BRITISH STANDARD

BS EN 50018:1995

Electrical apparatus for potentially explosive atmospheres — Flameproof enclosures "d"

The European Standard EN 50018:1994 has the status of a British Standard

UDC 621.31-213.34-213.6-78.614.833.4 .5:001.4:620.1:62-777

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Contents

National foreword

This British Standard has been prepared under the direction of the General Electrotechnical Standards Policy Committee and is the English language version of EN 50018 *Electrical apparatus for potentially explosive atmospheres — Flameproof enclosures "d"*, published by the European Committee for Electrotechnical Standardization (CENELEC).

This standard should be read in conjunction with BS EN 50014:1993 *Electrical apparatus for potentially explosive atmosphere — General requirements,* which it supplements.

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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 36, an inside back cover 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.

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50018

August 1994

UDC 621.31-213.34-213.6-78.614.833.4/.5:001.4:620.1:62-777

Supersedes EN 50018:1977 and its amendments
To be read in conjuction with EN 50014:1992

Descriptors: Electrical apparatus, potentially explosive atmosphere, explosive atmosphere, explosion proofing, specific requirement, flameproof enclosure "d"

English version

Electrical apparatus for potentially explosive atmospheres — Flameproof enclosures "d"

Matériel électrique pour atmosphères explosibles Enveloppe antidéflagrante "d"

Elektrische Betriebsmittel für explosionsgefährdete Bereiche Druckfeste Kapselung "d"

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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CENELEC

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

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Ref. No. EN 50018:1994 E

Foreword

This European Standard was prepared by CENELEC Subcommittee SC 31-2 Flameproof enclosures "d".

It was submitted to the CENELEC memebers for formal vote in July 1993 and was approved by CENELEC as EN 50018 on 1994-03-08. This EN supersedes EN 50018:1977 and its amendments A1:1979, A2:1982 and A3:1985.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1994-12-01
- latest date of withdrawal of conflicting national standards (dow) –

This European Standard is to be read in conjunction with EN 50014:1992, Electrical apparatus for potentially explosive atmospheres — General requirements, and with the second editions of the European Standards for the specific types of protection used in the scope of EN 50014:1992. This European Standard should not be considered in conjunction with any of the first edition standards listed in EN 50014:1977.

Contents

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1 Scope

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

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

2 Publications

2.1 IEC publications referred to in European Standard EN 50018

IEC 61,*Lamp caps and holders together with gauges for the control of interchangeability and safety*

IEC 61-1 — supplement K (1983) Part 1: *Lamp caps [HD 65.1 S1 (1978)]*

IEC 61-2 — supplement G (1983) Part 2: *Lampholders. [HD 65.2 S1 (1978)]*

IEC 79-1A (1975)*Electrical apparatus for explosive gas atmospheres* — Part 1: *Construction and test of flameproof enclosures of electrical apparatus. First supplement: Appendix D: Method of test for ascertainment of maximum experimental safe gap*

IEC 82 (1984), *Ballasts for tubular fluorescent lamps*

IEC 112 (1979)*Recommended method for determining the comparative tracking index of solid insulating materials under moist conditions. [HD 214 S2 (1980)]*

IEC 529 (1989)*Degrees of protection provided by enclosures (IP Code). [EN 60529 (1991)]*

IEC 707 (1981)*Methods of test for the determination of the flammability of solid electrical insulating materials when exposed to an igniting source. [HD 441 S1 (1983)]*

2.2 ISO standards referred to in European Standard EN 50018

ISO 31-0 (1992)*Quantities, units and symbols; — Part 0: General principles*

ISO 185 (1988)*Grey cast iron; classification*

ISO 468 (1982)*Surface roughness; Parameters, their values and general rules for specifying requirements*

ISO 965-1 (1980)*ISO general purpose metric screw threads; Tolerances; — Part 1: Principles and basic data*

ISO 965-3 (1980)*ISO general purpose metric screw threads; Tolerances; — Part 3: Deviations for constructional threads*

ISO 1210 (1992)*Plastics; Determination of burning behaviour of horizontal and vertical specimens in contact with a small-flame ignition source*

ISO 2738 (1987)*Permeable sintered metal materials; Determination of density, oil content, and open porosity*

ISO 4003 (1977)*Permeable sintered metal materials; Determination of bubble test pore size*

ISO 4022 (1987)*Permeable sintered metal materials; Determination of fluid permeability*

ISO 6892 (1984)*Metallic materials; Tensile testing. [EN 10002-1 (1990) and EN 10002-1 AC1 (1990)].*

2.3 European Standards referred to in European Standard EN 50018

EN 50014 (1992), *Electrical apparatus for potentially explosive atmospheres General requirements.*

EN 50019 (1994), *Electrical apparatus for potentially explosive atmospheres. Increased safety "e".*

EN 50020 (1994), *Electrical apparatus for potentially explosive atmospheres. Intrinsic safety "i".*

3 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.

3.1
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

3.2
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 remaining free volume

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

3.3
flameproof joint

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

3.4
width of flameproof joint (L)

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

3.5
distance (l)

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

3.6
gap of flameproof joint (i)

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

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

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

3.8
shaft

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

3.9
operating rod

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

3.10
pressure-piling

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

3.11
quick-acting door or cover

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. The device is arranged so that the operation has two stages:

— one for locking or unlocking;

— another for opening or closing.

3.12
door or cover fixed by threaded fasteners

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

3.13
threaded door or cover

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

3.14
breathing device

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

3.15
draining device

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

4 Apparatus grouping and temperature classification

The apparatus grouping and temperature classification defined in EN 50014 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.

Specific constructional requirements

5 Flameproof joints

5.1 General requirements

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

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

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

The surface of joints may be protected against corrosion.

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

5.2 Non-threaded joints

5.2.1 *Width of joints (L)*

The width of joints shall not be less than the minimum values given in Table 1 and Table 2. The width of joint for cylindrical metallic parts press-fitted into the walls of a metallic flameproof enclosure of volume not greater than 2 000 cm^3 may be reduced to 5 mm, if:

— the design does not rely only on an interference fit to prevent the part being displaced during the type tests of clause **15**, and

— the assembly meets the impact test requirements of EN 50014, taking the worst case interference fit tolerances into account, and

— the external diameter of the press-fitted part, where the width of joint is measured, does not exceed 60 mm.

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 1 and Table 2.

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

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

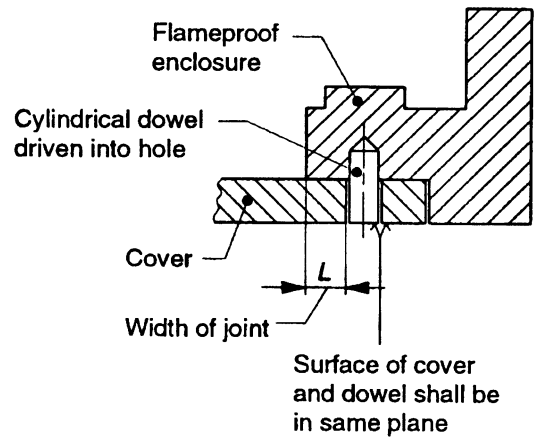


Figure 1 — Example of construction for indirect checking of a flanged Group I flameproof joint

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

5.2.3 *Spigot joints*

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

— either the cylindrical part and the plane part (see Figure 2).

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

— or the cylindrical part only (see Figure 3).

In this case the plane part need not comply with the requirements of Table 1 and Table 2.

NOTE For gaskets see also **5.4**.

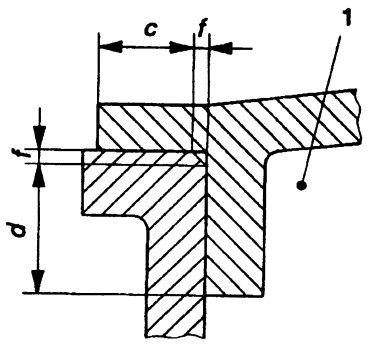


Figure 2

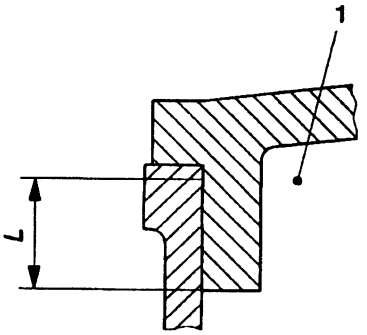


Figure 3

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

Figures 2 and 3 — Spigot joints

5.2.4 ***Holes in joint surfaces***

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

— 6 mm when the width of joint *L* is less than 12,5 mm;

— 8 mm when the width of joint *L* is equal to or greater than 12,5 mm but less than 25 mm;

— 9 mm when the width of joint *L* is equal to or greater than 25 mm.

The distance *l* is determined as follows:

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

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

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

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

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

The distance *l* is:

— the sum of the width *a* of the cylindrical part and the width *b* of the plane part, if *f* is less than or equal to 1 mm and if the gap of the cylindrical part is less than or equal to 0,2 mm for electrical apparatus of Groups I and IIA, 0, 15 mm for electrical apparatus of Group IIB, or 0, 1 mm for electrical apparatus of Group IIC (reduced gap);

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

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

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

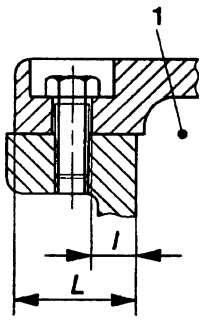


Figure 4

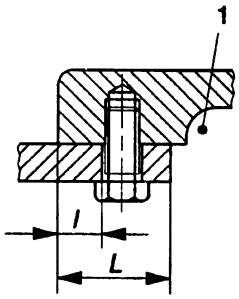


Figure 5

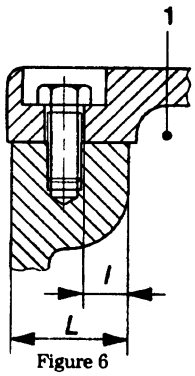


Figure 6

1 Interior of enclosure

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

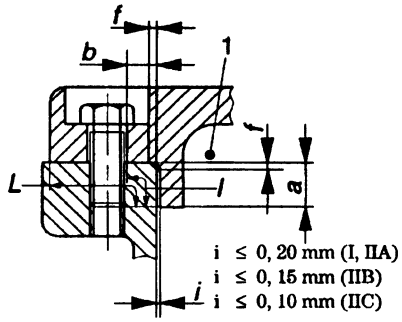


Figure 7

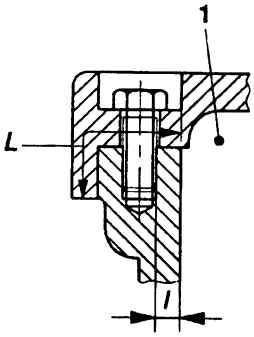


Figure 8

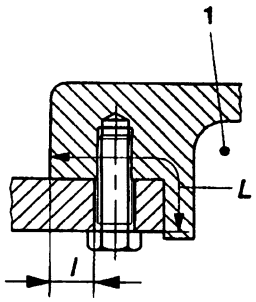


Figure 9

1 Interior of enclosure

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

Table 1 — Minimum width of joint and maximum gap for enclosures of Groups I, IIA and IIB

