SLOVENSKI STANDARD
SIST EN 1710:2006

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Oprema in komponente, namenjene za uporabo v potencialno eksplozivnih atmosferah v podzemnih rudnikih

Equipment and components intended for use in potentially explosive atmospheres in underground mines

Geräte und Komponenten für den Einsatz in schlagwettergefährdeten Bereichen von untertägigen Bergwerken

Appareils et composants destinés a être utilisés dans les mines souterraines grisouteuses

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29.260.20	Električni aparati za eksplozivna ozračja	Electrical apparatus for explosive atmospheres
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Equipment and components intended for use in potentially explosive atmospheres in underground mines

Appareils et composants destinés à être utilisés dans les mines souterraines grisouteuses

Geräte und Komponenten für den Einsatz in schlagwettergefährdeten Bereichen von untertägigen Bergwerken

This European Standard was approved by CEN on 26 September 2005.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Contents

Page

Foreword

This European Standard (EN 1710:2005) 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of an identical text or by endorsement, at the latest by May 2006, and conflicting national standards shall be withdrawn at the latest by May 2006.

This European Standard 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).

For relationship with EU Directive(s), see informative Annexes ZA and ZB, which are integral parts of this European Standard.

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

Introduction

This European Standard specifies requirements for the constructional features of equipment and components that may be an individual item or form an assembly, to enable them to be used in mines, or parts of mines, susceptible to explosive atmospheres of firedamp and/or combustible coal dust.

Most of the electrical equipment used on mining machinery is certified as an individual item of equipment e.g. the motor, switchgear etc., and meets its own marking requirements. This Notified Body Certification, however, does not deal with the interconnection of these items of equipment by cables or the machine electrical power system as an entity. In order to comply with 1.6.4 of the Essential Safety Requirements of the ATEX Directive (94/9/EC), the equipment and components including their interconnections should be assessed, from an ignition point of view, by the manufacturer.

Both non-electrical equipment and the interconnection of electrical/non-electrical equipment require an ignition hazard risk assessment to satisfy the Essential Health and Safety requirements of the ATEX Directive and be put in the appropriate declaration of conformity document.

Therefore, it is necessary that not just the equipment, but all its parts, is examined by the manufacturer according to a formally documented hazard assessment that establishes and lists all the possible ignition sources of the equipment including the cables and electrical supply system. The documentation shall list the measures that shall be introduced to prevent possible ignition sources becoming effective.

The need for this European Standard arises because of major operational differences between underground mining operations and those in other industries working with, or in, potentially explosive atmospheres. Examples of these differences are:

— the product being won from the underground strata may be combustible and continually releases firedamp during the winning process;

— the ignitability of the atmosphere around equipment and components usually depends upon the amount of dilution offered by an active ventilating system;

— the atmosphere in the general body of mine air in which machinery is working may change from one that is potentially explosive to one that is explosive (for example, during an outburst of firedamp);

— persons working in the mine are usually situated within the potentially explosive atmosphere;

— there is a need to monitor constantly the mine atmosphere at strategic places to ensure that power can be disconnected from all equipment except that which is suitable for use in an explosive atmosphere;

— in gassy coal mines, an explosion of firedamp at a machine can raise a combustible dust cloud that exacerbates the explosion;

— some mining machinery, especially that associated with winning the product, contains cutting devices and drilling devices that are intended to cut into the combustible product as part of their normal operation. This introduces an ignition risk from frictional heating or frictional sparking from contact with strata containing high concentrations of quartz or iron pyrites;

— long roadways in coal mines are equipped with mineral conveying systems carrying a product that has a potential for raising an explosive dust cloud.

To decide which equipment or its component parts should merit inclusion in this European Standard, ignition data has been examined based on French, German and UK experience.

When drafting this European Standard, it has been assumed that equipment and components are:

— designed in accordance with good engineering practice, taking account of expected shocks,vibrations and failure modes;

— of sound mechanical and electrical construction;

— made of materials with adequate strength and of suitable quality;

— free from defects and

— are kept in good repair and working order, e.g. so that the required dimensions remain within permissible tolerance despite wear.

1 Scope

This European Standard specifies the explosion protection requirements for the construction and marking of equipment that may be an individual item or form an assembly. This includes machinery and components placed on the market by a single supplier for use in mines susceptible to explosive atmospheres of firedamp and/or combustible dust (at atmospheric conditions as defined in EN 1127-2).

NOTE 1 This European Standard deals only with the ignition protection of mining machinery and manufacturers will need to take account of all other relevant EU Directives relating to the construction of machines e.g. the consolidated Machinery Directive 98/37/EC. Additionally, manufacturers will need to take account of any national legislation in the country where they intend to market their equipment.

