BS EN 60079-10-2:2015

BSI Standards Publication

Explosive atmospheres

Part 10-2: Classification of areas — Explosive dust atmospheres

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National foreword

This British Standard is the UK implementation of EN 60079-10-2:2015. It is identical to IEC 60079-10-2:2015. It supersedes BS EN 60079-10-2:2009 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EXL/31, Equipment for explosive atmospheres.

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This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Foreword

The text of document 31J/244/FDIS, future edition 2 of IEC 60079-10-2, prepared by SC 31J "Classification of hazardous areas and installation requirements" of IEC/TC 31 "Equipment for explosive atmospheres" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60079-10-2:2015.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2015-11-20
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This document supersedes EN 60079-10-2:2009.

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The text of the International Standard IEC 60079-10-2:2015 was approved by CENELEC as a European Standard without any modification.

IEC 60079-2	NOTE	Harmonized as EN 60079-2.
IEC 60079-11	NOTE	Harmonized as EN 60079-11.
IEC 60079-14	NOTE	Harmonized as EN 60079-14.
IEC 60079-28	NOTE	Harmonized as EN 60079-28.
IEC 60079-18	NOTE	Harmonized as EN 60079-18.
IEC 60079-31	NOTE	Harmonized as EN 60079-31.
IEC 60079-32-2	NOTE	Harmonized as EN 60079-32-2.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60079-0 (mod)	-	Explosive atmospheres -- Part 0: Equipment - General requirements	EN 60079-0	-
			+A11	2013
IEC 60079-10-1	-	Explosive atmospheres -- Part 10-1: Classification of areas - Explosive gas atmospheres	EN 60079-10-1	-
ISO/IEC 80079-20-2	-	Explosive atmospheres - Part 20-2: Material characteristics - Combustible dusts test methods	-	-

CONTENTS

INTRODUCTION

Dusts, as defined in this standard, are hazardous because when they are dispersed in air by any means they may 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 for the process of identification and classification of hazardous areas.

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

EXPLOSIVE ATMOSPHERES –

Part 10-2: Classification of areas – Explosive 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 other general considerations for dust layers are 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 might 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 (see Note 1).

NOTE 1 Atmospheric conditions 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 materials.

It does not apply to

– underground mining areas,
– dusts of explosives that do not require atmospheric oxygen for combustion such as pyrophoric substances, propellants, pyrotechnics, munitions, peroxides, oxidizers, water-reactive elements or compounds, or other similar materials.
– catastrophic failures which are beyond the concept of abnormality dealt with in this standard,
– any risk arising from an emission of toxic gas from the dust.

This standard does not apply to where a hazard might arise due to the presence of flammable gas or vapour, but the principles may be used in the assessment of a hybrid mixture (see also IEC 60079-10-1).

NOTE 2 Additional guidance on hybrid mixtures is provided in Annex C.

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

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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*

IEC 60079-10-1, *Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres*

ISO/IEC 80079-20-2, *Explosive Atmospheres – Part 20-2: Material Characteristics – Combustible dusts test methods*[1]

3 Terms and definitions

For the purposes of this document, the 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
hybrid mixture
mixture of a flammable gas or vapour with a dust

3.3
dust
generic term including both combustible dust and combustible flyings

3.4
combustible dust
finely divided solid particles, 500 μm or less in nominal size, which may form an explosive mixture with air at atmospheric pressure and normal temperatures

Note 1 to entry: This includes dust and grit as defined in ISO 4225.

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

Note 3 to entry: Materials passing a U.S. No. 40 Standard sieve as defined in ASTM E 11–04 are considered to meet the 500 μm criterion.

Note 4 to entry: Combustible dust test methods can be found in ISO/IEC 80079-20-2.

3.5
explosive dust atmosphere
mixture with air, under atmospheric conditions, of flammable substances in the form of dust, which, after ignition, permits self-sustaining propagation

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1 To be published.

3.6
conductive dust
combustible dust with electrical resistivity equal to or less than $10^3\ \Omega m$

Note 1 to entry: Conductive dust is classified as Group IIIC.

3.7
non-conductive dust
combustible dust with electrical resistivity greater than $10^3\ \Omega m$

Note 1 to entry: Non-conductive dust is classified as Group IIIB.

3.8
combustible flyings
solid particles including fibers, greater than 500 μm in nominal size, which may form an explosive mixture with air at atmospheric pressure and normal temperatures

Note 1 to entry: Examples of flyings include rayon, cotton (including cotton linters and cotton waste) sisal, jute, hemp, cocoa fiber, okum and waste kapok.