Type of joint		Minimum width of joint L mm	Maximum gap in 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 or spigot joints		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	0,30	0,20	0,40	0,30	0,20	0,40	0,30	0,20	0,40	0,20	0,15
		25	0,50	0,40	0,20	0,50	0,40	0,20	0,50	0,40	0,20	0,50	0,40	0,20
Cylindrical joints for shaft glands of rotating electrical machines with	Sleeve bearings	6	0,30	0,30	0,20	—	—	—	—	—	—	—	—	—
		9,5	0,35	0,30	0,20	0,35	0,30	0,20	—	—	—	—	—	—
		12,5	0,40	0,35	0,25	0,40	0,30	0,20	0,40	0,30	0,20	0,40	0,20	—
		25	0,50	0,40	0,30	0,50	0,40	0,25	0,50	0,40	0,25	0,50	0,40	0,20
		40	0,60	0,50	0,40	0,60	0,50	0,30	0,60	0,50	0,30	0,60	0,50	0,25
	Rolling-element bearings	6	0,45	0,45	0,30	—	—	—	—	—	—	—	—	—
		9,5	0,50	0,45	0,35	0,50	0,40	0,25	—	—	—	—	—	—
		12,5	0,60	0,50	0,40	0,60	0,45	0,30	0,60	0,45	0,30	0,60	0,30	0,20
		25	0,75	0,60	0,45	0,75	0,60	0,40	0,75	0,60	0,40	0,75	0,60	0,30
		40	0,80	0,75	0,60	0,80	0,75	0,45	0,80	0,75	0,45	0,80	0,75	0,40

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

Table 2 — Minimum width of joint and maximum gap for group IIC enclosures

Type of joint		Minimum width of joint L mm	Maximum gap in mm for volume V (cm^3)			
			$V \leq 100$	$100 < V \leq 500$	$500 < V \leq 2\,000$	$V > 2\,000$
Flanged joints[a]		6	0,10	—	—	—
		9,5	0,10	0,10	—	—
Spigot joints (Figure 2)	c[3] 6 mm	12,5	0,15	0,15	0,15	—
	$d_{min} = 0{,}5L$	25	0,18[b]	0,18[b]	0,18[b]	0,18[b]
	$L = c + d$	40	0,20[c]	0,20[c]	0,20[c]	0,20[c]
	$f \leq 1$ mm					
Cylindrical joints Spigot joints (Figure 3)		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
		40	0,20	0,20	0,20	0,20
Cylindrical joints for shaft glands of rotating electrical machines with rolling-element bearings		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

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

[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 $f \leq 0{,}5$.

5.2.5 *Conical joints*

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

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

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

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

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

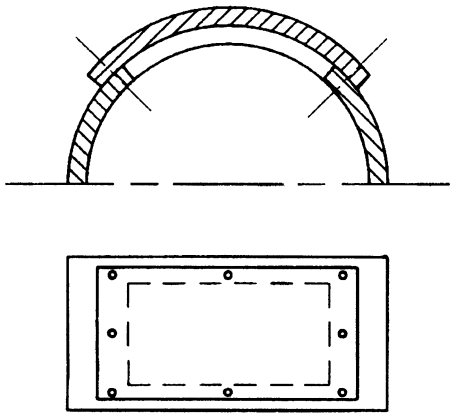


Figure 10 — Example for a joint with partial cylindrical surfaces

5.2.7 *Additional requirements for joints of electrical apparatus of Group IIC*

Flanged joints are not permitted for electrical apparatus of Group IIC intended for use in potentially explosive atmospheres containing acetylene; they are permitted for potentially explosive atmospheres containing no acetylene if the volume of the enclosure does not exceed 500 cm^3.

5.3 Threaded joints

Threaded joints shall comply with the requirements in Table 3 or Table 4.

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 width of the flameproof joint nor interrupt it.

The gasket shall then be mounted so that:

— the permissible gap and width of flanged joints or the plane part of a spigot joint are maintained;

— the minimum width 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 entries (see **13.1**) 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 surface of the plane part shall be measured after compression. The minimum width of the cylindrical part shall be maintained before and after compression.

Table 3 — 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 (e.g. more threads engaged) to ensure that the electrical apparatus can pass the test for non-transmission of an internal ignition which is prescribed in **15.2**.

[b] Cylindrical threaded joints which do not conform with the ISO standard, in respect of thread form or quality of fit, are permitted if the test for non-transmission of an internal ignition that is prescribed in **15.2** is passed when the width of threaded joint specified by the manufacturer is reduced by the amount specified in Table 6.

Table 4 — Taper threaded joints

Pitch	≥ 0,9 mm
Threads provided on each part	≥ 6

The internal and external thread shall have the same cone angle and thread form, which shall be defined.
Taking the maximum permissible tolerances, the actual number of engaged threads may be less than 5.

6 Cemented joints

6.1 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.

If a joint which is cemented does not fulfill the requirements of clause **5** in the absence of the cement it shall be subjected to **23.4.7.3** and **23.4.7.4** in EN 50014:1992.

6.2 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 upon the adhesion of the cement alone. Cemented joints shall comply with a test based on **15.3** with the relevant overpressure value given in **15.1.3**.

6.3 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:

≥ 3 mm if	$V \leq 10\ cm^3$
≥ 6 mm if	$10\ cm^3 < V \leq 100\ cm^3$
≥ 10 mm if	$V > 100\ cm^3$

7 Operating rods

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

7.1 If the diameter of the operating rod exceeds the minimum width of joint specified in Table 1 and Table 2, the width of joint shall be at least equal to this diameter but without, however, having to exceed 25 mm.

7.2 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. Alternatively, gap enlargement due to wear may be prevented by use of bearings complying with clause **8**.

8 Supplementary requirements for shafts and bearings

8.1 Joints of shafts

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 cylindrical joint (see Figure 18 and Figure 21), or

— a labyrinth joint (see Figure 19 and Figure 21) or

— a joint with a floating gland (see Figure 20).

8.1.1 *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 width of a flameproof joint nor interrupt it (see Figure 18).

The minimum radial clearance k (see Figure 21) of shafts of rotating electrical machines shall not be less than 0,05 mm.

8.1.2 *Labyrinth joints*

Labyrinth joints which do not comply with the requirements of Table 1 and Table 2 may nevertheless be considered as complying with the requirements of this European Standard if the tests specified in section “Verifications and tests” are satisfied.

The minimum radial clearance k (see Figure 21) of shafts of rotating electrical machines shall not be less than 0,05 mm.

8.1.3 *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 beating as specified by the manufacturer. 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 (see Figure 20).

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

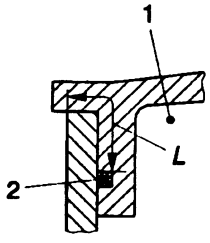


Figure 11

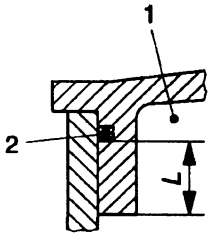


Figure 12

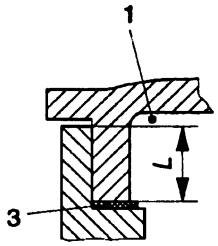


Figure 13

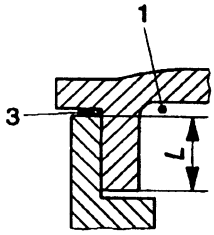


Figure 14

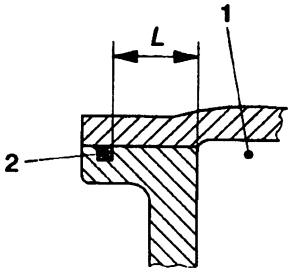


Figure 15

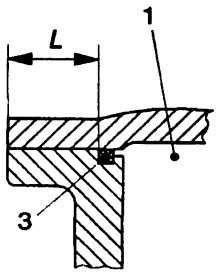


Figure 16

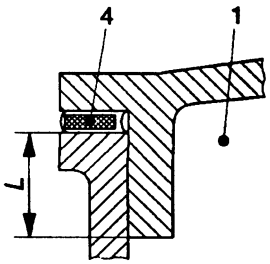


Figure 17

1 Interior of enclosure
2 O-ring
3 Gasket
4 Metallic or metal sheath gasket

Figures 11 to 17 — Illustration of the requirements concerning gaskets

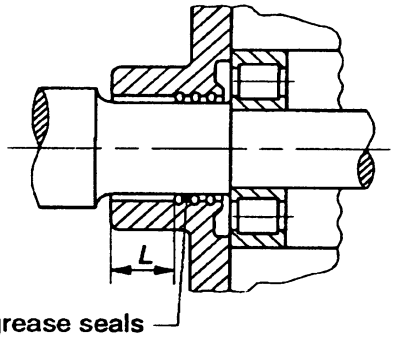


Figure 18 — Example of cylindrical joint for shaft of rotating electrical machine

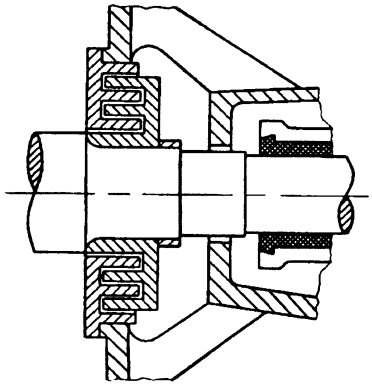
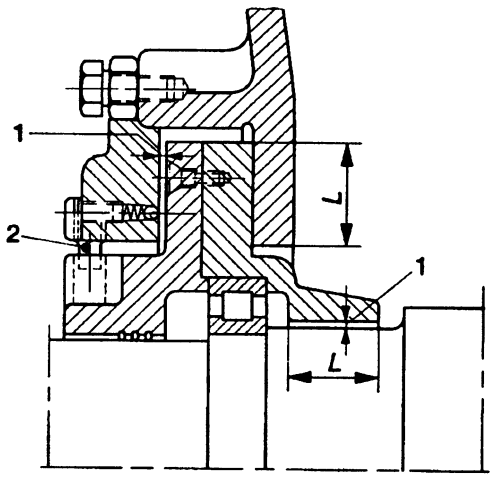
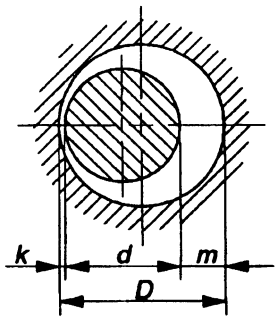


Figure 19 — Example of labyrinth joint for shaft of rotating electrical machine



1 Gap
2 Stop to prevent rotation of gland

Figure 20 — Example of joint with floating gland for shaft of rotating electrical machine



k = minimum radial clearance permissible without rubbing
m = maximal radial clearance taking k (minimum) into account
$D - d$ = diametral clearance

Figure 21 — Joints of shaft glands of rotating electrical 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 of joint at least equal to the diameter of the shaft but without having to exceed 25 mm.

