SLOVENSKI STANDARD
SIST EN 1127-2:2002+A1:2008

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Eksplozivne atmosfere - Preprečevanje eksplozije in zaščita pred njo - 2. del: Osnovni pojmi in metodologija za rudarstvo

Explosive atmospheres - Explosion prevention and protection - Part 2: Basic concepts and methodology for mining

Explosionsfähige Atmosphären - Explosionsschutz - Teil 2: Grundlagen und Methodik in Bergwerken

Atmosphères explosives - Prévention de l'explosion et protection contre l'explosion - Partie 2: Notions fondamentales et méthodologie dans l'exploitation des mines

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Explosionsfähige Atmosphären - Explosionsschutz - Teil 2: Grundlagen und Methodik in Bergwerken

This European Standard was approved by CEN on 31 August 2001 and includes Amendment 1 approved by CEN on 18 March 2008.

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Contents

Foreword

This document (EN 1127-2:2002+A1:2008) has been prepared by 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of an identical text or by endorsement, at the latest by October 2008 and conflicting national standards shall be withdrawn at the latest by October 2008.

This document includes Amendment 1, approved by CEN on 2008-03-18.

This document supersedes EN 1127-2:2002.

The start and finish of text introduced or altered by amendment is indicated in the text by tags [A1] 〈A1〉.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

[A1] For relationship with EU Directive(s), see informative Annexes ZA and ZB, which are integral parts of this document. 〈A1〉

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

Introduction

General

CEN and CENELEC are producing a series 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 to be considered in accordance with EN 292-1.

The European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential health and safety requirements.

- [A1] of Directives 98/37/EC and 2006/42/EC of the European Parliament and of the Council on the approximation of the laws of the Member States relating to machinery which both in Annex I, 1.5.7 require that machinery shall be designed and constructed to avoid any risk of explosion as well as [A1]

- of Directive 94/9/EC of the European Parliament and of the Council on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres (called ATEX-100a-Directive)

In accordance with EN 292-1, it is a type A standard.

Special considerations for mining

Explosions can result from:

- materials processed or used by the equipment, protective systems and components, e.g. minerals obtained as part of the winning process;

- materials released by the equipment, protective systems and components;

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

- materials of which the equipment, protective systems and components are constructed.

As the explosion protection of equipment, protective systems and components depends on

- the design and construction of the equipment, protective systems and components ;

- the intended use;

- the ambient conditions;

- the materials extracted and handled

this standard also includes aspects related to these factors, i.e. the manufacturer shall consider how and for what the equipment, protective systems and components will be used and take this into account during their design and construction. Only in this way can hazards inherent in equipment, protective systems and components be reduced.

NOTE This standard may 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.

Mines can be either gassy or non-gassy depending upon the mineral/material being extracted and whether or not firedamp can occur in the workings. It is usual practice to consider all coal mines as gassy mines. Non-coal mines can, however, also be susceptible to the occurrence of firedamp e.g. if minerals/materials are being extracted in the vicinity of oil-bearing strata or unworked coal seams which are disturbed by the extraction process or mines susceptible to outbursts of flammable gas.

In mines where flammable minerals/materials are extracted, there can also be a risk of explosions because small particles of the extracted product can be blown into the air to form dust/air mixtures able to support rapid combustion. Flammable dust can either be an explosion risk on its own (when in the form of an explosive dust/air mixture), or it can settle in layers which may be blown from the floor and sides of the roadways by a firedamp explosion. In the latter case, the explosive violence can increase manyfold as more and more fuel in the form of flammable dust is raised by a blast wave and added to the flame as it travels along the roadways.

The risk of an explosive atmosphere occurring and its consequences will therefore vary from mine to mine, depending on the type of mine, its layout, the mineral being extracted and the likelihood of firedamp and/or flammable dust occurring.

In **coal mining**, firedamp and coal dust naturally associated with the coal is released by the activity of the miners. Therefore, the potential explosion risk is greater as a result of explosive air/gas or air/dust mixtures forming that cannot be totally excluded by the preventive measures taken.

