BS EN 12111:2014

BSI Standards Publication

Tunnelling machines — Road headers and continuous miners — Safety requirements

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National foreword

This British Standard is the UK implementation of EN 12111:2014. It supersedes BS EN 12111:2002+A1:2009 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/513, Construction equipment and plant and site safety.

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

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Machines pour la construction de tunnels - Machines à attaque ponctuelle et mineurs continus - Prescriptions de sécurité

Tunnelbaumaschinen - Teilschnittmaschinen und Continuous miners - Sicherheitstechnische Anforderungen

This European Standard was approved by CEN on 20 March 2014.

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Contents

Foreword

This document (EN 12111:2014) has been prepared by Technical Committee CEN/TC 151 “Construction equipment and building material machines - Safety”, 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of an identical text or by endorsement, at the latest by November 2014 and conflicting national standards shall be withdrawn at the latest by November 2014.

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

This document supersedes EN 12111:2002+A1:2009.

The main technical changes compared to EN 12111:2002+A1:2009 are the following:

— modification of the scope, “impact rippers” deleted;

— update of normative references;

— improvement of requirements on access systems;

— requirements on control systems improved;

— revision of requirements on audible and visual warning signs;

— improvement of noise test code.

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).

For relationship with EU Directive, see informative Annex ZA, which is an integral part of this document.

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, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This document is a type C standard as stated in EN ISO 12100.

The machinery concerned and the extent to which hazards, hazardous situations and events are covered are indicated in the scope of this document.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

Annex A is normative and contains the “Noise Test Code” and Annex B is informative and contains “Figures”.

1 Scope

This European Standard deals with all significant hazards, hazardous situations and events relevant to road headers and continuous miners as defined in Clause 3 (hereinafter called machines) when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer (see Clause 4).

NOTE 1 Within the intended use, overturning of the road header or continuous miner is not a significant hazard.

Excavators are out of the scope of this standard and are covered by EN 474-1:2006+A4:2013 and EN 474-5:2006+A3:2013.

The following items and applications are not covered by this European Standard:

— the supply of electricity up to the switch box;

— use of the machine in potentially explosive atmospheres;

— use of the machine under hyperbaric conditions;

— loading and transport equipment which is not an integral part of the machine.

This European Standard covers incorporation of monitoring devices for hazardous atmospheres.

This European Standard is not applicable to machines manufactured before the date of publication of this European Standard by CEN.

NOTE 2 Directive 94/9/EC concerning equipment and protective systems intended for use in potentially explosive atmospheres can be applicable to the type of machine or equipment covered by this European Standard. The present standard is not intended to provide means of complying with the essential health and safety requirements of Directive 94/9/EC. For the application in potentially explosive atmospheres see EN 1710:2005+A1:2008.

2 Normative references

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

EN 3-7:2004+A1:2007, *Portable fire extinguishers - Part 7: Characteristics, performance requirements and test methods*

EN 474-1:2006+A4:2013, *Earth-moving machinery - Safety - Part 1: General requirements*

EN 617:2001+A1:2010, *Continuous handling equipment and systems - Safety and EMC requirements for the equipment for the storage of bulk materials in silos, bunkers, bins and hoppers*

EN 618:2002+A1:2010, *Continuous handling equipment and systems - Safety and EMC requirements for equipment for mechanical handling of bulk materials except fixed belt conveyors*

EN 620:2002+A1:2010, *Continuous handling equipment and systems - Safety and EMC requirements for fixed belt conveyors for bulk materials*

EN 894-1:1997+A1:2008, *Safety of machinery - Ergonomics requirements for the design of displays and control actuators - Part 1: General principles for human interactions with displays and control actuators*

EN 953:1997+A1:2009, *Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards*

EN 981:1996+A1:2008, *Safety of machinery - System of auditory and visual danger and information signals*

EN 1679-1:1998+A1:2011, *Reciprocating internal combustion engines - Safety - Part 1: Compression ignition engines*

EN 16228-1:2014, *Drilling and foundation equipment — Safety — Part 1: Common requirements*

EN 16228-2:2014, *Drilling and foundation equipment — Safety — Part 2: Mobile drill rigs for civil and geotechnical engineering, quarrying and mining*

EN 60076-2:2011, *Power transformers — Part 2: Temperature rise for liquid-immersed transformers (IEC 60076-2:2011)*

EN 60204-1:2006, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2005, modified)*

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 60439-2:2000, *Low-voltage switchgear and controlgear assemblies — Part 2: Particular requirements for busbar trunking systems (busways) (IEC 60439-2:2000)*

EN 60439-4:2004, *Low-voltage switchgear and controlgear assemblies — Part 4: Particular requirements for assemblies for construction sites (ACS) (IEC 60439-4: 2004)*

EN 60529:1991, *Degrees of protection provided by enclosures (IP code) (IEC 60529:1989)*

EN 60947-1:2007, *Low-voltage switchgear and controlgear — Part 1: General rules (IEC 60947-1:2007)*

EN 61310-1:2008, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals (IEC 61310-1:2007)*

EN 61439-1:2011, *Low-voltage switchgear and controlgear assemblies — Part 1: General rules (IEC 61439-1:2011)*

EN ISO 3411:2007, *Earth-moving machinery - Physical dimensions of operators and minimum operator space envelope (ISO 3411:2007)*

EN ISO 3449:2008, *Earth-moving machinery - Falling-object protective structures - Laboratory tests and performance requirements (ISO 3449:2005)*

EN ISO 3457:2008, *Earth-moving machinery - Guards - Definitions and requirements (ISO 3457:2003)*

EN ISO 3744:2010, *Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane (ISO 3744:2010)*

EN ISO 3746:2010, *Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane (ISO 3746:2010)*

EN ISO 3747:2010, *Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering/survey methods for use in situ in a reverberant environment (ISO 3747:2010)*

EN ISO 4413:2010, *Hydraulic fluid power - General rules and safety requirements for systems and their components (ISO 4413:2010)*

EN ISO 4414:2010, *Pneumatic fluid power - General rules and safety requirements for systems and their components (ISO 4414:2010)*

EN ISO 4871:2009, *Acoustics - Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 7096:2008, *Earth-moving machinery - Laboratory evaluation of operator seat vibration (ISO 7096:2000)*

EN ISO 11201:2010, *Acoustics - Noise emitted by machinery and equipment - Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections (ISO 11201:2010)*

EN ISO 11202:2010, *Acoustics - Noise emitted by machinery and equipment - Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections (ISO 11202:2010)*

