

**Električne naprave za uporabo ob prisotnosti gorljivega prahu - 1-1. del:
Električne naprave, zaščitene z ohišji - Konstruiranje in preskušanje**

Electrical apparatus for use in the presence of combustible dust - Part 1-1:
Electrical apparatus protected by enclosures - Construction and testing

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English version

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

Matériels électriques destinés à être
utilisés en présence de poussières
combustibles
Partie 1-1: Matériels électriques
protégés par enveloppes
Construction et essais

Elektrische Betriebsmittel zur Verwen-
dung in Bereichen mit brennbarem Staub
Teil 1-1: Elektrische Betriebsmittel mit
Schutz durch Gehäuse
Konstruktion und Prüfung

This European Standard was approved by CENELEC on 1998-09-01. 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.

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

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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. The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 50281-1-1 on 1998-09-01.

This European Standard was prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and supports the essential safety requirements of the EC Directive 94/9/EC.

This European Standard is to be read in conjunction with EN 50014:1997.

The following dates have been 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) 1999-09-01
- latest date by which national standards conflicting with the EN have to be withdrawn (dow) 1999-09-01

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Introduction

Combustible dust can be ignited by electrical apparatus in several main ways:

- by surfaces of the apparatus that are above the ignition temperature of the dust concerned temperature at which a dust ignites is a function of the properties of the dust, whether the dust is in a cloud or layer, the thickness of the layer and the geometry of the heat source;
- by arcing or sparking of electrical parts such as switches, contacts, commutators, brushes, or the like;
- by discharge of an accumulated electrostatic charge;
- by radiated energy (e.g. electromagnetic radiation);
- by mechanical sparking or frictional sparking or heating associated with the apparatus.

In order to avoid ignition hazards it is necessary that:

- the temperature of surfaces, on which dust can be deposited, or which would be in contact with a dust cloud, is to be kept below the temperature limitation specified in EN 50281-1-2;
- any electrical sparking parts, or parts having a temperature above the ignition temperature of the dust;
- are contained in an enclosure which adequately prevents the ingress of dust, or
the energy of electrical circuits is limited as to avoid arcs, sparks or temperatures capable of igniting combustible dust;
- any other ignition sources are avoided.

Where the apparatus has to meet other environmental conditions, for example, protection against ingress of water and resistance to corrosion, the method of protection used shall not adversely affect the integrity of the enclosure.

The protection specified in this standard will not provide the required level of safety unless the relevant codes of practice or requirements, for example in respect of protection against over-current, the electrical apparatus is operated within its rating and is installed and maintained according to currents, internal short circuits and other electrical faults. In particular, it is essential that the severity and duration of an internal or external fault be limited to values that can be sustained by the electrical apparatus without damage.

1 Scope

This European Standard is applicable to electrical apparatus protected by enclosure and temperature limitation for use in areas where combustible dust may be present in quantities which could lead to a fire or explosion hazard.

This standard specifies requirements for design, construction, and testing of electrical apparatus. EN 50281-1-2 gives guidance on the selection, installation and maintenance of the apparatus.

The ignition protection is based on the limitation of the maximum surface temperature of the enclosure and on the restriction of dust ingress into the enclosure by the use of "dust-tight" or "dust-protected" enclosures.

Apparatus within the scope of this standard may also be subjected to additional requirements in other publications - for example, EN 50014, Electrical apparatus for potentially explosive atmospheres.

The application of electrical apparatus in atmospheres which may contain explosive gas as well as combustible dust, whether simultaneously or separately, requires additional protective measures.

The principles of this standard may also be followed when combustible fibres or flyings cause a hazard.

This standard does not apply to dusts of explosives which do not require atmospheric oxygen for combustion, or to pyrophoric substances.

This Standard is not applicable to electrical apparatus for use in mines susceptible to firedamp; nor does it take account of any risk caused by an emission of flammable or toxic gas from the dust.

This standard does not include other types of protection and is only applicable to protection by enclosure and temperature limitation.

2 Normative references

EN 50014	1997	Electrical apparatus for potentially explosive atmospheres General requirements
EN 50019		Electrical apparatus for potentially explosive atmospheres Increased safety "e"
EN 50020		Electrical apparatus for potentially explosive atmospheres Intrinsic safety "i"
EN 50281-1-2		Electrical apparatus for use in the presence of combustible dust Part 1-2: Electrical apparatus protected by enclosures - Selection, installation and maintenance
EN 50281-2-1		Electrical apparatus for use in the presence of combustible dust Part 2-1: Test methods - Methods for determining the minimum ignition temperatures of dust

EN 60034-1	Rotating electrical machines Part 1: Rating and performance (IEC 60034-1:1996, modified)
EN 60034-5	Rotating electrical machines Part 5: Classification of degrees of protection provided by enclosures for rotating machinery (IEC 60034-5:1981, modified)
EN 60192	Low pressure sodium vapour lamps (IEC 60192:1973 + A1:1979 + A2:1988 + A3:1992)
EN 60243-1	Electrical strength of insulating materials - Test methods Part 1: Tests at power frequencies (IEC 60243-1:1998)
EN 60529	Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)
EN 60662	High pressure sodium vapour lamps (IEC 60662:1980 & amendments)
HD 429	Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials (IEC 60093:1980)
HD 611.1 S1	Guide for the determination of thermal endurance properties of electrical insulating materials Part 1: General guidelines for ageing procedures and evaluation of test results (IEC 60216-1:1990)
HD 611.2 S1	Guide for the determination of thermal endurance properties of electrical insulating materials Part 2: Choice of test criteria (IEC 60216-2:1990)
ISO 178	Plastics -- Determination of flexural properties
ISO 4225	Air Quality - General aspects - Vocabulary
ISO 527 (series)	Plastics -- Determination of tensile properties

3 Definitions

For the purpose of this European standard the following definitions apply:

3.1 dust: Small solid particles in the atmosphere which settle out under their own weight, but which may remain suspended in air for some time (includes dust and grit as defined in ISO 4225).