Firedamp/air mixtures are usually diluted by the ventilation and evacuated to the surface via the mine workings so that the gas content in normal operation is kept far below the lower explosion limit. However, as a result of system malfunction (e.g. fan failure), sudden release of large gas quantities (gas outbursts) or intensified gas release caused by decreasing air pressure or by increased coal production, the permissible gas concentration thresholds may be exceeded. The explosive atmosphere caused in this way, even though limited in space and/or time, may cause a hazard not just at its point of origin but also in the escape roads, waste air paths and other connected mine structures in the mine layout

Coal dust/air mixtures are usually neutralized at the dust source by water sprays, dust removal systems on heading machines and/or treating with inert dust in order to reduce the explosive potential. However, an explosion hazard can exist if explosive dust can become airborne, e.g. at transfer points, in bunkers and other conveying systems.

In contrast to surface industries, in gassy mines electrical and non-electrical equipment and mining personnel are in permanent contact with gas and/or dust/air mixtures which, under unfavourable conditions, may constitute explosive atmospheres. Accordingly, particularly stringent safety requirements are in force for explosion protection and escape possibilities in the event of a hazard. Due to the possibly devastating effects of underground gas/dust explosions, underground mining is permitted only well outside the explosion range.

As a deviation from EN 1127-1:1997 “Explosive atmospheres – Explosion prevention and protection - Part 1: Basic concepts and methodology", which does not cover mining, the term "area" is not used for the categorization of underground workings exposed to explosion hazards because normally this term stands for a clearly dimensionally specified space around a generally stationary technical installation, e.g. a chemical plant with fixed installations and specified limits around the manufacturing process. Therefore, Directive 94/9/EEC deals with the mining and non-mining industries separately by having equipment category I for mining and equipment category II for non-mining industry.

In gassy mines, the decision as to whether or not mine workers can operate in a particular workplace depends upon the atmospheric conditions prevailing at the time. Traditionally, a factor of safety is also introduced so that it is common practice throughout the European member states for equipment to be de-energized or made safe and for miners to be withdrawn from their workplace if the atmospheric conditions attain a specific percentage of the lower explosion limit (LEL) of methane (firedamp) in air as defined by the relevant national legislation of the member states

NOTE The current limit values for disconnecting equipment and withdrawing personnel are different in each member state.

In this European Standard two hazardous conditions are specified [1] taking into account the definitions in the Directive 94/9/EEC, i.e.

- **hazardous condition 2 (potentially explosive atmosphere)**
  range between 0 % and below LEL or above UEL up to 100 % of firedamp in air

- **hazardous condition 1 (explosive atmosphere)**
  range between LEL and UEL of firedamp in air

In mine workings with hazardous condition 1, only M 1 equipment is allowed to be used as it has a high degree of intrinsic safety. M 1 equipment, e.g. telephones or gas measuring equipment, may continue to be operated even in the event of rare equipment faults in explosive atmospheres. This is ensured by the existence of two independent protective measures or double fail-safe systems.

In mine workings with hazardous condition 2, both M 1 and M 2 equipment may be used. M 2 equipment may be used as it has a high degree of safety and is suitable for the severe conditions in mining. In an explosive atmosphere, M 2 equipment shall be capable of being disconnected or made safe

NOTE Under special conditions, it may be necessary to operate M 2 equipment in an explosive atmosphere for a short time, e.g. when personnel are escaping from mine workings with high firedamp readings with their M 2 caplights switched on, when personnel are being recovered by the mine rescue service or the firedamp extraction system has been started up

M 1 and M 2 equipment can only be operated with the characteristics specified by the manufacturer as only then do they ensure the relevant level of safety. The manufacturer specifies the operating characteristics for the equipment.

In practice, national regulations require that gas measurements be taken at certain points and at specific intervals and suitable measures are taken to de-energize the equipment either manually or automatically if the firedamp concentration reaches a certain value. A subdivision into hazards caused by an explosive gas atmosphere and those caused by an explosive dust atmosphere is, in contrast to EN 1127-1:1997, not advisable in underground mining as the hazard to the mine workings can be caused simultaneously by firedamp and by clouds of flammable dust. Therefore, the explosion protection measures shall always cover both, i.e. the hazard caused by firedamp and the one caused by flammable dust.

Directive 94/9/EEC extends the definition of potentially explosive atmosphere to include flammable dust as well as firedamp. Extensive research [2] has shown that the minimum ignition energy (MIE) of coal dust/air mixtures is several hundred times that of firedamp/air mixtures and that the maximum experimental safe gap (MESG) of coal dust particles is more than double that for firedamp. It is therefore reasonable to assume that the equipment, protective systems and components which are designed and constructed for use in firedamp/air mixtures are also suitable for use in coal dust/air mixtures.