EN ISO 11204:2010, *Acoustics - Noise emitted by machinery and equipment - Determination of emission sound pressure levels at a work station and at other specified positions applying accurate environmental corrections (ISO 11204:2010)*

EN ISO 11688-1:2009, *Acoustics - Recommended practice for the design of low-noise machinery and equipment - Part 1: Planning (ISO/TR 11688-1:1995)*

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

EN ISO 12922:2012, *Lubricants, industrial oils and related products (class L) - Family H (Hydraulic systems) - Specifications for hydraulic fluids in categories HFAE, HFAS, HFB, HFC, HFDR and HFDU (ISO 12922:2012)*

EN ISO 13732-1:2008, *Ergonomics of the thermal environment - Methods for the assessment of human responses to contact with surfaces - Part 1: Hot surfaces (ISO 13732-1:2006)*

EN ISO 13849-1:2008, *Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2006)*

EN ISO 13850:2008, *Safety of machinery - Emergency stop - Principles for design (ISO 13850:2006)*

EN ISO 14122-1:2001, *Safety of machinery - Permanent means of access to machinery - Part 1: Choice of fixed means of access between two levels (ISO 14122-1:2001)*

EN ISO 14122-2:2001, *Safety of machinery - Permanent means of access to machinery - Part 2: Working platforms and walkways (ISO 14122-2:2001)*

EN ISO 14122-3:2001, *Safety of machinery - Permanent means of access to machinery - Part 3: Stairs, stepladders and guard-rails (ISO 14122-3:2001)*

EN ISO 14122-4:2004, *Safety of machinery - Permanent means of access to machinery - Part 4: Fixed ladders (ISO 14122-4:2004)*

ISO 3795:1989, *Road vehicles, and tractors and machinery for agriculture and forestry — Determination of burning behaviour of interior materials*

ISO 3864-1:2011, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*

ISO 3864-2:2004, *Graphical symbols — Safety colours and safety signs — Part 2: Design principles for product safety labels*

ISO 3864-3:2012, *Graphical symbols — Safety colours and safety signs — Part 3: Design principles for graphical symbols for use in safety signs*

ISO 5006:2006, *Earth-moving machinery — Operator's field of view — Test method and performance criteria*

ISO 6405-1:2004, *Earth-moving machinery — Symbols for operator controls and other displays — Part 1: Common symbols*

ISO 6805:1994, *Rubber hoses and hose assemblies for underground mining — Wire-reinforced hydraulic types for coal mining — Specification*

ISO 8178-1:2006, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 1: Test-bed measurement of gaseous and particulate exhaust emissions*

ISO 8178-4:2007, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 4: Steady-state test cycles for different engine applications*

ISO 10532:1995, *Earth-moving machinery — Machine-mounted retrieval device — Performance requirements*

ISO 11112:1995, *Earth-moving machinery — Operator's seat — Dimensions and requirements*

ISO 12508:1994, *Earth-moving machinery — Operator station and maintenance areas — Bluntness of edges*

ISO 15817:2012, *Earth-moving machinery — Safety requirements for remote operator control systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100 and the following apply.

3.1
road header
self-propelled tunnel driving machine, normally mounted on crawler tracks, which is designed and intended to cut and load stiff clay, soft to medium hard rock and similar materials in sections by means of a rotating cutter head mounted axially or transversely on a boom which can swivel both horizontally and vertically

Note 1 to entry: Equipment for the installation of ground support can be included on the machine. Spoil may be discharged at the rear of the machine. As an example see Figure B.1.

3.2
continuous miner
self-propelled machine, normally mounted on crawler tracks, which is designed and intended to cut coal or soft minerals by means of one or more transversely mounted rotating drums which may be raised or lowered

Note 1 to entry: Equipment for the installation of ground support can be included on the machine. Spoil may be discharged at the rear of the machine. As an example see Figure B.2.

3.3
control station
location on a machine from where the functions of the machine can be controlled by an operator. Control may alternatively be from a remote station by cable or radio

3.4
servicing point
location on a machine where servicing and maintenance is carried out

3.5
tramming
travel of road header or continuous miner close to working face

3.6
conveying system
system for transporting excavated material

Note 1 to entry: It includes loading device, chain conveyor and slewing belt conveyor.

3.7
trailing cable
cable attached to the machine which can be extended or retracted as the machine trams and which connects it to the tunnel or mine power supply

Note 1 to entry: The trailing cable is part of the machine if there is a cable reel integrated in the machine.

3.8
main switch gear
device at which all power to the machine can be cut off

Note 1 to entry: This is normally provided by the user.

4 List of significant hazards

4.1 General

This clause contains all significant hazards, hazardous situations and events identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk.

Table 1 — List of significant hazards

No.	Hazards	Concerned subclauses
4.1	**Mechanical hazards due to**	
a)	Machine parts or work pieces, e.g.: - shape	5.2.1.1
	- mass and stability (potential energy of elements which may move under the effect of gravity);	5.5.8, 5.13
	- mass and velocity (kinetic energy of elements in controlled or uncontrolled motion);	5.5.8
	- accumulation of energy inside the machinery, e.g.: liquids and gases under pressure.	5.11, 5.16
b)	Crushing hazard	5.4, 5.5.8.2
c)	Shearing hazard	5.4
d)	Cutting or severing hazard	5.2.1.1, 5.4
e)	Entanglement hazard	5.4
f)	Drawing-in or trapping hazard	5.4
g)	Friction or abrasion hazard	5.2.1.1
h)	High pressure fluid injection or ejection hazard	5.11, 5.16
4.2	**Electrical hazards due to**	
a)	Contact of persons with live parts (direct contact)	5.8.1
b)	Contact of persons with parts which have become live under faulty conditions (indirect contact)	5.8.2, 5.8.3, 5.17
c)	Approach to live parts under high voltage	5.8.4.2, 5.17
d)	Electrostatic phenomena	5.8.7, 5.17
e)	Thermal radiation or other phenomena such as the	5.12.1

