

Electrical apparatus for potentially explosive atmospheres —

Part 5: Flameproof enclosure “d”

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Cooperating organizations

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 60 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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EN 50018

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explosibles — Enveloppe antidéflagrante “d”
(Inclut les amendements 1:1979 +
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Elektrische Betriebsmittel für
explosionsgefährdete Bereiche — Druckfeste
Kapselung “d”
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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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IEC Publication referred to in European Standard EN 50018

IEC 61	<i>Lamp caps and holders together with gauges for the control of interchangeability and safety</i>
IEC 61-2 (1969)	<i>Part 2: Lampholders</i>
IEC 61-2A (1970)	First supplement to IEC 61-2 (1969)
IEC 61-2B (1971)	Second supplement to IEC 61-2 (1969)
IEC 61-2C (1972)	Third supplement to IEC 61-2 (1969)
IEC 61-2D (1975)	Fourth supplement to IEC 61-2 (1969)
IEC 79-1A (1975)	First supplement [to IEC 79-1 (1971) Electrical apparatus for explosive atmospheres, Part 1 Construction and test of flameproof enclosures of electrical apparatus]; Appendix D: Method of test for ascertainment of maximum experimental safe gap
IEC 112 (1979)	<i>Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions</i>

ISO Standards referred to in European Standard EN 50018

ISO 48 (1975) (1st edition)	<i>Vulcanized rubbers — Determination of hardness (hardness between 30 and 85 IRHD)</i>
ISO/R 185 (1961) (1st edition)	<i>Classification of grey cast iron</i>
ISO/R 468 (1966) (1st edition)	<i>Surface roughness</i>
ISO/R 898-I (1968) (1st edition)	<i>Mechanical properties of fasteners — Part 1: Bolts, screws and studs</i>
ISO/R 898-II (1969) (1st edition)	<i>Mechanical properties of fasteners — Nuts with specified proof load values</i>
ISO 965-I (1973) (1st edition)	<i>ISO general purpose metric screw threads — Tolerances — Principals and basic data</i>
ISO 965-III (1973) (1st edition)	<i>ISO general purpose metric screw threads — Tolerances — Deviations for constructional threads</i>
ISO/R 1210 (1970)	<i>Plastics — Determination of flammability of plastics in the form of bars</i>
ISO 1818 (1975) (1st edition)	<i>Vulcanized rubbers of low hardness (10 to 35 IRHD) — Determination of hardness</i>

European Standard referred to in European Standard EN 50018

EN 50014 {1st edition}	<i>Electrical apparatus for potentially explosive atmospheres. General requirements</i>
EN 50014 Amendment No 3 (1982)	<i>Electrical apparatus for potentially explosive atmospheres. General requirements</i>
EN 50019 (March 1977) (1st edition)	<i>Electrical apparatus for potentially explosive atmospheres. Increased safety “e”</i>
EN 50020 (March 1977) (1st edition)	<i>Electrical apparatus for potentially explosive atmospheres. Intrinsic safety “i”</i>

This European Standard has been prepared by the CENELEC Technical Subcommittee 31.2.

Section I. General

1 Scope

1.1 This European Standard contains the specific requirements for the construction and testing of electrical apparatus with flameproof enclosure, type of protection “d”, intended for use in potentially explosive atmospheres.

1.2 This European Standard supplements European Standard EN 50014 “*General requirements*”, the requirements of which apply to electrical apparatus with flameproof enclosure.

2 Definitions

The following definitions specific to type of protection flameproof enclosure “d” are applicable in this European Standard; they supplement the definitions which are given in European Standard EN 50014 “*General requirements*”.

2.1

flameproof enclosure “d”

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

2.2

volume

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

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

2.3

flameproof joint

the place where corresponding surfaces of two parts of an enclosure come together and prevent the transmission of an internal explosion to the explosive atmosphere surrounding the enclosure

2.4

width of flameproof joint

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

2.5

gap of flameproof joint

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

2.6

maximum experimental safe gap (for an explosive mixture)

the maximum gap of a joint of 25 mm width which prevents any transmission of an explosion in 10 tests made under the conditions specified in IEC 79-1A

2.7

shaft

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

2.8

operating rod

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

2.9

pressure-piling

an increase of the explosion pressure above the normally expected pressure, e.g. as a result of sub-division of the flameproof enclosure

2.10

quick-acting door or cover

a 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

such a device shall be arranged so that the operation has two stages:

- one for locking or unlocking,
- another for opening or closing.

2.11 door or cover fixed by screws

a door or cover the opening or closing of which requires the manipulation of several screws or nuts

3 Grouping and temperature classification

The grouping and temperature classification defined in European Standard EN 50014 “*General requirements*” for the use of electrical apparatus in potentially explosive atmospheres apply to flameproof enclosures. The subdivisions A, B, C for electrical apparatus of Group II also apply.

Section II. Specific constructional requirements

4 Flameproof joints

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

4.1 Non-threaded joints. The design of joints shall be appropriate to the mechanical constraints applied to them.

The surface of joints may be protected against corrosion, e.g. by grease, electroplating or chemical treatment. The means used shall affect neither the characteristics nor the quality of the joint. Painting is not permitted.

