

Electrical apparatus for potentially explosive atmospheres —

Part 1: General requirements

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Cooperating organizations

The European Committee for Electrotechnical Standardization (CENELEC), under whose supervision this European Standard was prepared, comprises the National Committees of the following countries.

Austria	Netherlands
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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 35 and a back cover.

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

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English version

Electrical apparatus for potentially explosive atmospheres General requirements

(Includes Amendments 1: July 1979; 2: June 1982;
3: December 1982; 4: December 1982 and 5: February 1986)

Matériel électrique pour atmosphères
explosibles — Règles générales
(Inclut les amendements 1:1979 + 2:1982 +
3:1982 + 4:1982 + 5:1986)

Elektrische Betriebsmittel für
explosionsgefährdete Bereiche —
Allgemeine Bestimmungen
(Einschließlich Änderungen 1:1979 + 2:1982
+ 3:1982 + 4:1982 + 5:1986)

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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

IEC Publications referred to in European Standard EN 50014

IEC 34-5 (1968) (1st edition)	<i>Rotating electrical machines</i> Part 5 <i>Degrees of protection by enclosures for rotating machinery</i>
IEC 79-1A (1975)	<i>First supplement [to IEC 79-1 (1971) Electrical apparatus for explosive atmospheres, Part 1 Construction and test of flameproof enclosures of electrical apparatus]: Appendix D: Method of test for ascertainment of maximum experimental safe gap</i>
IEC 79-4 (1975) (2nd edition)	<i>Electrical apparatus for explosive gas atmospheres</i> Part 4 <i>Method of test for ignition temperature</i>
IEC 112 (1979)	<i>Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions</i>
IEC 144 (1963) (1st edition)	<i>Degrees of protection of enclosures for low-voltage switchgear and controlgear</i>
IEC 216	<i>Guide for the determination of thermal endurance properties of electrical insulating materials</i>
IEC 216-1 (1974)	Part 1: <i>General procedures for the determination of thermal endurance properties, temperature indices and thermal endurance profiles</i>
IEC 216-2 (1974)	Part 2: <i>Lists of materials and available tests</i>
IEC 292-1 (1969) (1st edition)	<i>Low-voltage motor starters</i> Part 1 <i>Direct-on-line (full voltage) a.c. starters [with following supplements: 292-1A (1971) & 292-1B (1973)]</i>

ISO Standards referred to in European Standard EN 50014

ISO 178 (1975)	<i>Plastics — Determination of flexural properties of rigid plastics</i>
ISO/R 179 (1961)	<i>Plastics — Determination of the Charpy impact resistance of rigid plastics. (Charpy impact flexural test)</i>
ISO 262 (1973) (1st edition)	<i>ISO general purpose metric screw threads — Selected sizes for screws, bolts and nuts</i>
ISO/R 272 (1968) (2nd edition)	<i>Hexagon bolts and nuts — Widths across flats, heights of heads, thicknesses of nuts — Metric series</i>
ISO/R 286 (1962) (1st edition)	<i>ISO system for limits and fits — Part 1: General, tolerances and deviations</i>
ISO/R 527 (1966)	<i>Plastics — Determination of tensile properties</i>
ISO/R 861 (1968) (1st edition)	<i>Hexagon socket-head cap screws — Metric series</i>
ISO 965/I (1973) (1st edition)	<i>ISO general purpose metric screw threads — Tolerances — Principles and basic data</i>
ISO 965/II (1973) (1st edition)	<i>ISO general purpose metric screw threads — Tolerances — Limits of sizes for commercial bolt and nut threads — Medium quality</i>
ISO 1817 (1975)	<i>Vulcanized rubbers — Resistance to liquids — Methods of test</i>
ISO 4892 (1981)	<i>Methods of exposure to laboratory light sources</i>

European Standards referred to in European Standard EN 50014

EN 50015 (1977) (1st edition)	<i>Electrical apparatus for potentially explosive atmospheres — Oil immersion “o”</i>
EN 50016 (1977) (1st edition)	<i>Electrical apparatus for potentially explosive atmospheres — Pressurized apparatus “p”</i>

EN 50017 (1977) *Electrical apparatus for potentially explosive atmospheres — Powder filling “q” (1st edition)*

EN 50018 (1977) *Electrical apparatus for potentially explosive atmospheres — Flameproof enclosure “d” (1st edition)*

EN 50019 (1977) *Electrical apparatus for potentially explosive atmospheres — Increased safety “e” (1st edition)*

EN 50020 (1977) *Electrical apparatus for potentially explosive atmospheres — Intrinsic safety “i” (1st edition)*

Fifth report on specifications and testing conditions relating to fire-resistant fluids used for power transmission — Commission of the European Community — Mines Safety and Health Commission, Luxembourg, 15.11.74.