No.	Hazards	Concerned subclauses
	projection of molten particles and chemical effects from short-circuits, overloads, etc.	
4.3	**Thermal hazards due to:**	
a)	Burns, scalds and other injuries by a possible contact of persons with objects or materials with an extreme high or low temperature, by flames or explosions and also by the radiation of heat sources	5.2.1.2 5.12
b)	damage to health by hot or cold working environment	5.3.3.1
4.4	**Hazards generated by noise**	
a)	resulting in hearing loss (deafness), other physiological disorders (e.g. loss of balance, loss of awareness)	5.5.4, 5.7
b)	resulting in interference with speech communication, acoustic signals, etc.	5.5.4, 5.7
4.5	**Hazards generated by vibration**	5.3.1, 5.3.2.3, 7.3.2
4.6	**Radiation**	
	Low-frequency, radio-frequency radiation; microwaves	5.8.9
4.7	**Hazards arising from materials and substances** (and their constituent elements) processed or used by the machinery	
a)	Hazards from contact with or inhalation of harmful fluids, gases, mists, fumes, and dusts	5.6, 5.8.6, 5.11, 5.16
b)	Fire or explosion hazard	5.5.8.1, 5.6.3, 5.16, 5.8.4, 5.8.5.1, 5.11.1, 5.12, 5.8.8
4.8	**Hazards arising from neglect of ergonomic principles in machinery design**	
a)	unhealthy postures or excessive effort	5.3.1, 5.17
b)	inadequate consideration of hand-arm or foot-leg anatomy	5.3.1
c)	neglected use of personal protection equipment	5.3.1, 5.17
d)	inadequate local lighting	5.9
e)	human error, human behaviour	5.5.2, 5.15
f)	inadequate design, location or identification of manual Controls	5.5
g)	inadequate design or location of visual display units	5.5
4.9	**Unexpected start-up, unexpected overrun/overspeed** (or any similar malfunction)	
a)	failure/disorder of the control system	5.5.2, 5.17
b)	Restoration of energy supply after an interruption	5.5.2
c)	external influences on electrical equipment	5.8.9
d)	errors in the software	5.5.2
e)	errors made by the operator (due to mismatch of Machinery with human characteristics and abilities)	5.5.2
4.10	**Impossibility of stopping the machine in the best possible conditions**	5.5.3, 5.5.6, 5.5.7, 5.5.8

No.	Hazards	Concerned subclauses
4.11	**Failure of the power supply**	5.5.2, 5.5.5, 5.8.2, 7.3.4
4.12	**Failure of the control circuit**	5.5.2, 5.5.3, 5.5.5, 5.5.8
4.13	**Falling or ejected objects or fluids**	5.3.2
4.14	**Loss of stability/overturning of machinery**	5.2.2, 5.13
4.15	**Slip, trip and fall of persons**	5.2.3
4.16	**Additional hazards due to mobility relating to the travelling function**	
a)	Movement when starting the engine	5.5.2
b)	Movement without a driver at the driving position	5.5.6
c)	Insufficient ability of machinery to be slowed down, stopped and immobilized	5.5.8
4.17	**Additional hazards due to mobility linked to the work position** (including driving station) on the machine	
a)	Fall of persons during access to (or at/from) the work position	5.2.3
b)	Exhaust gases/lack of oxygen at the work position	5.6.2, 5.6.3.
c)	Fire (flammability of the cab, lack of extinguishing means)	5.12
d)	Mechanical hazards at the work position fall of objects, penetration by objects; contact of persons with machine parts or tools	5.3.1, 5.3.2, 5.4, 5.5.2, 5.13, 5.17
e)	Insufficient visibility from the work positions	5.3.2, 5.3.3, 5.3.4
f)	Inadequate lighting	5.9
g)	Inadequate seating	
h)	Noise at the work position	
i)	Vibration at the work position	5.3.1
4.18	**Additional hazards due to mobility linked to the control system**	
a)	Inadequate location of manual controls	5.3.1, 5.5.6
b)	Inadequate design of manual controls and their mode of operation	5.5
4.19	**Additional hazards due to mobility and handling the machine** (lack of stability)	5.2.2, 5.13
4.20	**Additional hazards due to mobility linked to the power source and to the transmission of power**	
a)	Hazards from the engine and the batteries	5.8.9, 5.8.8
b)	Hazards from coupling and towing	5.14, 5.8.5.2
4.21	**Additional hazards due to mobility related from/to third persons**	
a)	Unauthorized start-up/use	5.5.3.2

No.	Hazards	Concerned subclauses
b)	Drift of a part away from its stopping position	5.5.8
c)	Lack or inadequacy of visual or acoustic warning means	5.5.4, 5.10
4.22	**Additional hazards due to mobility related to Insufficient instructions for the driver/operator**	7
4.23	**Additional hazards due to underground work**	
a)	Fire and explosion	5.6.3.1; 5.12, 5.8.6, 5.8.8, 5.15, 5.16
b)	Emission of dust, gases, etc.	5.3.1, 5.6, 5.15

5 Safety requirements and/or protective measures

5.1 General

Road headers and continuous miners shall comply with the safety requirements and/or protective measures of this clause.

In addition, they shall be designed according to the principles of EN ISO 12100 for hazards relevant but not significant which are not dealt with by this European Standard.

5.2 Specific requirements

5.2.1 Contact surfaces

5.2.1.1 Sharp corners and edges

Accessible parts of machines shall be designed and manufactured to minimize sharp edges, angles or rough surfaces which are likely to cause injury, see ISO 12508.

5.2.1.2 Hot surfaces

Where there is a risk of contact with hot surfaces in accessible areas, suitable measures shall be taken:

— to limit the temperature of hot surfaces, see EN ISO 13732-1;

— where this is not possible, to prevent contact with those surfaces/parts by screens or guards;

— to provide warning signs against residual risks, see 5.12.

This requirement does not apply to the excavation tools.

5.2.2 Stability

The manufacturer shall ensure the machine does not undergo any uncontrolled movements when operated in accordance with the conditions intended by the manufacturer. The limits of controlled movement shall be stated in the instruction handbook. This shall be achieved by having a sufficiently heavy machine or by the use of grippers.

The maximum permissible longitudinal and transverse slopes on which the machine can be operated shall be defined in the instruction handbook (see 7.3.1).

To ensure stability during assembly, the manufacturer shall provide information on assembly sequence in the instruction handbook.

5.2.3 Ladders, access ways and platforms

The manufacturer shall define in the instruction handbook the areas of the machine to which access is required to operate, service and maintain the machine (see 7.3.1). Access to these areas of machine shall be provided in accordance with EN ISO 14122-1, EN ISO 14122-2, EN ISO 14122-3 and EN ISO 14122-4.

Ladderways or stairways shall be provided to give access to control stations, servicing points and working platforms. Where not directly accessible from the ground, working platforms shall be provided at servicing points including filters, pumps, motors, lubricating points, battery compartments and fluid storage tanks. Where this requirement cannot reasonably be applied to the discharge conveyor, a temporary means of access, e.g. hydraulic access platform or ladder, will be required and the manufacturer shall record this in the instruction handbook – see 7.3.1.

