SLOVENSKI STANDARD
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Eksplozivne atmosfere - Protieksplozijska zaščita - 1. del: Osnovni pojmi in metodologija

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

Explosionsfähige Atmosphären - Explosionsschutz - Teil 1: Grundlagen und Methodik

Atmosphères explosives - Prévention de l'explosion et protection contre l'explosion - Partie 1 : Notions fondamentales et méthodologie

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

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Explosionsfähige Atmosphären - Explosionsschutz - Teil 1: Grundlagen und Methodik

This European Standard was approved by CEN on 3 June 2019.

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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 CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 1127-1:2019) has been prepared by Technical Committee CEN/TC 305 “Potentially explosive atmospheres - Explosion prevention and protection”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2020, and conflicting national standards shall be withdrawn at the latest by February 2022.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1127-1:2011.

Annex D provides details of significant technical changes between this document and the previous edition EN 1127-1:2011.

This document has been prepared under a standardization request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directives.

For relationship with EU Directives, see informative Annex ZA and ZB, which are integral parts of this document.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

CEN and CENELEC are producing a set of standards to assist designers, manufacturers and other interested bodies to interpret the essential safety requirements in order to achieve conformity with European Legislation. Within this series of standards CEN has undertaken to draw up a standard to give guidance in the field of explosion prevention and protection, as hazards from explosions are intended to be considered in accordance with EN ISO 12100:2010.

In accordance with EN ISO 12100:2010, it is a type B standard.

This standard describes the basic concepts and methodology of explosion prevention and protection.

CEN/TC 305 has a mandate in this area to produce B-type, and C-type standards, which will allow verification of conformity with the essential safety requirements.

Explosions can occur from:

a) materials processed or used by the equipment, protective systems and components;

b) materials released by the equipment, protective systems and components;

c) materials in the vicinity of the equipment, protective systems and components;

d) materials of construction of the equipment, protective systems and components.

Since safety depends not only on equipment, protective systems and components but also on the material being handled and its use, this standard includes aspects related to the intended use and foreseeable misuse, i.e. the manufacturer should consider in which way and for which purpose the equipment, protective systems and components will be used and take this into account during its design and construction. This is the only way hazards inherent in equipment, protective systems and components can be reduced.

NOTE This standard can also serve as a guide for users of equipment, protective systems and components when assessing the risk of explosion in the workplace and selecting the appropriate equipment, protective systems and components.

1 Scope

This document specifies methods for the identification and assessment of hazardous situations leading to explosion and the design and construction measures appropriate for the required safety. This is achieved by:

— risk assessment;

— risk reduction.

The safety of equipment, protective systems and components can be achieved by eliminating hazards and/or limiting the risk, i.e. by:

a) appropriate design (without using safeguarding);

b) safeguarding;

c) information for use;

d) any other preventive measures.

Measures in accordance with a) (prevention) and b) (protection) against explosions are dealt with in Clause 6, measures according to c) against explosions are dealt with in Clause 7. Measures in accordance with d) are not specified in this document. They are dealt with in EN ISO 12100:2010, Clause 6.

The preventive and protective measures described in this document will not provide the required level of safety unless the equipment, protective systems and components are operated within their intended use and are installed and maintained according to the relevant codes of practice or requirements.

This document specifies general design and construction methods to help designers and manufacturers in achieving explosion safety in the design of equipment, protective systems and components.

This document is applicable to any equipment, protective systems and components intended to be used in potentially explosive atmospheres, under atmospheric conditions. These atmospheres can arise from flammable/combustible substances processed, used or released by the equipment, protective systems and components or from materials in the vicinity of the equipment, protective systems and components and/or from the materials of construction of the equipment, protective systems and components.

This document is applicable to equipment, protective systems and components at all stages of its use.

This document is only applicable to equipment group II which is intended for use in other places than underground parts of mines and those parts of surface installations of such mines endangered by firedamp and/or combustible dust.

This document is not applicable to:

1) medical devices intended for use in a medical environment;

2) equipment, protective systems and components where the explosion hazard results exclusively from the presence of explosive substances or unstable chemical substances;

3) equipment, protective systems and components where the explosion can occur by reaction of substances with other oxidizers than atmospheric oxygen or by other hazardous reactions or by other than atmospheric conditions;

4) equipment intended for use in domestic and non-commercial environments where potentially explosive atmospheres may only rarely be created, solely as a result of the accidental leakage of fuel gas;

5) personal protective equipment covered by Regulation (EU) 2016/425;

6) seagoing vessels and mobile offshore units together with equipment on board such vessels or units;

7) means of transport, i.e. vehicles and their trailers intended solely for transporting passengers by air or by road, rail or water networks, as well as means of transport insofar as such means are designed for transporting goods by air, by public road or rail networks or by water; vehicles intended for use in a potentially explosive atmosphere shall not be excluded;

8) the design and construction of systems containing desired, controlled combustion processes, unless they can act as ignition sources in potentially explosive atmospheres.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