If a cylindrical or labyrinth flameproof joint is used in a rotating electrical machine with sleeve bearings, at least one face of the joint shall be of non-sparking metal (e.g. leaded brass) whenever the air gap between stator and rotor is greater than the minimum radial clearance k (see Figure 21) 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.

8.2.2 *Rolling-element bearings*

In shaft glands equipped with rolling-element bearings, the maximum radial clearance m (see Figure 21) shall not exceed two-thirds of the maximum gap permitted for such glands in Table 1 and Table 2.

9 Light-transmitting parts

For light-transmitting parts of luminaires and for inspection windows of glass or plastic materials of flameproof enclosures, the requirements of EN 50014 apply.

NOTE Precautions should be taken so that the mountings of light-transmitting parts do not produce internal mechanical stress in those parts.

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

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:

— relief of pressure in the event of internal explosion; or

— 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.

10.1 Openings for breathing or draining

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

NOTE If for technical reasons breathing or draining devices have to be provided, they should be so constructed that they are not liable to become inoperative in service (e.g. because of the accumulation of dust or paint).

10.2 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 potentially explosive atmosphere containing acetylene shall comprise not more than 60 % of copper by mass to limit acetylide formation.

10.3 Dimensions

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

10.4 Elements with measurable paths

Interstices and measurable lengths of path need not comply with the values given in Table 1and Table 2 provided that the elements pass the tests of section "Verifications and tests".

Additional requirements for crimped ribbon elements are given in Annex A.

10.5 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).

NOTE For functional reasons, it may also be necessary to state the fluid permeability and the open porosity specified in accordance with the standard methods for the particular material and the particular manufacturing methods (see Annex B).

10.6 Removable devices

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

10.7 Mounting arrangements of the elements

The breathing and draining elements shall be sintered, or fixed by other suitable methods:

— either directly into the enclosure to form an integral part of the enclosure; or

— 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** are to 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 section "Verifications and tests".

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:

— either from within, in which case the accessibility of screws and clamping ring shall be possible only from the inside; or

— 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 in **23.4.7.7** of EN 50014:1992.

11 Fasteners, associated holes and closing devices

11.1 Fasteners accessible from the outside and necessary for the assembly of the parts of a flameproof enclosure shall:

— For Group I, be special fasteners complying with the requirements of EN 50014.

When heads of fasteners are not protected, for example by counterbored holes, the electrical apparatus shall be marked "X".

— For Group II, be in conformity with **9.2** of EN 50014:1992 in respect of threads and heads.

11.2 Fasteners of plastic material or light alloys are not permitted.

11.3 The lower yield stress of screws and nuts shall be at least 240 N/mm^2 according to ISO 6892.

In carrying out the type tests specified in clause **15**, the testing station shall require the replacement of all or some of the screws specified by the manufacturer, if these are of a higher yield stress than 240 N/mm^2, by screws of the lowest yield stress available, but with a minimum of 240 N/mm^2, unless a calculation based on a pressure of 1,5 times the reference pressure shows that a higher yield stress is necessary.

If a yield stress higher than 240 N/mm^2 is necessary, the required yield stress shall be:

— either marked on the apparatus; or

— specified in the relevant certificate, in which case the apparatus shall be marked with an "X".

The type test is then carried out with the screws and nuts specified by the manufacturer.

11.4 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 yield stress higher than 240 N/mm^2 is necessary, the required yield stress shall be:

— either marked on the apparatus; or

— specified in the relevant certificate, in which case the apparatus shall be marked "X".

The type test is then carried out with the studs specified by the manufacturer.

11.5 Fasteners shall not pass through the walls of a flameproof enclosure unless they form a flameproof joint with the wall and they are non-detachable from the enclosure, e.g. by welding, riveting or an equally effective method.

11.6 In the case of holes for screws or studs which do not pass through the walls of flameproof enclosures, the remaining thickness of the wall of the flameproof enclosure shall be at least one-third of the nominal diameter of the screw or stud with a minimum of 3 mm.

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

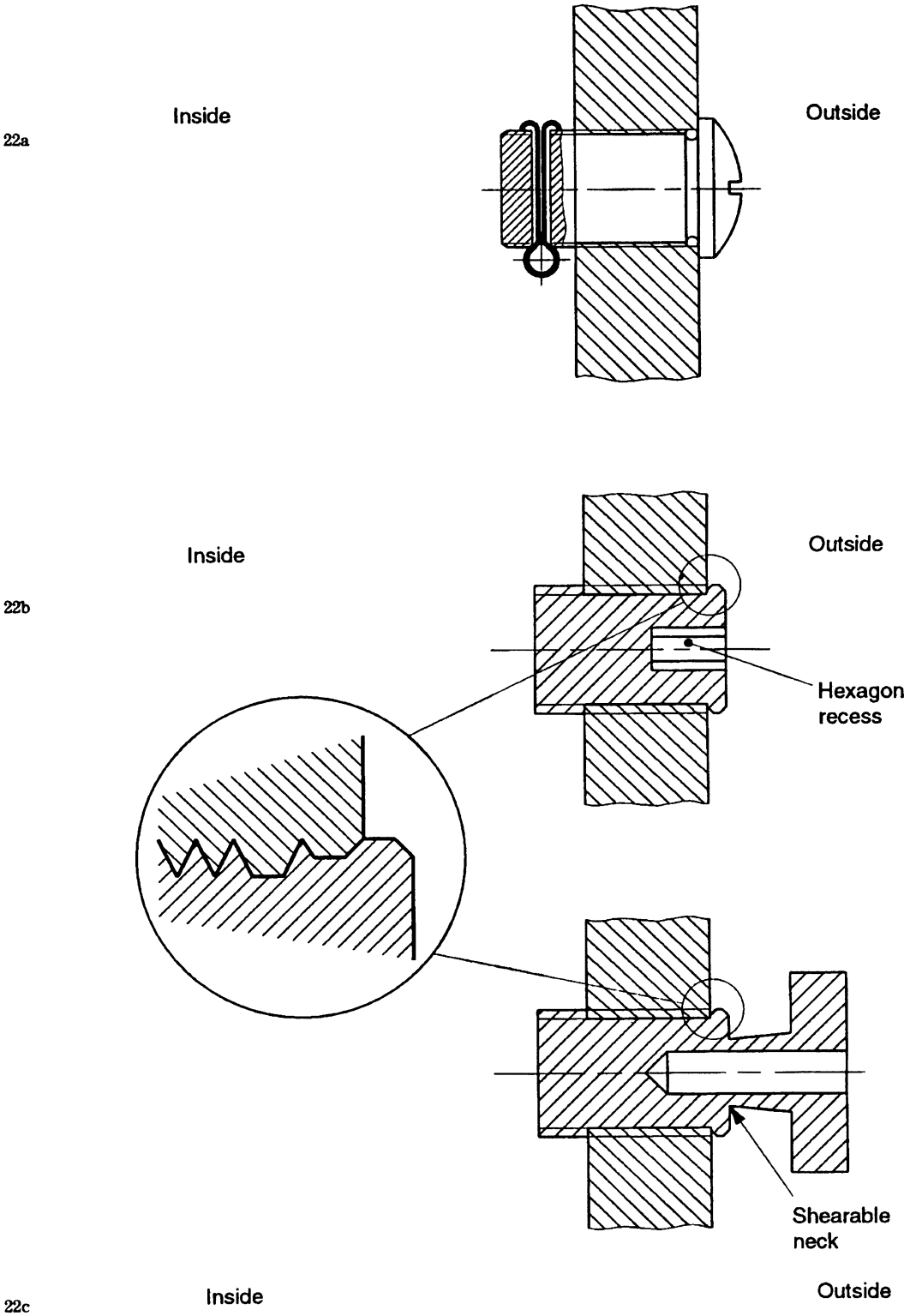


Figure 22 — Examples of closing devices for unused apertures

11.8 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 device so that the flameproof properties of the enclosure are maintained. This device shall be securely fixed in accordance with the requirements of **11.4** for studs.

11.9 If apertures provided in a flameproof enclosure (e.g. for cable or conduit entry) are not used, they shall be closed so that the flameproof properties of the enclosure are maintained (see Figure 22 for examples).

The closing device may be made so that it can be fitted or removed from either the outside or the inside of the wall of the flameproof enclosure.

The mechanically or frictionally locked closing device shall comply with one or more of the requirements of **11.9.1** to **11.9.3**.

11.9.1 If the closing device is removable from the outside, this shall be possible only after disengagement of a retaining device inside the enclosure (see Figure 22a).

11.9.2 It may be so designed that it can be fitted or removed only by the use of a tool complying with the requirements of **9.2** of EN 50014:1992 (see Figure 22b).

11.9.3 It may be of a special construction in which insertion is done by a method other than that used for removal. Removal shall only be by one of the methods specified in **11.9.1** or **11.9.2** or by a special technique (see Figure 22c).

11.10 Separate fastening arrangements, requiring the use of a tool, of the type required in **9.2** of EN 50014:1992 or some equally effective methods shall be provided to secure and release threaded doors or covers.

12 Materials and mechanical strength of enclosures; materials inside the enclosures

12.1 Flameproof enclosures shall withstand the relevant tests prescribed in section "Verifications and tests".

12.2 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.

12.3 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 may 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.

