

Specification for

Electrical apparatus for explosive atmospheres with type of protection N

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- Association of Manufacturers Allied to the Electrical and Electronic Industry (BEAMA Ltd.)
- British Battery Makers' Society
- Committee for Electrical Equipment for Use in Flammable Atmosphere (BEAMA Ltd.)
- Department of Energy (Petroleum Engineering Division)

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Foreword

This British Standard is a revision of BS 4683-3:1972 which is superseded and withdrawn. Account has been taken in the drafting of this standard of the recommendations in IEC 79-15:1987, published by the International Electrotechnical Commission, to which it is related.

This British Standard specifies additional requirements to be met by a wide range of electrical apparatus suitable for general industrial applications so that it is not likely to ignite a surrounding explosive atmosphere when installed in Zone 2 locations. The requirements are not intended to be applied to apparatus in normal industrial applications.

Because of the wide range of apparatus covered by this standard it is recognized that a number of the requirements and tests may need the exercise of sound engineering judgement on how the concepts expressed are to be given practical form for particular types of apparatus.

Product certification. 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 third party certification schemes may be forwarded by BSI to the Association of Certification Bodies.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 22, 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.

1 Scope

This British Standard specifies requirements for constructional features and methods of assessment and test for Group II electrical apparatus with type of protection N related to reducing the risk of ignition of an explosive atmosphere in a Zone 2 location to an acceptable level during normal operation. This apparatus is not suitable for use in Zone 1 or Zone 0 locations. The standard is applicable to non-sparking electrical apparatus and also to apparatus with parts or circuits producing arcs or sparks or having hot surfaces which, if unprotected, could be capable of igniting a surrounding explosive atmosphere.

The standard applies to apparatus suitable for use and storage at ambient temperatures between $-20\text{ }^{\circ}\text{C}$ and $+40\text{ }^{\circ}\text{C}$ inclusive unless the apparatus is marked with a different ambient temperature range (see clause 10).

Compliance with this British Standard does not imply any removal of, or lowering of, the requirements of any other British Standard with which the electrical apparatus complies. This standard supplements and may supersede the requirements for apparatus for normal industrial applications specified in other relevant British Standards. Where specific British Standards exist for particular apparatus with type N protection, e.g. BS 5000-16, such standards take precedence.

For apparatus not covered by specific British Standards for type N protection the application of relevant requirements in this standard may require the exercise of sound engineering judgement because of the wide range of apparatus covered by this standard. Where apparatus is to be certified the relevant requirements may need to be agreed between the manufacturer and the testing station.

Certain tests may be omitted if the parties concerned agree that they are not applicable to certain types of apparatus and justification for such omission is given in the documentation (see clause 11).

NOTE 1 Guidance on the classification of hazardous areas is given in BS 5345-2.

NOTE 2 Guidance on the installation and maintenance of apparatus with type of protection N is given in BS 5345-7.

NOTE 3 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard, the following definitions apply. Definitions which are identical, or technically identical, with those given in BS 4727, PD 6499 and BS 5501-1 are identified by †, ‡, * respectively.

2.1 electrical apparatus*

all items applied as a whole or in part for the utilization of electrical energy. These include, among others, items for the generation, transmission, distribution, storage, measurement, regulation, conversion, and consumption of electrical energy and items for telecommunications

2.2 explosive atmosphere*

a mixture with air, under atmospheric conditions, of flammable substances in the form of gas, vapour or mist, in such proportions that it can be exploded by excessive temperature, arcs or sparks

2.3 type of protection*

the measures applied in the construction of electrical apparatus to prevent ignition of the surrounding explosive atmosphere by such apparatus

2.4 type of protection N

type of protection applied to electrical apparatus such that, in normal operation, it is not capable of igniting a surrounding explosive atmosphere and a fault capable of causing ignition is not likely to occur

2.5 enclosure*

all the walls which surround the live parts of electrical apparatus including doors, covers, cable entries, rods, spindles and shafts, and which ensure the protection of the electrical apparatus

2.6 degree of protection by enclosure*

the measures applied to the enclosures of electrical apparatus to ensure:

- a) the protection of persons against contact with live or moving parts inside the enclosure and protection of the apparatus against ingress of solid foreign bodies;
- b) the protection of the apparatus against ingress of liquids

