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Equipment for use in the presence of combustible dust -- Part 3: Classification of areas where combustible dusts are or may be present

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English version

Equipment for use in the presence of combustible dust Part 3: Classification of areas where combustible dusts are or may be present

Appareils pour utilisation en présence de poussières combustibles
Partie 3: Classement des emplacements où des poussières combustibles sont ou peuvent être présentes

Betriebsmittel zur Verwendung in Bereichen mit brennbarem Staub
Teil 3: Einteilung von staubexplosionsgefährdeten Bereichen

This European Standard was approved by CENELEC on 2002-03-05. 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.

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CENELEC
European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This European Standard was prepared by a joint Working Group (JWG 17) from CENELEC TC 31, Electrical apparatus for explosive atmospheres - General requirements, and CEN TC 305.

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 50281-3 on 2002-03-05.

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.

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)	2003-03-01
- latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2005-03-01

Annexes designated "informative" are given for information only.
In this standard, annexes A to C are informative.

Contents

Introduction

Combustible dusts are hazardous because when they are dispersed in air by any means they form potentially explosive atmospheres. Further, layers of combustible dust may ignite and act as ignition sources for an explosive atmosphere.

Therefore, equipment placed in an environment where dust clouds can form should be dust ignition protected and have a surface temperature limitation below the temperature at which a dust cloud or layer will ignite.

This standard gives guidance on the identification of areas where hazards from combustible dust can arise. The purpose is to permit selection of appropriate equipment for use in such areas. General and special criteria are given, with examples, for the procedure used to identify areas.

By exercising ingenuity in the layout of equipment, it is frequently possible to locate much of the equipment in less hazardous or in non-hazardous locations and thus, to reduce the amount of special equipment required.

This standard contains an informative annex giving practical examples for classifying areas.

1 Scope

This standard is concerned with the classification of areas where explosive dust/air mixtures and combustible dust layers are present, in order to permit the proper selection of equipment for use in such areas.

In this standard, explosive dust atmospheres and combustible dust layers are treated separately. In Clause 4 area classification for explosive dusts clouds is described, with dust layers acting as one of the possible sources of release. In Clause 7 the hazard of dust layer ignition is described.

The standard assumes effective housekeeping based on a system of cleaning for the plant.

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

This standard is intended to be applied where there can be a risk due to the presence of explosive dust/air mixtures or combustible dust layers under normal atmospheric conditions. It does not apply to

- underground mining areas,
- areas where a risk can arise due to the presence of hybrid mixtures,
- dusts of explosives which do not require atmospheric oxygen for combustion, or to pyrophoric substances,
- catastrophic failures, which are beyond the concept of abnormality dealt with in this standard (see NOTE 1),
- any risk arising from an emission of flammable or toxic gas from the dust.

This standard does not take into account the effects of consequential damage following a fire or an explosion.

NOTE 1 Catastrophic failure in this context is applied, for example, to the rupture of a storage silo or a pneumatic conveyor.

NOTE 2 In any process plant, irrespective of size, there can be numerous sources of ignition apart from those associated with equipment. Appropriate precautions will be necessary to ensure safety in this context, but these are outside the scope of this standard.

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 (including amendments).

EN 1127-1 Explosive atmospheres - Explosion prevention and protection
Part 1: Basic concepts and methodology

EN 13237-1[1)] Potentially explosive atmosphere – Terms and definitions for equipment and protective systems intended for use in potentially explosive atmospheres

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

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1) At draft stage.

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

IEC 61241-3 Electrical apparatus for use in the presence of combustible dust
Part 3: Classification of areas where combustible dusts are or may be present.

ISO 4225 Air quality - General aspects – Vocabulary

3 Definitions

For the purpose of this standard the following definitions apply.

3.1
area
a three-dimensional region or space

3.2
atmospheric conditions (surrounding conditions)
conditions that include variations in pressure and temperature above and below reference levels of 101,3 kPa (1 013 mbar) and 20 °C (293 K), provided that the variations have a negligible effect on the explosive properties of the combustible dust (IEC 61241-3)

3.3
hybrid mixture
mixture of flammable substances in different physical states, with air (EN 1127-1)

NOTE An example of a hybrid mixture is a mixture of methane, coal dust and air.

