

Specification for

Electrical apparatus for explosive atmospheres —

**Part 2: The construction and testing of
flameproof enclosures of electrical
apparatus**

UDC 621.3 – 7:614.83

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This British Standard, having been approved by the Electrical Industry Standards Committee, was published under the authority of the Executive Board on
12 March 1971

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The following BSI references relate to the work on this standard:

Committee reference ELE/ELCP/4 and ELE/ELCP/4/1
Drafts for comment 67/25791, 68/29856 and 69/22647

Amendments issued since publication

Amd. No.	Date of issue	Comments
4275	June 1983	
5570	June 1987	
6430	March 1990	Indicated by a sideline in the margin

ISBN 0 580 06398 4

Contents

	Page
Co-operating organizations	Inside front cover
Foreword	iii
Introduction	1
Section 1. General	
1 Scope	1
2 Definitions	1
3 Grouping of enclosures	1
4 Enclosed apparatus	2
5 Joints	2
6 Operating rods (spindles)	3
7 Shafts and bearings	3
8 Inspection windows	3
9 Cover glasses for lighting fittings	4
10 Breathing and draining devices	4
11 Fastenings	4
12 Mechanical strength	5
13 Connection of external conductors and cables	5
14 Marking	6
Section 2. Checks and tests	
15 Type checks and tests	20
16 Routine checks and tests	21
Section 3. Special requirements for group IIC enclosures	
17 Compliance with Section 1	22
18 Volume	22
19 Joints	22
20 Operating rods, shafts and bearings	22
21 Tests	22
Appendix A Cements and sealing materials	25
Appendix B Alignment with IEC Publication 79-1	25
Figure 1	10
Figure 2	10
Figure 3	10
Figure 4	11
Figure 5	11
Figure 6	11
Figure 7	11
Figure 8	12
Figure 9	12
Figure 10 — Example of the use of a dowel pin to permit indirect observation of the closeness of fit of a joint	13
Figure 11 — Typical plain fixed gland	13
Figure 12 — Typical labyrinth gland	14
Figure 13 — Typical plain floating gland	14
Figure 14 — Sleeve bearings where $a < g$	15
Figure 15 — Sleeve bearings where $a > g$	15
Figure 16 — Typical window mountings	16
Figure 17 — Typical means of shrouding nuts, bolts, screws, etc. used for securing covers	17
Figure 18 — Indirect entry of cable. (Type X)	18

	Page
Figure 19 — Direct entry of cable. (Type Y)	19
Figure 20 — Definition of pressure rise time	23
Figure 21 — Illustration of requirements of 15.3.2	23
Figure 22 — Spigot joint in Group IIC enclosure	24
Figure 23 — Threaded joint in Group IIC enclosure	24
Table 1 — Groups I, IIA and IIB enclosures	7
Table 2 — Group IIC enclosures	8
Table 3 — To show the group of enclosure suitable for some flammable gases or vapours	9

Foreword

This standard makes reference to the following British Standards:

BS 229, *Flameproof enclosure of electrical apparatus*.

BS 1134, *Method for the assessment of surface texture*.

BS 4434, *Requirements for refrigeration safety*.

BS 4683, *Electrical apparatus for explosive atmospheres — Part 1: Classification of maximum surface temperatures*.

BS 5501, *Electrical apparatus for potentially explosive atmospheres — Part 5: Flameproof enclosure “d”*.

BS 6081, *Specification for terminations for mineral insulated cables*.

BS 6121, *Mechanical cable glands for elastomer and plastics insulated cables*.

This British Standard is Part 2 of BS 4683, “*Electrical apparatus for explosive atmospheres*”, and specifies the construction of, and the tests to be applied to, flameproof enclosures of electrical apparatus. It will replace BS 229:1957¹⁾ as the standard to which such enclosures are certified by the appropriate authority. BS 229¹⁾ will, however, remain in existence for as long as it is necessary to maintain the validity of existing certificates and to grant supplementary certificates.

Users of this British Standard are advised to consider the desirability of third party certification of product conformity with this British Standard. Enquiries as to the availability of the third party certification schemes will be forwarded by BSI to the Association of Certification Bodies.

This Part of BS 4683 is similar to IEC Publication 79, Part 1, “*Construction and test of flameproof enclosures of electrical apparatus*”.

Section 1 specifies the constructional requirements, and is similar to the first section of IEC Publication 79-1.

Section 2 specifies the tests to be applied to the flameproof enclosures and differs in certain aspects from the corresponding section of the IEC Recommendations.

Section 3 details the special requirements for Group IIC enclosures, and is virtually the same as the corresponding section in the IEC Recommendations.

