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Električne naprave za uporabo ob prisotnosti gorljivega prahu - 1-2. del: Električne naprave, zaščitene z ohišji - Izbira, vgraditev in vzdrževanje

Electrical apparatus for use in the presence of combustible dust - Part 1-2: Electrical apparatus protected by enclosures - Selection, installation and maintenance

ICS 29.260.20

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English version

Electrical apparatus for use in the presence of combustible dust
Part 1-2: Electrical apparatus protected by enclosures
Selection, installation and maintenance

Matériels électriques destinés à être utilisés en présence de poussières combustibles
Partie 1-2: Matériels électriques protégés par enveloppes
Sélection, installation et entretien

Elektrische Betriebsmittel zur Verwendung in Bereichen mit brennbarem Staub
Teil 1-2: Elektrische Betriebsmittel mit Schutz durch Gehäuse
Auswahl, Errichten und Instandhaltung

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

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Ref. No. EN 50281-1-2:1998 E

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 EN 50281-1-2 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 health and safety requirements of the EC Directive 94/9/EC.

This European Standard is to be read in conjunction with EN 50281-1-1:1998.

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

Annexes designated "informative" are given for information only.
In this standard, annex A is informative.

Contents

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. The 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 kept below the temperature limitation specified in this standard;

- any electrical sparking parts, or parts having a temperature above the temperature limit specified in this standard;

- 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 requirements, 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 electrical apparatus is operated within its rating and is installed and maintained according to the relevant codes of practice or requirements, for example in respect of protection against over-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 gives guidance on the selection, installation and maintenance of electrical apparatus.

NOTE: EN 50281-1-1 specifies requirements for the design, construction and testing of electrical 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.

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

The principles of this standard can 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 because of 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	Electrical apparatus for potentially explosive atmospheres General requirements
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 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 60079-14	Electrical apparatus for explosive gas atmospheres Part 14: Electrical installations in hazardous areas (other than in mines) (IEC 60079-14:1996)

EN 60529	Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)
EN 61241-2-2	Electrical apparatus for use in the presence of combustible dust Part 2: Test methods -- Section 2: Method for determining the electrical resistivity of dust in layers (IEC 61241-2-2:1993 + corr. May 1994)
HD 384 (series)	Electrical installations of buildings (IEC 60364 series)
ISO 4225	Air quality – General aspects - Vocabulary

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 that can burn or glow in air and could 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 426-02-04).

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.

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.

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 on the type of dust; its layer thickness, and the application of a safety factor.

NOTE: For details see clause 6.

4 Area classification

4.1 Equipment placed in areas outside the main dust hazard zones, but which may be temporarily subjected to a dust-laden atmosphere occasionally by a failure in the plant or any untoward happening shall be dust protected and have a surface temperature limitation below the dust ignition temperatures.

To determine the extent of measures necessary to avoid effective ignition sources, the hazardous places shall be classified into zones based on the frequency and duration of occurrence of a hazardous explosive atmosphere.

A place in which an explosive atmosphere is not expected to occur in such quantities as to require special precautions shall be regarded as non-hazardous within the meaning of this standard.

These areas, the dust hazard zones and the surrounding fringe zone, are designated Zone 20, 21 and 22 respectively, with the following definitions:

Layers, deposits and heaps of combustible dust shall be considered as any other source which can form an explosive atmosphere.

4.2 Zone 20: A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, or for long periods or frequently.

NOTE: In general these conditions, when they occur, arise inside containers, pipes and vessels etc.

4.3 Zone 21: A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur in normal operation occasionally.

NOTE: This zone can include, among others, places in the immediate vicinity of e.g. powder filling and emptying points and places where dust layers occur and are likely in normal operation to give rise to an explosive concentration of combustible dust mixture with air.

4.4 Zone 22: A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but if it does occur, will persist for a short period only.

NOTE: This zone can includes, among others, places from which dust can escape from leaks and form dust deposits (e.g. milling rooms, in which the dust escapes from the mills and then settles).

Layers, deposits and heaps of combustible dusts outside the containment shall be avoided. Where such accumulations of dust cannot be avoided, the surface temperature of the apparatus to be installed in such areas shall be reduced to a safe level as specified in clause 6.