12.4 When cast iron is used, the material shall be not less than the quality 150 (ISO 185).

12.5 Liquids shall not be used in flameproof enclosures when there is a risk of producing an explosive mixture, more hazardous than that for which the enclosure was designed, by the decomposition of these liquids. They may, however, be used if the enclosure passes the tests prescribed in section "Verifications and tests" 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.

12.6 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 CT1 400 M, according to IEC 112.

However, if the above-mentioned insulating materials do not pass this test they may be used 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.

13 Entries for flameproof enclosures

The flameproof properties of the enclosure are not altered if all entries meet the relevant requirements given in this clause.

The following different means can be used to provide the connection of electrical apparatus within a flameproof enclosure to external circuits or to other electrical apparatus; nevertheless, the manufacturer shall state, in the documents defining the electrical apparatus, those means which are explicitly intended to be used for this purpose, the places where they can be mounted and the maximum permitted number of these means.

13.1 Cable entries

Cable entries, whether integral or separate, shall meet the requirements of this standard, the relevant requirements of Annex C "Flameproof cable entries" and create, on the enclosure the joint widths and gaps prescribed in clause **5**.

Where cable entries are integral with the enclosure or specific to the enclosure they will be tested as part of the enclosure concerned.

Where cable entries are separate

— threaded Ex cable entries can be certified as apparatus. Such cable entries do not have to be submitted to the tests of **15.1** and the routine test of clause **16**.

Threaded cable entries and their associated holes with threads not complying with ISO standards shall be marked in such a manner that any confusion can be precluded.

— other cable entries can only be certified as an Ex component.

13.2 Conduit entries

13.2.1 Conduit entries are permitted only for electrical apparatus of Group II.

13.2.2 Conduit entries shall create on the enclosure the joint widths and gaps prescribed in clause **5**.

13.2.3 In addition, a sealing device such as a stopping box with setting compound shall be provided, either in the flameproof enclosure or immediately at the entrance thereto. A sealing device is considered as fitted immediately at the entrance of the flameproof enclosure when the device is fixed to the enclosure either directly or through an accessory necessary for coupling (such as a nipple or a three-piece union); it shall satisfy the type test for sealing prescribed in **15.3**. The setting compound shall be specified in the certificate either of the stopping box or of the complete electrical apparatus having the flameproof enclosure. The part of the stopping box between the setting compound and the flameproof enclosure shall be treated as a flameproof enclosure, i.e. the joints shall comply with clause **5** and the assembly shall be submitted to the tests for non-transmission of **15.2**.

NOTE The sealing device may be applied by the installer or user of the electrical apparatus according to instructions provided by the manufacturer.

13.3 Plugs and sockets and cable couplers

13.3.1 Plugs and sockets shall be constructed and mounted so that they do not alter the flameproof properties of the enclosure on which they are mounted, even when the two parts of the plugs and sockets are separated.

13.3.2 The widths and the gaps of the flameproof joints (see clause **5**) of the flameproof enclosures of plugs and sockets and cable couplers shall be determined by the volume which exists at the moment of separation of the contacts other than those for earthing or bonding or those which are parts of circuits complying with EN 50020 and EN 50039.

13.3.3 For plugs and sockets and cable couplers the flameproof properties of the enclosure shall be maintained in the event of an internal explosion both when the plugs and sockets or cable couplers are connected together and at the moment of separation of the contacts other than those for earthing or bonding or those which are parts of circuits complying with EN 50020 and EN 50039.

13.3.4 The requirements of **13.3.2** and **13.3.3** do not apply to plugs and sockets nor to cable couplers fixed together by means of special fasteners conforming to **11.1** and which bear a label with the warning.

"DO NOT SEPARATE WHEN ENERGIZED".

13.4 Bushings

13.4.1 Bushings may contain one or more conductors. When they are correctly assembled and mounted in the walls of the enclosure, all joint widths, gaps or cemented joints shall conform with the relevant requirements of clauses **5** and **6**.

When the bushing is formed by moulding insulation on metallic parts the requirements of **5.2**, **5.3** and **5.4** do not apply, but clause **6** is applicable. The insulation material itself can contribute to the mechanical strength of the enclosure.

When the bushing includes parts assembled with adhesive, this is considered as a cement if it complies with the requirements of clause **6**. Should this not be the case, the requirements of **5.2**, **5.3** and **5.4** are applicable.

13.4.2 The parts of bushings outside the flameproof enclosure shall be protected in accordance with one of the types of protection listed in EN 50014.

13.4.3 Bushings specific to a flameproof enclosure shall satisfy the type tests and routine tests for that enclosure.

13.4.4 Bushings not specific to one flameproof enclosure shall be submitted to a type test for resistance to pressure carried out by means of a static pressure test as specified in **15.1.3.1** at the following values:

— 20 bar for electrical apparatus of Group I;

— 30 bar for electrical apparatus of Group II.

These bushings shall be subject to routine pressure test as specified in **16.1**, except where the assembly procedure used is described in the manufacturer's documentation and is such as to ensure consistency in the manufactured products.

Verifications and tests[1)]

14 General

The requirements of EN 50014 concerning verifications and tests are, for type of protection flame-proof enclosure "d", supplemented by the following requirements.

The determination of the maximum surface temperature specified in **23.4.6.1** of EN 50014:1992 shall be made under the conditions defined in Table 5 of this standard.

Table 5 — Conditions for the determination of maximum surface temperature

Type of electrical apparatus	Test voltage	Overload or fault conditions
Luminaires (without ballast)	U_n + 10 %	None
Ballast	U_n + 10 %	U_n + 10 % Rectifier effect simulated by diode[a]
Motors	U_n ± 5 %	None
Resistors	U_n + 10 %	None
Electromagnets	U_n + 10 %	U_n and worst case air-gap
Other apparatus	U_n ± 10 %	[b]

NOTE U_n is the rated voltage of the apparatus.

[a] The rectifier effect is only to be simulated in the case of ballasts for tubular fluorescent lamps; it is therefore done according to IEC 82.

[b] To be agreed between manufacturer and testing station, depending on the type of apparatus.

15 Type tests

The type tests shall be carried out in the following sequence on one of the samples which has been subjected to the mechanical tests in accordance with **23.4.3** of EN 50014:1992.

1) Determination of the explosion pressure (reference pressure) in accordance with **15.1.2**.

2) Overpressure test in accordance with **15.1.3**.

3) Test for non-transmission of an internal ignition in accordance with **15.2**.

Testing stations may deviate from this test sequence in that the static or dynamic overpressure test may be carried out either after the test for non-transmission of an internal ignition or on another sample which has also been subjected to those other tests affecting mechanical strength already applied to the first sample; in no case, after the overpressure test, shall the joints of the enclosure have suffered a permanent deformation nor shall the enclosure have suffered any damage affecting the type of protection.

The enclosure shall, in general, be tested with all the enclosed apparatus in place. However, this may with the agreement of the testing station, be replaced by equivalent models.

If an enclosure is designed to take different types of apparatus and components, declared with the detailed mounting arrangements by the manufacturer, the enclosure may be tested empty provided that this is the most severe condition for explosion pressure development, and compliance with the other safety requirements of EN 50014 can be confirmed.

If the enclosure is designed so that it can be used in the absence of part of the enclosed apparatus the tests shall be made under the conditions considered by the testing station to be the most severe. In both cases the testing station shall then indicate in the certificate, on the basis of the proposals made by the manufacturer, the kinds of enclosed apparatus permitted and their mounting arrangements.

Joints of removable parts of flameproof enclosures shall be tested in the worst assembly conditions.

15.1 Tests of ability of the enclosure to withstand pressure

15.1.1 *General*

The object of these tests is to verify that the enclosure can withstand the pressure of an internal explosion.

The enclosure shall be subjected to tests in accordance with **15.1.2** and **15.1.3**.

The tests are considered satisfactory if the enclosure suffers no permanent deformation or damage, affecting the type of protection. In addition, the joints shall in no place have been permanently enlarged.

[1)] Verifications and tests are included in the single German word "Prüfung".

15.1.2 ***Determination of explosion pressure (reference pressure)***

The reference pressure is the highest value of the maximum smoothed pressure, relative to atmospheric pressure, observed during these tests. For smoothing, a frequency limit of 5 kHz ± 10 % shall be adopted.

15.1.2.1 Each test consists of igniting an explosive mixture inside the enclosure and of measuring the pressure developed by the explosion.

The mixture shall be ignited by one or more sparking plugs or another low energy source. However, when the enclosure contains a device which produces sparks capable of igniting the explosive mixture, this device may be used to produce the explosion. (It is nevertheless not necessary to produce the maximum power for which the device is designed.)

The pressure developed during the explosion shall be determined and recorded during each test. The locations of the sparking plug(s) as well as those of the pressure gauge(s) are left to the discretion of the testing station, to find the combination which produces the highest pressure. When detachable gaskets are provided by the manufacturer, these shall be fitted to the enclosure under test.

The number of tests to be made and the explosive mixture to be used, in volumetric ratio with air and at atmospheric pressure, are as follows:

— Electrical apparatus of Group I:

3 tests with (9,8 ± 0,5) % methane;

— Electrical apparatus of Group IIA:

3 tests with (4,6 ± 0,3) % propane;

— Electrical apparatus of Group IIB:

3 tests with (8 ± 0,5) % ethylene;

— Electrical apparatus of Group IIC:

3 tests with (14 ± 1) % acetylene and 3 tests with (31 ± 1) % hydrogen.

15.1.2.2 Rotating electrical machines shall be tested at rest and, when the testing station considers it necessary, when running. When they are tested running, they may be driven either by their own source of power or by an auxiliary motor. The speed shall be between 90 % and 100 % of the rated speed of the machine.

The pressures shall be determined at the ignition end, at the opposite end and at all points where higher pressures are likely to occur.

15.1.2.3 In cases where pressure-piling may occur during the test of flameproof enclosures, the tests shall be made with each gas at least five times. For Group IIB they shall afterwards be repeated at least five times with a mixture of (24 ± 1) % hydrogen/ methane (85/15).

NOTE There is presumption of pressure-piling when
— either the pressure values obtained during a series of tests, deviate from one to another by a factor of ≥ 1,5 or
— the pressure rise time is less than 5 ms.

15.1.2.4 Electrical apparatus intended to be used in a single specified gas may be tested with the mixture of that gas with air at atmospheric pressure that gives the highest explosion pressure. Such electrical apparatus shall then be certified not for the corresponding Group but only for the gas considered.

The restriction of use shall be indicated accordingly as specified in **27.2** Point 5 EN 50014:1992.