Note 2 to entry: Combustible flyings are classified as Group IIIA.

3.9
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 to entry: 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 to entry: The potential of creating an explosive dust cloud from a dust layer also needs to be considered.

3.10
non-hazardous area (dust)
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

3.11
dust containment
process equipment housing which is intended to handle, process, transport or store materials inside of it, while minimizing the risk of the release of dust to the surrounding atmosphere

3.12
source of dust release
point or location from which dust may be released into the atmosphere

Note 1 to entry: The source of dust release can be from a dust containment or from a dust layer.

3.13
continuous grade of release
release which is continuous or is expected to occur frequently or for long periods

3.14

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

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 1 to entry: 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
catastrophic failure
occurrence which exceeds the design parameters of the process plant and control system resulting in major release of flammable material

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

3.21
equipment (for explosive atmospheres)
general term including apparatus, fittings, devices, components, and the like used as a part of, or in connection with, an installation in an explosive atmosphere

3.22
ignition temperature of a dust layer
lowest temperature of a surface at which ignition occurs in a dust on the surface

Note 1 to entry: The ignition temperature of a dust layer may be determined by the test method given in ISO/IEC 80079-20-2.

3.23
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 1 to entry: The ignition temperature of a dust cloud may be determined by the test method given in ISO/IEC 80079-20-2.

3.24
verification dossier
set of documents showing the compliance of electrical equipment and installations

Note 1 to entry: Requirements for a ‘verification dossier’ are given in IEC 60079-14.

3.25
zones

3.25.1
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

3.25.2
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

3.25.3
Zone 22
area in which an explosive dust 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 1 to entry: The potential of creating an explosive dust cloud from a dust layer also needs to be considered.

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 explosive range. Depending on the circumstances, not every source of release will necessarily produce an explosive dust atmosphere. Dust clouds are also rarely of uniform density and consideration should be given to possible variances in concentration within a cloud for any condition or release.

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.

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

If the source of ignition cannot be avoided, then measures shall be taken to reduce the likelihood of dust and/or ignition sources so that the likelihood of coincidence is so small as to make the risk negligible.

NOTE 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, explosion suppression or explosion isolation.

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 may justify the use of equipment with a lower equipment protection level than normally required.

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. Considerations for dust layers are described in Clause 7.

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 ISO/IEC 80079-20-2.
- Material characteristics for the dusts that are present. These may be obtained from a variety of published sources, a process specialist or by testing. Characteristics that are obtained from published sources should be validated for the particular application, since there are often significant variations in dust characteristic values from one data source to another.
- Nature of dust releases from particular process sources. Specialist engineering knowledge may be required for this information.
- Operational and maintenance procedures 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 dust 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. Parameters such as particle size, moisture content, cloud and layer minimum ignition temperature and electrical resistivity shall be considered. The appropriate dust group; Group IIIA for combustible flyings, Group IIIB for non-conductive dust, or Group IIIC for conductive dust shall be identified.

   NOTE Information on dust characteristics can be found in ISO/IEC 80079-20-2.

b) The second step is to identify items of equipment where explosive dust mixtures may be contained or sources of dust release can be present, as given in Clause 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 have been taken that the zones can be identified and their boundaries 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, 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 specific plant involved and its functioning.

4.3 Competence of personnel

The area classification should be carried out by those who are competent and understand the relevance and significance of the characteristics of dust and those who are familiar with the process and the equipment, along with safety, electrical, mechanical, and other qualified engineering personnel.

NOTE These elements are covered in several personnel certification schemes, such as the IECEx Unit of Competence Ex002 according to IECEx OD 504.

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. However, a dilute or small continuous source of release in time can produce a dust layer.

The conditions need to be identified under 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 layers are formed, these should be noted (see Clause 7 for dust layers).

5.3 Identification and grading 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:

release that exists continuously, or may be expected to continue for long periods, or for short periods that occur frequently. For example, the inside of a mixing vessel or a storage silo that is filled and emptied often;

– 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 catastrophic 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 the release of dust.

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

6.2 Extent of zones

6.2.1 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. For Zone 21 and Zone 22 areas located outside buildings (open air), the zones can be altered due to weather effects such as wind, rain, etc. For outdoor areas the boundaries of the zones should provide for such variances.