5.3 Control station

5.3.1 General requirements

The machine shall be controlled from a control station on the machine or by remote control (see 5.5.8). Where it is always intended to control the machine remotely, a control station on the machine is not required.

Where a machine has more than one starting control for any function, key switches shall be fitted to ensure only one starting control is active at any time.

The control station shall be dimensioned in accordance with EN ISO 3411.

When there is a control station on the machine it shall be ergonomically designed in order to minimise operator fatigue and stress. Consideration shall be given to the fact that operators may wear personal protective equipment.

The control station if provided shall have a seat for the operator. It shall comply with the requirements of EN 474-1:2006+A4:2013, be adjustable, retain the operator in a stable position and allow the operator to control the machine under all expected operating conditions. For seat dimensions see ISO 11112. Arm rests or other means shall be provided to ensure safe operation of sensitive controls (e.g. hold-to-run controls). The seat shall be designed to minimise transmission of vibration to the operator. See EN ISO 7096.

5.3.2 Falling objects and ejected material

The control station shall be protected by location or guarding e.g. by deflector plates, against spoil rolling down the cutter arm, boom or conveyor.

The control station shall be protected against falling objects and materials ejected from the cutter head. Protection against falling objects shall be by falling object protective structure (FOPS). The FOPS shall comply with level II of EN ISO 3449.

NOTE The scope of EN ISO 3449 excludes road headers and continuous miners. However for road headers and continuous miners the requirements of EN ISO 3449 are equally applicable as for earth-moving equipment.

Protection against ejection of materials shall be by guarding of the cutter head or the provision of a protective structure or the use of reinforced glass or similar transparent material at the control station. The means of protection shall not reduce the operator's visibility.

5.3.3 Cab

5.3.3.1 General

A cab shall be provided fulfilling the following requirements:

— ventilation with adequate dust filtration and where applicable, heating and/or cooling;

— isolation from airborne noise and structure-borne noise;

— isolation against whole body vibration arising from the operation of the machine. The operator's seat shall meet the requirements of EN ISO 7096 with regard to its ability to reduce the vibration transmitted to the operator;

— a means of rapid escape from the cab;

— an emergency exit, e.g. in the form of knockout windows or knockout panels, on a different side of the cab from that where the normal exit is situated or provision of tools for breaking the window;

— a windscreen cleaning device;

— transparent panels of doors and windows shall be made of laminated safety glass or equivalent material;

— the materials of the interior of the cab shall be in accordance with the requirements of 5.11.1.

5.3.3.2 Additional requirements for continuous miners

For continuous miners with the control station on the machine, a cab is not required

— if the machine is intended for use in an explosive atmosphere;

— if the machine is intended for use in an ambient temperature not exceeding 40 °C.

5.3.3.3 Additional requirements for road headers

For road headers with the control station on the machine, a cab is not required

— if the machine is intended for use in an explosive atmosphere;

— if the maximum cutting height of the machine does not exceed 5 m.

5.3.4 Visibility

Visibility from the operating position shall be such that the operator can operate the machine safely in its foreseeable conditions of use. Where necessary, appropriate devices shall be provided to compensate for inadequate direct vision. The need for visibility aids shall be determined in accordance with ISO 5006 for “derivative machines”.

For tramming of the machine, additional visibility aids at the rear of the machine shall be provided to compensate for inadequate direct vision.

5.4 Guards

Wherever persons work or have access and there is a risk of injury by crushing, entangling, trapping, cutting or seizing due to moving or rotating parts, these parts shall be made safe by guards. Guards shall comply with EN 953. This requirement shall not apply to the cutter head and the loading device.

Continuous handling equipment shall be provided with guards in accordance with EN 617, EN 618 and EN 620, in order to prevent injury by trapping or seizing.

5.5 Control devices and systems

5.5.1 General

Control devices and systems shall be so designed and built that they match the high demands of an underground environment and are reliable in service.

They shall be able to withstand shock load 15 g/11 ms and vibration loading (depending on type of machinery and working conditions) along with ambient air temperatures up to 40 °C, and up to 100 % humidity.

5.5.2 Safety and reliability of control systems

Control functions of machinery shall be divided into operational functions and safety related functions. Whilst operational functions shall comply with good engineering practise for safety related functions increased requirements in respect of reliability shall be applied.

Safety related functions may be performed either by separate safety control equipment or by devices or subsystems of the operational control system. In this case the operational control system (or at least parts of it) also will be subject of requirements for safety related functions.

The safety related parts of the control systems of machines shall conform to the requirements of EN ISO 13849-1.

All safety related parts of control systems shall meet as minimum the Performance Level (PL) “c” according to EN ISO 13849-1.

5.5.3 Design of control systems

5.5.3.1 General

Electrical control systems shall be designed as per EN 60204-1.

Hydraulic control systems shall be designed as per EN ISO 4413.

Ergonomic requirements of EN 894-1 shall be addressed.

Control systems shall be configured so that:

— no dangerous condition can occur should the electric power input to the control system fail;

— the sequence of operations necessary to avoid dangerous operating conditions (for example dust suppression system - conveyor system - cutter head) can only be started or stopped in the prescribed sequence;

— for maintenance and special operation of the machine, individual movements of the machine shall be possible by means of a lockable operational mode selection switch;

— machines fitted with dust suppression systems can only cut rock or mineral when the dust suppression system is in operation, unless ground conditions are such that no dust is created.

5.5.3.2 Starting and stopping

5.5.3.2.1 Starting

It shall only be possible to start the machine by intentional actuation of a control device provided for the purpose.

The same requirement applies, when restarting the machine after a stoppage, whatever the cause.

5.5.3.2.2 Normal and operational stop

All machines shall be fitted with a stop control whereby they can be brought safely to a complete stop.

Each control station shall be fitted with a control device to stop some or all of the functions of the machinery so that it is rendered safe. Stop controls shall have priority over the start controls.

5.5.3.3 Emergency stop (on board)

Machines shall be fitted with emergency stop devices which shall conform to EN ISO 13850.

They shall stop all relevant movements or functions as quickly as possible to prevent a dangerous situation developing without creating an additional hazard.

The category of stop shall be Category '0' according to 4.1.4 of EN ISO 13850:2008.

Emergency stop devices shall be located in particular at the control station and on both sides of the machine, at the rear of the machine, and where appropriate at the front of the machine. They shall be mounted at a height of not more than 1,8 m from the ground or working platform as appropriate.

Once stopped the machine shall not restart except by deliberate actuation of the start controls.

5.5.3.4 Stop control function for remote operator control

Radio-transmitter shall be fitted with a stop control button which shall be designed in accordance with ISO 15817.