EN 13237:2012, *Potentially explosive atmospheres — Terms and definitions for equipment and protective systems intended for use in potentially explosive atmospheres*

EN 15198:2007, *Methodology for the risk assessment of non-electrical equipment and components for intended use in potentially explosive atmospheres*

EN ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

EN ISO 80079-36:2016, *Explosive atmospheres — Part 36: Non-electrical equipment for explosive atmospheres — Basic method and requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13237:2012 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
normal tightness
absence of leakage when any of the tightness tests or tightness monitorings appropriate for the application does not reveal any hazardous leaks during normal operation

3.2
enhanced tightness
absence of leakage when due to the design and measures of maintenance any of the tightness tests or tightness monitorings appropriate for the application does not reveal any hazardous leaks during normal operations and expected malfunctions

4 Risk assessment

4.1 General

For non-electrical equipment, components, protective systems, devices and assemblies of these non-electrical products, which have their own potential ignition sources and are intended for use in explosive atmospheres, risk assessment shall be carried out according to EN ISO 80079-36:2016. For other situations, risk assessment shall be carried out in accordance with EN ISO 12100:2010 and/or EN 15198:2007 unless other standards can be identified as being more appropriate, considering the following:

a) identification of explosion hazards and determination of the likelihood of occurrence of a hazardous explosive atmosphere (see 4.2);

b) identification of ignition hazards and determination of the likelihood of occurrence of potential ignition sources (see 4.3);

c) estimation of the possible effects of an explosion in case of ignition (see 4.4);

d) evaluation of the risk and whether the intended level of protection has been achieved;

NOTE The intended level of protection is defined by at least legal requirements and, if necessary, additional requirements specified by the user.

e) consideration of measures to reduce of the risks (see Clause 6).

A comprehensive approach shall be taken, especially for complex equipment, protective systems and components, plants comprising individual units and, above all, for extended plants. This risk assessment shall take into account the ignition and explosion hazard from:

1) the equipment, protective systems and components themselves;

2) the interaction between the equipment, protective systems and components and the substances being handled;

3) the particular process performed in the equipment, protective systems and components;

4) the surroundings of the equipment, protective systems and components and possible interaction with neighbouring processes.

4.2 Identification of explosion hazards

4.2.1 General

The explosion hazard is generally related to the materials and substances processed, used or released by equipment, protective systems and components and materials used to construct equipment, protective systems and components. Some of these released substances can undergo combustion processes in air. These processes are often accompanied by the release of considerable amounts of heat and can be associated with a pressure build-up and the release of hazardous materials. In contrast to burning in a fire, an explosion is essentially a self-sustained propagation of the reaction zone (flame) through the hazardous explosive atmosphere. This potential hazard associated with the hazardous explosive atmosphere is released when ignited by an effective ignition source.

The safety characteristics listed in 4.2.2 and 4.2.3 describe safety relevant properties of flammable/combustible substances. The material properties and the safety characteristics are used for the identification of the explosion hazard.

It is necessary to bear in mind that such safety characteristics are not constants but depend for instance on the techniques used for their measurement. Also, for dusts, tabulated safety data are for guidance only because the values depend on particle size and shape, moisture content and the presence of additives even in trace concentrations. For a specific application, samples of the dust present in the equipment should be tested and the data obtained used in the hazard identification.

4.2.2 Flammability properties

Since in this context it is not the material itself that represents the potential hazard but its contact or mixing with air, the properties of the mixture of the flammable/combustible substance with air shall be determined. These properties give information about a substance's burning behaviour and whether it could give rise to fire or explosions. Relevant data are e.g.:

a) lower explosion point (see EN 15794), that can be substituted by flash point (with a safety factor), if lower explosion point is not available;

b) explosion limits (LEL, UEL) (see EN 14034-3 and EN 1839);

NOTE Lower explosion limit (LEL) and upper explosion limit (UEL) are named lower flammability limit (LFL) and upper flammability limit (UFL) in EN ISO/IEC 80079-20-1.

c) limiting oxygen concentration (LOC) (see EN 14034-4 and EN 1839).

4.2.3 Explosion behaviour

The behaviour of the explosive atmosphere after ignition shall be characterized by data such as:

a) maximum explosion pressure (p_{max}) (see EN 14034-1, EN 14034-4 and EN 15967);

b) maximum rate of explosion pressure rise ($(dp/dt)_{max}$) (see EN 14034-2, EN 14491 and EN 15967);

c) maximum experimental safe gap (MESG) (see EN 60079-20-1).

4.2.4 Likelihood of occurrence of a hazardous explosive atmosphere

The likelihood of occurrence of a hazardous explosive atmosphere depends on the following:

— presence of a flammable/combustible substance;

— degree of dispersion of the flammable/combustible substance (e.g. gases, vapours, mists, dusts);

— concentration of the flammable/combustible substance in air within the explosion range;

— amount of explosive atmosphere sufficient to cause injury or damage in case of ignition.