3.4
dust
small solid particles including fibres and flyings 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)

3.5
explosive dust atmosphere
a 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 (IEV 426-02-04)

3.6
combustible dust
dust that can burn or glow in air and could form explosive mixtures with air at atmospheric pressure and normal temperatures

3.7
hazardous area (dust)
area in which combustible dust in cloud form is, or can be expected to be, present in quantities such as to require special precautions for the construction, installation and use of equipment in order to prevent ignition of an explosive dust/air mixture. Hazardous areas are divided into zones based upon the frequency and duration of the occurrence of explosive dust/air mixture

3.8
non-hazardous area (dust)
area in which combustible dust in cloud form is not expected to be present in quantities such as to require special precautions for the construction, installation and use of apparatus

3.9
dust containment
those parts of the process equipment inside which materials are handled, processed, transported or stored e.g. to prevent the release of dust to the surrounding atmosphere

3.10
source of dust release
a point or location from which combustible dust can be released to the atmosphere. This can be either from a dust containment or a dust layer.

Sources of release will be divided into the following grades depending on the order of decreasing severity:

- continuous formation of a dust cloud: Locations in which a dust cloud may exist continuously, or may be expected to continue for long periods or for short periods which occur frequently;
- primary grade of release: A source can be expected to release combustible dust in normal operation occasionally;
- secondary grade of release: A source which is not expected to release combustible dust during normal operation but if it releases, is likely to do so only infrequently and for short periods only

3.11
extent of zone
distance in any direction from the edge of a source of release to the point where the hazard associated with the release is considered to exist no longer

3.12
normal operation
the situation when the process equipment is operating within its design parameters. Minor releases of dust which may form a cloud or layer (e.g. releases from filters) can be part of normal operation

3.13
abnormal operation
expected process linked malfunctions that can occur infrequently

3.14
equipment
machines, apparatus, fixed or mobile devices, control components and instrumentation thereof and detection or prevention systems which, separately or jointly, are intended for the generation, transfer, storage, measurement, control and conversion of energy or the processing of material and which are capable of causing an explosion through their own potential sources of ignition

4 Area classification for combustible dusts

4.1 General

This standard adopts the concept, similar to that used for flammable gases and vapours, of using area classification to give an assessment of the risk of fire and/or explosion from dust clouds.

Hazardous and non hazardous areas are defined in 3.7 and 3.8, respectively.

Combustible dusts form explosive atmospheres only at concentrations in the explosion range. Although a cloud with a very high concentration may not be explosive, however the danger exists that should the concentration fall, it may enter the explosion range. Depending on the circumstances, not every source of release will necessarily produce an explosive dust/air mixture.

Dusts which are not removed by mechanical extraction ventilation settle out, at a rate depending on among other things particle size, into layers or accumulations. It has to be taken into account that a dilute or small continuous source of release in time is able to produce a potentially hazardous dust layer.

The hazards presented by combustible dusts are

- the formation of a dust cloud from any source of release including a layer or accumulation to form an explosive atmosphere (see clause 5),
- the formation of dust layers which are not likely to form a dust cloud but which may ignite due to self heating or hot surfaces and cause a fire hazard or over heating of equipment. The ignited layer may also act as an ignition source for an explosive atmosphere (see clause 7).

Explosive dust clouds and combustible dust layer may exist therefore sources of ignition should be avoided.

If this cannot be done, then measures should be taken to reduce the likelihood of combustible dust and/or ignition sources so that the likelihood of coincidence is so small as to be acceptable. In some cases, it can be necessary to employ some form of explosion protection such as explosion venting or explosion suppression.

In this standard, explosive dust atmospheres and ignitable dust layers are treated separately. In this clause area classification for explosive dust clouds is described, with dust layers acting as one of the possible sources of release. In clause 7 the hazard of dust layer ignition is described.