The category of stop shall be Category '0' according to 4.1.4 of EN ISO 13850:2008.

Once stopped the machine shall not restart except by actuation of the controls.

5.5.4 Warning system

A warning system shall be fitted to moving equipment such as required in Table 2. The warning system shall be electrically interlocked with the control system in accordance with the requirements of Table 2. EN 981:1996+A1:2008 gives specifications for different signals. Sound warning systems shall have a minimum sound level at least 10 dB above the expected ambient machine noise level under operating conditions.

Table 2 —Audible and visible warning system

Function	Type of Warning	Duration
Start-up of main hydraulic pump	Audible and visible: see Table 1 of EN 981:1996+A1:2008	5 - 10 s before start up
Start-up of the cutter head	Audible and visible: see Table 1 of EN 981:1996+A1:2008	5 - 10 s before start up
Backwards track movement	Visible or Audible: see Table 1 of EN 981:1996+A1:2008	Continuous
Detection of hazardous atmosphere (if monitoring system is incorporated)	Audible and visible: see Table 2 of EN 981:1996+A1:2008	Continuous

5.5.5 Failure of power supply

Re-establishment of the power supply after an interruption or fluctuation shall not lead to a hazardous situation. See EN 60204-1:2006, 7.5.

In particular provision shall be made for the following:

a) After re-establishment of the power supply the machine shall only start after an intentional actuation of the start controls;

b) the machine shall not be prevented from stopping if the command to stop has already been given.

5.5.6 Remote control

If the machine is capable of remote operator control by wireless or wired means, the control system shall meet the performance requirements of ISO 15817. The system shall be designed and constructed in such a way that it will respond only to signals from the intended control units.

In the case of remote controls, each control unit shall clearly identify the machinery to be controlled from that unit. The remote control system shall be designed and constructed in such a way as to affect only:

— the machinery in question;

— the functions in question.

A remote-controlled machine shall be equipped with devices for stopping all operations automatically and immediately and for preventing potentially dangerous operation in the following situations:

— if the driver loses control;

— if it receives a stop signal;

— if a fault is detected in a safety-related part of the system;

— if no validation signal is detected.

Once stopped the machine shall not restart except by deliberate actuation of the start controls. The instruction handbook (see Clause 7) shall contain a warning that the operator shall be able to observe the machine when operating the remote control.

5.5.7 Automatic profiling and guidance systems

Road header and continuous miner may incorporate an automatic profiling and guidance system. There shall be a hold to run control to engage the system and to ensure the operator is present, in any case, the machine does stop the automatic movement, after having finished one working sequence. That system shall control or limit the horizontal and/or vertical movement of the boom. It shall only be possible to engage the system when the cutter head or drum is rotating. Stopping the cutter head or drum for any reason shall automatically disengage the system. If the cutter head or drum deviates, the machine shall stop automatically. There shall be a visible indication at the control panel when the system is engaged.

5.5.8 Braking, stopping and holding

5.5.8.1 Braking and holding systems

Machines shall be equipped with braking systems for the crawler tracks.

For driving the machine, the braking system for the traction system of the machine shall be capable of stopping the machine for the intended slope, as specified in the information for use. The brake system shall have the ability to hold the machine with a 1,2 factor of safety when all power is shut off.

The design and construction of the braking systems shall allow the vehicle to function without significant difference in either direction of travel and to be able to move freely for towing purposes.

Any failure in the service or parking brake system shall not reduce the capability to stop and hold the vehicle.

Provision shall be made for examination of brake wear where relevant. Instructions shall be given in the information for use.

The braking system shall be designed and constructed in such a way that it does not produce sparks or cause fires.

5.5.8.2 Other equipment

Hydraulic cylinders shall be fitted with check valves (pipe rupture valves) to prevent movement if a hydraulic hose or pipe should break or leak.

5.6 Dust and gas control

5.6.1 Dust control

5.6.1.1 General

The manufacturer shall contribute to dust control by a combination of reduction in dust produced, dust suppression and dust extraction.

Dust control should ensure that exposure to dust (respirable quartz and total dust) does not exceed national limits during intended use of the machines.

5.6.1.2 Reduction in dust produced

The manufacturer shall design the road header or continuous miner to minimise the amount of dust produced.

NOTE Dust production can be reduced significantly by reducing cutter speed and increasing penetration depth.

5.6.1.3 Dust suppression

For road headers and continuous miners, the manufacturer shall provide an effective water spraying system (e.g. direct spray of water on the picks or water-mist spray system) at the cutter head. This shall not apply for the intended use in potash, gypsum and salt mines.

The manufacturer shall provide information on the performance of the system in the instruction handbook (see 7.3.1).

NOTE Exact pre-determination of performance of the system is not possible.

Depending on application conveyor sprays should also be considered.

5.6.1.4 Dust extraction system

As part of dust control a dust extraction system is required. The dust extraction system can be partially integrated with the machine, separate from the machine or part of the tunnel system.

The layout of the dust extraction system should be compatible with the tunnel ventilation system.

The manufacturer shall state in the instruction handbook the provision made for dust extraction on the machine. If at the purchaser's discretion a machine is delivered without a dust extraction system, the manufacturer shall state in the instruction handbook typical parameters for an external dust extraction system (see 7.3).

Disturbance of the overall tunnel airflow towards the face, by air discharged from the fans, radiators and air coolers of the machine shall be avoided.

The objective of the dust extraction system should be to keep the dust in front of the operator's position. Therefore the dustextraction intake should be as close to the face as possible but not more than 0,5 $\sqrt{A}$ (A = area of face in m^2). The capacity of the dust extraction system should be calculated on the assumption that to achieve this objective the airflow in the tunnel towards the face is 0,5m/sec.

5.6.2 Exhaust gas control

Only reciprocating internal combustion engines operating with a fuel having a flash point exceeding 55 °C and which meet the requirements of EN 1679-1 shall be used and then only for the travel functions of the machine. The engine shall meet the emission limits as required according to ISO 8178-4; measured according to ISO 8178-1.

5.6.3 Gas monitoring

5.6.3.1 Monitoring for potentially flammable or explosive gas

NOTE The scope of this standard does not cover the use of the machine in potentially explosive atmospheres. The use of machines in explosive atmospheres is covered by the ATEX-Directive (94/9/EC).

A monitoring system shall be provided unless the machinery is designed for the intended use in explosive atmospheres.

The monitoring system shall give a visible and audible alarm when the preset alarm value is reached.

In the absence of national regulations or standards a preset alarm value of 0.5 % methane in air by volume should be used (see 7.3.1).