Where exclusion of a specific gas or gases is required, the apparatus shall be marked "X".

Double marking can be applied for a specific gas and for the next lower Group than the Group of this gas (e.g. IIB + H2), if the enclosure has been submitted not only to the tests for the specific gas, but also to those necessary for the lower Group.

15.1.3 ***Overpressure test***

This test shall be made by one of the following methods, which are considered as equivalent:

15.1.3.1 *Overpressure test: first method (static)*

The relative pressure applied shall be:

— 1,5 times the reference pressure, with a minimum of 3,5 bar; or

— 4 times the reference pressure for enclosures not subject to routine overpressure testing; or

— the following pressures, when reference pressure determination has been impracticable.

Volume (cm^3)	**Group**	**Pressure** (bar)
≤ 10	I, IIA, IIB, IIC	10
> 10	I	10
> 10	IIA, IIB	15
> 10	IIC	20

The period of application of the pressure shall be at least 10 s but need not exceed 60 s.

The test is made once.

The overpressure test shall be considered satisfactory if the test result is in compliance with **15.1.1** and if there is no leakage through the walls of the enclosure.

15.1.3.2 *Overpressure test: second method (dynamic)*

The dynamic tests shall be so carried out that the maximum pressure to which the enclosure is subjected is 1,5 times the reference pressure, but with a minimum of 3,5 bar.

When the test is carried out with mixtures specified in **15.1.2.1** these may by precompressed to produce an explosion-pressure of 1,5 times the reference pressure.

The test shall be made once only except for electrical apparatus of Group IIC for which each test shall be made three times with each gas.

The overpressure test shall be considered satisfactory if the test result is in compliance with **15.1.1**.

15.2 Test for non-transmission of an internal ignition

Gaskets, (see **5.4**) are to be removed. The enclosure is placed in a test-chamber. The same explosive mixture is introduced into the enclosure and the test-chamber, at atmospheric pressure.

The length of threaded joints shall be reduced according to Table 6.

Flanged gaps of spigot joints, where the width of the joint L consists only of a cylindrical part (see Figure 3) are to be enlarged to values of 1 mm for Group I and IIA, 0,5 mm for Group IIB and 0,3 mm for Group IIC.

15.2.1 ***Electrical apparatus of Groups I, IIA and IIB***

15.2.1.1 The gaps i_E of the enclosure shall be at least equal to 90 % of the maximum constructional gap $i_C$as specified in the manufacturer's drawings ($0{,}9\ i_C \leq i_E \leq i_C$).

The explosive mixtures to be used, in volumetric ratio with air and at atmospheric pressure, are as follows:

— electrical apparatus of Group I:

(12,5 ± 0,5) % methane-hydrogen [(58 ± 1) % methane and (42 ± 1) % hydrogen] (MESG = 0,8 mm);

— electrical apparatus of Group IIA:

(55 ± 0,5) % hydrogen (MESG = 0,65 mm);

— electrical apparatus of Group IIB:

(37 ± 0,5) % hydrogen (MESG = 0,35 mm).

NOTE The explosive mixtures chosen for this test ensure that the joints prevent the transmission of an internal ignition, with a known margin of safety. This margin of safety, K, is the ratio of the maximum experimental safe gap of the representative gas of the Group concerned to the maximum experimental safe gap of the chosen test gas:

— electrical apparatus of Group I:

$$K = \frac{1{,}14}{0{,}8} = 1,42\,(\text{methane});$$

— electrical apparatus of Group IIA:

$$K = \frac{0{,}92}{0{,}65} = 1,42\,(\text{propane});$$

— electrical apparatus of Group IIB:

$$K = \frac{0{,}65}{0{,}35} = 1,85\,(\text{ethylene})$$

Alternatively, by agreement between testing station and the manufacturer, if the gaps of a test specimen do not fulfil the above condition one of the following methods may be used for the type test for non-transmission of an internal ignition:

— a gas/air mixture with a smaller MESG value:

	i_E/i_C	mixture
Group I	≥ 0,75	55 % H_2 ± 0,5
	≥ 0,6	50 % H_2 ± 0,5
Group IIA	≥ 0,75	50 % H_2 ± 0,5
	≥ 0,6	45 % H_2 ± 0,5
Group IIB	≥ 0,75	28 % H_2 ± 1
	≥ 0,6	28 % H_2 ± 1 at 1,4 bar

Table 6 — Reduction in length of a threaded joint for non-transmission test

Type of threaded joint	Reduction in length by			
	Groups I, IIA and IIB (15.2.1)		Group IIC (15.2.2)	
	15.2.2.1	15.2.2.2	15.2.2.1	15.2.2.2
Cylindrical, complying with ISO 965 fit medium or better	no reduction	1/3	1/3	no reduction
Cylindrical, with larger tolerances than permitted above	1/3	1/2	1/2	1/3
Taper	no reduction	1/3	1/3	no reduction
For tapered threads the joint shall be tested with the minimum hand tight engagement permitted by thread standard at the extremes of tolerances. Example of reduction of tapered threads: After marking the position of hand tight engagement on the thread, the devices are removed and the length of engagement is reduced by cutting the screw or drilling out the hole. The parts are then reassembled to the marked position.				

— pre compression of the normal test mixtures according to the following formula:

$$P_k = \frac{i_C}{i_E} \times 0,9$$

P_k = precompression factor

15.2.1.2 If enclosures of Groups IIA and IIB could be destroyed or damaged by the test in **15.2.1.1**, it is permitted that the test be made by increasing the gaps above the maximum values specified by the manufacturer. The enlargement factor of the gap is 1,42 for Group IIA electrical apparatus and 1,85 for Group IIB electrical apparatus. The explosive mixtures to be used in the enclosure and in the test chamber, in volumetric ratio with air and at atmospheric pressure, are as follows:

— electrical apparatus of Group IIA:

(4,2 ± 0,1) % propane;

— electrical apparatus of Group IIB:

(6,5 ± 0,5) % ethylene.

15.2.1.3 The test in **5.2.1.1** or **15.2.1.2** shall be made five times. The test result is considered satisfactory if the ignition is not transmitted to the test chamber.

15.2.2 ***Electrical apparatus of Group IIC***

The following methods can be used for this test.

15.2.2.1 *First method*

All gaps of joints other than threaded joints shall be increased to the value

$i_E = 1,5 \times i_C$

with a minimum of 0,1 mm for flanged joints

i_E = the test gap;

i_C = the maximum constructional gap, as specified on the manufacturer's drawings.

The following explosive mixtures, in volumetric ratio with air and at atmospheric pressure, are to be used in the enclosure and in the test-chamber.

— (28 ± 1) % hydrogen; and

— (7,5 ± 1) % acetylene.

Five tests shall be made with each mixture. If the apparatus is intended for use solely with hydrogen or solely with acetylene, the tests shall be made only with the corresponding gas mixture.

15.2.2.2 *Second method*

The enclosure shall be tested with a test gap i_E according to the following formula

$0,9\ i_C \leq i_E \leq i_C$

The enclosure and the test chamber are filled with one of the gas mixtures specified for the first method at a pressure equal to 1,5 times atmospheric pressure.

The test shall be made 5 times with each explosive mixture.

Alternatively if the gaps of a test specimen do not fulfill the above condition, by agreement between testing station and manufacturer, the following method may be used.

Precompression of the normal test mixtures according to the following formula:

$$P_k = \frac{i_C}{i_E} \times 1,35$$

P_k = Precompression factor

15.2.2.3 Electrical apparatus which are single constructions shall be tested five times with unaltered gaps and with each of the explosive mixtures specified in **15.2.2.1** at atmospheric pressure.

15.3 Test for sealing of stopping boxes with setting compound

A hydraulic testing device is to be used which avoids the application of pressure to the ends of the conductors; Figure 23 shows an example of a device fulfilling this condition and allowing a simultaneous test on two stopping boxes.

The combination of conductors or cables to be placed in the conduit is chosen by the testing station so as to obtain the most unfavourable conditions.

Filling of the stopping box submitted to the sealing test is carried out in accordance with the instructions of the manufacturer of the stopping box.

A piece of clean white blotting paper is placed under the stopping boxes being tested so as to detect any leakage of liquid. The liquid to be used is coloured water. The hydraulic circuit is to be purged.

The hydraulic pressure is then progressively raised to a value of 20 bar for Group I and 30 bar for Group II, which shall be reached in a maximum of 1 min. The pressure shown by the gauge is observed for 2 min and no reduction of pressure shall be observed.

At the end of the test, the blotting paper shall be free from any trace of leakage.

NOTE It may be necessary to seal all joints of the test device other than those of the parts under test.

15.4 Tests of flameproof enclosures with breathing and draining devices

The tests in accordance with **15.4.1** to **15.4.3** shall be carried out in the following order on a sample after the impact strength test of **10.8**.

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

15.4.1 *Tests of ability of the enclosure to withstand pressure*

The tests shall be made in accordance with **15.1** with the following additions and modifications.

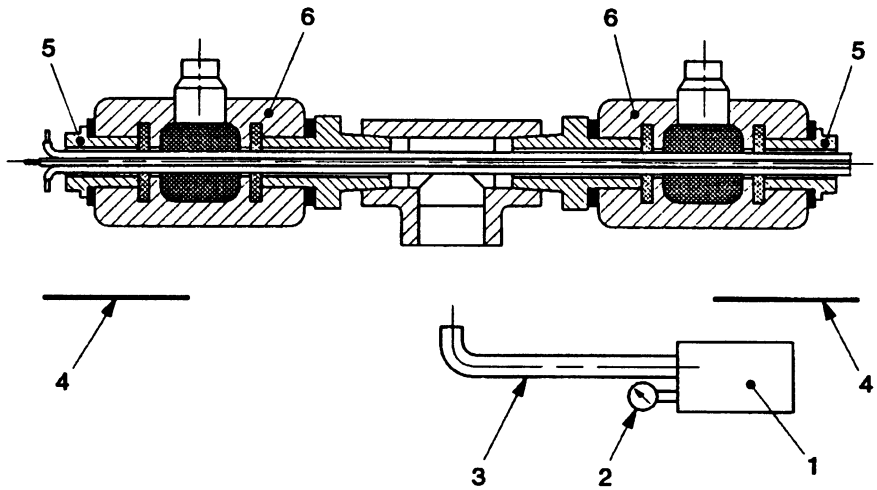
15.4.1.1 For the determination of the explosion pressure in accordance with **15.1.2**, breathing and draining devices shall be replaced by solid plugs.