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This European Standard has been prepared by the CENELEC Technical Subcommittee 31.1.

Section 1. General

1 Scope

1.1 This European Standard contains the “General requirements” for the construction and testing of electrical apparatus for use in potentially explosive atmospheres in order to ensure that such apparatus will not cause an explosion of the surrounding atmosphere. It is supplemented or modified by the following European Standards, concerning the specific standard types of protection:

- EN 50015: Oil immersion “o”
- EN 50016: Pressurized apparatus “p”
- EN 50017: Powder filling “q”
- EN 50018: Flameproof enclosure “d”
- EN 50019: Increased safety “e”
- EN 50020: Intrinsic safety “i”

It also covers the other safety aspects which shall be taken into consideration for such electrical apparatus.

1.2 The above European Standards and this European Standard are not applicable to the construction of electro-medical apparatus, exploders, test devices for exploders and for shotfiring circuits.

1.3 Devices in which, according to the manufacturer’s specifications, none of the values 1.2 V, 0.1 A, 20 μ J or 25 mW is exceeded need not be certified or marked.

2 Definitions

The following definitions are applicable in this European Standard and in the European Standards listed in 1.1.

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

potentially explosive atmosphere

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

2.3

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 (the danger is a real one)

2.4

explosive mixture

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

2.5

ignition temperature of an explosive mixture

the temperature at which the mixture ignites when tested according to the method given in IEC 79-4

2.6

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 include recognized overloads and fault conditions specified in the standard for the type of protection concerned.

2.7

rating

the designed performance of an electrical apparatus

2.8

type of protection

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

2.9

degree of protection of enclosures

the measures applied to the enclosures of electrical apparatus to ensure

- 1) 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;
- 2) the protection of the apparatus against ingress of liquids.

2.10

terminal compartment

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

2.11**connection facilities**

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

2.12**cable entry**

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

2.13**conduit entry**

a means of introducing a conduit into an electrical apparatus

2.14**sealing ring**

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

2.15**stopping box with setting compound**

a device preventing any explosion within electrical apparatus from being transmitted into a conduit

2.16**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

2.17**Ex component**

part of electrical apparatus for potentially explosive atmospheres which is not to be used alone in such atmospheres and which requires additional certification of any electrical apparatus with which it is used

3 Grouping and classification of electrical apparatus

3.1 Electrical apparatus for potentially explosive atmospheres is divided into

Group I: electrical apparatus for mines susceptible to firedamp;

Group II: electrical apparatus for places with a potentially explosive atmosphere, other than mines susceptible to firedamp.

For mines where gases other than firedamp may normally and naturally occur, the electrical apparatus shall be constructed in accordance with Group I requirements, but shall also be submitted to the tests prescribed for the appropriate Group II explosive mixture and marked accordingly.

3.2 The electrical apparatus of Group II is subdivided according to the nature of the potentially explosive atmosphere for which it is intended.

3.2.1 For certain types of protection, the subdivision A, B, C is prescribed; this is based on the maximum experimental safe gap (MESG) for flameproof enclosures or on the minimum ignition current (MIC) for intrinsically safe electrical apparatus (see Annex A).

3.2.2 For all types of protection, the temperature classes T1 to T6 correspond to the classification of electrical apparatus according to its maximum surface temperature.

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

4 Temperatures

4.1 Maximum surface temperature. The maximum surface temperature of electrical apparatus is:

4.1.1 For Group I electrical apparatus:

150 °C where coal dust can form a layer;
or 450 °C if the above risk is avoided, for example, by sealing against dust or by ventilation.

4.1.2 For Group II electrical apparatus:

preferably one of the values given in Table 1;
or another value.

NOTE When choosing electrical apparatus of Group II, the user shall take into account the influence and the smouldering temperature of dusts if they are likely to be deposited in a layer. This European Standard indicates in **26.2 6)** the corresponding marking.

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

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

4.2 Ambient temperatures. Electrical apparatus shall normally be designed for use in the ambient temperature range between – 20 °C and + 40 °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 special range of ambient temperatures or, if this is impracticable, the sign X according to 26.2 9) of this European Standard.

Table 2 summarizes these requirements.

Table 2 — Ambient temperatures in service and additional marking

Electrical apparatus	Ambient temperature in service	Additional marking
Normal	Maximum: + 40 °C Minimum: – 20 °C	none
Special	Stated by the manufacturer and specified in the certificate	Ambient temperature range or sign X

4.3 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 cm² (e.g. transistors or resistors used in intrinsically safe electrical circuits), their surface temperature may exceed that for the temperature class marked on the electrical apparatus, if there is no direct or indirect 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.

This 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.