NOTE While natural ventilation (wind) may cause dilution to below the explosive limit (therefore reducing the extent of the zone) it might also cause disturbance of any existing dust layer (thereby increasing the extent of a zone).

6.2.2 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.

6.2.3 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 periodically, for example starting and stopping of filling equipment;
– the Zone 21 formed outside the equipment by a primary grade of release, depends on several dust parameters, such as; dust amounts, flow rate, particle size and the dust moisture content. 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.
– where the spread of dust is limited by mechanical structures (walls, etc.), their surfaces can be taken as the boundary of the zone.

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 1 If dust layers are found to have accumulated outside the original Zone 21, then the classification of the zone 21 area might 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.

NOTE 2 If the boundary between Zone 21 and Zone 22 is difficult to determine, it might be practical to classify the entire area or room as Zone 21.

6.2.4 Zone 22

In most circumstances, the extent of Zone 22 can be defined by evaluating secondary grade sources of release in relation to the environment causing the explosive dust atmospheres.

The extent of Zone 22 is as follows:

– the extent of an area formed by a secondary grade source of release depends on several dust parameters such as dust amounts, flow rate, particle size and the dust moisture content. 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.
– where the spread of dust is limited by mechanical structures (walls, etc.), their surfaces can be taken as the boundary of the zone.

NOTE If dust layers are found to have accumulated outside the original zone 22, then the classification of the Zone 22 area may be required to be extended taking into account the extent of the layer and any disturbance of the layer which produces a cloud.

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

7 Dust layers

Inside containment, where dusts are handled or processed, layers of dust of uncontrolled thickness often cannot be prevented because they are an integral part of the process.

Outside containment the thickness of dust layers should be controlled by housekeeping and the level of housekeeping shall be known for the purpose of classification. It is essential to agree the nature of the housekeeping arrangements with plant management. Other risks associated with dust layers and the effect of housekeeping are discussed in Annex B.

Conditions that may cause dust layers to be raised to form a dust cloud, such as ventilation, wind or other conditions, must be taken into consideration during the area classification.

8 Documentation

8.1 General

Area classification, and the various steps taken which lead to the area classification, shall be documented.

All relevant information used shall be referred to. Examples of such information include:

a) recommendations from relevant codes and standards,
b) assessment of dust dispersion from all sources of release,
c) process parameters and dust mitigation measures, which influence the formation of explosive dust atmospheres and dust layers,
d) operational and maintenance parameters,
e) housekeeping programs;
f) assigned EPLs.

The results of the area classification study and any subsequent alteration to it shall be included in the verification dossier.

The properties, or basis for properties, used for the area classification concerning all process materials used on the plant shall be listed. The information should include items such as:

– ignition temperatures of a dust clouds,
– ignition temperatures of dust layers,
– minimum ignition energy of a dust cloud,
– the dust group,
– explosive limits,
– electrical resistivity,
– moisture content,
– particle size.

NOTE There are reference materials available that may provide some of the dust parameters related to explosive atmosphere safety, but there is a wide variability in dusts and testing may be necessary to determine all of the relevant parameters.

8.2 Drawings, data sheets and tables

8.2.1 Content of documents

Area classification documents may be in hard copy or electronic form and should include plans and elevations or three dimensional models, as appropriate, which show both the type and extent of zones, the extent and permitted thickness of dust layers, the minimum ignition temperature of the dust cloud and the dust layer. The documents should also include other relevant information such as:

a) the location and identification of sources of release. For large and complex plants or process areas, it may be helpful to itemize or number the sources of release so as to facilitate cross-referencing between the area classification data sheets and the drawings;

b) information about housekeeping and other preventative measures to obtain the classification made;

c) methods for maintaining and regularly reviewing the classification, as well as methods for reviewing when process materials, methods and equipment change;

d) distribution list of the classification;

e) the reasons for the decisions taken to establish the type and extent of zones and the extent of dust layers.

A symbol key shall always be provided on each drawing.

The preferred area classification symbols shown in Figure 1 may be varied,, e.g. for drawing clarity or to show differing dust characteristics.