4.1.1 Width of joints. The width of joints shall be not less than the minimum values given in Table 1 to Table 4.

The width of joint for cylindrical metallic bushes press-fitted into the walls of a metallic flameproof enclosure of volume not greater than 2 000 cm³ may be reduced to 5 mm if the design is such as to prevent the bushes from being forced out during the type tests prescribed in clause 14.

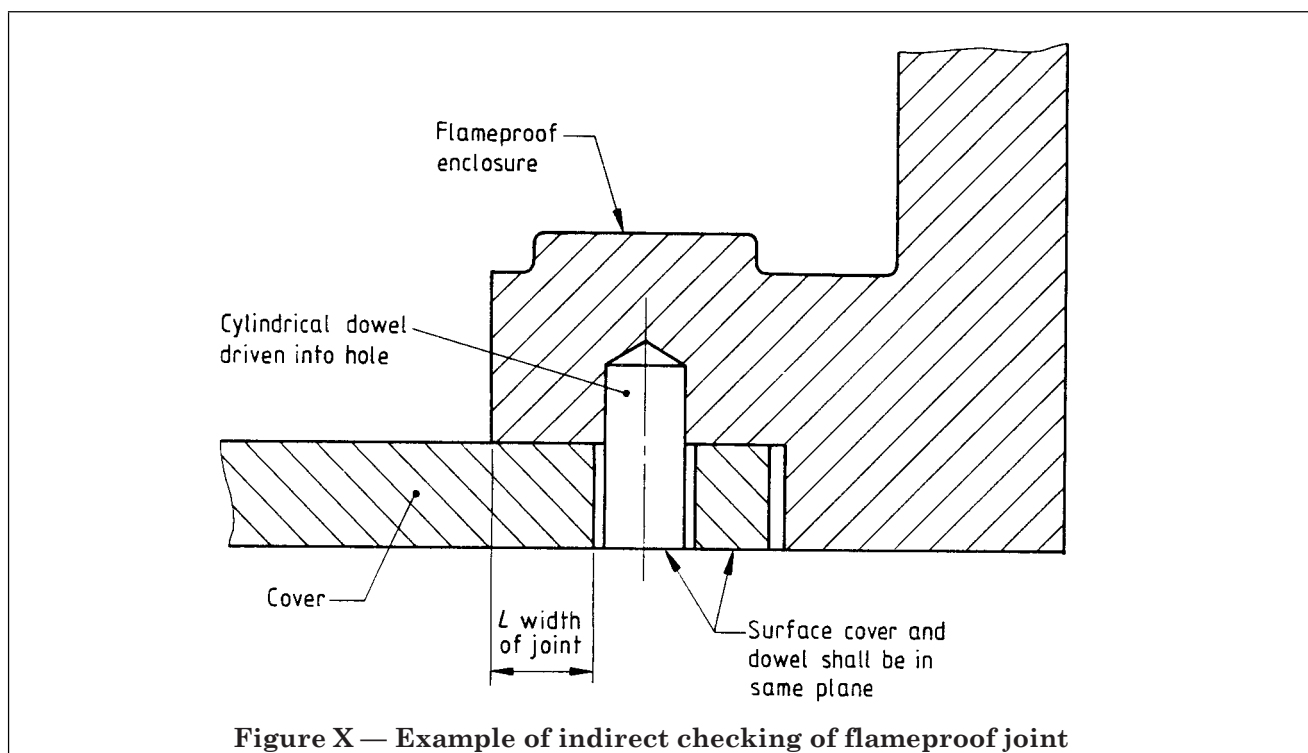
In the case of electrical apparatus of Group IIC, the external diameter of the bush shall not exceed 30 mm and either the bush shall have a shoulder on the inner side of the enclosure or its outer end shall rest against a shoulder on the enclosure.

4.1.2 Gaps. There shall be no intentional gap between the surfaces of flanged joints. The gap, if one exists between the surfaces of a joint, shall nowhere exceed the maximum values given in Table 1 to Table 4.

For electrical apparatus of Group I, it shall be possible to check, directly or indirectly, the gaps of flanged joints of covers and doors designed to be opened from time to time.

Figure X shows an example of indirect checking of a flameproof joint.

The surfaces of joints shall be machined so that their average roughness R_a (ISO/R 468) does not exceed 6.3 µm.



4.1.3 Joints of electrical apparatus of Group IIC

NOTE Appropriate measures for preventing ignition of the surrounding atmosphere due to the projection through the joints of internal deposits of debris or dust, and in particular of carbon deposits which can be produced by incomplete combustion of acetylene, are, for example, the provision of sealing gaskets, angled or labyrinth joints, deflectors, screens.

4.1.3.1 Flanged joints are not permitted for electrical apparatus of Group IIC intended for use in a potentially explosive atmosphere containing acetylene; they are permitted for potentially explosive atmospheres containing no acetylene if the volume of the enclosure does not exceed 500 cm³.

