BS EN 60079-10-2:2009

BSI British Standards

Explosive atmospheres —

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

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British Standards

National foreword

This British Standard is the UK implementation of EN 60079-10-2:2009. It is identical to IEC 60079-10-2:2009. It supersedes BS EN 61241-10:2004 which is withdrawn.

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

A list of organizations represented on this committee can be obtained on request to its secretary.

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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Explosive atmospheres - Part 10-2: Classification of areas - Combustible dust atmospheres (IEC 60079-10-2:2009)

Atmosphères explosives - Partie 10-2: Classification des emplacements - Atmosphères explosives poussiéreuses (CEI 60079-10-2:2009)

Explosionsfähige Atmosphäre - Teil 10-2: Einteilung der Bereiche - Staubexplosionsgefährdeten Bereiche (IEC 60079-10-2:2009)

This European Standard was approved by CENELEC on 2009-06-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

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

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

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

Central Secretariat: Avenue Marnix 17, B - 1000 Brussels

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Foreword

The text of document 31J/166/FDIS, future edition 1 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 was approved by CENELEC as EN 60079-10-2 on 2009-06-01.

This European Standard supersedes EN 61241-10:2004.

The significant technical changes with respect to EN 61241-10:2004 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 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)	2010-03-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2012-06-01

Annexes ZA and ZB have been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60079-10-2:2009 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60079-1	NOTE	Harmonized as EN 60079-1:2007 (not modified).
IEC 60079-2	NOTE	Harmonized as EN 60079-2:2007 (not modified).
IEC 60079-5	NOTE	Harmonized as EN 60079-5:2007 (not modified).
IEC 60079-6	NOTE	Harmonized as EN 60079-6:2007 (not modified).
IEC 60079-7	NOTE	Harmonized as EN 60079-7:2007 (not modified).
IEC 60079-11	NOTE	Harmonized as EN 60079-11:2007 (not modified).
IEC 60079-14	NOTE	Harmonized as EN 60079-14:2008 (not modified).
IEC 60079-15	NOTE	Harmonized as EN 60079-15:2005 (not modified).
IEC 60079-18	NOTE	Harmonized as EN 60079-18:2004 (not modified).
IEC 60079-26	NOTE	Harmonized as EN 60079-26:2007 (not modified).
IEC 60079-28	NOTE	Harmonized as EN 60079-28:2007 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

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

Publication	Year	Title	EN/HD	Year
IEC 60079-0	-[1]	Explosive atmospheres - Part 0: Equipment - General requirements	EN 60079-0	2009[2]

[1] Undated reference.

[2] Valid edition at date of issue.

Annex ZB
(informative)

ATEX Categories and Equipment Protection Levels (EPLs)

This European Standard has been written to incorporate the concept of Equipment Protection Levels (EPLs).

EPLs are analogous to the ATEX Categories, indeed the definitions are identical.

Wherever there is a reference to an EPL in the text it should be equated with the corresponding ATEX Category:

- EPL ‘Ga’ equates to ATEX Category 1G;
- EPL ‘Gb’ equates to ATEX Category 2G;
- EPL ‘Gc’ equates to ATEX Category 3G;
- EPL ‘Da’ equates to ATEX Category 1D;
- EPL ‘Db’ equates to ATEX Category 2D;
- EPL ‘Dc’ equates to ATEX Category 3D.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

EXPLOSIVE ATMOSPHERES –

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

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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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} Ωm

3.8
non-conductive dust
combustible dust with electrical resistivity greater than 10^{3} Ωm

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.

6.3.4 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 product 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. For areas outside buildings (open air), the boundary of zone 22 can be altered due to weather effects such as wind, rain, etc.;

NOTE 1 A distance of 3 m beyond zone 21 and 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.

- 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 22.

NOTE 2 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.

7 Dust layer hazard

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. The effect of housekeeping on dust layers is discussed in Annex C.

Information on the effect of hot surfaces with dust layers is given in Annex B.