8.2.2 Preferred Symbol key for area classification zones

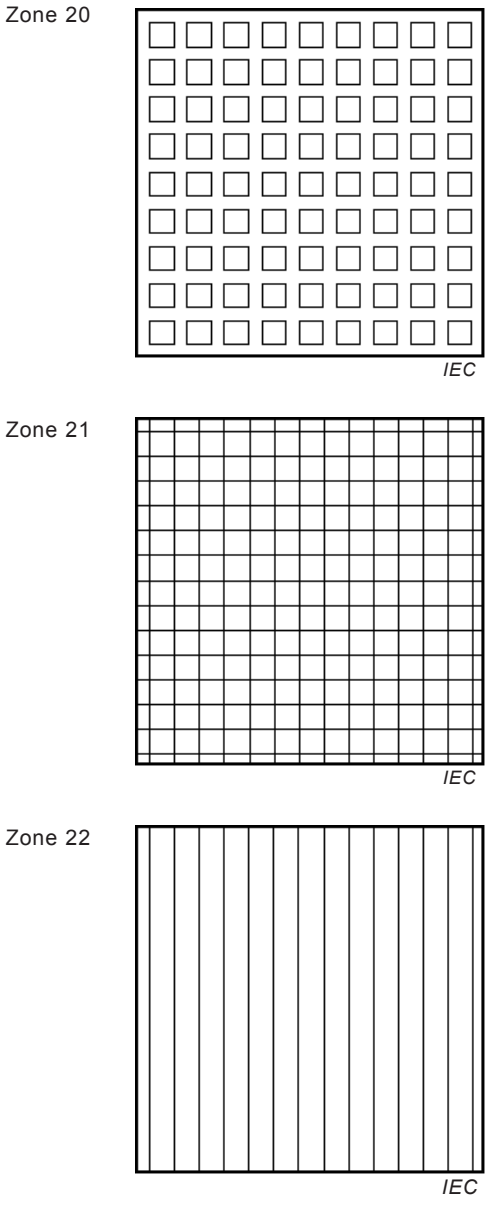


Figure 1 – Identification of zones on drawings

Annex A
(informative)

Area classification examples

A.1 Examples of zones

A.1.1 General

The following examples are not intended to be rigidly applied, and may need to be varied to suit particular process equipment and the situation. It also needs to be recognized that some equipment may exhibit more than one grade of release.

A.1.2 Zone 20

Examples of locations that may give rise to Zone 20:

– locations inside the dust containment;
– hoppers, silos, cyclones and filters, etc;
– dust transport systems, except some parts of belt and chain conveyors, etc;
– blenders, mills, dryers, bagging equipment, etc.

A.1.3 Zone 21

Examples of locations that may give rise to Zone 21:

– areas adjacent to dust containment and in the immediate vicinity of access doors subject to frequent removal or opening for operation purposes when internal explosive dust atmospheres are present;
– areas outside dust containment in the proximity of filling and emptying points, feed belts, sampling points, truck dump stations, belt dump over points, etc. where no measures are employed to prevent the formation of explosive dust atmospheres;
– areas outside dust containment where dust accumulates and where, due to process operations, the dust layer is likely to be disturbed and form explosive dust atmospheres;
– areas inside dust containment where explosive dust clouds are likely to occur (but neither continuously, nor for long periods, nor frequently), e.g. filling of a silo with bulk material with a low dust content and the dirty side of filters, if large self-cleaning intervals exist.

NOTE In many situations a distance of approximately 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.

A.1.4 Zone 22

Examples of locations that may give rise to Zone 22:

– outlets from bag filter vents which, in the event of a malfunction, can emit explosive dust atmospheres;
– locations near equipment opened at infrequent intervals or locations near equipment, that from experience can easily form leaks where dust is blown out, for example, pneumatic equipment or flexible connections that can become damaged, etc;
– storage of bags containing dusty products. Failure of bags can occur during handling, causing dust emission;
– areas that are normally classified as Zone 21 can fall into Zone 22 when measures, including exhaust ventilation, are employed to prevent the formation of explosive dust atmospheres. The measures should be carried out in the vicinity of (bag) filling and emptying points, feed belts, sampling points, truck dump stations and belt dump over points, etc;

– areas where controllable dust layers are formed that are likely to be disturbed and create explosive dust atmospheres. Only if the layer is removed by cleaning before hazardous dust atmospheres can be formed, is the area designated non-hazardous. This is the major purpose of good house keeping.

NOTE In many situations a distance of approximately 3 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 22.