Where the technical content of this British Standard differs materially from the Recommendations of IEC Publication 79-1, such sections are marked with an asterisk and details are given in Appendix B.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 26 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.

¹⁾ BS 229, “Flameproof enclosure of electrical apparatus”.

Introduction

BS 4683, “*Electrical apparatus for explosive atmospheres*”, is a new and comprehensive British Standard, and is published in several parts. Some parts detail the constructional requirements and conditions of test for specific types of apparatus and other parts give requirements and conditions applicable to more than one type of protection.

This British Standard is similar to, but not identical with, IEC Publication 79, “*Electrical apparatus for explosive gas atmospheres*”, and the technical details in some parts of the British Standard may differ from the Recommendations in the corresponding parts of Publication 79.

NOTE BS 5501-5:1977 is a more recent standard for electrical apparatus with flameproof enclosure “d” and is identical with European Standard EN 50018, which is referred to in EEC Directives 79/196/EEC (and 84/47/EEC) and 82/130/EEC. It is therefore the preferred standard for new designs of electrical apparatus.

BS 4683-2:1971 will eventually be made obsolescent and will subsequently be withdrawn, but it is retained for the time being primarily to provide a standard for servicing existing equipment and installations.

Section 1. General

1 Scope

This Part of BS 4683 prescribes the constructional features necessary for flameproof enclosures of electrical apparatus to ensure safety in service, the test requirements which they should meet and the marking to be applied to them.

These enclosures are suitable for housing electrical apparatus in atmospheres where a mixture of air and flammable gas or vapour may occur.

The requirements apply to metallic, non-metallic and composite enclosures, but for the present the additional requirements necessary for non-metallic materials are left to the discretion of the national or other appropriate authority.

The enclosures are grouped according to their industrial application and to the dimensions of the gaps between their joint surfaces, and an indication is given of the nature of the explosive gas atmosphere for which each group is appropriate.

Explosive gas atmospheres for which safe gaps are smaller than those given in this document are not at present covered by this British Standard.

Enclosures containing oil-immersed equipment are also excluded.

2 Definitions

For the purposes of this Part of this British Standard the following definitions apply:

- 1) *Flameproof enclosure*. An enclosure for electrical apparatus that will withstand an internal explosion of the flammable gas or vapour which may enter it, without suffering damage and without communicating the internal flammation to the external flammable gas or vapour for which it is designed, through any joints or structural openings in the enclosure.
- 2) *Volume*. The total (gross) volume of the enclosure, except where the enclosure and its contents are inseparable in use, in which case the volume is the free (nett) volume.
- 3) *Joint*. The place where corresponding surfaces of the different parts of an enclosure come together, and where flame paths from the inside to the outside of the enclosure occur.
- 4) *Length of flame path (width of joint)*. The shortest distance, measured along the flame path, from the inside to the outside of the flameproof enclosure.
- 5) *Gap (diametral clearance)*. The distance between the corresponding surfaces at a joint, measured normally to the surfaces. For cylindrical surfaces, the gap is the difference between the two diameters and is usually referred to as the diametral clearance.
- 6) *Shaft*. A component of circular cross section used for transmitting rotary motion.
- 7) *Operating rod (spindle)*. A component of circular cross section used for transmitting control movements which may be rotary or linear or a combination of both.
- 8) *Pressure piling*. A condition resulting from the ignition of pre-compressed gases in compartments or subdivisions other than that in which ignition was initiated.

3 Grouping of enclosures

Enclosures are classified in two groups:

Group I. For application in coal mining.

Group II. For application in other industries.

Enclosures in Group II are further subdivided according to the maximum gap specified.

The maximum gaps and diametral clearances for each group and subgroup of enclosures are given in Table 1 and Table 2.

Table 3 indicates which group or subgroup of enclosures is appropriate to some gases and vapours.

4 Enclosed apparatus

The enclosed apparatus shall comply with any relevant British Standards or, subject to agreement between the certifying authority and the manufacturer, with other relevant standards, as to performance, rating and other features that may affect the security of the flameproof enclosure. See also the Note at the end of 15.3.1.

5 Joints²⁾

All joints in the structure, whether permanently closed or designed to be opened from time to time, shall satisfy the following requirements.

NOTE The surface roughness of the joint surfaces should not exceed $6.3 \mu\text{m } R_a$ when measured as described in BS 1134, "Method for the assessment of surface texture", but superior finishes do not provide a higher degree of safety.

5.1 Length of flame path (width of joint). The width of any joint shall be consistent with good mechanical design but, with the exception of threaded joints, shall be not less than the appropriate minimum values given in Table 1. Threaded joints shall have a minimum of five full threads engaged and a minimum direct axial length of thread engagement of 8 mm. See Figure 1–Figure 9.