NOTE 2 Where the flammable gas in the atmosphere is not predominantly methane, reference will need to be made to 4.1 in either EN 60079-0:2004 or EN 13463-1:2001.

NOTE 3 The definition of ‘equipment’ is contained in EN 13463-1. The definition of ‘assembly’ can be found the ATEX guidelines, published by the European Commission.

Equipment complying with the relevant clauses of this European Standard is considered to meet the requirements for equipment of Group I - Category M2.

This European Standard also deals with the prevention of ignitions of explosive atmospheres caused by burning (or smouldering) of combustible material such as fabric fibres, plastic ”O”-rings, rubber seals, lubricating oils or greases used in the construction of the equipment if such items could be an ignition source. For example, the mechanical failure of rotating shaft bearings can result in frictional heating that ignites its plastic cage, plastic seal or lubricating grease. See also 5.2.4 of EN 13463-1:2001.

NOTE 4 The above clause of EN 13463-1 requires the ignition hazard assessment to include those components which, if they failed, could ignite any flammable substance (e.g. lubricating oil) contained within the equipment and which could consequently become, or create, an ignition source. In the case of coal mining equipment and components, the ignition temperature of the mineral oils or greases used is often below that of firedamp, i.e. below 560 °C.

2 Normative references

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

EN 982, *Safety of machinery — Safety requirements for fluid power systems and their components — Hydraulics*

EN 983, *Safety of machinery — Safety requirements for fluid power systems and their components — Pneumatics*

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

EN 1127-2:2002, *Explosive atmospheres — Explosion prevention and protection — Part 2: Basic concepts and methodology for mining*

EN 1554, *Conveyor belts — Drum friction testing*

EN 1676, *Aluminium and aluminium alloys — Alloyed ingots for remelting — Specifications*

EN 1834-2:2000, *Reciprocating internal combustion engines — Safety requirements for design and construction of engines for use in potentially explosive atmospheres — Part 2: Group I engines for use in underground workings susceptible to firedamp and/or combustible dust*

EN 1889-1:2003, *Machines for underground mines — Mobile machines working underground — Safety — Part 1: Rubber tyred vehicles*

EN 12163, *Copper and copper alloys — Rod for general purposes*

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

EN 13463-5:2003, *Non-electrical equipment for potentially explosive atmospheres — Part 5: Protection by constructional safety*

EN 13478, *Safety of machinery — Fire prevention and protection*

EN 50303:2000, *Group I, category M1 equipment intended to remain functional in atmospheres endangered by firedamp and/or coal dust*

EN 60079-0:2004, *Electrical apparatus for explosive gas atmospheres — Part 0: General requirements (IEC 60079-0:2004)*

EN 60204-1:1997, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:1997)*

EN 60204-11:2000, *Safety of machinery — Electrical equipment of machines — Part 11: Requirements for HV equipment for voltages above 1000 V a.c. or 1500 V d.c. and not exceeding 36 kV (IEC 60204-11:2000)*

EN 60332-1-1, *Tests on electric and optical fibre cables under fire conditions — Part 1-1: Test for vertical flame propagation for a single insulated wire or cable — Apparatus (IEC 60332-1-1:2004)*

EN 60332-1-2, *Tests on electric and optical fibre cables under fire conditions — Part 1-2: Test for vertical flame propagation for a single insulated wire or cable — Procedure for 1 kW pre-mixed flame (IEC 60332-1-2:2004)*

EN 60332-1-3, *Tests on electric and optical fibre cables under fire conditions — Part 1-3 Test for vertical flame propagation for a single insulated wire or cable — Procedure for determination of flaming droplets/particles (IEC 60332-1-3:2004):*

EN 60529, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN ISO 340, *Conveyor belts — Laboratory scale flammability characteristics — Requirements and test method (ISO 340:2004)*

EN ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles (ISO 12100-2:2003)*

ISO 1940-1:2003, *Mechanical vibration — Balance quality requirements for rotors in a constant (rigid) state — Part 1: Specification and verification of balance tolerances*

ISO 4952, *Structural steels with improved atmospheric corrosion resistance*

ISO 7010:2003, *Graphical symbols — Safety signs in workplaces and public areas*

3 Terms and definitions

For the purposes of this European Standard, the definitions in EN 1127-1:1997, EN 1127-2:2002, EN 60079-0:2004, EN 50303:2000 and EN13463-1:2001 apply.