3.2 combustible dust: Dust that can burn or glow in air and form explosive mixtures with air at atmospheric pressure and normal temperature

3.3 conductive dust: A dust with electrical resistivity equal to or less than 10^3 ohm m.

3.4 explosive dust atmosphere: Mixture with air, under atmospheric conditions, of flammable substances in the form of dust or fibres in which, after ignition, combustion spreads throughout the unconsumed mixture (see IEV 426-02-4).

3.5 ignition temperature of a dust layer: The lowest temperature of a hot surface at which ignition occurs in a dust layer of specified thickness on this hot surface (see EN 50281-2-1).

3.6 ignition temperature of a dust cloud: The lowest temperature of the hot inner wall of a furnace at which ignition occurs in a dust cloud in air contained therein (see EN 50281-2-1).

3.7 dust ignition protection: All relevant measures specified in this standard (e.g. dust ingress protection and surface temperature limitation) applied to electrical apparatus to avoid ignition of a dust layer or cloud.

3.8 dust-tight enclosure: An enclosure capable of preventing the ingress of all observable dust particles.

3.9 dust-protected enclosure: An enclosure in which the ingress of dust is not totally prevented but dust does not enter in sufficient quantity to interfere with the safe operation of the equipment. Dust shall not accumulate in a position within the enclosure where it is liable to cause an ignition hazard.

3.10 maximum surface temperature: The highest temperature which is attained by any part of the surface of electrical apparatus when tested under the defined dust free conditions.

NOTE: This temperature is attained under the test condition. Increasing the layer thickness can increase this temperature due to the thermal insulation properties of dust.

3.11 maximum permissible surface temperature: The highest temperature a surface of electrical apparatus is allowed to reach in practical service to avoid ignition. The maximum permissible surface temperature will depend upon the type of dust; its layer thickness, and the application of a safety factor.

NOTE: For details see EN 50281-1-2, clause 6.

3.12 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 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.

3.13 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 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.

3.14 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 air/dust mixtures are unlikely to occur or, if they do occur, are likely to do so only infrequently and for short periods only.

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

4 Requirements for all category 1 & 2 electrical apparatus (standards.iteh.ai)

4.1 General

4.1.1 Electrical apparatus for use in potentially explosive atmospheres shall

- a) comply with the requirements of this European Standard;

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 have to be specified to the manufacturer by the user and are not the responsibility of the testing station.

- b) comply with the requirements for dust ingress protection, see 9.1;

- c) 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 and the testing station is not required to verify compliance.

4.1.2 Enclosures which can be opened more quickly than the time necessary

- to allow incorporated capacitors to discharge to a value of residual energy of 0,2 mJ if charged to a voltage of 200 volts or more;
of 0,4 mJ if charged by a voltage of less than 200 volts
- to allow the cooling of enclosed hot components to a surface temperature below the maximum permissible surface temperature 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 DUST ATMOSPHERE IS PRESENT"

4.1.3 Enclosures containing light metals

The materials used in the construction of enclosures of electrical apparatus to this European Standard shall not contain, by weight: more than 6% of magnesium.

4.2 Non metallic enclosures and non metallic parts of enclosures

The following requirements and those of 23.4.7 of EN 50014 apply to:

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

However for sealing rings on which the type of protection depends the proof furnished according to B.3.3 of EN 50014 is sufficient.

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4.2.1 Definition of the material
4.2.1.1 The documents according to 23.2 of EN 50014 shall define both the material and the manufacturing process of the enclosure or part of the enclosure
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4.2.1.2 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 R527 with test bars of type 1.

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

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

4.2.2 Thermal endurance

The plastics materials shall have a temperature index "TI" corresponding to the 20 000 h point (see 4.2.1.2) 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 of EN 50014), having regard to the maximum ambient temperature in service (see 10.3).

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 of EN 50014).

4.2.3 Electrostatic charges of enclosures or parts of enclosures of plastics material.

The following requirements apply to outer plastics surfaces:

Where electrical apparatus is constructed with outer plastic surfaces there shall be a limitation of 100 cm² except that this may be increased to 400 cm² if the exposed area of plastics are surrounded by a conductive earth metal frame.

Static discharges of the propagating brush type shall be prevented. This may be achieved by the use of plastics material having one or more of the following characteristics:

- Insulation resistance $\leq 10^9$ Ohm (resistance against electrostatic discharge to earth through or across the surface of insulation, measured to the method described in HD 429 S1 with an effective area of the circular electrode of 20 cm²);
- Breakdown voltage ≤ 4 kV (measured across the thickness of the insulating material to the method described in EN 60243-1);
- Thickness ≥ 8 mm of the external insulation on metal parts. (External plastic layers of 8 mm and greater on metal parts, such as measurement probes or similar components, make propagating brush discharges unlikely to occur. When evaluating the minimum thickness of the insulation to be used or specified, it is necessary to allow for any expected wear under normal usage).

NOTE: When selecting electrical insulating material 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.