2.7**restricted breathing enclosure**

enclosure that is designed to restrict the entry of gases

2.8**enclosed break device**

device incorporating electrical contacts that are made and broken that will withstand an internal explosion of the flammable gas or vapour which may enter it without suffering damage and without communicating the internal explosion to the external flammable gas or vapour

2.9**non-incendive part**

part with contacts for making and breaking a potentially-incendive circuit where either the contacting mechanism or the enclosure in which the contacts are housed is so constructed that ignition of the prescribed flammable gas or vapour is prevented under specified operating conditions

a non-incendive part is limited in use to the particular circuit for which it has been shown to be non-ignition capable and, therefore, cannot be separately assessed as complying with this standard

2.10**hermetically-sealed device**

device which is so constructed that the external atmosphere cannot gain access to the interior and in which the seal is made by fusion, e.g. by soldering, brazing, welding or the fusion of glass to metal

2.11**sealed device**

device which is so constructed that it cannot be opened during normal service and is sealed effectively to prevent entry of an external atmosphere

2.12**encapsulated device**

device, which may or may not contain voids, which is so constructed that it is totally immersed in an encapsulating compound so that it is sealed to prevent entry of an external atmosphere

2.13**maximum surface temperature***

the highest temperature which is attained in service under the most unfavourable conditions (but within the tolerances) by any part or surface of an electrical apparatus, which is able to produce an ignition of the surrounding atmosphere

NOTE The most unfavourable conditions are those covered by normal operation.

2.14**normal operation**

the operation of apparatus conforming electrically and mechanically with its design specification and used within the limits specified by the manufacturer

NOTE The limits specified by the manufacturer may include persistent operational conditions such as stalled rotors, failed lamps, and overloads.

2.15**energy limitation**

concept applicable to circuits in which no spark or any thermal effect produced in the test conditions prescribed in this standard is capable of causing ignition of a given flammable gas or vapour

2.16**explosive mixture***

a specific mixture used for testing electrical apparatus for potentially explosive atmospheres

2.17**terminal compartment***

a separate compartment or part of a main enclosure, communicating or not with the main enclosure, and containing connection facilities

2.18**connection facilities***

terminals, screws and other parts, used for the electrical connection of conductors of external circuits

2.19**cable entry***

a device permitting the introduction of an electric cable into an electrical apparatus

2.20**conduit entry***

a means of introducing a conduit into an electrical apparatus

2.21**stopping box**

a device to restrict the flow of a gas or a liquid between apparatus and a conduit

2.22**rated value**

a quantity value assigned, generally by a manufacturer for a specified operating condition of a component, to a device or equipment

2.23**rating***

the set of rated values and operating conditions

2.24**duty cycle†**

variation of load with time which may or may not be repeated and in which the cycle time is too short for thermal equilibrium to be attained

2.25**creepage distance‡**

shortest distance along the surface of the insulating material between two conductive parts

NOTE A joint between two pieces of insulating material is considered part of the surface.

2.26**separation**

shortest distance through solid insulating material between two conductive parts

2.27**clearance‡**

shortest distance in air between two conductive parts

2.28**portable apparatus**

apparatus that can be moved while in operation or that can easily be moved from one place to another ready for use while connected to the supply

3 General requirements**3.1 Potential ignition sources**

The apparatus shall not in normal operation:

- produce an operational arc or spark unless that arc or spark is prevented from causing ignition of a surrounding explosive atmosphere by one of the methods described in clause 9;
- develop a maximum surface temperature in excess of the maximum value appropriate to the temperature classification of the apparatus, unless the temperature of the surface or hot spot is prevented from causing ignition of a surrounding explosive atmosphere by one of the methods described in clause 9 as appropriate, or is otherwise shown to be safe as specified in 3.3.2.

NOTE Contacts with provision for sliding are considered as sparking in normal operation unless precautions are taken such as clamping of the contact itself to the conductive track.

3.2 Apparatus group

Apparatus is Group II and shall be Group IIA, IIB or IIC when specified in this standard.

Where electrical apparatus is for use only in a particular gas, it shall be marked with the symbol II followed by the name or chemical formula of the gas (see clause 10).

NOTE For the purposes of this standard, the allocation of gases is as for the apparatus groupings in BS 5345-1.

