# IEC 60079-10-2

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# INTERNATIONAL STANDARD

# NORME INTERNATIONALE





**Explosive atmospheres –**
**Part 10-2: Classification of areas – Combustible dust atmospheres**

**Atmosphères explosives –**
**Partie 10-2: Classement des emplacements – Atmosphères explosives poussiéreuses**

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## Explosive atmospheres – Part 10-2: Classification of areas – Combustible dust atmospheres

## Atmosphères explosives – Partie 10-2: Classement des emplacements – Atmosphères explosives poussiéreuses

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

# EXPLOSIVE ATMOSPHERES –

## Part 10-2: Classification of areas – Combustible dust atmospheres

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International Standard IEC 60079-10-2 has been prepared by subcommittee 31J: Classification of hazardous areas and installation requirements, of IEC technical committee 31: Equipment for explosive atmospheres.

This first edition of IEC 60079-10-2 cancels and replaces the first edition of IEC 61241-10 published in 2004. This edition constitutes a technical revision.

The significant technical changes with respect to the first edition of IEC 61241-10 are as follows:

- the hazards presented by dust have been clarified;
- dust groups have been introduced;
- Annex D explaining Equipment Protection Levels (EPLs) has been introduced;
- 1 m of usual extent of zone 22 beyond zone 21 has been expanded to 3 m.

The text of this standard is based on the following documents:

| FDIS | Report on voting |
|---|---|
| 31J/166/FDIS | 31J/168/RVD |

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 60079 series, under the general title *Explosive atmospheres*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

# INTRODUCTION

Dusts, as defined in this standard, are hazardous because when they are dispersed in air by any means, they form potentially explosive atmospheres. Furthermore, layers of dust may ignite and act as ignition sources for an explosive atmosphere.

This part of IEC 60079 gives guidance on the identification and classification of areas where such hazards from dust can arise. It sets out the essential criteria against which the ignition hazards can be assessed and gives guidance on the design and control parameters which can be used in order to reduce such a hazard. General and special criteria are given, with examples, for the procedure used to identify and classify areas.

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

# EXPLOSIVE ATMOSPHERES –

# Part 10-2: Classification of areas – Combustible dust atmospheres

## 1 Scope

This part of IEC 60079 is concerned with the identification and classification of areas where explosive dust atmospheres and combustible dust layers are present, in order to permit the proper assessment of ignition sources 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 examples in this standard are based on a system of effective housekeeping being implemented in the plant to prevent dust layers from accumulating. Where effective housekeeping is not present, the area classification includes the possible formation of explosive dust clouds from dust layers.

The principles of this 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 atmospheres 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 that 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

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60079-0, *Explosive Atmospheres – Part 0: Equipment – General requirements*

## 3 Terms and definitions

For the purposes of this document, terms and definitions given in IEC 60079-0 and the following apply.

NOTE Additional definitions applicable to explosive atmospheres can be found in IEC 60050-426.

**3.1**
**area**
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

**3.3**
**hybrid mixture**
mixture of flammable substances in different physical states, with air

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

**3.4**
**dust**
generic term including both combustible dust and combustible flyings

**3.5**
**combustible dust**
finely divided solid particles, 500 µm or less in nominal size, which may be suspended in air, may settle out of the atmosphere under their own weight, can burn or glow in air, and may form explosive mixtures with air at atmospheric pressure and normal temperatures

NOTE 1 This definition may also include dust and grit as defined in ISO 4225.

NOTE 2 The term 'solid particle' is intended to address particles in the solid phase and not the gaseous or liquid phase, but does not preclude a hollow particle.