When the preset shut-down value is reached all electrical and mechanical equipment which is unsuitable for use in an explosive atmosphere shall be shut down immediately and automatically.

In the absence of national regulations and standards a preset shut-down value of 0.8 % methane in air by volume should be used (see 7.3.1).

The instruction handbook shall state when the intended use of the machinery specifically excludes the risk of methane ingress.

5.6.3.2 Monitoring for oxygen hazards

Unless the machine is designed for the intended use in explosive atmospheres, the machine shall incorporate a system for continuously monitoring the presence of oxygen deficiency. The monitoring system shall trigger a visible or audible alarm at the control station as soon as the preset threshold value is attained.

In the absence of national regulations and standards a preset threshold value of 19 % oxygen should be used.

5.7 Noise

5.7.1 General

There is a risk of hearing damage and interference with speech communication, acoustic signals, etc. being sustained by persons working on or near the machine. Machines shall generate noise levels as low as possible and practicable. Therefore noise reduction shall be an integral part of the design process taking into account measures at source as very generally described in EN ISO 11688-1.

NOTE The main noise sources include process noise, cutter head, conveying system, main drive, de-dusting system, bolting equipment as interchangeable device.

5.7.2 Noise reduction at source at the design stage

Noise can be reduced by the following measures:

— use of components and ancillaries with a low-noise emission;

— isolation of structure borne noise or impact sound of power units;

— on board diesel power pack with low noise emission (if installed);

— control cabin with effective sound insulation;

— use of noise reducing enclosures, e.g. for power packs, compressors.

5.7.3 Information on residual risk

Information on residual risk, i.e. noise emission values shall be given to the user, see 7.3.1.

5.8 Electrical requirements

5.8.1 General

All electrical equipment shall comply with the relevant parts of EN 60204-1 or EN 60204-11 depending on voltage used, and in addition with the requirements below.

5.8.2 Control of electrical power supply

The machine shall be fitted with a switch box at which it shall be possible to cut off all power on the machine.

In addition, it shall be possible to send a signal from the switch box by a pilot core within the trailing cable to cut off power at the main switch gear.

All switchgear shall comply with the requirements of EN 61439-1, EN 60439-2 and EN 60439-4 where relevant and EN 60947-1 and shall be installed in cabinets. These cabinets shall give protection to at least Class IP 55 in accordance with EN 60529, and shall also be arranged and built to protect the switchgear against mechanical damage.

The manufacturer shall state in the instruction handbook the requirements for the electrical supply in the tunnel to the machine, see 7.3.

5.8.3 Portable equipment, accessory and lighting circuits

The circuits for portable equipment, accessories and lighting shall comply with Clause 15 of EN 60204-1:2006. In addition measures shall be taken to mitigate the risks associated with electrical equipment in a tunnel environment including:

— the use of residual current protective device with a fault current rating of a maximum of 30 mA;

or

— use of Reduced Low-voltage circuits where the maximum voltage to earth that can occur is reliably limited to a value unlikely to cause danger to persons (SELV, PELV);

or

— the use of 110 V centre earth tap supply.

5.8.4 Monitoring of circuits

5.8.4.1 Circuits not exceeding 1000 V

Circuits not exceeding 1000 V shall comply with EN 60204-1

In circuits not exceeding 1000 V a residual current protective device with a fault current rating of a maximum of 300 mA or an insulation monitoring system shall be installed in accordance with the type of supply system. In the case of insulation monitoring, when a reduction of the insulation resistance to less than 100 Ohm/V occurs the failure shall be indicated by means of a visible or audible signal. The power supply shall be cut when the insulation resistance falls below 50 Ohm/Volt.

NOTE Monitoring of the insulation status (earth fault) in power circuits in accordance with national regulations is the responsibility of the user

If variable frequency drives are used, the protective devices shall work properly under conditions with harmonics caused by the variable frequency drives.

5.8.4.2 Circuits exceeding 1000 V

Circuits exceeding 1000 V shall comply with EN 60204-11.

NOTE EN 60204–11 does call for monitoring the continuity of the earth wire in the supply cable. This monitoring is the responsibility of the user.

5.8.5 Cables

5.8.5.1 General

All conductors and cables shall comply with Clauses 12 and 13 of EN 60204-1:2006 In addition, cables shall be oil and water proof and have low smoke and flame resistant characteristics.

5.8.5.2 Trailing cable

The trailing cable shall be mechanically anchored to the machine.

An on-board cable reel shall be fitted with a device which shall stop tramming of the machine when the length of the cable left on the reel is equivalent to 1 revolution of the reel.

Control wires may be included in the trailing cable in order to remotely switch off the power supply to the machine at the supply transformer respectively and the associated main switch gear (gate end box).

At the moment there is no European Standard on trailing cables, therefore the cable should comply with appropriate national requirements.

When cables are wound on drums the current load factor shall be reduced in relation to the straight cable rating as a function of the number of windings in accordance with the cable manufacturer's specification.

5.8.6 Transformers

Only air cooled transformers or fluid cooled transformers using synthetic coolants and insulating fluids with flash points above 300 °C (see EN 60076-2 classification K) shall be used on machines. Oil filled transformers and transformers using cooling fluids containing PCB (polychlorinated biphenyl) shall not be used underground.

Air cooled transformers shall not be adversely affected by dust in the cooling air.

5.8.7 Bonding

In addition to the requirements of EN 60204-1:2006, Clause 8, bonding shall be installed within the machine for potential equalisation. All exposed electrically conducting (metallic) parts which are isolated from or not sufficiently electrically connected to the machine frame in accordance with EN 61439-1, shall be connected together and to an equipotential conductor. The material for the bonding conductor shall be copper braid and the cross-section shall be in accordance with EN 61439-1.

5.8.8 Rechargeable batteries

Rechargeable batteries shall be housed in a ventilated enclosure to prevent any build-up of electrolytic gas given off during charging which could accumulate to form a potentially explosive atmosphere.

5.8.9 Electromagnetic compatibility

The requirements of EN 60204-1:2006, 4.4.2, shall be adhered to.

5.9 Lighting

5.9.1 General

All lighting facilities shall have a degree of protection against water ingress of at least IP 55 in accordance with EN 60529 and be resistant to mechanical damage, for example by protective dome and cage.

5.9.2 Working areas

Machines shall be equipped with lights for illuminating working areas. Illumination in the working area of the machine shall be at least 100 lux measured at the rotating cutter head, at the rotating drum or the hammer. Illumination of the conveyor discharge point shall be at least 20 Lux.