A.2 Bag emptying station within a building and without exhaust ventilation

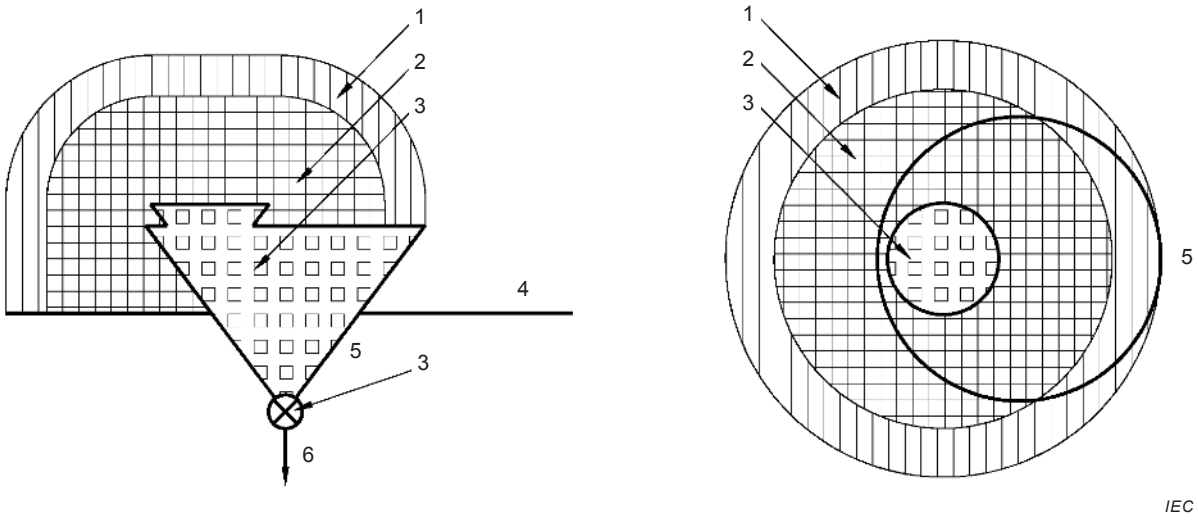
In this example, shown in Figure A.1, bags are manually emptied frequently into a hopper from which the contents are conveyed pneumatically into some other part of the plant without exhaust ventilation. Part of the hopper is normally filled with product.

Zone 20 Inside the hopper because an explosive dust atmosphere is present frequently or even continuously.

Zone 21 The open man-hole has no exhaust ventilation and is a primary grade source of release. Consequently, a Zone 21 is defined around this man-hole, extending some distance from the edge of the man-hole and extending down to the floor.

Zone 22 A Zone 22 could occur adjacent to the Zone 21 due to accumulation of dust as a layer, or if the dust release is composed of very fine particles that could occasionally travel outside the normal Zone 21 boundary under abnormal operating conditions.

NOTE If dust layers accumulate, then further classification may be required taking into account the extent of the layer and any disturbance of the layer which produces a cloud, together with the level of housekeeping (see Annex B). Any air movements during the discharge of bags may occasionally carry the dust cloud beyond Zone 21 under abnormal operating conditions, in which case a Zone 22 may be required in accordance with 6.2.4.



Key

1 Zone 22, see 6.2.4

2 Zone 21, see 6.2.3

3 Zone 20, see 6.2.2

4 floor

5 bag discharge hopper

6 to process via a rotary valve

NOTE 1 The relative dimensions are for illustration only. In practice other distances may be required.

NOTE 2 Additional measures such as explosion venting or explosion isolation, etc. may be necessary but are outside the scope of this standard and are not therefore given.

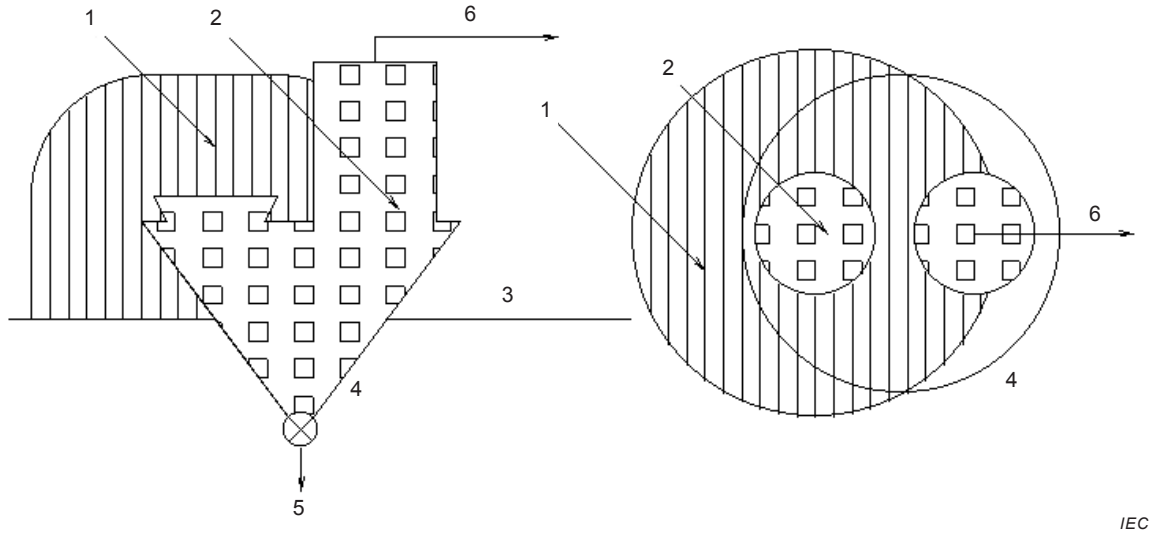
Figure A.1 – Bag emptying station within a building and without exhaust ventilation