Minimum width of joint and maximum gap for Groups I, IIA and IIB enclosures

Type of joint		Minimum width of joint L mm	Maximum gap (mm) for volume V (cm ³)											
			$V \leq 100$			$100 < V \leq 500$			$500 < V \leq 2\,000$			$V > 2\,000$		
			I	IIA	IIB	I	IIA	IIB	I	IIA	IIB	I	IIA	IIB
Flanged cylindrical ^a , or spigot		6	0.3	0.3	0.2	—	—	—	—	—	—	—	—	—
		9.5	0.35	0.3	0.2	0.35	0.3	0.2	—	—	—	—	—	—
		12.5	0.4	0.3	0.2	0.4	0.3	0.2	0.4	0.3	0.2	0.4	0.2	0.15
		25	0.5	0.4	0.2	0.5	0.4	0.2	0.5	0.4	0.2	0.5	0.4	0.2
Shaft glands of rotating electrical machines with	Sleeve bearings ^a	6	0.3	0.3	0.2	—	—	—	—	—	—	—	—	—
		9.5	0.35	0.3	0.2	0.35	0.3	0.2	—	—	—	—	—	—
		12.5	0.4	0.35	0.25	0.4	0.3	0.2	0.4	0.3	0.2	0.4	0.2	—
		25	0.5	0.4	0.3	0.5	0.4	0.25	0.5	0.4	0.25	0.5	0.4	0.2
		40	0.6	0.5	0.4	0.6	0.4	0.3	0.6	0.5	0.3	0.6	0.6	0.25
	Rolling-element bearings ^b	6	0.45	0.45	0.3	—	—	—	—	—	—	—	—	—
		9.5	0.5	0.45	0.35	0.5	0.4	0.25	—	—	—	—	—	—
		12.5	0.6	0.5	0.4	0.6	0.45	0.3	0.6	0.45	0.3	0.6	0.3	0.2
		25	0.75	0.6	0.45	0.75	0.6	0.4	0.75	0.6	0.4	0.75	0.6	0.3
		40	0.8	0.75	0.6	0.8	0.75	0.45	0.8	0.75	0.45	0.8	0.75	0.4

^a See also 6.1 and 7.2.1.

^b See also 7.2.2.

Table 4 — Minimum width of joint and maximum gap for Group IIC enclosures

Type of joint	Width of joint L	Maximum gap for volume $V(\text{cm}^3)$			
		≤ 100	> 100 ≤ 500	> 500 $\leq 2\,000$	$> 2\,000$
Flanged joints ^a	$\geq 6 \text{ mm}$ $\geq 9.5 \text{ mm}$	0.10 mm 0.10 mm	— 0.10 mm	— —	— —
Spigot joints (Figure 1, Figure 2, Figure 3) $L = d$	$\geq 6 \text{ mm}$ $\geq 12.5 \text{ mm}$ $\geq 25 \text{ mm}$ $\geq 40 \text{ mm}$	0.10 mm 0.15 mm 0.15 mm 0.20 mm	0.10 mm 0.15 mm 0.15 mm 0.20 mm	— 0.15 mm 0.15 mm 0.20 mm	— — 0.15 mm 0.20 mm
Spigot joints (Figure 4)	$c \geq 6 \text{ mm}$ $d_{\min} = 0.5 L$ $L = c + d$ $f \leq 1 \text{ mm}$	$\geq 12.5 \text{ mm}$ $\geq 25 \text{ mm}$ $\geq 40 \text{ mm}$	0.15 mm 0.18 mm ^b 0.20 mm ^c	0.15 mm 0.18 mm ^b 0.20 mm ^c	— 0.18 mm ^b 0.20 mm ^c
Cylindrical joints	$\geq 6 \text{ mm}$ $\geq 9.5 \text{ mm}$ $\geq 12.5 \text{ mm}$ $\geq 25 \text{ mm}$ $\geq 40 \text{ mm}$	0.10 mm 0.10 mm 0.15 mm 0.15 mm 0.20 mm	— 0.10 mm 0.15 mm 0.15 mm 0.20 mm	— — 0.15 mm 0.15 mm 0.20 mm	— — — 0.15 mm 0.20 mm
Cylindrical joints for shaft glands of rotating electrical machines with rolling-element bearings	$\geq 6 \text{ mm}$ $\geq 9.5 \text{ mm}$ $\geq 12.5 \text{ mm}$ $\geq 25 \text{ mm}$ $\geq 40 \text{ mm}$	0.15 mm 0.15 mm 0.25 mm 0.25 mm 0.30 mm	— 0.15 mm 0.25 mm 0.25 mm 0.30 mm	— — 0.25 mm 0.25 mm 0.30 mm	— — — 0.25 mm 0.30 mm

^a Flanged joints are not permitted for explosive mixtures of acetylene/air.
^b i_T of cylindrical part increased to 0.20 if $f \leq 0.5$.
^c i_T of cylindrical part increased to 0.25 if $f \leq 0.5$.

4.1.3.2 Spigot joints. For the determination of the width L of spigot joints, the following may be taken into account:

either the cylindrical part only. In this case, the gap of the plane part shall not exceed the maximum gap specified in Table 4 (see Figure 1, Figure 2 and Figure 3). If a sealing gasket is provided on the plane part (see Figure 2), the gap is measured between the surfaces of the plane part. However, if the sealing gasket is of metal or a metal-clad compressible material (see Figure 3), the gap is measured between each face of the plane part of the joint and the gasket. The gap of the plane part of the joint is measured after compression of the gasket; the width L is measured before compression of the gasket; or the cylindrical part and the plane part (see Figure 4). In this case, the width c of the plane part shall be at least 6 mm, and the width d of the cylindrical part shall be at least equal to half of the prescribed minimum value of L specified in Table 4.

4.1.4 Holes in joint surfaces. Where the surface of a flanged joint is interrupted by holes intended for the passage of screws or studs for assembling the parts of a flameproof enclosure, the minimum value of the distance l to the edge of the hole shall be equal to or greater than

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

The distance l is determined as follows.