The comparison of firedamp and coal dust experimental data relates only to atmospheres. Additional precautions are required when considering coal dust deposits as, in this case, the maximum surface temperature of the equipment (limited to 150 °C for Group I equipment) on which the deposits can form can be limited to values below the minimum ignition temperature.

It shall be borne in mind that in coal mines and non-coal mines there can be areas where firedamp does not occur but where there is a risk of explosion because of flammable dust.

A list of standards under preparation by CEN/TC 305 is given in annex C.

1 Scope

This European Standard gives general guidelines for explosion prevention and protection in mining by outlining the basic concepts and methodology for the design and construction of equipment, protective systems and components.

This European Standard applies to Group I equipment, protective systems and components intended for use in underground parts of mines and those parts of their surface installations at risk from firedamp and/or flammable dust.

NOTE Detailed information on specific equipment, protective systems and components is contained in the relevant individual standards. Safety-relevant data regarding flammable materials and explosive atmospheres are required for the design and construction of the explosion protection measures

This European Standard specifies methods for the identification and assessment of hazardous situations that may lead to explosions and describes the design and construction measures appropriate for the required safety. This is achieved by

- hazard identification;
- risk assessment;
- elimination or minimization of risk;
- information for use.

The safety of equipment, protective systems, and components can be achieved, as described in EN 292-2:1991, by removal of hazards and/or limiting the risk, i.e.

a) by risk reduction by design;

b) by safeguarding;

c) by information for use;

d) by additional precautions.

NOTE Risk reduction by design in accordance with clause 3 of EN 292-2:1991 should not be confused with the concept of "design" as described in 6.5 of this standard.

Measures in accordance with a) (prevention) and b) (protection) against explosions are dealt with in clause 6 of this standard, measures according to c) against explosions are dealt with in clause 7 of this standard. Measures in accordance with d) are not described in this European Standard. They are dealt with in clause 6 of EN 292-2:1991.

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

This standard is applicable to any equipment, protective systems and components intended to be used in potentially explosive atmospheres. These atmospheres can arise from flammable materials 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.

As shot firing can release potentially explosive atmospheres, this standard is also applicable to the equipment used for shot firing, apart from the explosives and detonators.

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

This standard is not applicable to:

- medical devices intended for use in a medical environment;
- equipment, protective systems and components where the explosion hazard results exclusively from the presence of explosives or unstable chemical substances;
- equipment, protective systems and components where the explosion can result from reaction of substances with oxidizing agents other than atmospheric oxygen or by other hazardous reactions or conditions other than atmospheric conditions;

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

- personal protective equipment within the meaning of Directive 89/686/EEC;

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

- mines where firedamp and/or flammable dust are not naturally present and surface installations such as coal preparation plants, power plants, coke oven plants etc. in which an explosive atmosphere can be present, but which are not part of a coal mine. These are covered by EN 1127-1:1997.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 292-1:1991, *Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology.*

EN 292-2:1991, *Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles and specifications.*

EN 954-1, *Safety of machinery - Safety related parts of control systems - Part 1: General principles for design.*

EN 1050, *Safety of machinery - Risk assessment.*

EN 1127-1:1997, *Explosive atmospheres - Explosion prevention and protection – Part 1:Basic concepts and methodology.*

prEN 13237-1:1998, *Potentially explosive atmospheres - Explosion prevention and protection - Part 1: Terms and definitions for equipment and protective systems intended for use in potentially explosive atmospheres.*

EN 13463-1:2001, *Non-electrical equipment for potentially explosive atmospheres - Part 1: Basic methodology and requirements.*

EN 13478, *Safety of machinery - Fire prevention and protection.*

EN 50014, *Electrical apparatus for potentially explosive atmospheres - General requirements.*

EN 50016, *Electrical apparatus for potentially explosive atmospheres - Pressurized apparatus "p".*

EN 50017, *Electrical apparatus for potentially explosive atmospheres - Powder filling "q".*

EN 50018, *Electrical apparatus for potentially explosive atmospheres - Flameproof enclosure "d".*

EN 50019, *Electrical apparatus for potentially explosive atmospheres - Increased safety "e".*

EN 50020, *Electrical apparatus for potentially explosive atmospheres - Intrinsic safety "i".*

EN 50028, *Electrical apparatus for potentially explosive atmospheres - Encapsulation "m".*