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, which influence the formation of explosive dust atmospheres and dust layers,
d) operational and maintenance parameters,
e) housekeeping programs.

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

The 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.

8.2 Drawings, data sheets and tables

Area classification documents may be in hard copy or electronic form and should include plans and elevations, 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.

The area classification symbols which are shown in Figure 1 are the preferred ones. A symbol key shall always be provided on each drawing.

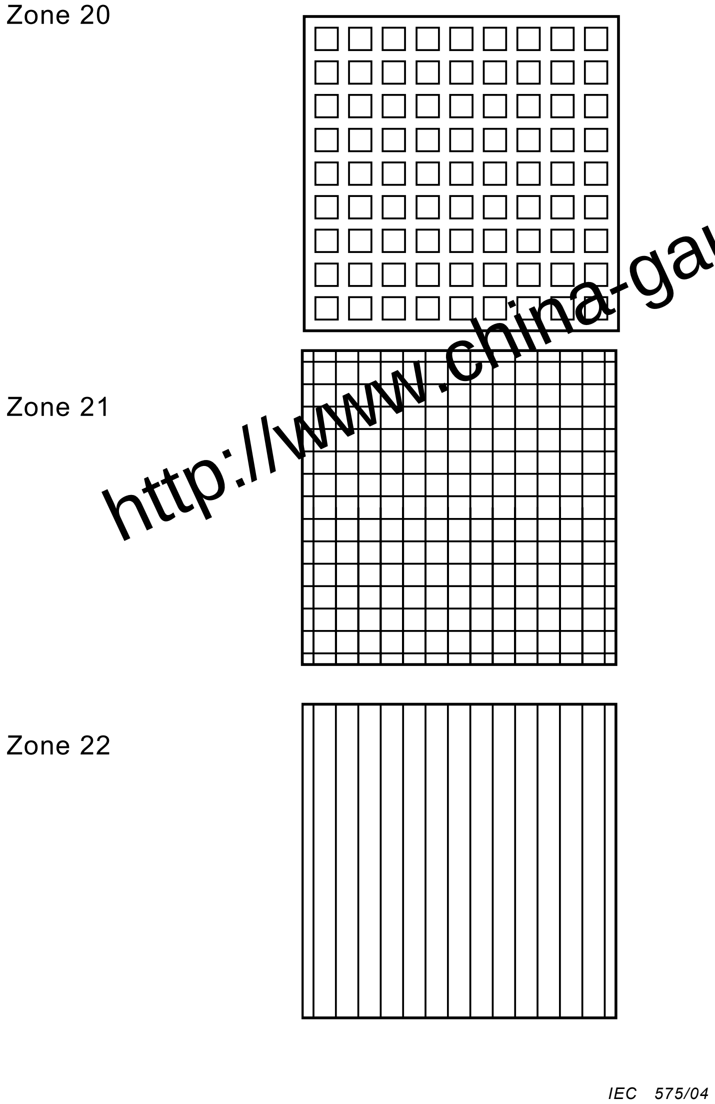


Figure 1 – Identification of zones on drawings

Annex A
(informative)

Area classification application

A.1 Examples of zones

A.1.1 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.1.2 Zone 21

Examples of locations that may give rise to zone 21:

- areas outside 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. silos (if filled and/or emptied only occasionally) and the dirty side of filters, if large self-cleaning intervals exist.

A.1.3 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.