4.1.4.1 Flanged joints with holes outside the enclosure (see Figure 5 and Figure 7). The distance l is measured between each hole and the inside of the enclosure.

4.1.4.2 Flanged joints with holes inside the enclosure (see Figure 6). The distance l is measured between each hole and the outside of the enclosure.

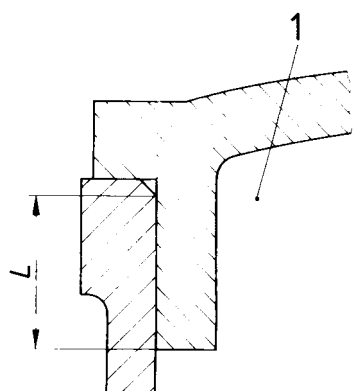


Figure 1

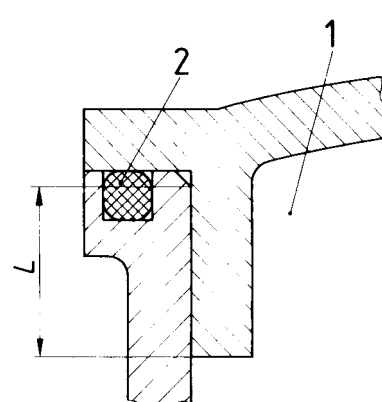


Figure 2

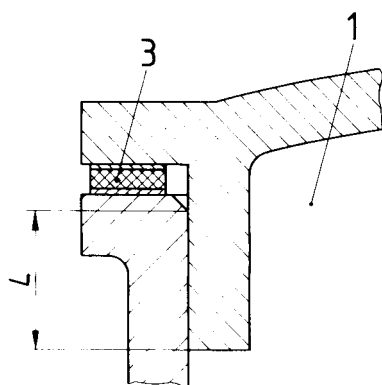


Figure 3

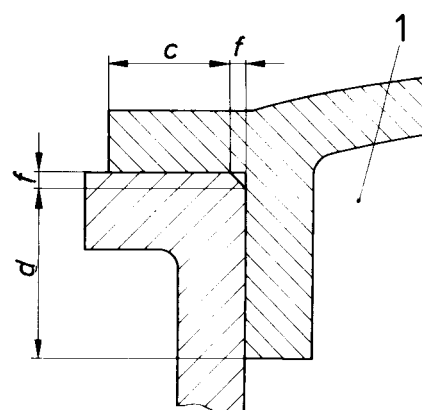


Figure 4

- 1 Interior of enclosure
2 Sealing gasket
3 Metal or metal-clad compressible sealing gasket

