

Electrical apparatus for potentially explosive atmospheres — General requirements

The European Standard EN 50014:1997, with the incorporation of amendments A1:1999 and A2:1999, has the status of a British Standard

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National foreword

This British Standard is the English language version of EN 50014:1997, including Corrigendum April 1998 and amendments A1:1999 and A2:1999. It partially supersedes BS EN 50014:1993, which is an identical standard to the second edition of EN 50014 published by CENELEC in 1992.

There are many subordinate standards in existence which give particular requirements for different types of protection, and which refer to BS EN 50014:1993. Only when all the subordinate standards have either been withdrawn or revised and published by CENELEC, will it be possible to withdraw BS EN 50014:1993. These subordinate standards are quoted in clause 1 of this standard.

The UK participation in its preparation was entrusted to Technical Committee GEL/31, Electrical apparatus for explosive atmospheres, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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English version

Electrical apparatus for potentially explosive atmospheres General requirements

(includes amendments A1:1999 and A2:1999)

Matériel électrique pour atmosphères explosibles —
Règles générales
(inclut les amendements A1:1999 et A2:1999)

Elektrische Betriebsmittel für explosionsgefährdete
Bereiche — Allgemeine Bestimmungen
(enthält Änderungen A1:1999 und A2:1999)

This European Standard was approved by CENELEC on 1996-12-09; amendment A1 was approved by CENELEC on 1998-08-01; amendment A2 was approved by CENELEC on 1998-10-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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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

Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 31, Electrical apparatus for explosive atmospheres – General requirements. It consists of the text of EN 50014:1992 and an amendment to this second edition which was submitted to the unique acceptance procedure and approved by CENELEC on 1996-12-09 for inclusion into an “editorial” third edition of the standard.

The European Standard was prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of the EC Directive 94/9/EC. This European Standard is to be read in conjunction with editions published during and after 1997 of the European Standards for specific types of protection listed in the scope of this standard. It does not apply to the editions of those standards and their amendments published before 1997.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1997-12-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow)

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given only for information. In this standard, annexes B and C are normative; annexes A, D and E are informative.

Foreword to amendment A1

This amendment was prepared by Technical Committee CENELEC TC 31, Electrical apparatus for explosive atmospheres — General requirements. The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as amendment A1 to EN 50014:1997 on 1998-08-01.

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- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) —

Foreword to amendment A2

This amendment was prepared by Technical Committee CENELEC TC 31, Electrical apparatus for explosive atmospheres — General requirements. The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as amendment A2 to EN 50014:1997 on 1998-10-01.

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GENERAL

1 Scope

1.1 This European Standard specifies the general requirements for construction, testing and marking of:

- electrical apparatus;
- Ex cable entries;
- Ex components;

intended for use in potentially explosive atmospheres of gas, vapour and mist.

Potentially explosive atmospheres include the presence of combustible dusts.

Except where otherwise stated in the supplementary standards, this standard and the related standards provide protection in accordance with Category 2 or Category M2.

1.2 This European Standard is supplemented or modified by the following European Standards concerning the specific types of protection:

- EN 50015, *Oil immersion “o”*.
- EN 50016, *Pressurization “p”*.
- EN 50017, *Powder filling “q”*.
- EN 50018, *Flameproof enclosure “d”*.
- EN 50019, *Increased safety “e”*.
- EN 50020, *Intrinsic safety “i”*.
- EN 50028, *Encapsulation “m”*.
- EN 50033, *Caplights for mines susceptible to firedamp*.
- EN 50039, *Intrinsically safe electrical systems “i”*.

1.3 The above European Standards and this European Standard are not applicable to the construction of electromedical apparatus, shot-firing exploders, test devices for exploders and for shot-firing circuits.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- EN 50015, *Electrical apparatus for potentially explosive atmospheres — Oil immersion “o”*.
- EN 50016, *Electrical apparatus for potentially explosive atmospheres — Pressurization “p”*.
- EN 50017, *Electrical apparatus for potentially explosive atmospheres — Powder filling “q”*.
- EN 50018, *Electrical apparatus for potentially explosive atmospheres — Flameproof enclosure “d”*.
- EN 50019, *Electrical apparatus for potentially explosive atmospheres — Increased safety “e”*.
- EN 50020, *Electrical apparatus for potentially explosive atmospheres — Intrinsic safety “i”*.

EN 50028, *Electrical apparatus for potentially explosive atmospheres — Encapsulation “m”*.