4 Requirements for equipment (machines) and components

4.1 General

All electrical and non-electrical equipment and components for use in a potentially explosive atmosphere shall be designed and constructed to good engineering practice and in conformity with requirements of group I category M2 equipment to ensure that ignition sources do not occur.

To specify the category of the equipment, it shall be subject to an ignition hazard assessment in accordance with 5.2 of EN 13463-1:2001 for non-electrical and EN 60079-0 for electrical equipment.

NOTE 1 Where necessary, to determine any local conditions of use that affect the ignition hazard assessment, negotiations may need to take place between the manufacturer or authorized representative, purchaser and/or user.

NOTE 2 Examples of the ignition hazard assessment for various types of mining machinery have been included in the informative Annexes A and B. These are based on specific machines, but are not definitive and can contain alternatives. Manufacturers are required to carry out an ignition hazard assessment for each individual machine and determine the most appropriate measures to prevent those ignition sources becoming effective.

In particular, the following requirements described in EN 60079-0 and EN 13463-1 apply to all machines and shall be taken into account:

— the need to restrict the maximum surface temperature;

— the need to meet the electrostatic requirements;

— the need to restrict the use of exposed light metals;

— the need to perform tests on non-metallic parts on which the ignition protection depends to ensure they will not deteriorate in the conditions of use in mines and cause the protection to be lost (see also clause 6).

NOTE 3 To meet the requirements for maximum surface temperature, the assessment needs to be made at the maximum duty cycle that the equipment is subject to in operation. This can be based on a combination of direct measurement of the equipment under test, calculation or previous experience.

Equipment may be prevented from exceeding the maximum surface temperature by one, or a combination of, the following measures:

— continuous rating of the equipment so that it can easily cope with the maximum duty cycle;

— a suitable short-time rating of the equipment;

— additional cooling systems;

— shut-down devices measuring the temperature of either the surface or the cooling system;

— limitation of power transfer through the equipment, e.g. current limitation of motor supply or disengagement of mechanical power.

Where the means of limiting the surface temperature is not by continuous rating, the manufacturer has to specify the special conditions of safe use in the user instructions, e.g. maximum oil temperature at which the equipment is automatically de-energized.

NOTE 4 Welding, cutting, grinding, burning and other processes involving naked flames and/or open sparking are normally prohibited in coal and other gassy mines unless special precautions are taken. Machines intended for use in potentially explosive atmospheres should therefore be constructed so that such processes are not normally required to assemble, dismantle, maintain or repair machinery underground in a gassy mine (see Directive 92/104/EEC).

In addition to the requirements for non-metallic materials specified in EN 60079-0 and EN 13463-1, where such materials can be an ignition source, they shall be fire-resistant (see 6.2).

4.2 Non-electrical equipment and components

All non-electrical equipment and components (including parts used within the machine in order to connect them), shall comply with the requirements of EN 13463-1 and, where necessary, one of the other types of ignition protection listed in that standard, except where specific requirements exist in this European Standard, e.g. the fitting of water spray ignition protection to cutting picks.

NOTE 1 EN 13463-1 deals with ignition protection of non-electrical equipment and components intended for use in both potentially explosive gas atmospheres and potentially explosive dust atmospheres, existing either separately, or combined.

NOTE 2 Examples of ignition protection standards particularly relevant to mining are:

— EN 13463-5 (Protection by constructional safety ‘c’);

— EN 13463-6 (Protection by control of ignition sources ‘b’);

— EN 13463-8 (Protection by liquid immersion ‘k’).

4.3 Electrical equipment and components

4.3.1 General

All electrical equipment and components shall comply with the requirements of EN 60079-0 and at least one of the types of ignition protection listed in that standard.

NOTE 1 EN 60079-0 deals primarily with the ignition protection of electrical equipment and components intended for use in potentially explosive gas atmospheres. For gassy mines, equipment tested in an explosive gas atmosphere and protected against igniting firedamp is also adequately protected against ignition of an explosive coal dust cloud.

NOTE 2 Examples of ignition protection standards particularly relevant to mining are:

— EN 60079-1 (Flameproof enclosure "d");

— EN 60079-7 (Increased safety "e");

— EN 50020 (Intrinsic safety "i").

As a general rule, electrical equipment on machines shall comply with EN 60204-1 and EN 60204-11, except where the differences are stated in the following clauses of this European Standard.

Where protective measures depend on devices external to the machine, the manufacturer shall specify these in the user instructions. For the purposes of this European Standard, the requirements below commence at the point where the electrical supply is connected to the machine (terminals, plug and socket).

NOTE 3 All terms used to describe electrical devices are as defined in IEC 60050-441.