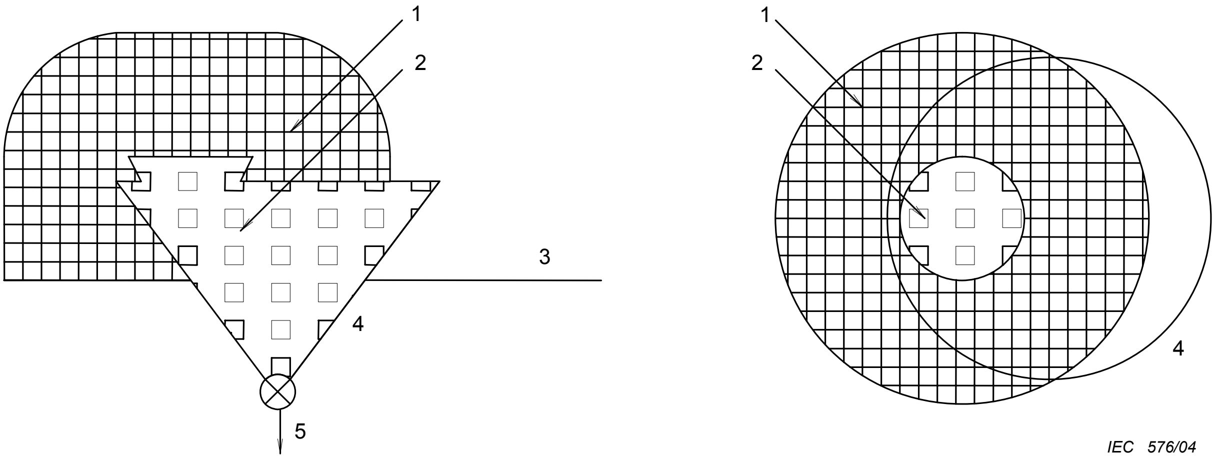
A.2 Bag emptying station within a building and without exhaust ventilation

In this example, bags are manually emptied frequently into a hopper from which the contents are conveyed pneumatically into some other part of the plant. 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 is a source with a primary grade 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.

NOTE 1 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 C). If air movements during the discharge of bags may occasionally carry the dust cloud beyond zone 21, then a zone 22 may be required in accordance with 6.3.3.



Key

1 zone 21, see 6.3.3
2 zone 20, see 6.3.2
3 floor
4 bag discharge hopper
5 to process

NOTE 2 The relative dimensions are for illustration only. In practice other distances may be required.

NOTE 3 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.

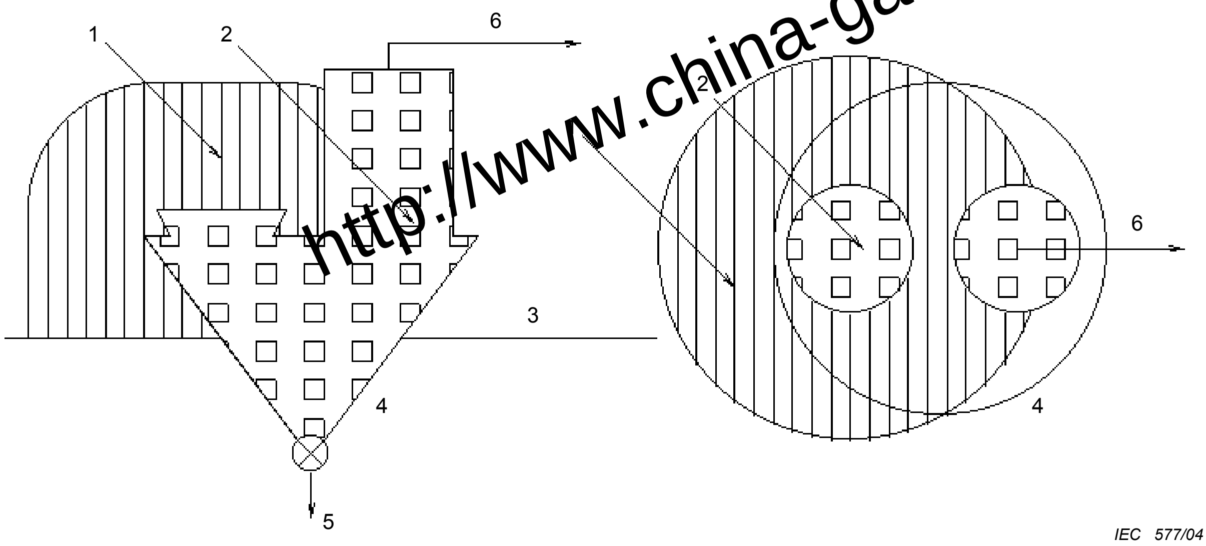
Figure A.1 – Bag emptying station within a building and without exhaust ventilation