5.9.3 Travelling and maintenance areas

Machines shall be equipped with lights when travelling. Illumination in the field of view of the travel area according to 5.3.3 shall be minimum 20 lux and the lights shall come on automatically when travel mode is selected.

Machines shall be equipped with integral lighting at locations where regular maintenance work is necessary.

5.10 Retroreflective plates

Retroreflective plates shall be fitted to the front and rear of a machine to define the width of the machine. Each plate shall be a minimum of 0.05 m^2 in area with oblique red and yellow retroreflective stripes.

Retroreflective material should comply with the requirements of United Nations Economic Commission for Europe (UNECE) Regulation 104 class “C”.

5.11 Hydraulic and pneumatic systems

5.11.1 Hydraulic systems

Hydraulic pumps and motors, control systems and the interconnecting pipe work and hoses shall be designed and constructed according to EN ISO 4413. Adequate shielding in accordance with Clause 9 of EN ISO 3457:2008 shall be provided to protect persons in working areas.

In addition the following requirements shall be met:

— non-toxic hydraulic fluids shall be used;

— machine shall be capable to work with low-flammability hydraulic fluids conforming to EN ISO 12922 and the manufacturer shall state in the information for use, which low-flammable hydraulic fluids can be used;

NOTE 1 For transportation purposes machines are normally supplied without oil.

— all hydraulic systems shall be designed so that in the event of rupture of a component the loss of hydraulic fluid is minimised. Hydraulic tanks shall be fitted with low level warning alarms;

— hydraulic cylinders used for lifting shall be fitted with load-sustaining devices mounted on the cylinder;

— hoses and pipes shall be separated from electric power wiring wherever practical and shall be guarded against hot surfaces and sharp edges;

— hoses and pipes which have to be disconnected in operation shall be fitted with self-sealing couplings with built-in check valves, couplings shall be marked to ensure correct reconnection;

— a temperature gauge or a temperature monitor which gives a warning signal if the maximum operating temperature is exceeded shall be provided in the hydraulic system;

— electrically operated valves shall be protected to at least class IP 55 in accordance with EN 60529;

— it shall be possible to discharge any stored hydraulic pressure prior to maintenance even with the power to the machine switched off.

All rubber hoses and hose assemblies should comply with ISO 6805 or MSHA requirements or other national regulations.

NOTE 2 When hydraulic fluid is required to be biodegradable, reference can be made to ISO 15380.

5.11.2 Pneumatic systems

Compressors, air motors, control systems and pneumatic accessories and interconnecting pipework and hoses of any pneumatic system shall be designed and constructed according to EN ISO 4414.

5.12 Fire protection

5.12.1 General

The design of the machine shall avoid the risks of fire.

NOTE 1 Guidance on fire hazard identification, risk assessment, fire detection, prevention and protection measures is given in EN 13478.

NOTE 2 Power units such as motors, transformers, hydraulic power packs and electrical cabinets on the machines generate fire risks. Areas with a concentration of electrical cables and high temperatures constitute a risk.

In particular the following shall be considered:

— reduce sources of ignition, for example, short circuits in electrical systems, hot surfaces, lack of lubrication, hydraulic oil sprays and lubricating oil leakage and grease leakage;

— reduce the combustible inventory to a minimum, for example by using fire-resistant materials in accordance with ISO 3795.

5.12.2 Fixed fire extinguishing systems

All machines shall be equipped with a fixed fire extinguishing system. The fixed fire extinguishing system shall cover the places where there is a fire risk according to the fire risk assessment. No fixed fire extinguishing system is required on machines constructed for the intended use in explosive atmospheres.

The system shall be filled with appropriate extinguishing agents for the relevant fire risks envisaged. Activation of the system shall be by manual operation. If low-flammable hydraulic fluids are not used, automatic operation shall be utilised. The system once activated, shall be capable of discharging extinguishant over a predetermined area of the machine without the need for further human intervention. For equipment within enclosures, discharge shall be within that enclosure.

Effects on equipment should be considered when selecting extinguishing agents (e.g. damage by dry chemical extinguishing agents).

NOTE Gas extinguishants are only effective in enclosures.

5.12.3 Portable fire extinguishers

Each machine shall be equipped with a minimum of two portable fire extinguishers containing a suitable agent filled with a minimum of 6 kg of an appropriate extinguishing agent. The extinguishing agent shall be suitable for all classes of fire including lubricating and hydraulic oils, grease, belt conveyors, hoses, electricity and diesel fuel. Halon gas shall not be used. Fire extinguishers shall comply with the requirements of EN 3-7.

Fire extinguishers shall be readily accessible by the operator and persons on the ground. Fire extinguishers shall be positioned where they are protected from the effects of heat and mechanical damage, and if portable be mounted so that tools are not required for their removal from holding brackets.

For maintenance and servicing reasons it may be preferable to have fire extinguishers supplied from local suppliers.

5.13 Ground support equipment

5.13.1 Installing elements for ground support

When the machine is designed to handle ground support elements it shall be provided with equipment for handling the ground support elements. This equipment shall prevent the ground support elements from uncontrolled movement during the erection process.

The manufacturer shall state in the instruction handbook the type and the maximum weight of ground support elements to be handled, see 7.3.1.

5.13.2 Drilling for bolting

When the machine is intended for drilling for bolting, drills shall comply with the requirements for guarding and control systems according to EN 16228-1 and −2.

5.14 Retrieval, towing, transportation and lifting

5.14.1 General

Machines shall be equipped with devices for retrieval, towing, transportation and lifting and shall comply with 5.14.2, 5.14.3, 5.14.4.

The same devices may be used for retrieval, towing, transportation and lifting if allowed by the configuration of the machine.

5.14.2 Retrieval and towing

Retrieval and towing points shall be provided at the front and/or rear of the machines according to ISO 10532. Attachment points for retrieving and towing of the machines shall be described in the instruction handbook (see 7.3.1) as well as permissible forces and correct use.

5.14.3 Transportation

To transport machinery safely, tie-down points to anchor the machine e.g. on a trailer, shall be provided and clearly identified on the machine (see ISO 6405-1:2004, symbol 7.27). Instructions for their use shall be included in the instruction handbook (see 7.3.1).

5.14.4 Lifting

Lifting points shall be provided and be clearly identified on the machine (see ISO 6405-1:2004, symbol 7.23) and be designed for the mass envisaged for transportation and shall be clearly identified on machine or subassemblies that are to be lifted in one piece.

The method of lifting heavy attachments, components and machines shall be described in the instruction handbook (see 7.3.1).