5.2 Gap.²⁾ There shall be no intentional gap between joint surfaces. The gap, if any, between joint surfaces shall nowhere exceed the appropriate maximum value given in Table 1.

Means shall be provided to enable the closeness of the joint surfaces to be observed directly or indirectly. One method of providing for indirect observation is shown in Figure 10.

5.3 Holes in joints. If a joint surface is interrupted by holes for clamping bolts or the like, the minimum value of the distance l , as shown in Figure 1, Figure 2 and Figure 3, shall be as follows:

for widths of joint (L) less than 12.5 mm	6 mm
for widths of joint (L) equal to or exceeding 12.5 mm, but less than 25 mm	8 mm
for widths of joint (L) equal to or exceeding 25 mm	9 mm

5.4 Packing materials and gaskets. If compressible packing material or a gasket is necessary to seal a joint, for example against ingress of moisture or dust, the packing shall be applied as a supplement to, but shall not be included in, the flameproof joint (see Figure 6–Figure 9). This requirement does not apply to the entry of conductors and cables, as specified in 13.1.2 and 13.2.

The packing shall not prevent the correct closure of the flameproof joint from meeting the requirements of Table 1.

NOTE This clause does not exclude the use of permanently plastic jointing materials within the flameproof joint, whose presence does not affect the gap, subject to the approval of the appropriate authority.

5.5 Cement and sealing material.²⁾ Cement or sealing material may be used for the permanent attachment of insulators or the insertion of windows. The cement or sealing material shall be chemically stable and inert, compatible with the surfaces being joined, and shall be resistant to water, oil and industrial solvents, or adequately protected from exposure to them. It shall be unaffected by the variations in temperature to which it will be subjected in normal operation.

NOTE Particulars of cements and sealing materials which have been found to be satisfactory for this purpose are given in Appendix A.

Where cement or sealing material is used, the design shall be such that the strength of the enclosure does not depend upon the cement or sealing material.

The shortest distance through the cement or sealing material shall be not less than the appropriate minimum value of the flame path for a flanged joint, given in Table 1 and Table 2.

5.6 Closing of unused apertures. Unused apertures in the wall of the enclosure shall be closed so that the above joint requirements are satisfied and the integrity of the flameproof enclosure is maintained.

The closing device shall comply with at least one of the following requirements.

It may be fitted or removed from inside or outside the enclosure. If removable from the outside, it shall only be possible after disengagement of a retaining device accessible only from the inside of the enclosure, or be separately secured by means of a shrouded fastener (see Clause 11), or be capable of being removed only by means of a special key (see Clause 11), or shall be of special design in which the means of insertion cannot be used for removal, and a special technique of removal is necessary unless one of the above methods of removal is used.

²⁾ See Appendix B.

6 Operating rods (spindles)

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

6.1 The length of the operating rod or spindle supported by the wall of the enclosure shall be at least equal to the minimum length of the flame path prescribed in Table 1 for the appropriate volume of enclosure.

6.2 If the diameter of the operating rod or spindle exceeds the minimum length specified in Table 1 the length of flame path shall be not less than the diameter of the operating rod or spindle, provided that the length of flame path need not exceed 25 mm.

6.3 The diametral clearance where the operating rod or spindle passes through the hole in the enclosure shall not exceed the appropriate maximum value given in Table 1.

6.4 If the diametral clearance is likely to be enlarged by wear in normal use, means shall be provided to correct any such enlargement, for example a replaceable bush. In extreme cases, a gland which is not subject to wear in normal use shall be added.

7 Shafts and bearings

A flameproof gland shall be provided wherever a shaft passes through the wall of a flameproof enclosure. The gland shall be so designed that it will not be subjected to wear by decentralization or wear of the bearing. (For sleeve bearings, see 7.1 below.)

The gland may be a plain fixed gland (Figure 11), a labyrinth gland (Figure 12) or a plain floating gland (Figure 13).

The length of flame path and diametral clearance shall be in accordance with Table 1. In addition, the requirements of the following subclauses shall apply.

7.1 Sleeve bearings³⁾ The length of flame path in a flameproof gland associated with a sleeve bearing shall be not less than the diameter of the shaft, provided that the length of flame path need not exceed 25 mm.

If a plain fixed gland or a labyrinth gland is used for a rotating machine having sleeve bearings, and the radial clearance between the rotor and the stator is greater than the radial movement permitted by the gland, the following requirements shall apply. (See Figure 14 and Figure 15.)

7.1.1³⁾ The gland shall be arranged for easy access, so that the radial clearance of the gland can be measured.