EN 50033, *Electrical apparatus for potentially explosive atmospheres — Caplights for mines susceptible to firedamp*.

EN 50039, *Electrical apparatus for potentially explosive atmospheres — Intrinsically safe electrical systems “i”*.

EN 50281-1-1, *Electrical apparatus for use in the presence of combustible dust — Part 1-1: Electrical apparatus protected by enclosures — Construction and testing*.

EN 60034-5:1986, *Rotating electrical machines — Part 5: Classification of degrees of protection provided by enclosures for rotating machines*. (Modified IEC 345:1981)

EN 60423:1994, *Conduits for electrical purposes — Outside diameters of conduits for electrical installations and threads for conduits and fittings*. (IEC 60423:1993, modified)

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

EN 60662:1993, *High pressure sodium vapour lamps*. (Modified IEC 662:1980 +A2:1987 +A3:1990)

EN 60192: 1993, *Low pressure sodium vapour lamps*. (IEC 192:1973 +A1:1979 +A2:1988 +A3:1992)

HD 611.1 S1:1992, *Guide for the determination of thermal endurance properties of electrical insulating materials — Part 1: General guidelines for ageing and evaluation of test results*. (IEC 216-1:1990)

HD 611.2 S1:1992, *Guide for the determination of thermal endurance properties of electrical insulating materials — Part 2: List of materials and available tests*. (IEC 2162:1990)

IEC 79-1A:1975, *First supplement to IEC 79-1 (1971) Electrical apparatus for explosive gas atmospheres — Part 1: Construction and test of flameproof enclosures of electrical apparatus: Appendix D: Method of test for ascertainment of maximum experimental safe gap*.

IEC 79-4:1975, *Electrical apparatus for explosive gas atmospheres — Part 4: Method of test for ignition temperature*.

IEC 60050(486):1991, *International Electrotechnical Vocabulary. Chapter 486: Secondary cells and batteries*.

ISO 48:1979, *Vulcanized rubbers — Determination of hardness (Hardness between 30 and 85 IRHD)*.

ISO 178:1993, *Plastics — Determination of flexural properties of rigid plastics*.

ISO 179:1993, *Plastics — Determination of Charpy impact strength of rigid materials*.

ISO 262:1973, *ISO general purpose metric screw threads — Selected sizes for screws, bolts and nuts*.

ISO 286-2:1988, *ISO system of limits and fits — Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts*.



ISO 426-2:1983, *Wrought copper–zinc alloys — Chemical composition and forms of wrought products — Part 2: Lead copper–zinc alloys.*

ISO 527:1993, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics.*

ISO 965-1:1980, *ISO general purpose metric screw threads — Tolerances — Part 1: Principles and basic data.*

ISO 965-2:1980, *ISO general purpose metric screw threads — Tolerances — Part 2: Limits of sizes for general purpose bolt and nut threads — Medium quality.*

ISO 1817:1985, *Rubber, vulcanized — Determination of the effect of liquids.*

ISO 1818:1975, *Vulcanized rubbers of low hardness (10 to 35 IRHD) — Determination of hardness.*

ISO 4014:1988, *Hexagon head bolts — Product grades A and B.*

ISO 4017:1988, *Hexagon head screws — Product grades A and B.*

ISO 4026:1993, *Hexagon socket set screws with flat point.*

ISO 4027:1993, *Hexagon socket set screws with cone point.*

ISO 4028:1993, *Hexagon socket set screws with dog point.*

ISO 4029:1993, *Hexagon socket set screws with cup point.*

ISO 4032:1986, *Hexagon nuts, style 1 — Product grades A and B.*

ISO 4762:1989, *Hexagon socket head cap screws — Product grade A.*

ISO 4892-1:1994, *Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance.*

3 Definitions and symbols

For the purpose of this European Standard and the European Standards listed in 1.2, the following definitions apply.

3.1

electrical apparatus

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

3.2

potentially explosive atmosphere

an atmosphere which could become explosive (the danger is a potential one)

3.3

explosive gas atmosphere

a mixture with air, under atmospheric conditions, of flammable substances in the form of gas, vapour or mist, in which after ignition, combustion spreads throughout the unconsumed mixture

3.4

explosive test mixture

a specified explosive mixture used for the testing of electrical apparatus for potentially explosive atmospheres

3.5

ignition temperature of an explosive gas atmosphere

the lowest temperature of a heated surface at which, under specified conditions according to IEC 79-4, the ignition of a flammable substance in the form of a gas or vapour mixture with air will occur

3.6

service temperature

the temperature reached when the apparatus is operating at its rating

3.7

maximum service temperature

the highest value of the service temperatures

NOTE Each apparatus may reach different service temperatures in different parts.

