordance with 10.9.3.3.3.

- e) the tests shall be carried out five times for each gas mixture for the [equipment gas](#)-groups in which the device is intended for use.



Key	
TS	test sample position
I	inlet
Exh.	exhaust outlet
IG	ignition source
PT	pressure transducer

Figure 2524 – Component test rig for breathing and draining devices

For enclosure volumes of greater than 2,5 l, a representative enclosure of the intended volume shall be used, and the test procedure shall be carried out as follows:

- e) the test mixtures shall be as for 15.4.3.1, as appropriate;
- f) the temperature of the external surface of the device shall be monitored during tests;
- g) any device shall be operated as specified by the manufacturer's documentation. After each of five tests, the explosive mixture shall be maintained external to the device for a sufficient time to allow any continuous burning on the face of the device to become evident, for at least 10 min, so as to increase the temperature of the external surface of the device or to make temperature transfer to the outer face possible; and
- h) the tests shall be carried out five times for each gas mixture for the [equipment gas](#)-groups in which the device is intended for use.

10.9.3.2.3 Acceptance criteria

During the thermal tests, no flame transmission shall occur and no continuous burning shall be observed. The device shall show no evidence of thermal or mechanical damage or deformation which could affect its flame-arresting properties.

The measured external surface temperature rise of the device shall be multiplied by a safety factor of 1,2 and added to the maximum service temperature of the device for the determination of the temperature class of the [electrical](#)-equipment.

NOTE Breathing and draining devices which fail any of the tests of 10.9.3.2.3 are excluded from evaluation as a component device. However, when used as an integral part of a flameproof enclosure, they are tested with the specific enclosure in accordance with 15.4.

10.9.3.3 Test for non-transmission of an internal ignition

10.9.3.3.1 General

After the bubble test in 10.9.3, this test shall be carried out on a standard test rig, as illustrated in [Figure 2524](#), and made in accordance with 15.4.4, with the following additions and modifications.

10.9.3.3.2 Test procedure

The position of the ignition source shall be as shown in [Figure 2524](#):