In assessment of the likelihood of occurrence of a hazardous explosive atmosphere, possible formation of the hazardous explosive atmosphere through chemical reactions, pyrolysis and biological processes from the materials present shall be taken into account.

If it is impossible to estimate the likelihood of occurrence of a hazardous explosive atmosphere, the assumption shall be made that such an atmosphere is always present.

a) Presence of a flammable/combustible substance

Flammable/combustible substances shall be considered as materials which can form a hazardous explosive atmosphere unless an investigation of their properties has shown that in mixtures with air they are incapable of self-sustained propagation of an explosion. In assessment of the likelihood of occurrence of a hazardous explosive atmosphere, possible formation of the hazardous explosive

atmosphere through chemical reactions, pyrolysis and biological processes from the materials present shall be taken into account.

b) Degree of dispersion of flammable/combustible substances

By their very nature, gases, vapours and mists have a degree of dispersion high enough to produce a hazardous explosive atmosphere. For dusts the occurrence of a hazardous explosive atmosphere can be assumed if the particle size fractions are equal or less than 0,5 mm.

NOTE 1 Numerous mists, aerosols and types of dusts that occur in actual practice have particle sizes between 0,001 mm and 0,1 mm.

NOTE 2 Combustible flyings are a type of dust (group III A, see EN IEC 60079-0), including fibres (e.g. cotton/carbon/jute fibres), where one dimension is greater than 0,5 mm and which may form with air a hazardous explosive atmosphere.

Attention shall be paid to the fact that explosions can occur in hybrid mixtures though none of the flammable/combustible substances of the mixture is individually within the explosion range.

c) Concentration of flammable/combustible substances

An explosion is possible when the concentration of the dispersed flammable/combustible substance in air achieves a minimum value (lower explosion limit). An explosion will not occur when the concentration exceeds a maximum value (upper explosion limit).

NOTE 3 Some chemically unstable substances, e.g. acetylene and ethylene oxide, can undergo exothermic reactions even in the absence of oxygen and have an upper explosion limit of 100 %.

The explosion limits vary with pressure and temperature. As a rule, the concentration range between the explosion limits increases with increasing pressure and temperature. In the case of mixtures with oxygen, the upper explosion limits are far higher than for mixtures with air.

If the surface temperature of a combustible liquid exceeds the lower explosion point, a hazardous explosive atmosphere can be formed (see 6.2.1.2).

NOTE 4 Hybrid mixtures, e.g. aerosols and mists, can become an explosive mixture at temperatures that are far below the lower explosion point (LEP).

The explosion limits for dusts do not have the same significance as those for gases and vapours. Dust clouds are usually inhomogeneous. The dust concentration can fluctuate greatly due to dust depositing and dispersion into the atmosphere. Consideration shall always be given to the possible formation of hazardous explosive atmospheres when deposits of combustible dust are present.

d) Amount of hazardous explosive atmosphere

The assessment whether an explosive atmosphere is present in a hazardous amount depends on the possible effects of the explosion (see 4.4).

4.3 Identification of ignition hazards

4.3.1 General

At first it shall be determined which types of ignition sources are possible and which are related to the equipment (or components or protective systems). The different ignition sources are considered in Clause 5. The significance of all ignition sources that could come into contact with the hazardous explosive atmosphere shall be assessed.

The ignition capability of all equipment related ignition sources shall then be compared with the ignition properties of the flammable/combustible substance (see 4.3.2).

This step shall result in a complete list of all potential ignition sources of the equipment, component or protective system. Afterwards the likelihood of occurrence of the potential ignition sources to become effective shall be assessed, taking also into account those that can be introduced e.g. by maintenance and cleaning activities.

4.3.2 Ignition properties

The ignition properties of the hazardous explosive atmosphere shall be determined. Relevant data are, e.g.:

a) minimum ignition energy (see EN ISO/IEC 80079-20-2);

b) minimum ignition temperature of an explosive dust atmosphere (see EN ISO/IEC 80079-20-2);

c) auto-ignition temperature of an explosive gas atmosphere (see EN ISO/IEC 80079-20-1).

4.3.3 Likelihood of occurrence of effective ignition sources

The potential ignition sources shall be classified according to the likelihood to become effective in the following manner:

a) ignition sources which can occur continuously or frequently;

b) ignition sources which can occur in rare situations;

c) ignition sources which can occur in very rare situations;

In terms of the equipment, protective systems and components used this classification shall be considered equivalent to:

d) ignition sources which can occur during normal operation;

e) ignition sources which can occur solely as a result of malfunctions;

f) ignition sources which can occur solely as a result of rare malfunctions.

NOTE Protective measures can be used to make the ignition source non-effective (see 6.4).

If the likelihood of occurrence of an effective ignition source cannot be estimated, the assumption shall be made that the ignition source is present at all times.

4.4 Estimation of the possible effects of an explosion

To estimate the possible effects of an explosion the following shall be considered, e.g.:

— pressure waves;

— flames and hot gases;

— thermal radiation;

— flying debris;

— hazardous releases of materials.