3.8

maximum surface temperature

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

NOTE 1 The manufacturer will prescribe the product standard and also in his particular design he should take into account the following other conditions:

- fault conditions specified in the standard for the types of protection concerned;
- all operating conditions specified in any other standard specified by him, including recognized overloads;
- any other operating condition specified by him.

NOTE 2 The relevant surface temperature may be internal or external depending upon the type of protection concerned.

3.9

enclosure

all the walls, doors, covers, cable entries, rods, spindles, shafts, etc., which contribute to the type of protection of and/or the degree of protection IP of the electrical apparatus

3.10

type of protection

the specific measures applied to electrical apparatus to avoid ignition of a surrounding explosive atmosphere

3.11

degree of protection of enclosure (IP)

a numerical classification according to EN 60529, preceded by the symbol “IP” applied to the enclosure of electrical apparatus to provide for:

- protection of persons against contact with or approach to live parts and against contact with moving parts (other than smooth rotating shafts and the like) inside the enclosure; and
- protection of the electrical apparatus against ingress of solid foreign objects; and, where indicated by the classification;
- protection of the electrical apparatus against harmful ingress of water.

NOTE The enclosure that provides the degree of protection IP is not necessarily identical to the apparatus enclosure for the types of protection listed in 1.2.

3.12

rated value

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

3.13

rating

the set of rated values and operating conditions

3.14

cable entry

a device permitting the introduction of one or more electric and/or fibre optic cables into an electrical apparatus so as to maintain the relevant type of protection

3.15

Ex cable entry

a cable entry tested separately from the apparatus enclosure but certified as an apparatus and which can be fitted to the apparatus enclosure during installation without further certification

3.16

conduit entry

a means of introducing a conduit into an electrical apparatus so as to maintain the relevant type of protection

3.17

compression element

an element of a cable entry acting on the sealing ring to enable the latter to fulfil its function

3.18

clamping device

an element of a cable entry for preventing tension or torsion in the cable from being transmitted to the connections

3.19

sealing ring

a ring used in a cable or conduit entry to ensure the sealing between the entry and the cable or conduit

3.20

terminal compartment

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

3.21

connection facilities

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

3.22

bushing

an insulating device carrying one or more conductors through an internal or external wall of an enclosure

3.23

Ex component

a part of electrical apparatus or a module (other than an Ex cable entry), marked with the symbol “U”, which is not intended to be used alone and requires additional certification when incorporated into electrical apparatus or systems for use in potentially explosive atmospheres

3.24

“X” symbol

the symbol used as a suffix to a certificate reference to denote special conditions for safe use

3.25

“U” symbol

the symbol used as a suffix to a certificate reference to denote an Ex component

NOTE The symbols “X” and “U” should not be used together.

3.26

equipment Group I Category M1

equipment designed, and, where necessary, equipped with additional special means of protection to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a very high level of protection

equipment in this category is intended for use in underground parts of mines as well as those parts of surface installations of such mines endangered by fire damp and/or combustible dust

equipment in this category is required to remain functional, even in the event of rare incidents relating to equipment, with an explosive atmosphere present, and is characterized by means of protection such that:

- either, in the event of failure of one means of protection, at least an independent second means provides the requisite level of protection; or
- the requisite level of protection is assured in the event of two faults occurring independently of each other

3.27

equipment Group I Category M2

equipment designated to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a high level of protection

equipment in this category is intended for use in underground parts in mines as well as those parts of surface installations of such mines likely to be endangered by fire damp and/or combustible dust

this equipment is intended to be de-energized in the event of an explosive atmosphere

the means of protection relating to equipment in this category assure the requisite level of protection during normal operation and also in the case of more severe operating conditions, in particular those arising from rough handling and changing environmental conditions

3.28

equipment Group II Category 1

equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a very high level of protection

equipment in this category is intended for use in areas in which explosive atmospheres caused by mixtures of air and gases, vapours or mists or by air/dust mixtures are present continuously, for long periods or frequently equipment in this category must ensure the requisite level of protection, even in the event of rare incidents relating to equipment, and is characterized by means of protection such that:

- either, in the event of failure of one means of protection, at least an independent second means provides the requisite level of protection; or
- the requisite level of protection is assured in the event of two faults occurring independently of each other

3.29

equipment Group II Category 2

equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and of ensuring a high level of protection. Equipment in this category is intended for use in areas in which explosive atmospheres caused by gases, vapours, mists or air/dust mixtures are likely to occur

the means of protection relating to equipment in this category ensure the requisite level of protection, even in the event of frequently occurring disturbances or equipment faults which normally have to be taken into account

3.30

equipment Group II Category 3

equipment designed to be capable of functioning in conformity with the operating parameters established by the manufacturer and ensuring a normal level of protection

equipment in this category is intended for use in areas in which explosive atmospheres caused by gases, vapour, mists, or air/dust mixtures are unlikely to occur or, if they do occur, are likely to do so only infrequently and for a short period only

equipment in this category ensures the requisite level of protection during normal operation

NOTE In this standard the word “apparatus” has the same meaning as the word “equipment” used in the Directive 94/9/EC.

3.31

component

any item essential to the safe functioning of equipment and protective systems but with no autonomous function

NOTE In this standard the words “Ex component” have the same meaning as the word “component” used in the Directive 94/9/EC.

3.32

cell

an assembly of electrodes and electrolyte which constitutes the smallest electrical unit of a battery

3.33

primary cell or battery

an electrochemical system capable of producing electrical energy by chemical reaction

3.34

secondary cell or battery

an electrically rechargeable electrochemical system capable of storing electrical energy and delivering it by chemical reaction

3.35

open cell or battery

a secondary cell, or battery, having a cover provided with an opening through which gaseous products may escape
[IEC 486-01-18]

3.36

sealed valve regulated cell or battery

a cell or battery which is closed under normal conditions, but which has an arrangement which allows the escape of gas if the internal pressure exceeds a predetermined value. The cell cannot normally receive an addition to the electrolyte
[IEC 486-01-20/1]

3.37

sealed gas tight cell or battery

a cell or battery which remains closed and does not release either gas or liquid when operated within the limits of charge or temperature specified by the manufacturer

NOTE 1 Such cells and batteries may be equipped with a safety device to prevent dangerously high internal pressure. The cell or battery does not require addition to the electrolyte and is designed to operate during its life in its original sealed state.

NOTE 2 The above definition is taken from EN 50020. It differs from the definition in IEC 481-01-20/1 by virtue of the fact that it applies to either a cell or battery

3.38

battery

an assembly of two or more cells electrically connected to each other to increase the voltage or capacity

3.39

capacity

the quantity of electricity or electrical charge, which a fully charged battery can deliver under specified conditions

3.40

nominal voltage

(of a cell or battery) is that specified by the manufacturer

3.41

maximum open circuit voltage

(of a cell or battery) is the maximum attainable voltage under normal conditions, that is, from either a new primary cell, or a secondary cell just after a full charge. (See the tables in 22.3.1.2 which show the maximum open circuit voltage for acceptable cells)

3.42

charging

the act of forcing current through a secondary cell or battery in the opposite direction to the normal flow to restore the energy stored originally

3.43

reverse charging

the act of forcing current through either a primary cell or secondary cell in the same direction as the normal flow e.g. in an expired battery

3.44

deep discharge

refers to an event which reduces a cell voltage below that recommended by the cell or battery manufacturer

3.45

inherently safe (lhs) cell (or battery)

a primary cell or battery in which the short circuit current and maximum surface temperature are limited to a safe value by its internal resistance

REQUIREMENTS FOR ALL ELECTRICAL APPARATUS

4 Apparatus grouping and temperature classification

4.1 Electrical apparatus for potentially explosive atmospheres is divided into:

- Group I: Electrical apparatus for mines susceptible to fire damp;
- Group II: Electrical apparatus for places with a potentially explosive atmosphere, other than mines susceptible to fire damp.

Electrical apparatus intended for mines where the atmosphere, in addition to fire damp, may contain significant proportions of other flammable gases (i.e. other than methane), shall be constructed and tested in accordance with the requirements relating to Group I and also to the subdivision of Group II corresponding to the other significant flammable gases. This electrical apparatus shall then be marked appropriately [for example “EEx d I/IIB T3” or “EEx d I/II (NH₃)”].

4.2 Electrical apparatus of Group II may be subdivided according to the nature of the potentially explosive atmosphere for which it is intended.