3.3 Maximum surface temperature

3.3.1 Except for the internal parts of enclosed-break devices, restricted-breathing enclosures, hermetically-sealed devices, lamps, sealed devices or components or apparatus complying with 3.3.2 a) or b), the temperature of any external or internal surface to which the surrounding atmosphere has access shall not exceed the maximum surface temperature given in Table 1 for the temperature class or the maximum surface temperature marked on the apparatus (see clause 10). The temperature shall be measured with the apparatus in the most unfavourable conditions and at the most unfavourable voltage within the range of 90 % to 110 % of the rated voltage of the electrical apparatus unless other British Standards for normal industrial applications prescribe values outside this range.

Table 1 — Classification of maximum surface temperatures

Class	Maximum surface temperature
	°C
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85
NOTE These values are identical to those given in BS 4683-1 and BS 5501-1.	

3.3.2 The maximum surface temperature of the electrical apparatus shall be below the lowest ignition temperature of the explosive gas atmosphere for which the electrical apparatus is designed, subject to the following exceptions.

- Components having a total surface area of less than 10 cm², e.g. transistors or resistors, where the surface temperature may exceed that for the temperature class marked on the electrical apparatus by 50 K for T5 or 65 K for T4.
- Apparatus, where surface temperatures higher than indicated by the marked temperature classification are permissible, provided that it is shown by test that the maximum surface temperature is at least 50 K below the lowest temperature at which ignition of the specified explosive gas-air mixture or mixtures will occur under the intended conditions of use. This is valid only for the flammable gases and vapours specified in the documentation for the apparatus (see also clause 10).

NOTE During the test, the safety margins may be provided by increasing the ambient temperature.

3.4 Adverse service conditions

If the electrical apparatus has to withstand particular adverse service conditions, e.g. mechanical, electrical, thermal and chemical effects, these shall be specified by the purchaser and appropriate measures agreed between the purchaser and the manufacturer.

4 Constructional requirements

4.1 Degree of protection

4.1.1 The enclosure of the apparatus, when tested in accordance with appendix A, shall provide at least the degree of protection described in a) or b) unless safety would not be impaired by contact with solid foreign bodies or liquids (for example, strain gauges, resistance thermometers, thermocouples) in which case the documentation (see clause 11) shall explain why and shall prescribe any special installation requirements which may be necessary in which case the apparatus shall be marked with the symbol “X” (see clause 10):

- a) IP 54 where there are bare live parts or IP 44 where there are insulated live parts;
- b) IP 4X where there are bare live parts or IP 2X where there are insulated live parts and the apparatus is intended for installation only in locations providing adequate protection against the entry of solid foreign bodies or liquids capable of impairing safety, and the apparatus is marked with the symbol “X” (see clause 10).

A higher degree of protection shall apply to specific types of apparatus where indicated in this standard.

NOTE An enclosure may comprise one or a combination of the following: an hermetically-sealed enclosure, a restricted breathing enclosure, or an enclosure which is not restricted breathing.

4.1.2 Where the degree of protection provided by the enclosure depends on a gasketed joint, gaskets shall be attached or secured to one of the mating faces to prevent loss, damage or incorrect assembly. The gasket material shall not adhere to the joint faces.

NOTE 1 An adhesive may be used for attaching a gasket to one of the mating faces.

NOTE 2 Gasket materials should be resistant to ageing.

4.2 Mechanical strength

Enclosures shall be capable of satisfying the criteria for compliance of the impact test given in appendix B. Portable apparatus shall additionally be capable of satisfying the criteria for compliance of the drop test given in appendix B. Apparatus shall be marked with the symbol “X” when required by the method of test.

4.3 Guards

Every guard provided for the protection of a light-transmitting part or window shall have a maximum mesh size of 50 mm × 50 mm.

4.4 Circulating currents

Precautions shall be taken where necessary to guard against the occurrence of sparks due to the presence of circulating currents caused by stray magnetic fields.

NOTE Precautions may include the provision of bonding between parts of the enclosure and provision of an adequate quantity of bolts for bolted parts of enclosures.

5 Connection facilities and wiring

5.1 General

The contact pressure at terminals shall not be dependent on the presence of insulating materials.

5.2 Connection of external conductors (including protective conductors)

5.2.1 Electrical apparatus which is intended for connection to external circuits shall include connection facilities except for electrical apparatus which is manufactured with a permanently attached cable. The connection facilities shall be so designed that the conductors can be readily connected to the terminals and can be clamped in such a manner that they are gripped and secured against twisting and loosening, and that the contact pressure is maintained.

NOTE 1 Terminals which rely on friction alone for their integrity against loosening may be used.

For terminals suitable for cable lugs means shall be provided for preventing accidental reduction of clearances.