EN 50033, *Electrical apparatus for potentially explosive atmospheres - Caplights for mines susceptible to firedamp.*

EN 50303, *Group I, category M1 equipment intended to remain functional in atmospheres endangered by firedamp.*

prEN 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems.*

EN 61779-1, *Electrical apparatus for the detection and measurement of flammable gases - Part 1: General requirements and test methods.*

EN 61779-2, *Electrical apparatus for the detection and measurement of flammable gases - Part 2: Performance requirements for group I apparatus indicating a volume fraction up to 5 % methane in air (IEC 61779-2:1998, modified).*

EN 61779-3, *Electrical apparatus for the detection and measurement of flammable gases - Part 3: Performance requirements for group I apparatus indicating a volume fraction up to 100 % methane in air (IEC 61779-3:1998, modified).*

EN 61779-4, *Electrical apparatus for the detection and measurement of flammable gases - Part 4: Performance requirements for group II apparatus indicating a volume fraction up to 100 % lower explosive limit (IEC 61779-4:1998, modified).*

EN 61779-5, *Electrical apparatus for the detection and measurement of flammable gases - Part 5: Performance requirements for group II apparatus indicating a volume fraction up to 100 % gas (IEC 61779-5:1998, modified).*

CLC/R 044-001, *Safety of machinery – Guidance and recommendations for the avoidance of hazards due to static electricity.*

3 Terms, definitions and abbreviated terms

For the purposes of this European Standard, the following terms and definitions as well as abbreviated terms apply in addition to the terms and definitions of prEN 13237-1.

3.1
firedamp
any potentially explosive mixture of gases or any flammable gas naturally occurring in a mine

NOTE As firedamp consists mainly of methane, the terms firedamp and methane are used frequently in mining practice as synonyms.

3.2
protection against firedamp explosions
explosion prevention and protection in underground parts of mines and those parts of surface installations of such mines liable to be endangered by firedamp and or flammable dust

3.3
flammable substance
substance in the form of gas, vapour, liquid, solid, or mixtures of these, able to undergo an exothermic reaction with air when ignited [EN 1127-1:1997]

3.4
component
"component" means any item essential to the safe functioning of equipment and protective systems but with no autonomous function [Directive 94/9/EC, Chapter I, Article 1]

3.5
deflagration
explosion propagating at subsonic velocity [ISO 8421-1, 1987-03-01, 1.11]

3.6
detonation
explosion propagating at supersonic velocity and characterized by a shock wave [ISO 8421-1, 1987-03-01, 1.12]

3.7
equipment
"equipment" means machines, apparatus, fixed or mobile devices, control components and instrumentation thereof and detection and prevention systems which, separately or jointly, are intended for the generation, transfer, storage, measurement, control and conversion of energy, for the processing of material, and which are capable of causing an explosion through their own potential sources of ignition [Directive 94/9/EC, Chapter I, Article 1]

3.8
explosion
abrupt oxidation or decomposition reaction producing an increase in temperature, pressure, or in both simultaneously [ISO 8421-1, 1987-03-01, 1.13]

3.9
explosion limits
limits of the explosion range [EN 1127-1:1997]

3.10
lower explosion limit (LEL)
lower limit of the explosion range [EN 1127-1:1997]

3.11
upper explosion limit (UEL)
upper limit of the explosion range [EN 1127-1:1997]

3.12
explosion points
lower and upper explosion point [EN 1127-1:1997]

3.13
lower explosion point
temperature of a combustible liquid at which the concentration of the saturated vapour in air is equal to the lower explosion limit [EN 1127-1:1997]

3.14
upper explosion point
temperature of a combustible liquid at which the concentration of the saturated vapour in air is equal to the upper explosion limit [EN 1127-1:1997]

3.15
explosion range
range of the concentration of a flammable substance in air, within which an explosion can occur [EN 1127-1:1997]

3.16
explosion-resistant
property of vessels and equipment designed to be either explosion-pressure-resistant or explosion-pressure-shock resistant [EN 1127-1:1997]

3.17
explosion-pressure-resistant
property of vessels and equipment designed to withstand the expected explosion pressure without becoming permanently deformed [EN 1127-1:1997]

3.18
explosion-pressure-shock resistant
property of vessels and equipment designed to withstand the expected explosion pressure without rupturing, but allowing permanent deformation [EN 1127-1:1997]