4.2.1 For the types of protection “d” flameproof enclosure, or “i” intrinsic safety, electrical apparatus of Group II is subdivided into IIA, IIB and IIC as required in the specific European Standards concerning those types of protection.

NOTE 1 This subdivision is based on the maximum experimental safe gap (MESG) for flameproof enclosures or the minimum ignition current (MIC) for intrinsically safe electrical apparatus (see annex A).

NOTE 2 Apparatus marked IIB is suitable for applications requiring Group IIA apparatus. Similarly, apparatus marked IIC is suitable for applications requiring Group IIA or Group IIB apparatus.

4.2.2 For all types of protection, apparatus of Group II shall be marked as a function of its maximum surface temperature according to 5.1.2.

4.3 The electrical apparatus may be tested for a particular explosive atmosphere. In this case it shall be certified and marked accordingly.

5 Temperatures

5.1 Maximum surface temperature

5.1.1 For electrical apparatus in Group I the maximum surface temperature shall be specified in relevant documentation according to 23.2.

This maximum surface temperature shall not exceed:

- 150 °C on any surface where coal dust can form a layer;
- 450 °C where coal dust is not expected to form a layer (for example due to sealing or ventilation), provided:

- a) the actual maximum surface temperature is marked on the apparatus; or
- b) the symbol “X” is placed after the certificate reference to indicate the conditions for safe use.

NOTE When choosing electrical apparatus of Group I, the user should take into account the influence and the smouldering temperature of coal dusts if they are likely to be deposited in a layer on surfaces with temperatures above 150 °C.

5.1.2 Group II electrical apparatus shall be arranged and marked according to 27.2f) and shall be either:

- preferably classified in a temperature class given in Table 1; or
- defined by the actual maximum surface temperature; or
- if appropriate, defined by the specific gas for which it is intended.

Table 1 — Classification of maximum surface temperatures for Group II electrical apparatus

Temperature class	Maximum surface temperature °C
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

5.2 Ambient temperatures

Electrical apparatus shall normally be designed for use in the ambient temperature range between -20°C and $+40^{\circ}\text{C}$; in this case no additional marking is necessary.

When the electrical apparatus is designed for use in a different range of ambient temperatures, it is considered to be special; the ambient temperature range shall then be stated by the manufacturer and specified in the certificate; the marking shall then include either the symbol T_a or T_{amb} together with the special range of ambient temperatures or, if this is impracticable, the symbol “X” shall be placed after the certificate reference, according to 27.2i) of this European Standard (see Table 2).

Table 2 — Ambient temperatures in service and additional marking

Electrical apparatus	Ambient temperature in service	Additional marking
Normal	Maximum: $+40^{\circ}\text{C}$ Minimum: -20°C	none
Special	Special range stated by the manufacturer and specified in the certificate	T_a or T_{amb} with the special range, for example $-30^{\circ}\text{C} \leq T_a \leq 40^{\circ}\text{C}$ or the symbol “X”

5.3 Surface temperature and ignition temperature

The lowest ignition temperature of the explosive atmospheres concerned shall be above the maximum surface temperature. However, for components having a total surface area of not more than 10 cm^2 , their surface temperature may exceed that for the temperature class marked on the electrical apparatus for Group II or the corresponding maximum surface temperature for Group I, if there is no risk of ignition from these components, with a safety margin of:

50 K for T1, T2 and T3;

25 K for T4, T5 and T6 and Group I.

This safety margin shall be ensured by experience of similar components or by tests of the electrical apparatus itself in representative explosive mixtures.

NOTE During the tests, the safety margin may be provided by increasing the ambient temperature.

More specific relaxation for the surface temperature of small components such as are used in “i” circuits, are given in EN 50020.

6 General

6.1 Electrical apparatus for use in potentially explosive atmospheres shall:

- a) comply with the requirements of this European Standard as modified by the specific European Standards for the type(s) of protection as listed in 1.2;

NOTE If the electrical apparatus has to withstand particularly adverse service conditions (e.g. rough handling, humidity effects, ambient temperature variations, effects of chemical agents, corrosion) these should be specified to the manufacturer by the user and are not the responsibility of the testing station.

- b) be constructed in accordance with the principles of good engineering practice in safety matters. The manufacturer shall under his own responsibility indicate compliance by marking the electrical apparatus (in accordance with clause 25), and the testing station is not required to verify compliance.