A.3 Bag emptying station with exhaust ventilation

The example shown in Figure A.2 is similar to the example given in Clause A.2, but in this case the system has extract ventilation. In this way, the dust can be kept within the system as much as possible.

Zone 20 Inside the hopper because an explosive dust atmosphere is present frequently or even continuously.

Zone 22 The open man-hole is a source with a secondary grade of release. There is no escape of dust in normal circumstances because of the dust extraction system. In a well-designed extraction system, any dust released will be sucked inside. Consequently, only a Zone 22 is defined around this man-hole, extending some distance from the edge of the man-hole and extending down to the floor. The exact extent of the Zone 22 area needs to be determined based on the characteristics of the dust and the process.



Key

1 Zone 22, see 6.2.4

2 Zone 20, see 6.2.2

3 floor

4 bag discharge hopper

5 to process via a rotary valve

6 to extract within containment

NOTE 1 The relative dimensions are for illustration only. In practice other distances may be required.

NOTE 2 Additional measures, such as explosion venting or explosion isolation etc. may be necessary but are outside the scope of this standard and are not therefore given.

Figure A.2 – Bag emptying station with exhaust ventilation

A.4 Cyclone and filter with clean outlet outside building

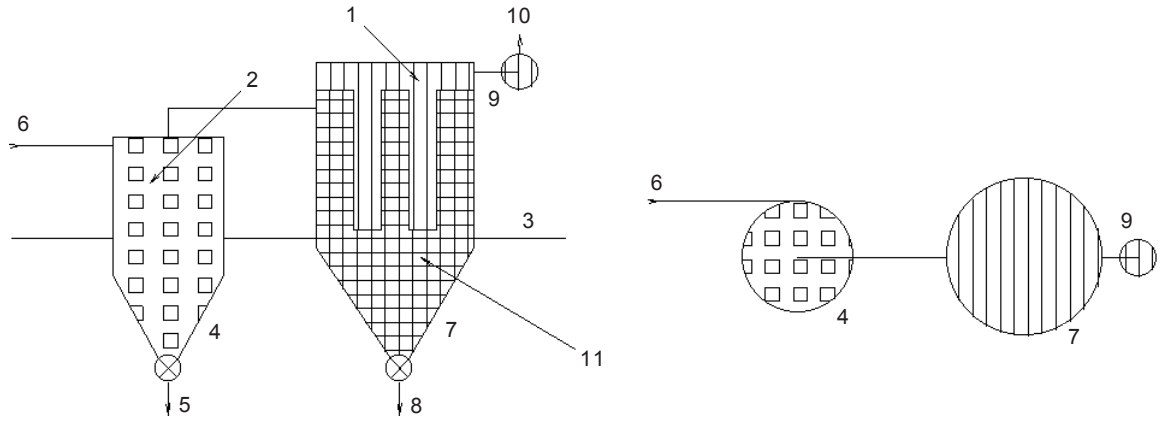
In the example shown in Figure A.3, the cyclone and filter are part of a suction extraction system. The extracted product passes via a continuously operating rotary valve and falls into a closed bin. Due to the cyclone, the amount of dust in the filter is very small and therefore the self-cleaning intervals are large. For this reason, the interior only occasionally contains a dust cloud during normal operation. The extraction fan on the filter unit blows the extracted air to the outside.

Zone 20 Inside the cyclone because an explosive dust atmosphere is present frequently or even continuously.

Zone 21 There is a Zone 21 on the dirty side of the filter only if small quantities of dust are not collected by the cyclone in normal operation.