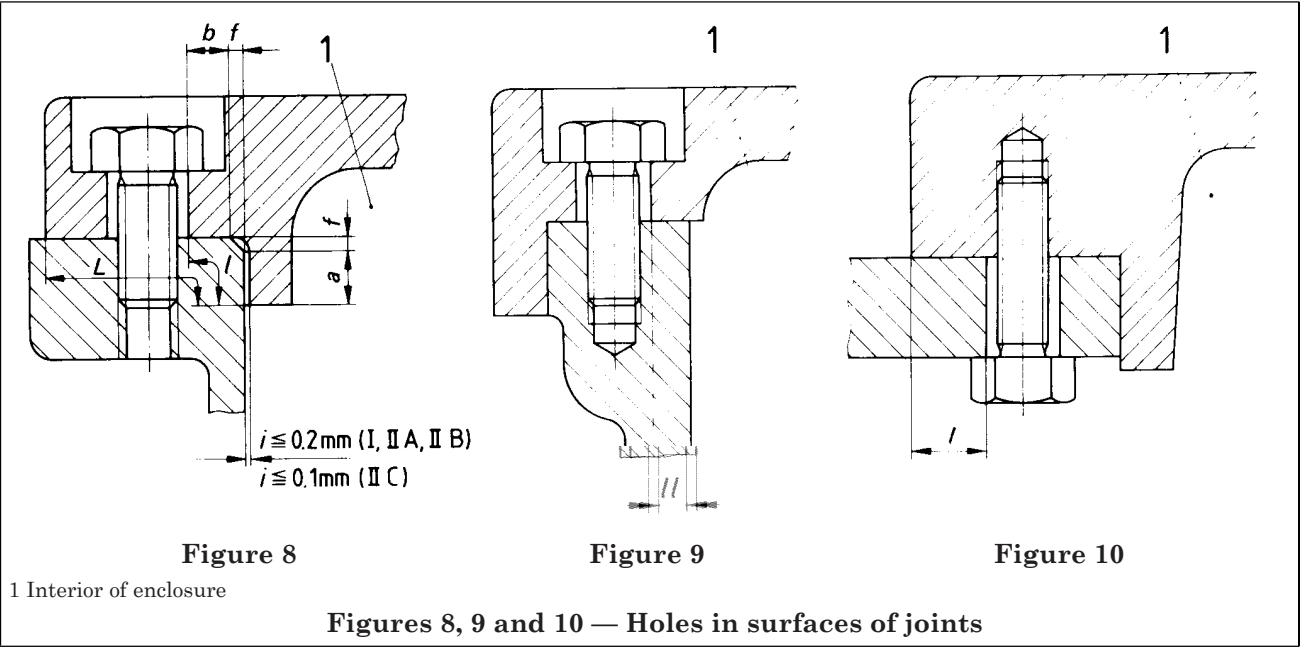
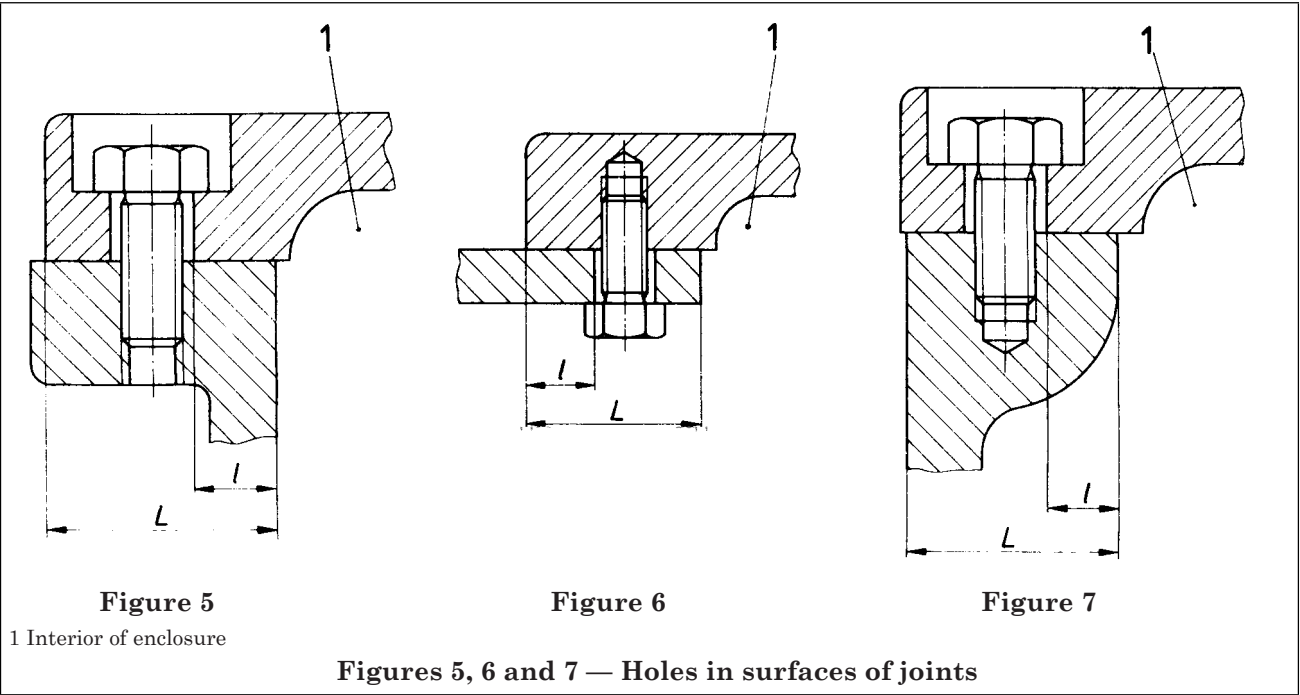
Figures 1 to 4 — Spigot joints for Group IIC enclosures

4.1.4.3 *Spigot joints where, to the edges of the holes, the joint consists of a cylindrical part “a” and a plane part “b” (see Figure 8). The distance l is*

the sum of the width a of the cylindrical part and the width b of the plane part, if f is less than or equal to 1 mm and if the gap of the cylindrical part is less than or equal to 0.2 mm for electrical apparatus of Groups I, IIA and IIB or 0.1 mm for electrical apparatus of Group IIC (reduced gap);

the width b of the plane part alone, if either of the above-mentioned conditions is not met.

4.1.4.4 *Spigot joints where, to the edge of the holes, the joint consists only of the plane part, in so far as plane joints are permitted (see Figure 9 and Figure 10). The distance l is the width of the plane part between the inside of the enclosure and a hole where the holes are outside the enclosure (see Figure 9), or between a hole and the outside where the holes are inside the enclosure (see Figure 10).*



4.2 Threaded joints. Threaded joints shall comply with the requirements in Table 5.

Table 5 — Threaded joints

Pitch	$\geq 0.7 \text{ mm}^a$
Quality of fit (for cylindrical threads) (ISO 965-I and 965-III)	Medium or better ^b
Threads engaged	≥ 5
Depth of engagement	
Enclosures $\leq 100 \text{ cm}^3$	$\geq 5 \text{ mm}$
Enclosures $> 100 \text{ cm}^3$	$\geq 8 \text{ mm}$

^a Where the pitch exceeds 2 mm, special precautions may be necessary to ensure that the electrical apparatus can pass the test for non-transmission of an internal ignition which is prescribed in 14.2.

^b Cylindrical threaded joints which do not conform with the ISO Standard are permitted if the test for non-transmission of an internal ignition that is prescribed in 14.2 is passed when the width of threaded joint specified by the manufacturer is reduced by one-third.