6.2 Enclosures which can be opened more quickly than the time necessary:

- to allow incorporated capacitors, charged by a voltage of 200 V or more, to discharge to a value of residual energy of:
 - 0,2 mJ for electrical apparatus of Group I and Group IIA; or
 - 0,06 mJ for electrical apparatus of Group IIB; or
 - 0,02 mJ for electrical apparatus of Group IIC; or
 - double the above energy levels if the charging voltage is less than 200 V; or
- to allow the cooling of enclosed hot components to a surface temperature below the temperature class of the electrical apparatus,

shall be marked with the warning:

“AFTER DE-ENERGIZING, DELAY X MINUTES BEFORE OPENING”

“X” being the value in minutes of the delay required.

Alternatively, the apparatus may be marked with the warning:

“DO NOT OPEN WHEN AN EXPLOSIVE GAS ATMOSPHERE MAY BE PRESENT”.

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

The following requirements, also those of **23.4.7**, apply to:

- non-metallic enclosures;
- non-metallic parts of enclosures, on which the type of protection depends.

However, for sealing rings (see **3.19**) on which the type of protection depends the proof furnished according to **B.3.3** is sufficient.

7.1 Definition of the material

7.1.1 The documents according to **23.2** shall define both the material and the manufacturing process of the enclosure or part of the enclosure.

7.1.2 For plastics materials, the definition shall include:

- the name of the manufacturer of the material;
 - the exact and complete reference of the material, its colour, as well as the kind and percentage of fillers and other additives when they are included;
- NOTE A standard ISO number should be used where possible.
- the possible surface treatments, such as varnishes, etc.;
 - the temperature index “TI”, corresponding to the 20 000 h point on the thermal endurance graph without loss of flexing strength exceeding 50 % determined in accordance with HD 611.1 S1 and HD 611.2 S1 and based on the flexing property in accordance with ISO 178. If the material does not break in this test before exposure to the heat, the index shall be based on the tensile strength in accordance with ISO 527-2 with test bars of type 1A or 1B.

The data by which these characteristics are defined shall be supplied by the manufacturer.

7.1.3 The testing station is not required to verify compliance of the material with its definition.

7.2 Thermal endurance

The plastics materials shall have a temperature index “TI” corresponding to the 20 000 h point (see **7.1.2**) of at least 20 K greater than the temperature of the hottest point of the enclosure or the part of the enclosure (see **23.4.6.1**), having regard to the maximum ambient temperature in service (see **5.2**).

The endurance to heat and to cold of the enclosures, or parts of enclosures, of plastics materials shall be satisfactory (see **23.4.7.3** and **23.4.7.4**).

7.3 Electrostatic charges of enclosures or parts of enclosures of plastics material

The following requirements apply only to plastics enclosures, to plastics parts of enclosures and to other exposed plastics parts of electrical apparatus for:

- non-fixed electrical apparatus;
- fixed apparatus with plastics parts that are likely to be rubbed or cleaned on site.

7.3.1 Electrical apparatus of Group I

Enclosures of plastics material with surface area projected in any direction of more than 100 cm², shall be so designed that under normal conditions of use, maintenance and cleaning, danger of ignition due to electrostatic charges is avoided.

This requirement shall be satisfied by suitable selection of the material so that the insulation resistance, measured according to the method given in **23.4.7.8** of this European Standard does not exceed 1 GΩ (at $(23 \pm 2)^\circ\text{C}$ and $(50 \pm 5)\%$ relative humidity, or by virtue of the size, shape and layout, or other protective methods, such that dangerous electrostatic charges are not likely to occur.

If, however, the danger of ignition cannot be avoided in the design, a warning label shall indicate the safety measures to be applied in service.

NOTE 1 When selecting electrical insulating materials attention should be paid to maintaining a minimum insulation resistance to avoid problems arising from touching exposed plastics parts that are in contact with live parts.

NOTE 2 Further restrictions may apply to plastics enclosures for use in areas where an explosive gas atmosphere is present continuously or is present for long periods.