A.3 Bag emptying station with exhaust ventilation

This is similar to the example given in Clause A.1, 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 6.3.4

2 zone 20, see 6.3.2

3 floor

4 bag discharge hopper

5 to process

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

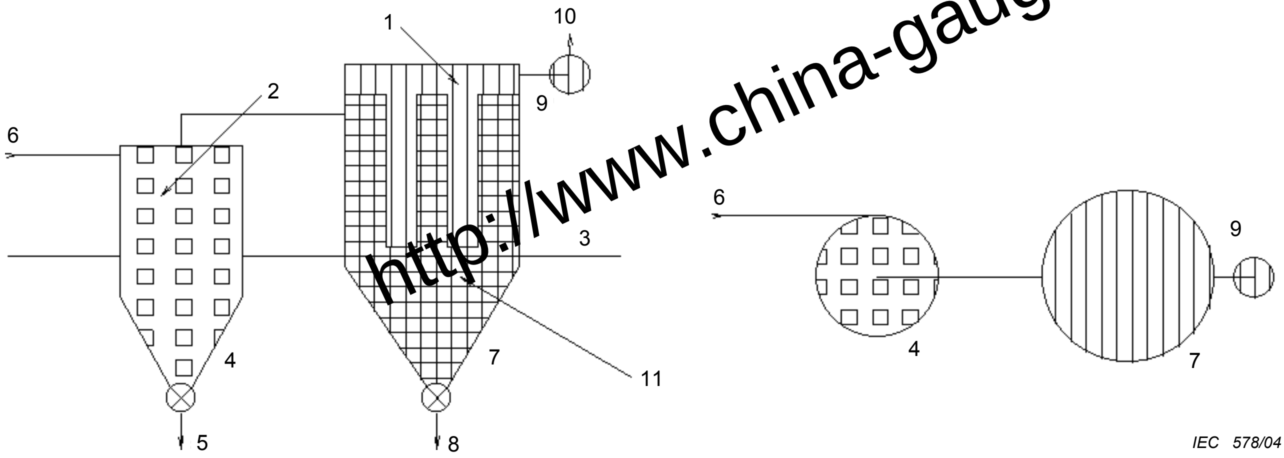
In this example, the cyclone and filter are part of a suction extraction system. The extracted product passes via a continuously operating rotary valve and falls into a closed bin. The quantity of fines is very small and therefore the self-cleaning intervals are large. For this reason, the interior only occasionally contains a flammable 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. If this is not the case, the dirty side of the filter is zone 20.

Zone 22 The clean side of the filter may contain a flammable 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 1 If dust layers accumulate outside the plant equipment, then further classification may be required, taking into account the extent of the layer and any disturbance of the layer that produces a cloud. The effect of conditions outside may be taken into account, e.g. wind, rain or humidity may prevent layers of dust accumulating.



Key

1 zone 22, see 6.3.4

2 zone 20, see 6.3.2

3 floor

4 cyclone

5 to product silo

6 inlet

7 filter

8 to fines bin

9 extract fan

10 to outlet

11 zone 21, see 6.3.3

NOTE 2 The relative dimensions are for illustration only. In practice, other distances may be required.

NOTE 3 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 this example, powder in 200 l 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.