Section 2. Requirements for all electrical apparatus

5 General

5.1 Electrical apparatus for use in potentially explosive atmospheres shall:

5.1.1 comply with the requirements of this European Standard except where these requirements are modified by the specific European Standards for the types of protection concerned listed in 1.1.

NOTE If the electrical apparatus has to withstand particularly adverse service conditions (e.g. rough handling, humidity effects, effects of chemical agents, ambient temperature variations) these have to be specified by the user, and the appropriate measures have to be agreed between user and manufacturer.

5.1.2 be constructed so as not to affect adversely the safety of persons, domestic animals and property when properly installed, maintained and used in the applications for which it was designed and manufactured. The manufacturer shall, under his sole responsibility, indicate that this is so by making a declaration in the form given in Annex E.

5.2 Enclosures for electrical apparatus which can be opened more quickly than the time necessary:

for the discharge of incorporated capacitors to a residual energy of

- 0.2 mJ for electrical apparatus of Groups I and IIA, or
- 0.06 mJ for electrical apparatus of Group IIB, or
- 0.02 mJ for electrical apparatus of Group IIC;

or for the cooling of enclosed components to a temperature below the temperature class of the electrical apparatus

shall be provided with a label stating the delay required before attempting to open the enclosure.

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

The following requirements, also those of 22.4.7, apply to non-metallic enclosures and non-metallic parts of enclosures, except for non-metallic accessories such as sealing rings of cable entries, insulation of plugs and sockets, insulation of bushes, sealing gaskets on which the type of protection does not depend, light transmitting parts with a surface of less than 100 cm².

6.1 Definition of the material

6.1.1 The documents presented by the manufacturer and verified by the testing station in accordance with 22.2 of this European Standard shall define precisely both the material and the manufacturing process of the enclosure or part of enclosure.

6.1.2 For plastics materials, the definition shall include:

- the name and address 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;
- the possible surface treatments, such as varnishes, etc.;

the thermal endurance graph in accordance with IEC Publications 216-1 and 216-2;

the standard designation, where it exists in the documents published by ISO/TC 61.

NOTE The characteristics to be given are the resistance to bending in accordance with ISO 178 and, if the material does not break in this test before exposure to heat, the tensile strength in accordance with ISO/R 527 with test bars of type 1.

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

6.2 Thermal endurance of plastics materials.

The plastics materials used for the enclosures or parts of enclosures shall have a temperature index TI (corresponding to the 20 000 h point of the thermal endurance graph referring to the resistance to bending with a loss of 50 % of the initial value; see also note to **6.1.2**) of 20 K greater than the temperature of the hottest point of the enclosure or the part of the enclosure, having regard to the maximum ambient temperature in service (see **4.2**).

The endurance to heat and to cold of the enclosures, or parts of enclosures, of plastics materials shall be satisfactory (see **22.4.7.3** and **22.4.7.4**).

6.3 Electrostatic charges of enclosures of plastics material

6.3.1 Electrical apparatus of Group I. Enclosures of plastics material with a surface area projected in any direction of more than 100 cm², or containing exposed metallic parts with a capacitance to earth of more than 3 pF, under the most unfavourable conditions in practice, 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:

either by suitable selection of the material: its insulation resistance, measured according to the method given in **22.4.7.8** of this European Standard shall not exceed:

1 GΩ at (23 ± 2) °C and (50 ± 5) % relative humidity, or

100 GΩ under the extreme service conditions of temperature and humidity specified for the electrical apparatus;

or by the size, shape, layout or by other protective methods. The non-appearance of dangerous electrostatic charges shall then be verified by actual tests for ignition of an air-methane mixture of (8,5 ± 0,5) % methane.

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.

6.3.2 Electrical apparatus of Group II. Enclosures should be so designed that under normal conditions of use, maintenance and cleaning, all danger of ignition due to electrostatic charges is avoided, for example,

by suitable disposition of the surfaces of the enclosure;

or by suitable selection of the material so that the insulation resistance of the enclosure, measured according to the method given in **22.4.7.8** of this European Standard, does not exceed:

1 GΩ at (23 ± 2) °C and (50 ± 5) % relative humidity, or

100 GΩ under the extreme service conditions of temperature and humidity specified for the electrical apparatus; the sign X shall then be placed after the certificate reference, as given in **26.2 9**);

or by virtue of the size, shape and layout, or other protective methods, dangerous electrostatic charges are not likely to occur.

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

6.4 Threaded holes in enclosures of plastics material. 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.

7 Light alloy enclosures

7.1 The alloys used in the construction of enclosures of electrical apparatus of Group I shall not contain, by weight,

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

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

7.2 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 light alloy when the thread form is compatible with the light alloy used for the enclosure.