4.2 Area classification objectives for explosive dust atmospheres

In most practical situations where combustible dusts are present, it is difficult to ensure that an explosive dust/air mixture will never occur. It can also be difficult to ensure that equipment will never give rise to a source of ignition. Therefore, in situations where an explosive dust/air mixture has a high likelihood of occurring, reliance is placed on using equipment which is designed to have an extremely low likelihood of creating a source of ignition.

Conversely, where the likelihood of an explosive dust/air mixture occurring is lower, equipment constructed to a less rigorous specification can be used.

4.3 Area classification procedure for explosive dust atmospheres

Area classification is based on an informed input from a number of sources. The decision to area classify depends on whether the dust is combustible or not. Dust combustibility can be confirmed by laboratory tests. An understanding of the material characteristics to be used in the process is required and these should be obtained from a process specialist. Account has to be taken of the operating and maintenance regime for the plant including the housekeeping. Specialist engineering knowledge may also be necessary to provide information on the nature of releases from particular items of plant. Close co-operation is necessary from specialists in safety and equipment. The definitions for zones of risk deal only with the cloud risk.

a) The first step is to identify the material characteristics, e.g. particle size, moisture content, cloud and layer minimum ignition temperature and the electrical resistivity.
b) The second step is to identify where dust containment or sources of dust release can be present, as given in 5.2. It may be necessary to consult process line diagrams and drawings of plant layout. This step should include the identification of the possibility of the formation of dust layers as given in clause 7.

c) The third step is to determine the likelihood that dust will be released from those sources and thus, the likelihood of explosive dust/air mixtures in various parts of the installation as given in 5.2.2

It is only after these steps that the zones can be identified and their extents defined. The decisions on the zone types and extents and the presence of dust layers has to be recorded on the area classification drawing. (The drawing is to be used subsequently as the basis for the selection of equipment).

The reasons for the decisions taken should be recorded in notes of the area classification study to facilitate understanding at future area classification reviews. Reviews of the area classification shall take place following changes to the process or changes to process materials or if dust escapes become more common due to deterioration of the plant. It may be appropriate to hold reviews on a periodic basis.

Because this standard is to cover a wide range of circumstances, no exact identification of necessary measures can be given for each individual case. It is important, therefore, that the recommended procedure should be carried out by personnel having knowledge of the principles of area classification, the process material used, the plant involved and its functioning.

5 Sources of release for explosive dust atmospheres

5.1 General

Explosive dust atmospheres are formed from sources of dust release. Sources of dust release are a point or location from which combustible dust can be released or raised, such that an explosive dust/air atmosphere can be formed. This includes layers of combustible dust capable of being dispersed to form a dust cloud. Depending on the circumstances, not every source of release will necessarily produce an explosive dust/air mixture. On the other hand a dilute or small continuous source of release in time can produce a potentially hazardous dust layer.

The types of sources of release are defined in 3.10.

5.2 Identification of sources of release

The conditions need to be identified in which process equipment, process steps or other actions that can be expected in plants, can form explosive dust/air mixtures or create combustible dust layers. It is necessary to consider separately the inside and outside of a dust containment.

5.2.1 Dust containment

Inside a dust containment dust is not released to the atmosphere but as part of the process continuous dust clouds may be formed. These may exist continuously or may be expected to continue for long periods or for short periods which occur frequently depending on the process cycle. The equipment should be studied for normal operation, abnormal operation and in the startup and shutdown condition so that the incidence of cloud and layer presence can be identified. Where thick layers are formed these should be noted (see clause 7 for dust layers).

5.2.2 Sources of release

Outside the dust containment many factors can influence the area classification. Where higher than atmospheric pressures are used within the dust containment (positive pressure pneumatic transfer) dust can easily be blown out of leaking equipment. In the case of negative pressure within the dust containment, the likelihood of formation of dusty areas outside the equipment is very low. Dust particle size, moisture content and where applicable transport velocity, dust extraction rate and fall height can influence release rate potential. Once the process potential for release is known, each source of release must be identified and its grade of release determined.