7.3.2 Electrical apparatus of Group II

Enclosures shall be so designed that under normal conditions of use, maintenance and cleaning, danger of ignition due to electrostatic charges is avoided. This requirement shall be satisfied by any one of a) or b) or c) below:

- a) suitable selection of the material so that the insulation resistance of the enclosure, measured in accordance with **23.4.7.8** (of this European Standard), does not exceed 1 GΩ at $(23 \pm 2)^\circ\text{C}$ and $(50 \pm 5)\%$ relative humidity;
- b) limitation of the surface area, projected in any direction, of plastics enclosures or plastics parts of enclosures as follows (see also Note 2):

- for Group IIA and IIB apparatus to a maximum of 100 cm², except that this may be increased to a maximum of 400 cm² if the exposed areas of plastics are surrounded by conductive earthed frames;

- for Group IIC apparatus, including light-transmitting parts, to a maximum of 20 cm², except that this may be increased to a maximum of 100 cm² if the plastics parts are additionally protected against the occurrence of dangerous electrostatic charges;

c) by virtue of the size, shape and lay-out, or other protective methods, shall be such that dangerous electrostatic charges are not likely to occur.

If, however, the danger of ignition cannot be avoided in the design of the apparatus a warning label shall indicate the safety measures to be applied in service.

NOTE 1 When selecting electrical insulating materials attention should be paid to maintaining a minimum insulation resistance to avoid problems arising from touching exposed plastics parts that are in contact with live parts.

NOTE 2 Further restrictions may apply to plastics enclosures for use in areas where an explosive gas atmosphere is present continuously or is present for long periods (Zone 0).

7.4 Threaded holes

Threaded holes for fasteners which secure covers intended to be opened in service for adjustment, inspection and other operational reasons may only be tapped into the plastics material when the thread form is compatible with the plastics material of the enclosure.

8 Enclosures containing light metals

8.1 Materials used in the construction of enclosures of electrical apparatus of Group I shall not contain, by mass:

- a) more than 15 % in total of aluminium, magnesium and titanium; and
- b) more than 6 % in total of magnesium and titanium.

The materials used in the construction of enclosures of electrical apparatus of Group II shall not contain, by mass, more than 6 % of magnesium.

8.2 Threaded holes in enclosures for fasteners which secure covers intended to be opened in service for adjustment, inspection and other operational reasons may only be tapped in the material of the enclosure when the thread form is compatible with the material used for the enclosure.

The provisions of 8.1 do not apply to Group I surveying instruments carried by persons.

9 Fasteners

9.1 General

Parts necessary to achieve a standard type of protection or used to prevent access to uninsulated live parts shall be capable of being released or removed only with the aid of a tool.

Fastening screws for enclosures of materials containing light metals may be made of light metal or plastics if the material of the fastener is compatible with that of the enclosure.

9.2 Special fasteners

When any of the European Standards for a specific standard type of protection requires a special fastener, this shall conform to the following:

- the thread shall be coarse pitch in accordance with ISO 262, with a tolerance fit of 6g/6H in accordance with ISO 965;
- the head of the screw or nut shall be in accordance with ISO 4014, ISO 4017, ISO 4032 or ISO 4762, and in the case of hexagon socket set screws ISO 4026, ISO 4027, ISO 4028 or ISO 4029;
- the holes of the electrical apparatus shall comply with the requirements of 9.3.

NOTE For Group I the heads of special fasteners liable to mechanical damage in normal service which may invalidate the type of protection should be protected, for example by the use of shrouds or counter-bored holes.

9.3 Electrical apparatus — Holes for special fasteners

9.3.1 Holes for the threaded fasteners of 9.2 shall be threaded for a distance to accept a thread engagement, h , at least equal to the major diameter of the thread of the fastener (see Figures 1 and 2).

9.3.2 The thread shall have a tolerance fit of 6H in accordance with ISO 965, and either:

- a) the hole under the head of the associated fastener shall allow a clearance not greater than a medium tolerance fit of H13 in accordance with ISO 286-2 (see Figure 1) and ISO 273; or
- b) the hole under the head (or nut) of an associated reduced shank fastener shall be threaded to enable the fastener to be retained. The dimensions of the threaded hole shall be such that the surrounding surface in contact with the head of such a fastener shall be at least equal to that of a fastener without a reduced shank in a clearance hole (see Figure 2).

9.3.3 In the case of hexagon socket set screws the screw thread shall have a tolerance fit of 6H in accordance with ISO 965 and shall not protrude from the threaded hole after tightening.

10 Interlocking devices

Interlocking devices used to maintain a type of protection shall be so constructed that their effectiveness cannot readily be defeated by the use, for example, of a screwdriver or pliers.

11 Bushings

Bushings used as connection facilities and which may be subjected to a torque while the connection or disconnection is being made shall be mounted in such a way that all parts are secured against turning.

The relevant torque test is specified in 23.4.5.