**3.6**
**explosive dust atmosphere**
mixture with air, under atmospheric conditions, of flammable substances in the form of dust, or flyings in which, after ignition, permits self-sustaining flame propagation

**3.7**
**conductive dust**
combustible dust with electrical resistivity equal to or less than $10_3\,\Omega m$

**3.8**
**non-conductive dust**
combustible dust with electrical resistivity greater than $10_3\,\Omega m$

**3.9**
**combustible flyings**
solid particles, including fibres, greater than 500 µm in nominal size, which may be suspended in air, may settle out of the atmosphere under their own weight, can burn or glow in air, and may form explosive mixtures with air at atmospheric pressure and normal temperatures

NOTE Examples of fibres and flyings include rayon, cotton (including cotton linters and cotton waste), sisal, jute, hemp, cocoa fibre, oakum, and baled waste kapok.

**3.10**
**hazardous area (dust)**
area in which combustible dust, in the form of a cloud is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of equipment

NOTE 1 Hazardous areas are divided into zones based upon the frequency and duration of the occurrence of explosive dust atmospheres (see 6.2 and 6.3).

NOTE 2 The potential of creating an explosive dust cloud from a dust layer also needs to be considered.

**3.11**
**non-hazardous area (dust)**
an area in which combustible dust in the form of a cloud is not expected to be present in quantities such as to require special precautions for the construction, installation and use of equipment

**3.12**
**dust containment**
process equipment housing which is intended to handle, process, transport or store materials inside of it, while preventing the release of combustible dust to the surrounding atmosphere

**3.13**
**source of dust release**
point or location from which combustible dust can be released into the atmosphere

NOTE This can be from a dust containment or a dust layer.

**3.14**
**continuous grade of release**
release which is continuous or is expected to occur frequently or for long periods

**3.15**
**primary grade of release**
release which can be expected to occur periodically or occasionally during normal operation

**3.16**
**secondary grade of release**
release which is not expected to occur in normal operation and, if it does occur, is likely to do so only infrequently and for short periods

**3.17**
**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

**3.18**
**normal operation**
operation of equipment conforming electrically and mechanically with its design specification and used within the limits specified by the manufacturer

NOTE Minor releases of dust which may form a cloud or layer (e.g. releases from filters) can be part of normal operation.

**3.19**
**abnormal operation**
process-linked malfunctions that occur infrequently

**3.20**
**equipment (for explosive atmospheres)**
general term including apparatus, fittings, devices, components, and the like used as a part of, or in connection with, an electrical installation in an explosive atmosphere

**3.21**
**ignition temperature of a dust layer**
lowest temperature of a hot surface at which ignition occurs in a dust layer of specified thickness on a hot surface

NOTE The ignition temperature of a dust layer may be determined by the test method given in IEC 61241-2-1.

**3.22**
**ignition temperature of a dust cloud**
lowest temperature of the hot inner wall of a furnace at which ignition occurs in a dust cloud in air contained therein

NOTE The ignition temperature of a dust cloud may be determined by the test method given in IEC 61241-2-1.

**3.23**
**verification dossier**
set of documents showing the compliance of electrical equipment and installations

NOTE Requirements for a 'verification dossier' are given in IEC 60079-14.

## 4 Area classification

### 4.1 General

This standard adopts the concept, similar to that used for flammable gases and vapour, of using area classification to give an assessment of the likelihood of an explosive dust atmosphere occurring.

Dusts form explosive atmospheres only at concentrations within the explosion range. Although a cloud with a very high concentration may not be explosive, the danger nevertheless 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 atmosphere.

Dusts that are not removed by mechanical extraction or ventilation, settle out at a rate depending on properties, such as particle size, into layers or accumulations. It shall 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 dusts are as follows:

– the formation of a dust cloud from any source of release, including a layer or accumulation, to form an explosive dust atmosphere (see Clause 5);
– the formation of dust layers, which are not likely to form a dust cloud, but may ignite due to self-heating or exposure to hot surfaces or thermal flux 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).

Since explosive dust clouds and dust layers may exist, any source of ignition should be avoided.

Subsequent to the completion of the area classification, a risk assessment may be carried out to assess whether the consequences of ignition of an explosive atmosphere requires the use of equipment of a higher equipment protection level (EPL) or justify the use of equipment with a lower equipment protection level than normally required. The EPL requirements may be recorded, as appropriate, on the area classification drawings to allow proper assessment of ignition sources.