15.4.1.2 For the overpressure test in accordance with **15.1.3** a thin flexible membrane (e.g. a thin plastic sheet) shall be fitted to the inner surfaces of the breathing and draining devices. After the overpressure test, the device shall show no permanent deformation or damage, affecting the type of protection.

15.4.2 *Thermal tests*

15.4.2.1 *Test procedure*

The enclosure with the device(s) fitted shall be tested in accordance with the method **15.4.3.1** but with the ignition source only in the position giving the most unfavourable thermal results.



1 Hydraulic pump
2 Pressure gauge
3 Hose
4 Blotting paper
5 Packing gland to be removed for the test
6 Stopping box

Figure 23 — Sealing test for stopping boxes with setting compound

The temperature of the external surface of the device(s) shall be monitored during the test. The test shall be made five times. The test mixture to be used shall be (4,8 ± 0,1) % propane in volumetric ratio with air and at atmospheric pressure. Additionally, for devices intended for use in acetylene, (7,5 ± 1) % acetylene in volumetric ratio with air and at atmospheric pressure shall be used.

In an enclosure where there is the possibility of a forced or induced flow of a potentially dangerous gas, the enclosure shall be arranged during the tests so that the gas can flow through the device(s) and the enclosure.

Any ventilation or sampling system shall be operated as specified in the manufacturer's documentation. After each of the five tests the external explosive mixture shall be maintained for a sufficient time to allow any continuous burning on the face of the device to become evident (e.g. for at least 10 min so as to increase the temperature of the external surface of the device or to make heat transfer to the outer face possible.)

15.4.2.2 *Acceptance criteria*

No continuous burning shall be observed. No flame transmission shall occur. The measured external surface temperature rise of the device shall be multiplied by a safety factor of 1,2 for the determination of the temperature class of the electrical apparatus.

15.4.3 ***Test for non-transmission of an internal ignition***

This test shall be made in accordance with **15.2** with the following additions and modifications.

15.4.3.1 *Test procedure*

An ignition source shall be placed first close to the inner surface of the breathing and draining device and subsequently in one or more places if a high peak explosion pressure and rate of rise of pressure at the face of the device is likely to occur. Where the enclosure has more than one identical device, the device to be tested shall be that which gives the most unfavourable results. The test mixture within the enclosure shall be ignited. The test shall be made five times for each position of the ignition source.

15.4.3.2 *Non-transmission test for breathing and draining devices*

For breathing and draining devices of Groups I, IIA and IIB the non-transmission test of **15.2.1** shall be applied.

For breathing and draining devices of Group IIC with measurable paths, **15.2.2** and either **15.4.3.2.1** or **15.4.3.2.2** is to be applied. For breathing and draining devices of Group IIC with non-measurable paths,**15.4.3.2.1** or **15.4.3.2.2** is to be applied.

15.4.3.2.1 *Method A*

For devices intended for use only in hydrogen, only the test with the hydrogen/air mixture is required. The tests are made five times with each test mixture. The tests are made according to **15.2.2.2** and **15.4.3.1**.

15.4.3.2.2 *Method B*

The use of this method involves limitation of the range of Group IIC gases covered. The restriction of use shall be indicated accordingly as specified in **27.2**. Point 5 of EN 50014:1992.

Where exclusion of a specific gas or gases is required, the apparatus shall be marked "X".

Carbon disulfide is excluded for enclosures with a volume greater than 100 cm^3.

The test mixtures to be used consist of the following, in volumetric ratio and at atmospheric pressure:

a) (40 ± 1) % hydrogen, (20 ± 1) % oxygen and the rest nitrogen;

b) (10 ± 1) % acetylene, (24 ± 1) % oxygen and the rest nitrogen.

The tests shall be made 5 times with each test mixture, in accordance with **15.4.3.1**.

For devices intended for use only in hydrogen, only test mixture a) is to be used.

15.4.3.3 *Acceptance criterion*

The test result is considered satisfactory if no ignition is transmitted to the test-chamber.

16 Routine tests

16.1 The following routine tests are intended to ensure that the enclosure withstands the pressure and also that it contains no holes or cracks connecting to the exterior.

The routine tests include an overpressure test made according to one of the methods described for the type tests in **15.1.3**. The method is to be agreed between the manufacturer and the testing station.

16.1.1 The routine overpressure test may be made by the first method even when the overpressure type test has been made by the second method.

When the determination of the reference pressure has been impracticable (the pressure appearing abnormal) and when a dynamic test involves a risk to the enclosed apparatus (windings, etc.), the static pressures to be applied are as follows:

Volume (cm^3)	Group	Pressure (bar)
≤ 10	I, IIA, IIB, IIC	10
> 10	I	10
> 10	IIA, IIB	15
> 10	IIC	20

16.1.2 When the second method is chosen, the routine test consists of

— either an explosion test with, inside and outside the enclosure, the appropriate explosive mixture specified in **15.1.2** (for the determination of explosion pressure) at 1,5 times atmospheric pressure;

— or a dynamic overpressure test as described in **15.1.3.2** for type tests, followed by a non-transmission test with explosive mixtures as specified in **15.2.1.2** or **15.2.2.1** (test for non-transmission of an internal ignition, with enlarged gaps) inside and outside the enclosure at atmospheric pressure;

— or a dynamic overpressure test as described in **15.1.3.2** for type tests, followed by a static test at a pressure of at least 2 bar.

16.1.3 For the routine test, it is sufficient to test the enclosure empty. However, if the routine test is dynamic and the enclosed apparatus influences the pressure rise during an internal explosion, the test conditions shall be decided by agreement between the manufacturer and the testing station.

The individual parts of a flameproof enclosure (e.g. cover and base) can be tested separately. The test conditions shall be such that the stresses are comparable to those to which these parts are exposed in the complete enclosure.

16.2 Routine tests are not required for enclosures with a volume less than or equal to 10 cm^3. This exception also applies to enclosures with a volume greater than 10 cm^3 when the prescribed type test has been made at a static pressure of four times the reference pressure. However, enclosures of welded construction shall in every case be submitted to the routine test.

For enclosures where reference pressure measurement is impractical, exemption from routine pressure testing shall not apply.

Routine tests are not required for bushings not specific to one flameproof enclosure, if the assembly procedure is sufficiently documented (see **13.4.4**).

16.3 The routine tests are considered satisfactory if:

— the enclosure withstands the pressure without suffering permanent deformation of the joints or damage to the enclosure, and

— when the test has been made by the dynamic followed by static tests of **16.1.2** there is no leakage through the walls of the enclosure or if made dynamically there is no transmission of an internal ignition.

Other requirements

17 Switchgear

Group I flameproof enclosures which are to be opened from time to time on site, e.g. for adjustment purposes or for resetting of protection relays and which contain remotely operated switching devices in which circuits can be made or broken by a separate influence (which may be mechanical, electrical, electro-optical, pneumatic, acoustic, magnetic or thermal) when this influence is not applied manually to the apparatus itself, which produce, in service arcs or sparks capable of ignition an explosive mixture shall comply with the following requirements.

17.1 Means of isolation

All accessible conductors, except those of intrinsically safe circuits complying with EN 50020 or EN 50039 and those for bonding or earthing, shall be capable of being isolated from the supply before the opening of the flameproof enclosure.

The means of isolation of these flameproof enclosures shall be either:

17.1.1 fitted inside the flameproof enclosure, in which case the parts which remain energized after the means of isolation has been opened shall either

— be protected by one of the standard types of protection listed in EN 50014; or

— shall have clearances and creepage distances between phases and to earth in accordance with the requirements of EN 50019, and be protected by an enclosure that provides a degree of protection of at least IP20 according to IEC 529 arranged so that a tool cannot contact the energized parts through any openings. This does not apply to parts of intrinsically safe circuits complying with EN 50020 or EN 50039 which remain energized.

In either case, a warning label “DO NOT OPEN WHEN ENERGIZED” shall be provided on the cover protecting the parts which remain energized. or

17.1.2 fitted inside another enclosure complying with one of the standard types of protection listed in EN 50014.

or

17.1.3 a plug and socket or a cable coupler complying with the requirements of **13.3**.

17.2 Doors or covers

17.2.1 ***Quick-acting doors or covers***

These doors or covers shall be mechanically interlocked with an isolator so that

17.2.1.1 the enclosure retains the properties of the flameproof enclosure, type of protection "d", as long as the isolator is closed and

17.2.1.2 the isolator can only be closed when these doors or covers ensure the properties of the flameproof enclosure, type of protection "d".

17.2.2 ***Doors or covers fixed by screws***

These doors or covers shall bear a label "DO NOT OPEN WHEN ENERGIZED".

17.2.3 ***Threaded doors or covers***

These doors or covers shall bear a label "DO NOT OPEN WHEN ENERGIZED".

18 Lampholders and lampcaps

The following requirements apply to lampholders and lampcaps which together have to form a flameproof enclosure, type of protection "d", so that they may be used in luminaires of increased safety, type of protection "e".

18.1 Device preventing lamps working loose

The device which prevents lamps working loose, required in **B.1** of EN 50019:1992, increased safety "e", may be omitted for threaded lampholders provided with a quick-acting switch in a flameproof enclosure, type of protection "d", which breaks all poles of the lamp circuit before contact separation.

18.2 Holders and caps for lamps with cylindrical caps

18.2.1 Holders and caps for tubular fluorescent lamps shall comply with the dimensional requirements of data sheets Fa 6 of IEC 61.

18.2.2 For other holders, the requirements of clause **5** shall apply, but the width of the flameproof joint between the holder and the cap shall be at least 10 mm at the moment of contact separation.

18.3 Holders for lamps with threaded caps

18.3.1 The threaded part of the holder shall be of a material which is resistant to corrosion under the likely conditions of service.

18.3.2 At the moment of contact separation during unscrewing of the lamp, at least two complete turns of the thread shall be engaged.

18.3.3 For threaded lampholders E 27 and E 40, electrical contact shall be established by spring-loaded contact-elements. In addition, for electrical apparatus of Group IIB or IIC, the making and breaking of contact during insertion and removal of the lamp, shall take place within a flameproof enclosure, type of protection "d", of Group IIB or IIC respectively.

NOTE For threaded lampholders E 10 and E 14, the requirements of **18.3.3** are not necessary.

19 Non-metallic enclosures and non-metallic parts of enclosures

The following requirements apply to non-metallic enclosures and non-metallic parts of enclosures, except for:

— sealing rings of cable entries; and

— non-metallic parts on which the type of protection does not depend.