5 Design details and test methods

The apparatus shall be selected taking into account the following conditions:

- Ignition temperatures of a dust layer determined for a 5 mm layer thickness as specified in EN 50281-2-1;

- Maximum surface temperature measured under dust free conditions as specified in 10.5 of EN 50281-1-1;

- Maximum permissible surface temperature for apparatus, in the presence of dust clouds as specified in 6.1 and having dust layers up to 5 mm thickness calculated as specified in 6.2.1;

- Construction of enclosure meeting the general requirements as specified in clauses 4 and 6 of EN 50281-1-1;

- Dust tightness tested by the method specified in EN 60529 for Category 1 (using artificial depression) meeting the requirements of

Zone 20	Zone 21 Zone 22 with conductive dust	Zone 22
IP 6X	IP 6X	IP 5X
Marking II 1 D	Marking II 2 D	Marking II 3 D

6 Temperature limitation

The maximum surface temperature permitted for apparatus operating in any zone shall be determined by the deduction of a safety margin from the minimum ignition temperature of the dust concerned, when tested in accordance with the methods specified in EN 50281-2-1 (or IEC 61241-2-1) for both dust clouds and layers up to 5 mm thickness.

The following rules for temperature limitation shall be applied independently of the zone in which the apparatus is intended to be used.

6.1 Temperature limitations because of the presence of dust clouds

The maximum surface temperature of the apparatus shall not exceed two-thirds of the ignition temperature in °C of the dust/air mixture concerned.

$T_{max} = 2/3\ T_{Cl}$ where T_{Cl} is the ignition temperature of a cloud of dust

6.2 Temperature limitation because of the presence of dust layers

6.2.1 Dust layers up to 5 mm thickness

The maximum surface temperature of the apparatus when tested to the method given in 10.5 of EN 50281-1-1 shall not exceed a value of 75 K below the minimum ignition temperature for 5 mm layer thickness of the dust concerned.

$T_{max} = T_{5mm} - 75K$ where T_{5mm} is the ignition temperature of 5 mm layer of dust

6.2.2 Dust layers above 5 mm up to 50 mm thickness

Where there is a possibility that dust layers in excess of 5 mm up to 50 mm may be formed on apparatus, the maximum permissible surface temperature shall be reduced accordingly. The reduction in maximum permissible surface temperature of apparatus used in the presence of dusts having ignition temperatures in excess of 250 °C for a 5 mm shall be in accordance with the graph in Figure 1.

NOTE: Before applying the information in this graph, reference should be made to EN 50281-2-1 (or IEC 61241-2-1).

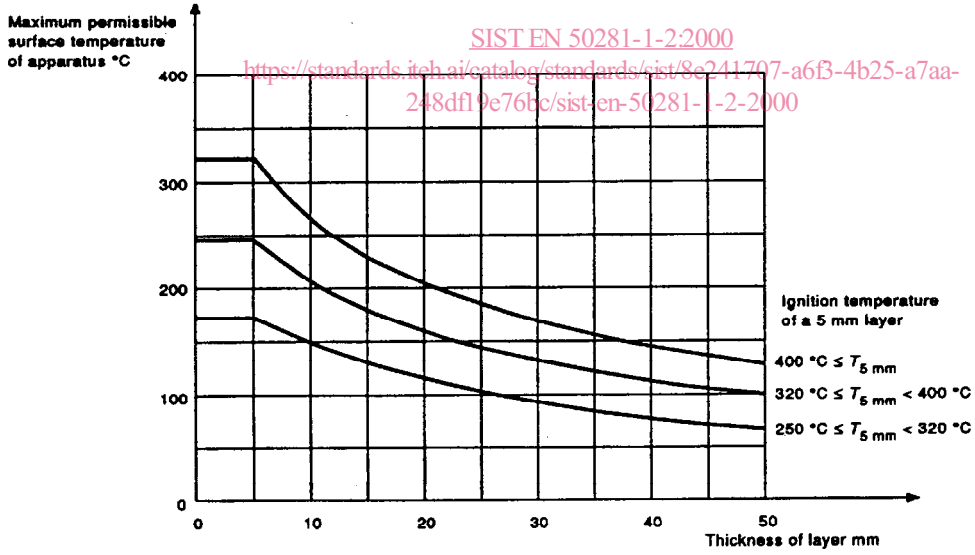

Figure 1: Reduction in maximum permissible surface temperature for increasing depth of dust layers

Laboratory investigation shall be carried out for apparatus where the ignition temperature of a 5 mm layer is below 250 °C, or there is any doubt concerning the application of the graph.

6.2.3 Dust layers of excessive thickness

Where it cannot be avoided that a dust layer of excessive thickness is formed on top of an apparatus or around the sides and bottom of an apparatus, or where the apparatus is totally submerged in the dust, due to the thermally insulating effect, a much lower surface temperature may be necessary.

NOTE: See informative Annex A for examples of "excessive layers".