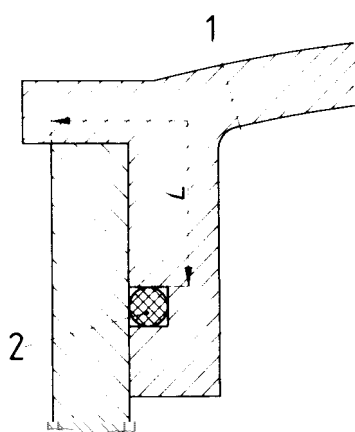


Figure 11

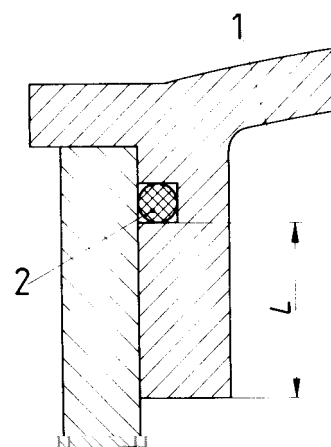


Figure 12

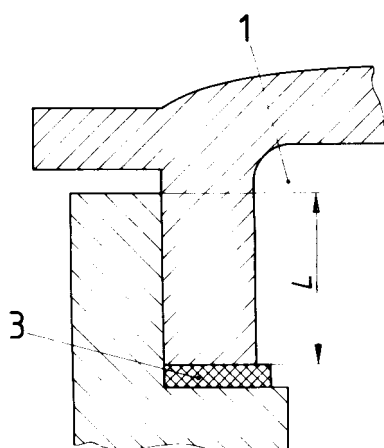


Figure 13

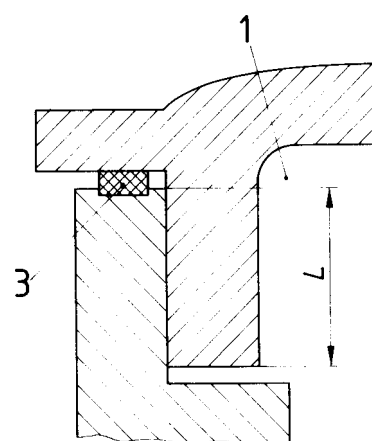


Figure 14

1 Interior of enclosure
2 O-ring
3 Sealing gasket

Figures 11 to 14 — Illustration of the requirements concerning sealing gaskets

4.3 Sealing gaskets. If a gasket of compressible or elastic material is used to seal a joint, e.g. to prevent the ingress of moisture or dust or to prevent the leakage of a liquid, it shall be applied as a supplement to, and not be included in, the flameproof joint (see Figure 11 to Figure 14).

The sealing gasket shall be mounted so that the prescribed gap and width of the flameproof joint are maintained.

These requirements do not apply to cable entries (see 12.1).

4.4 Joints of insulators and light-transmitting parts

4.4.1 Joints of insulators and light-transmitting parts need not comply with the requirements of 4.1, 4.2 and 4.3 if these parts are 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.

4.4.2 Cementing directly into the wall of the enclosure is permitted for luminaires; for other electrical apparatus cementing directly is only permitted when the visible surface of the light-transmitting part does not exceed,

for electrical apparatus of Group I, 25 cm²;

for electrical apparatus of Group II, 100 cm².

4.4.3 As an exception to 4.3, joints of insulators and of light-transmitting parts may contain a gasket if this is of metal or of a non-flammable compressible material with a metallic sheath.

5 Cemented joints

5.1 Materials. The materials used for cementing shall conform with the requirements of European Standard EN 50014 “General requirements”.

5.2 Mechanical strength. Cemented joints are only permitted 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 on the cement alone.

5.3 Width of cemented joints. The shortest path through a cemented joint from the inside to the outside of a flameproof enclosure shall be at least 6 mm for enclosures of volume less than or equal to 100 cm³, and 10 mm for enclosures of volume greater than 100 cm³.

6 Operating rods

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

6.1 If the diameter of the operating rod exceeds the minimum width of joint specified in Table 1 to Table 4, the width of joint shall be at least equal to this diameter but without, however, having to exceed 25 mm.

6.2 If the diametral 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, e.g. by means of a replaceable bush.

7 Shafts and bearings of rotating electrical machines

7.1 Joints

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

The flameproof joint may be

a cylindrical joint (see Figure 15 and Figure 18), or

a labyrinth joint (see Figure 16), or

a joint with a floating gland (see Figure 17).

7.1.2 Cylindrical joints. Where a cylindrical joint contains grooves for the retention of grease, the part containing the grooves shall not be included when determining the width of the flameproof joint (see Figure 15).

The minimum radial clearance k (see Figure 18) of shafts of rotating electrical machines shall be not less than

0.075 mm for electrical apparatus of Groups I, IIA or IIB;

0.05 mm for electrical apparatus of Group IIC.

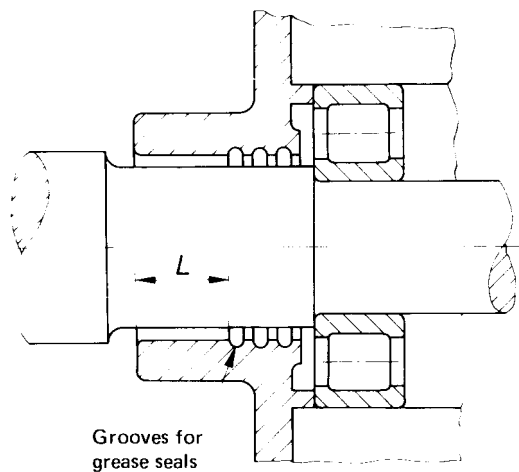


Figure 15 — Example of cylindrical joint for shaft of rotating electrical machine