19.1 Permitted non-metallic enclosures

Non-metallic enclosures are permitted:

— if their free volume is $\leq 3\ 000\ cm^3$;

— without limitation of volume if the enclosure is partly made of non-metallic material and if the surface area of each of the parts of non-metallic material does not exceed $500\ cm^2$; however, the light transmitting part of a luminaire may have a surface area not exceeding $8\ 000\ cm^2$.

19.2 Special constructional requirements

19.2.1 ***Resistance to tracking and creepage distances on internal surfaces of the enclosure walls***

When an enclosure or a part of an enclosure of non-metallic material serves directly to support live bare parts, the resistance to tracking and the creepage distances on the internal surfaces of the walls of the enclosure shall comply with the requirements of EN 50019:1992.

However, for enclosures of electrical apparatus of Group I which may be subjected to electrical stresses capable of producing arcs in air and which result from rated currents of more than 16 A, the requirements stated in **12.6** are to be observed.

19.3 Supplementary requirements for type tests

The type tests according to **23.4** of EN 50014:1992 shall be supplemented by the tests which are indicated in **19.3.1** and **19.3.2**.

19.3.1 ***Tests of flameproofness***

19.3.1.1 *Test procedure*

The tests for flameproofness shall be made in the following order on the enclosures which have been previously subjected, as far as these tests are applicable, to the tests of **23.4.7** of the European standard EN 50014:1992.

19.3.1.2 *Tests of ability of the enclosure to withstand pressure*

These tests shall be made as specified in **15.1**.

19.3.1.3 *Test of erosion by flame*

This test shall be made only on enclosures of volume greater than 100 cm^3 and of which the flameproof joints have at least one face of plastics material. For this test:

— static gaps of flanged joints and plane parts of spigot joints of the enclosure shall be set to a value between 0,1 mm and 0,15 mm; however, if the maximum permitted static gap for the Group under consideration is less than 0,15 mm, the gaps shall be set to the maximum permitted value;

— cylindrical joints and cylindrical parts of spigot joints, as well as threaded joints, shall not be modified;

— for bushings which are common to two adjacent flameproof enclosures, the test shall be carried out in the enclosure giving the worst conditions.

The test consists of 50 ignitions of the explosive mixture specified in **15.1.2.1** for the corresponding Group. In the case of electrical apparatus of Group IIC, 25 ignitions shall be made with each of the two explosive mixtures specified in **15.1.2.1**.

The test is judged satisfactory if the following test for non-transmission is satisfactory.

19.3.1.4 *Test for non-transmission of an internal ignition*

This test shall be made as specified in **15.2**.

19.3.2 ***Flammability***

This test shall be carried out only for enclosures or parts of enclosures of plastic materials.

19.3.2.1 The test shall be carried out in accordance with ISO 1210.

The test pieces shall:

— be cut from the enclosure of the electrical apparatus; or

— be moulded as individual pieces; or

— be cut from plates prepared for this purpose.

The test pieces moulded as individual pieces or the plates from which the test pieces are cut shall be produced under conditions as close as possible to those used to produce the enclosures of the electrical apparatus. These conditions shall be recorded in the manufacturer's documentation.

NOTE If the conditions under which the enclosures are produced are critical, they should be recorded in the certification documents.

The time during which any test piece continues to burn after removal of the flame shall be less than 15 s. During this time, the test piece shall not be burnt completely (ISO 1210).

19.3.2.2 If the test in **19.3.2.1** is not applicable due to distortion of the test piece out of the flame one of the following tests shall be applied.

19.3.2.2.1 *First alternative test method*

The burning test is to be conducted in a chamber, enclosure or laboratory hood that is free from draughts. Each specimen is to be supported from the upper (6 mm) end of the specimen, with the longitudinal axis vertical, by the clamp on the ring stand so that the lower end of the specimen is 10 mm above the top of the burner tube and 300 mm above the horizontal layer of dry absorbent surgical cotton (50 mm × 50 mm swatch thinned to a maximum free standing thickness of 6 mm).

The bunsen burner shall have a tube with a length of 100 mm and an inside diameter of (9,5 ± 0,5) mm. The tube shall not be equipped with end attachments such as a stabilizer.

The gas should be technical grade methane gas with suitable regulator and meter for uniform gas flow. (Natural gas having a heat content of approximately 37 MJ per cubic meter has been found to provide similar results).

The test specimens shall be (125 ± 5) mm in length, (13 ± 0,3) mm in width and (4 ± 0,2) mm in thickness.

When necessary, the specimens shall be preconditioned (see **5.2** of ISO 1210). The burner is to be placed remote from the specimen, ignited, and adjusted to produce a blue flame 20 mm high. The flame should be obtained by adjusting the gas supply and the air ports of the burner until a 20 mm yellow tipped blue flame is produced and then an increase in the air supply is to be made until the yellow-tip disappears. The height of the flame is to be measured again and corrected, if necessary.

The test flame is to be placed centrally under the lower end of test specimen and allowed to remain for 10 seconds. The test flame is then to be withdrawn at least 150 mm away and the duration of flaming of the specimen noted. When flaming of the specimen ceases, the test flame is to be immediately placed again under the specimen.

After 10 seconds, the test flame is again to be withdrawn, and the duration of flaming and glowing is to be noted.

The flammability properties of the tested material are acceptable when:

— no specimen burns with flaming combustion for more than 10 seconds after each application of the test flame;

— the total flaming combustion time does not exceed 50 seconds for the 10 flame applications for each set of 5 specimens;

— no specimen burns with flaming or glowing combustion up to the holding clamp;

— no specimen drips flaming particles that ignite the dry absorbent surgical cotton located 305 mm below the test specimen;

— no specimen burns with glowing combustion which persists beyond 30 seconds after the second removal of the test flame.

19.3.2.2.3 *Second alternative test method*

The test shall be carried out in accordance with IEC 707 *(Method FD: Flame — Vertical specimen).*

The test pieces shall:

— be cut from the enclosure of the electrical apparatus; or

— be moulded as individual pieces; or

— be cut from plates prepared for this purpose.

The test pieces moulded as individual pieces or the plates from which the test pieces are cut shall be produced under conditions as close as possible to those used to produce the enclosures of the electrical apparatus. These conditions shall be recorded in the manufacturer's documentation.

19.3.2.2.3 In these cases 50 explosions according to **19.3.1.3** shall be done inside the enclosure as a type test before applying the tests according **19.3.1.2** and **19.3.1.4**, except if the test of erosion by flame has already been carried out successfully.

19.4 Test report

The test report shall include:

— the complete reference of the electrical apparatus;

— the complete reference of the non-metallic material used for the manufacture of the enclosure or parts of the enclosure;

— the result obtained in each of the tests specified;

— the description of tests which have not been made according to the specified requirements and the reasons for the deviations.

20 Pressure transducers using capillaries

The capillaries shall either comply with the gap dimensions given in Table 1 or Table 2 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 pressure transducers shall be certified if they pass the test for non-transmission of an internal ignition given in **15.2**.

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

A.1 Crimped ribbon elements shall be constructed from cupro-nickel, stainless steel or a metal agreed between the manufacturer and the testing station. Aluminium, titanium, magnesium and their alloys shall not be used.

A.2 Where the paths through the device can be specified in the drawings and can be measured in the complete device, an upper and lower tolerance limit for the path dimensions shall be specified and shall be monitored in production.

A.3 Where **A.2** does not apply, the relevant requirements of Annex B shall apply.

A.4 The type tests of **15.4.3** shall be carried out with samples manufactured with the largest permitted gap dimensions.

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

B.1 Sintered metal elements

B.1.1 Sintered metal elements shall be constructed from one of the following:

— stainless steel;

— 90/10 copper-tin bronze (see however **10.2**);

— a specific metal or specific alloy agreed between the manufacturer and the testing station.
Aluminium, titanium, magnesium and their alloys shall not be used.

B.1.2 The equivalent bubble test pore size shall be determined by the method specified in ISO 4003.

B.1.3 The density of the sintered metal element shall be determined in accordance with ISO 2738.

B.1.4 Where determination of open porosity and/or fluid permeability of elements is required in connection with functional aspects of devices, measurements shall be made in accordance with ISO 2738 and ISO 4022.

B.1.5 Sintered metal elements shall be clearly identified in the documentation by declaring:

— the material in accordance with **10.2** and **B.1.1**;

— the maximum bubble test pore size in µm in accordance with **B.1.2**;

— the minimum density in accordance with **B.1.3**;

— the minimum thickness;

— where appropriate the fluid permeability and open porosity in accordance with **B.1.4**.

B.2 Pressed metal wire elements

B.2.1 Metal wire elements shall be constructed from stainless steel wire braid or another specified metal agreed between the manufacturer and the testing station. Aluminium, titanium, magnesium and their alloys shall not be used. Manufacture shall start from a wire braid which is compressed in a die to form a homogeneous matrix.

B.2.2 In order to evaluate the density, the wire diameter shall be specified. Information shall also be given on the mass, length of wire braid, thickness of the element and mesh size. The ratio between the mass of the element and the mass of an identical volume of the same solid metal shall be between 0,4 and 0,6.

B.2.3 The equivalent bubble test pore size shall be determined by the method specified in ISO 4003.

B.2.4 The density of the element shall be determined in accordance with ISO 2738.

B.2.5 Where determination of open porosity and/or fluid permeability is required in connection with functional aspects of elements, measurements shall be made in accordance with ISO 2738 and ISO 4022.

B.2.6 Metal wire elements shall be clearly identified in the documentation by declaring:

— the material in accordance with **10.2** and **B.2.1**;

— the maximum bubble test pore size in µm in accordance with **B.2.3**;

— the minimum density in accordance with **B.2.4**;

— the dimensions, including tolerances;

— the original wire diameter;

— where appropriate the fluid permeability and open porosity in accordance with **B.2.5**.

B.3 Metal foam elements

B.3.1 Metal foam elements shall be produced by coating a reticulated polyurethane foam with nickel, removing the polyurethane by thermal decomposition, converting the nickel into a nickel-chrome alloy, e.g. by gaseous diffusion, and compressing the material as necessary.

B.3.2 Metal foam elements shall contain at least 15 % chromium by mass.

B.3.3 The equivalent bubble test pore size shall be determined by the method specified in ISO 4003.

B.3.4 The density of the element shall be determined in accordance with ISO 2738.