7.1.2³⁾ A permanent instruction plate prominently mounted shall call the user's attention to the need for regular and frequent checking of the radial clearance of the gland.

7.1.3³⁾ The plate shall plainly state the maximum radial clearance allowed.

7.2 Ball and roller bearings. For shafts fitted with ball or roller bearings, the radial clearance in the flameproof gland shall not exceed the maximum diametral clearance allowed for glands used with sleeve bearings.

7.3 Plain glands. Where a plain gland with grooves for grease seals is used, the part containing the grooves shall be disregarded in determining the length of the flame path. The uninterrupted length of the gland shall be not less than the appropriate value given in Table 1 (see Figure 11).

The diametral clearance shall not exceed the appropriate value given in Table 1, but shall be not less than 0.1 mm.

NOTE³⁾ It is recommended that, where practicable within the terms of Table 1, the radial clearance for machines designed for continuous rotation should nowhere be less than 0.075 mm.

7.4 Labyrinth glands. It is recognized that labyrinth glands whose dimensions do not comply in all respects with the requirements of Table 1 may be satisfactory. Such glands may be regarded as being in accordance with this British Standard if they can be shown to satisfy the test requirements given in Section 2.

NOTE³⁾ Where the designer proposes to use larger gaps than are given in Table 1, discussions should be held with the certifying authority, to ensure an adequate margin of safety.

8 Inspection windows

The general requirements of this British Standard apply to inspection windows. Every inspection window shall also satisfy the following requirements:

8.1 Material. Glass or any suitable substitute may be used. A substitute for glass shall be chemically and physically stable and shall be capable of withstanding effectively the maximum temperature of the apparatus under the rated conditions.

NOTE³⁾ Insufficient data is at present available to permit materials other than glass to be included in the specification. Where adequate evidence of suitability is available, however, substitutes for glass may be accepted at the discretion of the certifying authority.

³⁾ See Appendix B.

8.2 Mounting of windows. An inspection window shall be mounted in one of the following ways:

1) ³⁾The transparent material may be sealed directly into the enclosure to form an integral part of it. If a clamping ring or similar device is used to maintain the strength of the enclosure, the heads of the screws or the clamping ring itself, if of the screwed type, shall only be accessible from the inside of the enclosure, so that the transparent material cannot be replaced without removing the cover.

2) ³⁾The transparent material may be clamped directly into the enclosure, with or without a gasket.

It shall be secured in position either by a metal ring fixed by screws or by a screwed ring. The heads of the screws or the clamping ring shall only be accessible from the inside of the flameproof enclosure, so that the transparent material cannot be replaced without removing the cover.

The flame path, which may include that part of the thickness of the transparent material which lies within the seating, shall comply with 5.1. The breadth of the seating shall be not less than 6 mm, except where the thickness of the transparent material is not less than half the diameter, where the breadth of the seating shall be not less than 3 mm.

If a compressible gasket is used with this type of window, it shall be physically and chemically stable and appropriate to the conditions of use. It shall be fixed to the transparent material, but not on the side which forms the flameproof joint (see Figure 16).

3) The transparent material may be sealed or cemented into a frame which is clamped into the enclosure, so that the window may be replaced as an entity without having to effect sealing on site.

The sealing, cementing or gasket used in fixing the window shall satisfy the general requirements specified in 5.4 and 5.5.

8.3 Strength. The window shall satisfy the requirements of the impact test specified in Section 2.

9 Cover glasses for lighting fittings

The general requirements of this British Standard apply to transparent covers of lighting fittings. Such covers shall also satisfy the requirements for inspection windows, given in Clause 8.

In Group I lighting fittings, however, the transparent material shall not be clamped directly into the enclosure without a gasket, as permitted for windows by 8.2 2).

10 Breathing and draining devices

Breathing and draining devices shall be so constructed that they are not likely to become unsafe in service. Provision for breathing or draining shall not be made by deliberately increasing the gap of a joint.

10.1 The dimensions of the openings constituting the vent shall provide a margin of safety in relation to the dimensions that can be shown by test to be flameproof (as defined in this British Standard).

10.2 If the device is constructed so that it can be taken to pieces, it shall be designed so that it will not be possible to reassemble the parts in such a way as either to reduce or enlarge the openings constituting the vents.

11 Fastenings⁴⁾

Where removable threaded fasteners, which consist of bolts, screws, bolts with nuts, screws with nuts or studs with nuts, are used for securing any component parts of the flameproof enclosure, the holes for such fasteners shall not pass through the wall of the enclosure. The thickness of metal surrounding a hole shall be not less than 3 mm, or one third of the diameter of the hole, whichever is the greater.