NOTE 1 If this cannot be done, then measures should be taken to reduce the likelihood of dust and/or ignition sources so that the likelihood of coincidence is so small as to be acceptable.

NOTE 2 In some cases, where the risk of explosion cannot be completely avoided, it can be necessary to employ some form of explosion protection such as explosion venting or explosion suppression.

NOTE 3 In this standard, explosive dust atmospheres and 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. The hazard of dust layer ignition is described in Clause 7.

NOTE 4 Additional information on EPLs is given in Annex D.

### 4.2 Area classification procedure for explosive dust atmospheres

Area classification is based on a number of factors and may require informed input from a number of sources. These factors include:

- Whether the dust is combustible or not. Dust combustibility can be confirmed by laboratory tests to the future IEC 60079-20-2.
- Material characteristics for the process concerned. These should be obtained from a process specialist.
- Nature of release from particular items of plant. Specialist engineering knowledge may be required for this information.
- Operational and maintenance regime for the plant, including housekeeping.
- Other equipment and safety information.

Close co-operation is necessary from specialists in safety and equipment. Although the definitions for zones deal only with the cloud risk, layers that can be disturbed to form a dust cloud shall also be considered. The procedure for identifying zones is as follows.

a) The first step is to identify whether the material is combustible and, for the purpose of assessment of ignition sources, determine the material characteristics, such as particle size, moisture content, cloud and layer minimum ignition temperature and electrical resistivity, and the appropriate dust group, Group IIIA for combustible flyings, Group IIIB for non-conductive dust, or Group IIIC for conductive dust.

b) The second step is to identify where dust containment or sources of dust release can be present, as given inClause 5. It may be necessary to consult process line diagrams and plant layout drawings. 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 atmospheres in various parts of the installation as given in 5.3.

It is only after these steps that the zones can be identified and their extents defined. The decisions on the zone types and extent and the presence of dust layers shall be documented, usually on an area classification drawing. These documents are used subsequently as the basis for the assessment of ignition sources.

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 emission becomes more common due to deterioration of the plant. It is expected that a review be made following the commissioning of a plant or process, and thereafter on a periodic basis.

Because this standard covers 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

### 5.1 General

Explosive dust atmospheres are formed from sources of dust release. A source of dust release is a point or location from which dust can be released or raised, such that an explosive dust atmosphere can be formed. This definition includes layers of 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 atmosphere. On the other hand, a dilute or small continuous source of release in time can produce a potentially hazardous dust layer.

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

### 5.2 Dust containment

Inside a dust containment, dust is not released into the outside atmosphere but as part of the process, continuous dust clouds may form inside the containment. These clouds may exist continuously or may be expected to continue for long periods or for short periods. The frequency of their appearance depends on the process cycle. The equipment shall be studied for normal operation, abnormal operation and in the start up and shut-down conditions so that the incidence of cloud and layer presence can be identified and the results of this study shall be included in the verification dossier. Where thick layers are formed, these should be noted (see Clause 7 for dust layers).

NOTE Requirements for a 'verification dossier' are given in IEC 60079-14.

### 5.3 Identification and gradation of 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 (e.g. 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, factors such as 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 shall be identified and its grade or grades of release determined.

Grades of release are as follows:

– continuous grade of release:
  where a dust cloud exists continuously, or may be expected to continue for long periods, or for short periods that occur frequently;

– primary grade of release:
  release that can be expected to occur periodically or occasionally during normal operation. For example, the close vicinity around an open bag filling or emptying point;

– secondary grade of release:
  release that is not expected to occur in normal operation and, if it does occur, is likely to do so only infrequently and for short periods. For example, a dust handling plant where deposits of dust are present.

Consideration of major or catastrophic plant failures is not required in assessing potential sources of release. For example some of the items that should not be regarded as sources of release during normal and abnormal operation include:

– pressure vessels, the main structure of the shell including closed nozzles and man-holes;
– pipes, ducting and trunking without joints;
– valve glands and flanged joints, provided that in the design and construction, adequate consideration has been given to the prevention of leakage of dust.