Zone 22 The clean side of the filter may contain a dust cloud if the filter element fails. This applies to the interior of the filter, downstream of the filter element, extract ducting and around the discharge of the extract duct. Zone 22 will extend some distance around the outlet of the ducting and extends down to the ground (not shown in diagram). The exact extent of the Zone 22 area needs to be determined based on the characteristics of the dust and the process.

NOTE If dust layers accumulate outside the plant equipment, then further classification may be required, taking into account the extent of the layer, environmental condtions and any disturbance of the layer that produces a cloud.



Key

1	Zone 22, see 6.2.4	7	filter
2	Zone 20, see 6.2.2	8	to fines bin
3	floor	9	extract fan
4	cyclone	10	to outlet
5	to product silo	11	Zone 21, see 6.2.3
6	inlet		

NOTE 1 The relative dimensions are for illustration only. In practice, other distances may be required.

NOTE 23 Additional measures, such as explosion venting or explosion isolation etc. may be necessary but are outside the scope of this standard and are not therefore given.

Figure A.3 – Cyclone and filter with clean outlet outside building

A.5 Drum tipper within a building without exhaust ventilation

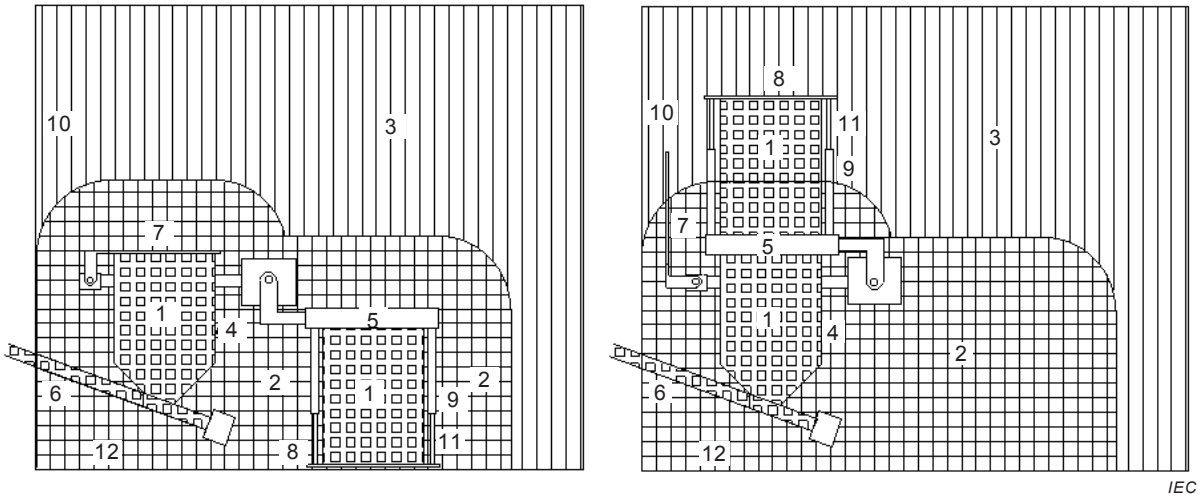
In the example shown in Figure A.4, powder in drums is emptied into a hopper to be transported by screw conveyor to an adjacent room. A full drum is positioned on the platform and the lid removed. Hydraulic cylinders clamp the drum to the diaphragm valve which is closed. The hopper lid is opened and the drum carrier rotated to place the diaphragm valve on top of the hopper. The diaphragm valve is opened and powder is transported by the screw conveyor over a period of time until the drum is empty.

When a new drum is required, the diaphragm valve is closed. The drum carrier is rotated back to its original position and the hopper lid is closed. The hydraulic cylinders release the drum and its lid is replaced before the drum is removed.

Zone 20 The interior of the drum, hopper and screw conveyor will contain dust clouds frequently and for long periods and are therefore classified Zone 20.

Zone 21 Releases of dust in the form of a cloud occur when the lid of the drum and the lid of the hopper are removed and when the diaphragm valve is placed on or removed from the top of the hopper. Consequently Zone 21 is defined for some distance around the tops of the drum, hopper and around the diaphragm valve. The exact extent of the Zone 21 needs to be determined based on the characteristics of the dust and the process.

Zone 22 The remainder of the room is Zone 22 due to the possibility of accidental spillage forming dust layers and disturbance of large quantities of dust.