4.3.2 Electrical equipment protection

When electrical equipment is used in a potentially explosive atmosphere, the conditions of use specified in the EC type-examination certificate shall be complied with.

NOTE Typical conditions for safe use might, for example, include the minimum flow of cooling water, temperature protection settings, duty cycle (short time rating).

4.3.3 Overcurrent protection

4.3.3.1 Overload protection

For the protection of motors and their supply cables against overloading, the requirements of EN 60204-1 and EN 60204-11 shall apply.

NOTE 1 The objective is to ensure that the maximum surface temperature is in accordance with EN 60079-0.

Possible overloads or temperature rises may be caused by:

a) high starting frequency;

b) starting under load.

Motors that are likely to be overloaded shall additionally be protected by temperature monitoring devices.

The setting of the overload tripping device may be above the nominal current of the motor if it is monitored by direct temperature monitoring, in accordance with the EC type-examination certificate.

NOTE 2 Such direct temperature monitoring is typically achieved by locating temperature sensors in the motor stator windings, near to the bearings.

Protection against overload shall be achieved by the use of fuses, directly-operating trip relays, current-transformer-operated trip relays or thermal trip devices, etc. Depending on the system, combinations of the above might be required.

Overload protection shall not be provided if:

— a hazard is caused by its operation, e.g. the prevention of high voltages on secondary windings of current transformers, or tripping of exciter windings in generators or synchronous motors, or electrical braking circuits and

— its exclusion is in accordance with the EC type-examination certificate.

Overload protection devices shall be installed at the beginning of each circuit and at positions where the current-carrying capacity of a conductor is reduced.

4.3.3.2 Short-circuit protection

The requirements of EN 60204-1 and EN 60204-11 shall apply.

Electrical equipment and components including cables shall either be able to withstand the effects of an electrical short-circuit or be protected against the effects of an electrical short-circuit.

NOTE This is normally achieved by using equipment

— with a suitable short-circuit rating;

— able to withstand a short-circuit for the time that a disconnection device capable of interrupting a short-circuit current requires to break the circuit (breaking capacity, usually expressed in MVA).

In the event of a short-circuit, the thermal stability of cables shall also be considered. The national regulations may specify the maximum permissible tripping times and the maximum permissible adjutments for short-circuit protection

4.3.4 Earth-fault protection

The requirements of EN 60204-1 and EN 60204-11 shall apply insofar as they describe shock-hazard protection and include automatic disconnection of the supply if an insulation fault occurs.

NOTE 1 The specific design depends on network configuration and should allow for connection to a disconnecting device that automatically interrupts the power supply to a machine if either the insulation of a supply cable is faulty or a fault occurs in the machine circuits. Information should be provided in the user instructions about the connection of the machine to the electrical system of the mine.

All enclosures and exposed metallic parts of electrical equipment and components capable of igniting a firedamp/air atmosphere or a coal dust/air cloud shall be electrically connected together and to a continuous protective conductor (individual external conductor or integrated into a multi-core cable).

Earth-fault protection shall be provided by either a) or b) below:

a) the protection shall be designed such that when one phase is connected to earth (protective conductor) in a system having near infinite insulation resistance, the protection system shall operate when the earth-fault current attains a value greater than 20 % of the prospective earth-fault current, or

NOTE 2 For mines having a potentially explosive atmosphere, the connection between the protective conductor and the other conductors will usually have an earth-fault current restricting device fitted in order to limit the maximum prospective earth current in the power system to a value below that specified in national legislation.

b) the insulation resistance between live conductors and the protective conductor shall be monitored. The design of the earth-fault monitoring device shall ensure that faulty components in the circuit are disconnected.

The reconnection of power to the equipment while an insulation fault persists shall be prevented.

In the case of battery-powered traction vehicles and vehicles with on-board starter batteries, the insulation level between the vehicle frame or earth or bonded metallic parts and the positive and negative poles shall be continuously monitored. Indication shall be given to the vehicle operator if the insulation level between any pole and the vehicle frame, earth or metallic parts falls to a level below a fixed value.

NOTE 3 Permissible values are stipulated in national legislation.

4.3.5 Mechanical protection of live parts

All electrical equipment on machines, including cables and components shall protected against all forms of damage expected in mining conditions (impact, rubbing, crushing) which could cause an ignition risk, e.g. an arc resulting from a short-circuit of live conductors.

4.3.6 Electric cables that are part of the equipment

Mechanical protection may be dispensed with if the cable is electrically protected such that the power supply is disconnected before a short-circuit occurs if a detectable earth-fault occurs.