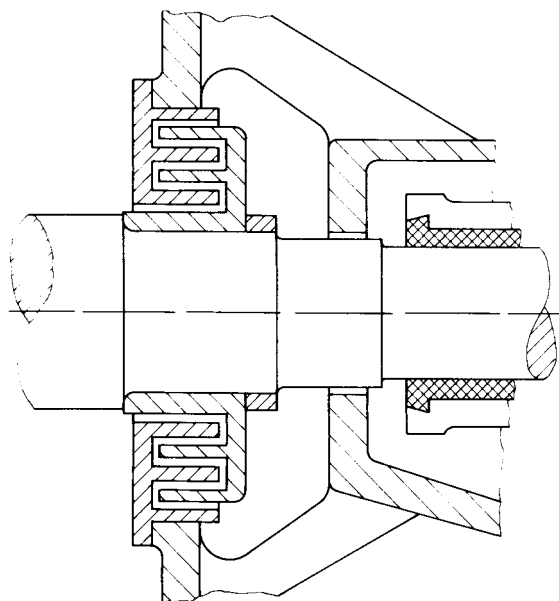
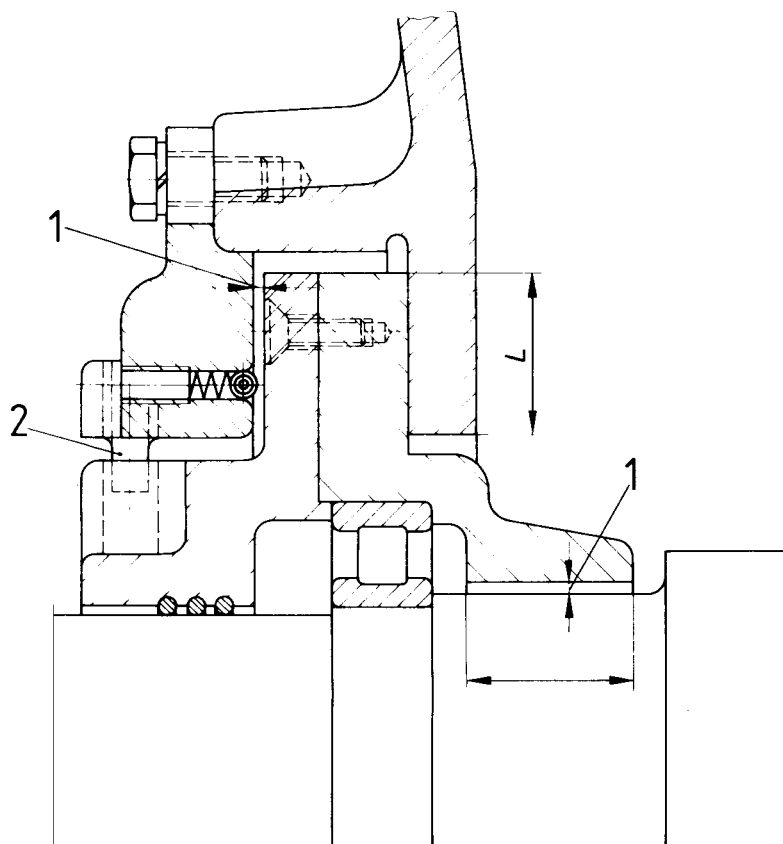
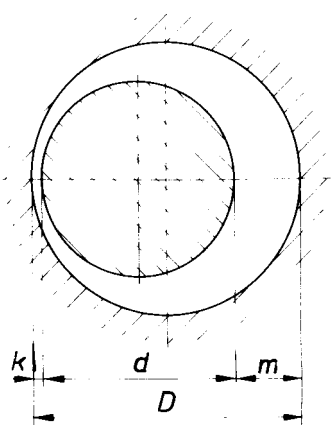


Figure 16 — Example of labyrinth joint for shaft of rotating electrical machine



- 1 Gap
- 2 Stop to prevent rotation of gland

Figure 17 — Example of joint with floating gland for shaft of rotating electrical machine



- k = minimum radial clearance
- m = maximal radial clearance
- $D - d$ = diametral clearance

Figure 18 — Joints of shaft glands of rotating electrical machines

7.1.3 Labyrinth joints. Labyrinth joints which do not comply in all respects with the requirements of Table 1 to Table 4 may nevertheless be considered as complying with the requirements of this European Standard if the tests specified in section III are satisfied.

7.1.4 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. The gland may move freely radially with the shaft and axially on the shaft but it shall remain concentric with it. A device shall prevent rotation of the gland.

Floating glands are not permitted for electrical apparatus of Group IIC.

7.2 Bearings

7.2.1 Sleeve bearings. The width of joint in a shaft gland associated with a sleeve bearing shall be at least equal to the diameter of the shaft but without, however, having to exceed 25 mm.

If a cylindrical joint or labyrinth joint is used in a rotating electrical machine with sleeve bearings, at least one face of the joint shall be of non-sparking material (e.g. brass) whenever the air gap between stator and rotor is greater than the minimum radial clearance k (see Figure 18) 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 machines of Group IIC.

7.2.2 Rolling-element bearings. In shaft glands equipped with rolling-element bearings, the maximum radial clearance m (see Figure 18) shall not exceed two-thirds of the maximum gap permitted for such glands in Table 1 to Table 4.