There shall be a free space between the end of the fastener and the bottom of the hole when the fastener is screwed fully home without a washer.

If, for convenient manufacture, holes are drilled through the wall of the enclosure, such holes shall be blinded by inserting a threaded plug of a length not less than 6 mm or the diameter of the hole, whichever is the greater. Such plugs shall be fixed as described in the following paragraph.

Fasteners which are permanently attached to the enclosure shall be securely welded or riveted, or attached by some other equally effective means.

Fasteners used for securing doors, covers and blanking plates to the flameproof enclosure shall be shrouded, or some equivalent device permanently attached to the flameproof enclosure shall be provided. Shrouds shall project beyond the fastener which they protect (see Figure 17). Alternatively, fasteners having heads so designed that proper tightening and removal can be achieved only by means of a special key, may be used without shrouds.

⁴⁾ See Appendix B.

If the security of the flameproof enclosure depends on the use of bolts, screws or studs of higher tensile strength than that of ordinary mild steel, such bolts, screws or studs should be of a type not interchangeable with normal bolts, screws or studs. If this requirement has not been observed the national or other appropriate authority may, for the test, require high tensile bolts, screws or studs to be replaced by similar fastenings made of mild steel having a tensile strength of 430 MN/m².

NOTE It is strongly recommended that all bolts etc. used for attaching any one cover plate or access door are of the same length if they are of the same diameter and pitch.

12 Mechanical strength

The mechanical strength of the enclosure shall be adequate for its intended conditions of use.

12.1 The flameproof enclosure shall be capable of sustaining the internal test pressure specified in Section 2 without suffering damage, or such deformation as would weaken any part of the structure, or would permanently enlarge any joint in the structure so as to exceed the gap specified in Table 1 and Table 2.

12.2 Where two or more flameproof enclosures are incorporated together the requirements of this British Standard apply independently to each, and particularly to the partitions between them and to any terminals or operating rods that pass through the partitions.

12.3 Where an enclosure comprises two or more communicating compartments or is subdivided by the disposition of the internal parts or apparatus, pressure-piling (as defined in 2.8) may occur. This generally results in an abnormally rapid rise of pressure and may lead to a higher maximum pressure than would otherwise be expected. The shape of the inside of the enclosure shall be such that pressure-piling is precluded, as far as is practicable. If it is impracticable to avoid pressure-piling, the mechanical strength of the enclosure shall be increased to allow for it.

13 Connection of external conductors and cables⁵⁾

External conductors and cables may be connected by either of the two following methods:

Type X: Indirect entry; where the external conductors and cables are connected by means of a plug and socket or within a terminal box.

Type Y: Direct entry; where the external conductors and cables are connected within the main enclosure.

With either method, precautions shall be taken to guard against disturbance of the conductor terminations if the cable is pulled.

NOTE Direct entry (Type Y) may not in all circumstances be acceptable to authorities responsible for administering statutory regulations.

13.1 Indirect entry (Type X)⁵⁾

13.1.1 ⁵⁾Where a plug and socket is used, the construction shall be such that the flameproof properties of the main enclosure are maintained when the plug is withdrawn from the socket (see Figure 18).

13.1.2 ⁵⁾Where a flameproof terminal box is used, the following requirements shall be observed:

The entry of the external conductors and cables into the terminal box shall meet the requirements of 13.2.

The connections between the external conductors and the circuits inside the main enclosure shall be effected by terminal assemblies inserted in the wall separating the two chambers in compliance with Clause 5 (see also 12.2).

The terminal assemblies, and bushings if any, may be replaced by conductors which are sealed to form a flameproof barrier.

13.1.3 ⁵⁾Where a terminal box is protected by a method other than that of flameproof enclosure, it shall meet the requirements of the relevant British Standard.

13.2 Direct entry (Type Y). The entry of the external conductors and cables shall be made through packing glands or sealing material in a manner which maintains the flameproof properties of the enclosures.

NOTE⁵⁾ Cable glands which may be suitable are specified in BS 6081 "Specification for terminations for mineral insulated cables" and BS 6121 "Mechanical cable glands for elastomer and plastics insulated cables".

If the cable is jointed and sealed into the enclosure by the manufacturer, a length of at least 3 metres shall be supplied unless otherwise agreed with the purchaser.

Where the conductors or cables are in conduit, they shall pass into the enclosure through a compound-filled box or other appropriate device, which may either be integral with the enclosure or attached to it (see Figure 19).

13.3 Unused entries. Unused entries in the wall of the enclosure or terminal box shall be capable of being closed in accordance with 5.6.

⁵⁾ See Appendix B.