Key

1	Zone 20, see 6.2.2	7	hopper lid
2	Zone 21, see 6.2.3	8	drum platform
3	Zone 22, see 6.2.4	9	hydraulic cylinders
4	hopper	10	wall
5	diaphragm valve	11	drum
6	screw conveyor	12	floor

NOTE 1 The relative dimensions are for illustration only. In practice, other distances may be required.

NOTE 2 Additional measures such as explosion venting or explosion isolation etc. may be necessary but are outside the scope of this standard and are not therefore given.

Figure A.4 – Drum tipper within a building without exhaust ventilation

Annex B
(informative)

Housekeeping

B.1 Introductory remarks

Area classification in this standard is based on definitions for zones. Any hazards presented by dust layers should be considered separately from dust clouds.

Three risks are presented by dust layers:

1) A primary explosion within a building may raise dust layers into clouds and cause secondary explosions more damaging than the primary event. Dust layers should always be controlled to reduce this risk.
2) Dust layers may be ignited by the heat flux from equipment on which the layer rests, which may be a slow process.
3) A dust layer, even a thin layer, may be raised into a cloud, ignite and cause an explosion.

These risks depend on the properties of the dust and the thickness of layers, which is influenced by the nature of the housekeeping. The likelihood of a layer causing a fire can be controlled by the correct selection of equipment and effective housekeeping.

Changes to the state of the dust layer, e.g. moisture absorbency, may reduce or eliminate the ability to raise a dust layer into a dust cloud. In this case, there may be no secondary explosion risk, and any fire risk may remain the same or be similarly reduced.

B.2 Levels of housekeeping

The frequency of cleaning alone is not enough to determine whether a layer contains sufficient dust to be a risk as identified in B.1.. The rate of deposition of the dust has different effects, for example, a secondary grade of release with a high deposition rate may create a dangerous layer much more quickly than a primary grade with a lower deposition rate. Both the frequency of cleaning and the effectiveness of cleaning are important.

Thus, the presence and duration of a dust layer depends on:

– the grade of release from the source of the dust,
– the rate at which dust is deposited, and
– the effectiveness of housekeeping (cleaning).

Three levels of housekeeping can be described.

Good: Dust layers are kept to negligible thickness, or are non-existent, irrespective of the grade of release. In this case, the risk of the occurrence of explosive dust clouds from layers and the risk of fire due to layers has been removed.

Fair: Dust layers are not negligible but are short-lived (typically less than one shift). The dust is removed before any fire can start.

Poor: Dust layers are not negligible and persist for a long period of time (typically more than one shift). The fire risk and secondary explosion risk may be significant.

Poor housekeeping combined with conditions that can create a dust cloud from a layer should be prevented. Any conditions that can create a dust cloud (for example, someone entering the room) shall be considered in the hazardous area classification.

NOTE When a planned level of housekeeping is not maintained, additional fire and explosion risks are created.

Annex C
(informative)

Hybrid mixtures

C.1 General

A hybrid mixture is a combined mixture of a flammable gas or vapour with a combustible dust or combustible flyings. This hybrid mixture may behave differently than the gas / vapour or dust individually. The number of situations that may be encountered in industry will be highly variable and as such it is not practical to provide specific guidance. However this Annex provides guidance on issues that should be considered when hybrid mixtures are found.

C.2 Ventilation

The use of ventilation as a control measure needs to be carefully considered as it may reduce the gas/vapour hazard but increase the dust hazard or have other varying effects on the different components of the mixture.

C.3 Explosive limits

A hybrid mixture may form an explosive atmosphere outside the explosive limits of the gas / vapour or explosive concentrations for the dust individually. It is recommended that a hybrid mixture is considered to be explosive if the concentration of the gas / vapour exceeds 25 % of the LEL for the gas / vapour.

C.4 Chemical reactions

Consideration should also be given to chemical reactions that may occur within the materials or entrapped gas in the dust that may result in evolution of gas in the process.

C.5 Minimum ignition parameters

Where a hybrid mixture exists, the minimum ignition parameters such as the minimum ignition energy and auto ignition temperature for the gas / vapour mixture, or the minimum ignition temperature of a dust cloud, could be different than any component present in the mixture. In the absence of other information the parameters used should be the worst case of any component in the mixture.

C.6 Final classification

Where a hybrid mixture exists, consideration should be given to the assignment of both gas and dust zones to match the worst case requirement for both the gas and dust hazard. The worst case consequence should be considered when considering any EPL assessment.

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2 To be published.

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