B.3.5 Where determination of open porosity and/or fluid permeability is required in connection with functional aspects of elements, measurements shall be made in accordance with ISO 2738 and ISO 4022.

B.3.6 Metal foam elements shall be clearly defined in the documentation by declaring:

— the material, in accordance with **10.2**, **B.3.1** and **B.3.2**;

— the maximum bubble test pore size in µm in accordance with **B.3.3**;

— the minimum thickness;

— the minimum density;

— where appropriate, the open porosity and fluid permeability in accordance with **B.3.5**.

Annex C (normative) Additional requirements for flameproof cable entries

C.1 This annex contains specific requirements which apply, in addition to those in the European standard EN 50014 *General requirements* to the construction and testing of flameproof cable entries.

C.2 Constructional requirements

C.2.1 *Sealing methods*

C.2.1.1 *Cable entries with elastomeric sealing rings*

C.2.1.1.1 If a cable entry can accept any sealing ring with the same outside diameter but with different internal dimensions, the ring shall have a minimum uncompressed axial height of:

— 20 mm, for circular cables of diameter not greater than 20 mm and for non-circular cables of perimeter not greater than 60 mm;

— 25 mm, for circular cables of diameter greater than 20 mm and for non-circular cables of perimeter greater than 60 mm.

C.2.1.1.2 If a cable entry can accept only one specific elastometric sealing ring, this ring shall have a minimum uncompressed axial height of 5 mm. In this case the cable entry shall be marked with an "X". However, for flameproof enclosures of Group I and IIC with a volume greater than 2 000 cm^3, the minimum axial heights are those required in **C.2.1.1.1**.

C.2.1.2 *Cable entries sealed with setting compound*

The minimum length of the compound shall be 20 mm when installed.

The manufacturer shall specify:

— the maximum diameter over cores of the cable that the entry is intended to accept;

— the maximum numbers of cores that can pass through the compound.

These specified values shall ensure that at all points along the 20 mm seal length at least 20 % of the cross section area is filled with compound.

The cable entry shall be capable of being fitted and removed from electrical apparatus without disturbing the compound seal after the specified curing period of the compound.

The filling compound and appropriate installation instructions are provided with the cable entry to the user by the manufacturer. These instructions are to form part of the descriptive documents.

C.2.2 *Threaded cable entries*

Threads forming a flameproof joint shall comply with the relevant requirements of **5.3**.

For cylindrical threads the threaded part shall be at least 8 mm in length and comprise at least 6 full threads. If the thread is provided with an undercut, then a non-detachable and non-compressible washer or equivalent device shall be fitted to ensure the required length of thread engagement.

NOTE The requirement for 6 threads is to ensure that at least 5 full threads will be in engagement when the cable entry is assembled onto the flameproof enclosure.

C.3 Type tests

C.3.1 *Sealing test*

C.3.1.1 *Cable entries with sealing ring*

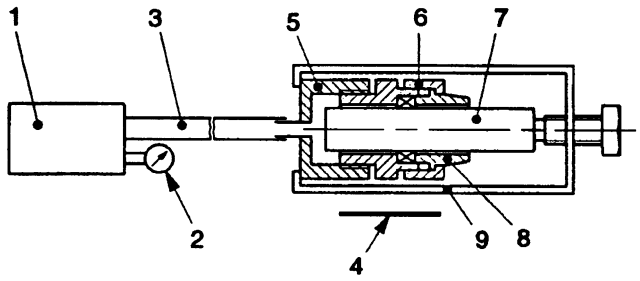
These tests shall be carried out using, for each type of cable entry, one sealing ring of each of the different permitted sizes. In the case of elastomeric sealing rings, each ring is mounted on a clean, dry, polished mild steel cylindrical mandrel of diameter equal to the smallest cable diameter permissible in the ring as specified by the manufacturer of the cable entry.

In the case of metallic or composite sealing rings, each ring is mounted on the metal sheath of a clean dry sample of cable of diameter equal to the smallest diameter permissible in the ring, as specified by the manufacturer of the cable entry.

In the case of sealing rings for non-circular cables, each ring is mounted on a clean dry sample of cable of perimeter equal to the smallest value permitted in the ring, as specified by the manufacturer of the cable entry.

The assembly is then fitted into the entry and a torque is applied to the screws (in the case of a flanged compression device) or to the nut (in the case of a screwed compression device) to obtain a seal under a hydraulic pressure of 20 bar for Group I and 30 bar for Group II.

NOTE The torque figures referred to in the preceding paragraph may be determined experimentally prior to the tests, or they may be supplied by the manufacturer of the cable entry.



1 Hydraulic pump
2 Pressure gauge
3 Hose
4 Blotting paper
5 Adaptor
6 Sealing ring
7 Mandrel/Metal-sheathed cable
8 Compression component
9 Retaining clamp

Figure 24 — Device for the sealing tests for cable entries

The assembly is then mounted into a hydraulic testing device using coloured water or oil as the liquid, as shown in principle in Figure 24. The hydraulic circuit is then purged. The hydraulic pressure is then gradually increased.

The sealing is considered satisfactory if the blotting paper is free from any trace of leakage when the pressure has been maintained at 20 bar for Group I or 30 bar for Group II, for two minutes.

NOTE It may be necessary to seal all the joints of the cable entry mounted in the test device, other than those associated with the sealing ring under test. When a sample of metal-sheathed cable is used, it may be necessary to avoid the application of pressure to the ends of the conductors or to the interior of the cable.

C.3.1.2 *Cable entries sealed with setting compound*

The test shall be carried out using, for each size of cable entry, metal mandrels, the number and diameter, of which result in the least practical amount of compound as specified in **C.2.1.2** paragraph 2 through any cross section of the entry.

The setting compound is prepared following the manufacturer's instructions and then filled into the appropriate volume. It is allowed to harden for the appropriate time. The test prescribed in **23.4.7.3** and **23.4.7.4** of EN 50014:1992 shall be applied.

The assembly is the mounted into the hydraulic testing device defined in **C.3.1.1** above and the same procedure is applied. The acceptance criteria are also the same.

C.3.2 ***Test of mechanical strength***

C.3.2.1 *Cable entries with a screwed compression element*

A torque of twice that required in the sealing test shall be applied to the compression element; however, the value of this torque expressed in Nm shall always be at least 3 times the value in millimetres of the maximum permissible cable diameter when the cable entry is designed for circular cables or equal to the value in millimetres of the maximum permissible cable perimeter when the cable entry is designed for non circular cables.

The cable entry is then dismantled and its parts are examined.

C.3.2.2 *Cable entries with a compression element fixed by screws*

A torque of twice that required in the sealing test shall be applied to the compression element screws; however, the value of this torque shall always be at least equal to the following values:

M 6 : 10 Nm
M 8 : 20 Nm
M10 : 40 Nm
M12 : 60 Nm
M14 : 100 Nm
M16 : 150 Nm

The cable entry is then dismantled and its parts are examined.

C.3.2.3 *Cable entries sealed with setting compound*

In the case of threaded entries, a torque in Nm equal to the minimum value specified in **C.3.2.1** shall be applied to the entry when screwed into a steel test block having a suitable threaded hole.

The cable entry is then dismantled and its parts are examined.

C.3.2.4 *Acceptance criteria*

The tests **C.3.2.1** to **C.3.2.3** shall be considered to be satisfactory if no damage is found to any of the parts of the cable entry.

NOTE Any damage to the sealing ring may be disregarded, as the test is intended to show that the mechanical strength of the cable entry is sufficient to withstand the conditions of use.

National annex NA (informative)
Committees responsible

The United Kingdom participation in the preparation of this European Standard was entrusted by the General Electrotechnical Standards Policy Committee (GEL/-) to Technical Committee GEL/114 upon which the following bodies were represented:

Association of British Mining Equipment Companies
British Cable Makers' Confederation
British Coal Corporation
British Electrical Systems Association (BEAMA Ltd.)
British Gas plc
British Lighting Association for the Preparation of Standards (Britlaps)
Council for Electrical Equipment for Flammable Atmospheres (Beama Ltd.)
Department of Transport (Marine Directorate)
Electric Trace Heating Industry Council (Ethic)
Electrical Contractors' Association
Energy Industries Council
Engineering Equipment and Materials Users' Association
ERA Technology Ltd.
GAMBICA (BEAMA Ltd.)
Gland Manufacturers' Technical Committee
Health and Safety Executive
Institute of Petroleum
Lighting Industry Federation Ltd.
Loss Prevention Council
Ministry of Defence
Rotating Electrical Machines Association (BEAMA Ltd.)
Sira Limited
Trades Union Congress
United Kingdom Offshore Operators' Association

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

British Valve and Actuator Manufacturers' Association
Institution of Mechanical Engineers
Transmission and Distribution Association (BEAMA Ltd.)

blank

National annex NB (informative)

Cross-references

Publication referred to	Corresponding British Standard
EN 50014:1992	BS EN 50014:1993 *Electrical apparatus for potentially explosive atmospheres — General requirements*
EN 50019:1994	BS EN 50019:1994 *Electrical apparatus for potentially explosive atmospheres — Increased safety "e"*
EN 50020:1994	BS EN 50020:1994 *Electrical apparatus for potentially explosive atmospheres — intrinsic safety "i"*
	BS 5101 *Specification for lamp caps and holders together with gauges for the control of interchangeability and safety*
IEC 61-1	Part 1:1975 *Lamp caps*
IEC 61-2	Part 2:1975 *Lamp holders*
IEC 112:1979	BS 5901:1980 *Method of test for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions*
IEC 707:1981	BS 6334:1983 *Methods of test for the determination of the flammability of solid electrical insulating materials when exposed to an igniting source*
IEC 529	BS EN 60529:1991 *Specification for degrees of protection provided by enclosures (IP code)*
ISO 31-0:1992[1)]	BS 5775 *Specification for quantitites, units and symbols* Part 0:1993 *General principles*
ISO 965-1:1980 ISO 965-3:1980	BS 3643 *ISO metric screw threads* Part 1:1981 *Principles and basic data*
	BS 5600 *Powder metallurgical materials and products*
ISO 2738:1987	Part 3 *Methods of testing sintered metal materials and products, excluding hard metals*
	Section 3.2 1998 *Determination of density, oil content and open porosity*
ISO 4003:1997	Section 3.5:1979 *Determination of bubble test pore size for permeable sintered metal materials*
ISO 4022:1987	Section 3.6:1988 *Determination of fluid permeability*

[1)] ISO 31-0:1981, referred to in the text, has been superseded by ISO 31-0:1992.

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