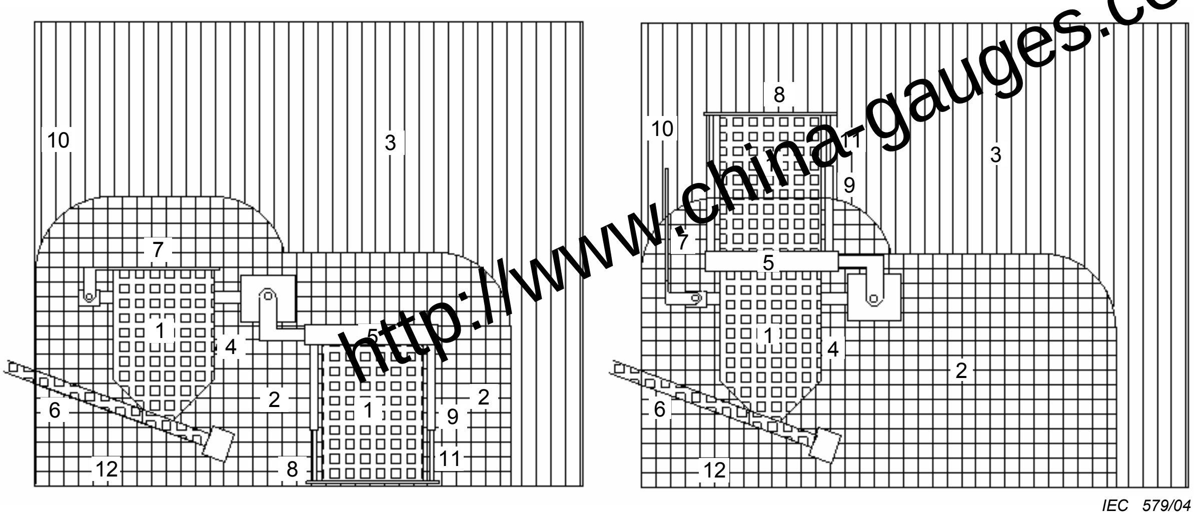
When a new drum is required, the diaphragm valve is closed. The drum carrier is rotated back to its original position and the hopper lid is closed. The hydraulic cylinders release the drum and its lid is replaced before the drum is removed.

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 area 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 and disturbance of large quantities of dust.



Key

1 zone 20, see 6.3.2
2 zone 21, see 6.3.3
3 zone 22, see 6.3.4
4 hopper
5 diaphragm valve
6 screw conveyor
7 hopper lid
8 drum platform
9 hydraulic cylinders
10 wall
11 drum
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)

Risk of fire from hot surface ignition of dust layer

The risk of fire is based on the possibility that a layer of dust could be ignited by a hot surface or heat flux from equipment. The appropriate measure to control this risk is temperature limitation of surfaces in contact with dust layers or limiting the energy release from the equipment under consideration.

For application and installation of electrical equipment details are given in IEC 60079-14. This information may also be used for any other hot surfaces.

Annex C
(informative)

Housekeeping

C.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 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.

C.2 Levels of housekeeping

The frequency of cleaning alone is not enough to determine whether a layer contains sufficient dust to control these risks. 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 (less than one shift). The dust is removed before any fire can start.

Poor: Dust layers are not negligible and persist for more than one shift. The fire risk may be significant, and this should be controlled by selecting equipment according to IEC 60079-14.

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 1 When a planned level of housekeeping is not maintained, additional fire and explosion risks are created. Some equipment may no longer be suitable.

NOTE 2 Changes to the state of the dust layer, e.g. moisture absorbency, may make it impossible to raise the layer into a dust cloud. In this case, there may be no secondary explosion risk, but the risk of fire may remain the same.

Annex D
(informative)

Introduction of an alternative risk assessment method encompassing 'equipment protection levels' for Ex equipment

D.1 Introductory remarks

This annex provides an explanation of the concept of a risk assessment method encompassing equipment protection levels (EPLs). These EPLs are introduced to enable an alternative approach to current methods of selecting Ex equipment.

D.2 Historical background

Historically, it has been acknowledged that not all types of protection provide the same level of assurance against the possibility of an incendive condition occurring. The installation standard, IEC 60079-14, allocates specific types of protection to specific zones, on the statistical basis that the more likely or frequent the occurrence of an explosive atmosphere, the greater the level of security required against the possibility of an ignition source being active.

Hazardous areas (with the normal exception of coal mining) are divided into zones, according to the degree of hazard. The degree of hazard is defined according to the probability of the occurrence of explosive atmospheres. Generally, no account is taken of the potential consequences of an explosion, nor of other factors such as the toxicity of materials. A true risk assessment would consider all factors.