8 Light-transmitting parts

8.1 For light-transmitting parts of luminaires and for inspection windows of glass or plastics material of flameproof enclosures, the requirements of European Standard EN 50014 “*General requirements*” apply.

8.2 Precautions shall be taken so that the mountings of light-transmitting parts made of glass do not produce internal mechanical stress in those parts.

9 Breathing and draining devices

9.1 If for technical reasons breathing or draining devices have to be provided, they shall be so constructed that they are not liable to become inoperative in service (e.g. because of the accumulation of dust or paint). The openings for breathing or draining shall not be produced by deliberate enlargement of the gaps of plane joints.

9.2 The dimensions of the openings of breathing or draining devices need not comply with the values specified in Table 1 to Table 4; however, electrical apparatus fitted with such devices shall pass the tests specified in section III.

9.3 If a device can be taken to pieces, it shall be designed so that a reduction or enlargement of the openings during re-assembly is impossible.

10 Fasteners and screws

10.1 Fasteners accessible from the outside and necessary for the assembly of the parts of a flameproof enclosure shall be special fasteners complying with the requirements of European Standard EN 50014 “*General requirements*”.

10.1.1 Screws, studs and nuts of plastics or light metals are not permitted. If they are of a metal other than steel, the certificate shall state the type and quality of the material.

10.1.2 Studs shall be securely fixed, i.e. they shall be welded or riveted or permanently attached to the enclosure by another equally effective method. If a quality higher than that of class 4.6 (ISO/R 898-I) is necessary, the certificate shall state the quality of the studs provided for by the manufacturer.

10.1.3 The quality of steel screws and nuts shall be one of those defined in ISO/R 898-I and ISO/R 898-II. The lowest qualities permitted are the following:

hexagonal-headed screws:	class 4.6;
hexagonal nuts:	class 4;
hexagonal socket screws:	class 8.8.

The shrouds or recesses may be of the standard or reduced diameter types, as defined in European Standard EN 50014 “*General requirements*”. However, in carrying out the tests specified in clause 14, the testing authority shall require the replacement of all or some of the screws specified by the manufacturer by screws of class 4.6 or 8.8 unless calculation, based on a pressure of 1.5 times the reference pressure, shows this to be unnecessary. The choice of the quality to be used is determined by the type of screw head which fits the shrouds or recesses. In the absence of shrouds or recesses (screws greater than M 16 for Group II or greater than M 24 for Group I), class 4.6 is to be chosen.

Screws with cylindrical heads and hexagonal sockets shall be used if the effectiveness of the flameproof enclosure type of protection depends on the use of screws of a quality better than class 4.6. In this case, the reduced diameter shroud or recess specified in European Standard EN 50014 “*General requirements*” shall be used.

10.2 If screws are used for fixing a part of a flameproof enclosure, the threaded holes for those screws shall not penetrate the walls of the enclosure. However, screws may penetrate the walls of a flameproof enclosure if they have an unthreaded part which forms a flameproof joint with the wall and they are non-detachable from the enclosure, e.g. by welding, riveting or another equally effective method.

10.3 The thickness of metal around threaded holes for screws or studs shall be at least one-third of the nominal diameter of the screw or stud, with a minimum of 3 mm.

10.4 When screws are fully tightened into blind holes, with no washer fitted, at least one full thread shall remain free at the base of the hole.

10.5 If, for ease of manufacture, a wall of a flameproof enclosure has to be drilled through, the resulting hole shall subsequently be closed by a threaded plug complying with the requirements of Table 5; this plug shall in addition be securely fixed in accordance with the requirements relating to studs in 10.1.2 above.

11 Materials and mechanical strength of enclosures and materials inside the enclosures

11.1 Flameproof enclosures shall withstand the relevant tests prescribed in section III.

11.2 When several flameproof enclosures are assembled together, the requirements of this European Standard apply to each of them separately, and in particular to the partitions separating them and to all the bushings and operating rods which pass through the partitions.

11.3 When an enclosure contains several intercommunicating compartments or when it is subdivided because of the disposition of the internal parts, pressures and rates of rise of pressure greater than normal can be produced.

Such phenomena shall be precluded as far as possible by the construction. If it is impossible to avoid these phenomena, the resulting higher stresses shall be taken into account in the construction of the enclosure.

11.4 When cast iron is used, the material shall be of at least the quality 15 (ISO/R 185).

11.5 Liquids shall not be used in flameproof enclosures when there is a risk of producing an explosive mixture by the decomposition of these liquids. They may, however, be used if the enclosure passes the tests prescribed in section III for the type of explosive mixture produced; however, the surrounding explosive atmosphere shall be appropriate to the group for which the electrical apparatus is constructed.

11.6 In flameproof enclosures of Group I, insulating materials subjected to electrical stresses capable of causing arcs in air and which result from rated currents of more than 16 A (in switching apparatus such as circuit-breakers, contactors, isolators) shall have a comparative tracking index equal to or greater than CTI 400 M, according to IEC Publication 112.

The above mentioned insulating materials which do not pass this test may be used, however, if their volume is limited to 1 % of the total volume of the empty enclosure or if a suitable detection device enables the power supply to the enclosure to be disconnected, on the supply side, before possible decomposition of the insulating material leads to dangerous conditions. The presence and effectiveness of such a device shall be verified by the testing station.