NOTE 2 This may be achieved by the use of insulating barriers at least as high as the terminals or by insulating the shanks of lugs.

5.2.2 Connection facilities shall accommodate at least the size of conductor appropriate to the rated current of the equipment.

NOTE System conditions (voltage drop, fault level, etc.) may make it necessary to provide terminals suitable for larger conductors than are required by thermal considerations.

5.2.3 Cable and conduit entries shall be constructed and mounted so that they do not alter the specific characteristics of the electrical apparatus on which they are mounted. This shall apply to the whole range of cable diameters specified by the manufacturer of the cable entries as suitable for use with those cable entries.

The cable entries shall provide for:

- a) passage of the cable through the enclosure wall without damage to the cable; and
- b) if necessary, clamping of the cable and the bonding of the metal armouring, sheath or screen.

Entries for flexible cables shall have no sharp edges capable of damaging the cable when it is moved through an angle of 90° in any direction with respect to the axis of the entry. The entry point shall be rounded so that the radius of curvature of the cable cannot be less than a quarter of the diameter of the maximum size cable allowed for the entry.

In the case of portable apparatus any cable entry shall satisfy the appropriate clamping requirements of BS 5501-1.

5.2.4 Conduit entries shall screw into threaded holes or be locked in plain holes situated:

- a) in the wall of the enclosure; or
- b) in an adaptor plate designed to be fitted in or on the walls of the enclosure; or
- c) in a suitable stopping box, integral with or attached to the wall of the enclosure.

5.2.5 Where the temperature under rated conditions is expected to exceed 70 °C at the cable or conduit entry point, or 80 °C at the branching point of the conductors, a label shall be provided on the outside of the electrical apparatus as a guide for the user for the selection of the cable, or of the wiring in the conduit.

In the case of multiple sources of heat, where a diversity factor is applied, it shall be stated in the documentation (see clause 11).

5.3 Internal connections

Internal connections shall not be subject to undue mechanical stress. They shall be such that contact pressure is maintained. Examples are:

- a) screwed or bolted connections;
- b) crimped connections;
- c) soldering;
- d) brazing;
- e) welding;
- f) pinching screws, provided that the pinching screws are prevented from damaging the conductors, e.g. by means of ferrules or pressure plates;
- g) machine-wrapped joints (for currents not greater than 1 A);
- h) pressure-type wire connectors;
- i) plugs and sockets (see 5.5).

5.4 Internal wiring

Internal wiring shall be prevented from risks of contact with, and chafing against, sharp metallic parts by mechanical protection or clamping.

5.5 Plugs and sockets

5.5.1 Plugs and sockets and similar connectors for internal connections shall be deemed to be normally sparking unless they require a separating force of at least 15 N, or they are prevented by mechanical means from loosening or separating.

5.5.2 Connectors for internal connections shall be arranged or identified in such a manner that incorrect connection is unlikely.

5.5.3 Plugs and sockets for external connections shall be either:

- a) electrically or mechanically interlocked so that separation cannot occur whilst the contacts are energized and so that the contacts cannot be energized whilst the plug and socket are separated; or
- b) secured together by fasteners or locking devices and bear a warning label "DO NOT CONNECT OR DISCONNECT WHEN ENERGIZED".

The fixed part of a plug and socket connector shall maintain the degree of protection of the enclosure on which it is mounted even when the movable part has been removed.

NOTE The fixed part of a plug and socket connector should be arranged so as to avoid accumulation of dust when the movable part has been removed.

6 Electric strength

6.1 Insulation from earth or frame

Where the electrical circuits within the apparatus are not connected directly to the frame of the apparatus or not intended to be connected to the frame in service, the insulation or separation distance used shall be capable of withstanding the following test voltages for 1 min + 5 %, – 0 %:

- a) for apparatus supplied with voltages not exceeding 90 V peak or in which internal voltages not exceeding 90 V peak are present, 500 V r.m.s. + 5 %, – 0 %;
- b) for other apparatus, or where internal voltages in excess of 90 V peak are present, $(1\,000 + 2U^{1})$ V r.m.s. or 1 500 V r.m.s., whichever is the greater, with a tolerance of + 5 %, – 0 %.

For apparatus with galvanically separated parts the test voltages shall be applied separately, at the appropriate voltage, to each part.

¹⁾ *U* is the higher of the nominal supply voltage or the maximum voltage occurring within the apparatus.