Acceptance of equipment into each zone is historically based on the type of protection. In some cases the type of protection may be divided into different levels of protection which again historically correlate to zones. For example, intrinsic safety is divided into levels of protection 'ia' and 'ib'. The encapsulation 'm' standard includes two levels of protection 'ma' and 'mb'.

In the past, the equipment selection standard has provided a solid link between the type of protection for the equipment and the zone in which the equipment can be used. As noted earlier, nowhere in the IEC system of explosion protection is there any account taken of the potential consequences of an explosion, should it occur.

However, plant operators often make intuitive decisions on extending (or restricting) their zones in order to compensate for this omission. A typical example is the installation of 'zone 1 type' navigation equipment in zone 2 areas of offshore oil production platforms, so that the navigation equipment can remain functional even in the presence of a totally unexpected prolonged gas release. In the other direction, it is reasonable for the owner of a remote, well secured, small pumping station to drive the pump with a 'zone 2 type' motor, even in zone 1, if the total amount of gas available to explode is small and the risk to life and property from such an explosion can be discounted.

The situation became more complex with the publication of the first edition of IEC 60079-26 which introduced additional requirements to be applied for equipment intended to be used in zone 0. Prior to this, Ex ia was considered to be the only technique acceptable in zone 0.

It has been recognized that it is beneficial to identify and mark all products according to their inherent ignition risk. This would make equipment selection easier and provide the ability to better apply a risk assessment approach, where appropriate.

D.3 General

A risk assessment approach for the acceptance of Ex equipment has been introduced as an alternative method to the current prescriptive and relatively inflexible approach linking equipment to zones. To facilitate this, a system of equipment protection levels has been introduced to clearly indicate the inherent ignition risk of equipment, no matter what type of protection is used.

The system of designating these equipment protection levels is as follows.

D.3.1 Mines susceptible to firedamp (Group I)

D.3.1.1 EPL Ma

Equipment for installation in a coal mine susceptible to firedamp, having a 'very high' level of protection, which has sufficient security that it is unlikely to become an ignition source in normal operation, during expected malfunctions or during rare malfunctions, even when left energized in the presence of an outbreak of gas.

NOTE Typically communications circuits and gas detection equipment will be constructed to meet the Ma requirements – for example an Ex ia telephone circuit.

D.3.1.2 EPL Mb

Equipment for installation in a coal mine susceptible to firedamp, having a 'high' level of protection, which has sufficient security that it is unlikely to become a source of ignition in normal operation or during expected malfunctions in the time span between there being an outbreak of gas and the equipment being de-energized.

NOTE Typically Group I equipment will be constructed to meet the Mb requirements – for example Ex d motors and switchgear.

D.3.2 Gases (Group II)

D.3.2.1 EPL Ga

Equipment for explosive gas atmospheres, having a 'very high' level of protection, which is not a source of ignition in normal operation, during expected faults malfunctions or during rare malfunctions.

D.3.2.2 EPL Gb

Equipment for explosive gas atmospheres, having a 'high' level of protection, which is not a source of ignition in normal operation or during expected malfunctions.

NOTE The majority of the standard protection concepts bring equipment within this equipment protection level.

D.3.2.3 EPL Gc

Equipment for explosive gas atmospheres, having an 'enhanced' level of protection, which is not a source of ignition in normal operation and which may have some additional protection to ensure that it remains inactive as an ignition source in the case of regular expected occurrences (for example failure of a lamp).

NOTE Typically, this will be Ex n equipment.

D.3.3 Dusts (Group III)

D.3.3.1 EPL Da

Equipment for combustible dust atmospheres, having a 'very high' level of protection, which is not a source of ignition in normal operation, during expected malfunctions, or during rare malfunctions.

D.3.3.2 EPL Db

Equipment for combustible dust atmospheres, having a 'high' level of protection, which is not a source of ignition in normal operation or during expected malfunctions.