Based on the likelihood of the formation of explosive dust atmospheres, the areas can be designated according to Table 1.

**Table 1 – Designation of zones depending on presence of dust**

| Presence of dust | Resulting zone classification of area of dust clouds |
|---|---|
| Continuous grade of release | 20 |
| Primary grade of release | 21 |
| Secondary grade of release | 22 |

NOTE 1 Some silos may be filled or emptied only infrequently. The inside may then be classified as zone 21. Equipment inside the silo may be used only when the silo is being emptied or filled. Assessment of ignition sources should take account of the fact that the dust cloud is likely to be present while the equipment is in operation.

NOTE 2 In the rare event of a large container of dust bursting, this may cause a deep layer to form. If any deep layer formed in this way is removed quickly or the equipment isolated, it may not be necessary to classify the area as zone 22. It is expected that this possibility would have been identified and recorded in the study together with suitable control procedures.

NOTE 3 Many products such as grain and sugar contain a small amount of dust mixed into a large amount of granular material. The risk that the coarse material can be overheated and start to burn should be taken into account, even if no dust explosion is possible at that location. Burning granular material may be transported through a process, to create the risk of an explosion elsewhere.

## 6 Zones

### 6.1 General

Areas classified for explosive dust atmosphere are divided into zones, which are identified according to the frequency and duration of the occurrence of explosive dust atmosphere. Some examples of zones are given in Annex A.

### 6.2 Zones

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

Zone 20

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

Zone 21

A place in which an explosive dust atmosphere, in the form of a cloud of dust in air, is likely to occur in normal operation occasionally.

Zone 22

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

### 6.3 Extent of zones

#### 6.3.1 General

The extent of a zone for explosive dust atmospheres is defined as the distance in any direction from the edge of a source of dust release to the point where the hazard associated with that zone is considered to no longer exist. Explosive dust atmospheres from a dust cloud would normally be deemed not to exist if the dust concentration is a suitable safety margin less than the minimum dust concentration required for an explosive dust atmosphere to exist. Consideration should be given to the fact that fine dust can be carried from a source of release by air movement within a building. Where the classification gives rise to small unclassified areas between classified areas, the classification should be extended to the full area.

#### 6.3.2 Zone 20

The extent of zone 20 includes the inside of ducts, producing and handling equipment in which explosive dust atmospheres are present continuously, for long periods, or frequently.

If an explosive dust atmosphere outside dust containment is continuously present, a zone 20 classification is required.

#### 6.3.3 Zone 21

In most circumstances, the extent of zone 21 can be defined by evaluating sources of release in relation to the environment causing explosive dust atmospheres.

The extent of zone 21 is as follows:

– the inside of some dust handling equipment in which an explosive dust atmosphere is likely to occur;

– the area outside the equipment, formed by a primary grade of release depends on several dust parameters such as dust amounts, flow rate, particle size and product moisture content. This zone should remain limited. Consideration needs to be given to the source of release taking into account the conditions leading to the release in order to determine the appropriate extent of the zone. For areas outside buildings (open air), the boundary of zone 21 can be altered due to weather effects such as wind, rain, etc.;

NOTE 1 A distance of 1 m around the source of release is often sufficient (with a vertical downwards extension to the ground or to the level of a solid floor) in considering a zone 21.

– where the spread of dust is limited by mechanical structures (walls, etc.), their surfaces can be taken as the boundary of the zone.

Practical considerations can make it desirable for the whole area under consideration to be classified as zone 21.

A non-confined zone 21 (not limited by mechanical structures, e.g. a vessel with an open man-hole) located inside, will usually be surrounded by a zone 22.

NOTE 2 If dust layers are found to have accumulated outside the original zone 21, then the classification of the zone 21 area may be required to be extended (it could become a zone 22) taking into account the extent of the layer and any disturbance of the layer that produces a cloud.