D.3.3.3 EPL Dc

Equipment for combustible dust atmospheres, having an 'enhanced' level of protection, which is not a source of ignition in normal operation and which may have some additional protection to ensure that it remains inactive as an ignition source in the case of regular expected occurrences (for example failure of a lamp).

For the majority of situations, with typical potential consequences from a resultant explosion, it is intended that the following would apply for use of the equipment in zones (this is not directly applicable for mines susceptible to firedamp, as the zone concept does not generally apply). See Table D.1.

Table D.1 – Traditional relationship of EPLs to zones (no additional risk assessment)

Equipment protection level	Zone
Ga	0
Gb	1
Gc	2
Da	20
Db	21
Dc	22

D.4 Risk of ignition protection afforded

The various levels of protection of equipment must be capable of functioning in conformity with the operational parameters established by the manufacturer to that level of protection. See Table D.2.

Table D.2 – Description of risk of ignition protection provided

Protection afforded	Equipment protection level Group	Performance of protection	Conditions of operation
Very high	Ma Group I	Two independent means of protection or safe even when two malfunctions occur independently of each other	Equipment remains functioning when explosive atmosphere present
Very high	Ga Group II	Two independent means of protection or safe even when two malfunctions occur independently of each other	Equipment remains functioning in zones 0, 1 and 2
Very high	Da Group III	Two independent means of protection or safe even when two malfunctions occur independently of each other	Equipment remains functioning in zones 20, 21 and 22
High	Mb Group I	Suitable for normal operation and severe operating conditions	Equipment de-energized when explosive atmosphere present
High	Gb Group II	Suitable for normal operation and frequently occurring disturbances or equipment where malfunctions are normally taken into account	Equipment remains functioning in zones 1 and 2
High	Db Group III	Suitable for normal operation and frequently occurring disturbances or equipment where malfunctions are normally taken into account	Equipment remains functioning in zones 21 and 22
Enhanced	Gc Group II	Suitable for normal operation	Equipment remains functioning in zone 2
Enhanced	Dc Group III	Suitable for normal operation	Equipment remains functioning in zone 22

D.5 Implementation

The fourth edition of IEC 60079-14 (encompassing the former requirements of IEC 61241-14) introduced the EPLs to allow a system of “risk assessment" as an alternative method for the selection of equipment.

Additional marking and the correlation of the existing types of protection are being introduced into the revisions to the following IEC standards:

- IEC 60079-0 (encompassing the former requirements of IEC 61241-0)
- IEC 60079-1
- IEC 60079-2 (encompassing the former requirements of IEC 61241-4)
- IEC 60079-5
- IEC 60079-6
- IEC 60079-7
- IEC 60079-11 (encompassing the former requirements of IEC 61241-11)

- IEC 60079-15
- IEC 60079-18 (encompassing the former requirements of IEC 61241-18)
- IEC 60079-26
- IEC 60079-28

For the types of protection for explosive gas atmospheres the EPLs require additional marking. For explosive dust atmospheres the present system of marking the zones on equipment is being replaced by marking the EPLs.

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IEC 60079-5, *Explosive atmospheres – Part 5: Equipment protection by powder filling "q"*

IEC 60079-6, *Explosive atmospheres – Part 6: Equipment protection by oil-immersion "o"*

IEC 60079-7, *Explosive atmospheres – Part 7: Equipment protection by increased safety "e"*

IEC 60079-11, *Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "i"*

IEC 60079-14, *Explosive Atmospheres – Part 14: Electrical installations design, selection and erection*

IEC 60079-15, *Explosive atmospheres – Part 15: Equipment protection by type of protection "n"*

IEC 60079-18, *Explosive atmospheres – Part 18: Equipment protection by encapsulation "m"*

IEC 60079-26, *Explosive atmospheres – Part 26: Equipment with equipment protection level (EPL) Ga*

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IEC 61241-2-1, *Electrical apparatus for use in the presence of combustible dust – Part 2: Test methods – Section 1: Methods for determining the minimum ignition temperatures of dust*

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

ISO 4225:1994, *Air quality – General aspects – Vocabulary*

1 Under preparation.

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