5.15 Instruction storage

A space intended for the safekeeping of the operator’s handbook and other instructions shall be provided near the operator's station. The space shall be lockable, unless the operator's station can be locked.

5.16 Fuel and fluid storage

5.16.1 General

Fuel and hydraulic tanks shall be provided with a fluid level indicator. Pressure in the tanks exceeding the specified pressure shall be automatically compensated by a suitable device (vent, safety valve etc.).

Fuel tanks shall withstand an internal pressure of 0,03 MPa (0,3 bar) without permanent deformation or leakage. Non-metallic fuel tanks shall be made of flame retardant material. The speed of flame spread shall not exceed 50 mm/min, when tested according to ISO 3795.

Filler openings of tanks for fuel or hydraulic fluid shall have easy access for filling and shall be located outside the cab.

5.16.2 Fuel system

An easily accessible device shall be fitted to block the fuel line as close as possible to the tank to prevent leakage in case of failure in the fuel line between the fuel tank and the engine.

5.17 Maintenance

Locations at which planned maintenance is required shall be readily accessible, preferably from ground level. Where such locations are not accessible from ground level they shall comply with 5.2.3.

It shall be possible to carry out adjustment, maintenance, lubrication, repair, cleaning and service operations while the machine is shut down and the prime mover stopped.

If for technical reasons one or more of the above work items cannot be carried out under a shutdown condition, precautions shall be taken so that the work can be carried out safely, see 7.3.3.

Where it is foreseeable that planned maintenance work will be required, the manufacturer shall provide means for handling components over 25 kg in weight.

6 Verification of safety requirements and/or protective measures

Safety requirements and/or protective measures of Clauses 5 and 7 of this standard shall be verified according to the table below. It includes the following types of verification:

1) design check: the result of which establishes whether the design documents comply with the requirements of this standard;

2) calculation: the result of which establishes whether the requirements of this standard have been met;

3) visual verification: the result of which establishes whether that something is present (e.g. a guard, a marking, a document);

4) measurement: the result of which establishes whether the requirements of this standard have been met (e.g. geometric dimensions, safety distances, resistance of insulation of the electric circuits, noise, vibrations);

5) functional tests: the result of which shows whether adequate signals intended to be forwarded to the main control system of the complete machine are available and comply with the requirements and with the technical documentation.

Table 3 — Verification of safety requirements and/or measures

Clause	Design check	Calculation	Visual verification	Measurement	Functional test
5.2.1.1			x		
5.2.1.2	x				
5.2.2 Para 1	x	x			
5.2.2 Para 2			x		
5.2.2 Para 3	x				
5.2.3 Para 1			x		
5.2.3 Para 2			x		
5.3.1 Para 1			x		
5.3.1 Para 2			x		
5.3.1 Para 3	x				
5.3.1 Para 4	x				
5.3.1 Para 5	x				
5.3.2 Para 1			x		
5.3.2 Para 2	x				
5.3.2 Para 3			x		
5.3.3			x		
5.3.3.1	x		x		

Clause	Design check	Calculation	Visual verification	Measurement	Functional test
5.3.3.2	x				
5.3.3.3	x				
5.3.4 Para 1	x				
5.3.4 Para 2			x		
5.4 Para 1	x		x		
5.4 Para 2	x		x		
5.5.1 Para 1	x				
5.5.1 Para 2	x				
5.5.2 Para 1	x		x		
5.5.2 Para 2	x		x		
5.5.2 Para 3	x				
5.5.2 Para 4	x				
5.5.3.1 Para 1	x				
5.5.3.1 Para 2	x				
5.5.3.1 Para 3	x				
5.5.3.1 Para 4	x				
5.5.3.2.1	x				
5.5.3.2.2	x				
5.5.3.3 Para 1	x		x		
5.5.3.3 Para 2	x				
5.5.3.3 Para 3	x				
5.5.3.3 Para 4			x		
5.5.3.3 Para 5	x		x		
5.5.3.4 Para 1	x		x		
5.5.3.4 Para 2	x				
5.5.3.4 Para 3	x		x		
5.5.4	x			x	x
5.5.5 Para 1	x				
5.5.5 Para 2	x				
5.5.6 Para 1	x				
5.5.6 Para 2			x		
5.5.6 Para 3	x				
5.5.6 Para 4			x		
5.5.7	x		x		x
5.5.8.1 Para 1	x				
5.5.8.1 Para 2					x
5.5.8.1 Para 3	x				
5.5.8.1 Para 4	x				

Clause	Design check	Calculation	Visual verification	Measurement	Functional test
5.5.8.1 Para 5			x		
5.5.8.1 Para 6	x				
5.5.8.2	x				
5.6.1	x				
5.6.1.1	x				
5.6.1.2 Para 1	x		x		
5.6.1.2 Para 2			x		
5.6.1.3 Para 1	x		x		
5.6.1.3 Para 2			x		
5.6.1.3 Para 3	x				
5.6.2			x		
5.6.3.1 Para 1	x				
5.6.3.1 Para 2	x		x		
5.6.3.1 Para 3	x				
5.6.3.1 Para 4			x		
5.6.3.2	x		x		
5.7.1	x				
5.7.2	x				
5.7.3				x	x
5.8.1	x	x			
5.8.2 Para 1	x		x		
5.8.2 Para 2	x				
5.8.2 Para 3	x				
5.8.2 Para 4			x		
5.8.3	x				
5.8.4.1 Para 1	x				
5.8.4.1 Para 2	x				
5.8.4.2	x				
5.8.5.1	x				
5.8.5.2 Para 1			x		
5.8.5.2 Para 2	x				
5.8.5.2 Para 3	x				
5.8.6 Para 1	x				
5.8.6 Para 2	x				
5.8.7	x				

Clause	Design check	Calculation	Visual verification	Measurement	Functional test
5.8.8	x		x		
5.8.9	x				
5.9.1	x		x		
5.9.2	x		x	x	
5.9.3 Para 1			x	x	
5.9.3 Para 2			x		
5.10	x		x		
5.11.1 Para 1	x		x		
5.11.1 Para 2	x				
5.11.2	x				
5.12.1 Para 1	x				
5.12.1 Para 2	x				
5.12.2 Para 1	x				
5.12.2 Para 2	x				
5.12.3 Para 1	x		x		x
5.12.3 Para 2		x	x		
5.13.1 Para 1	x				x
5.13.1 Para 2			x		
5.13.2	x				
5.14.1			x		
5.14.2	x	x	x		
5.14.3	x		x		
5.14.4 Para 1	x		x		
5.14.4 Para 2			x		
5.15			x		
5.16.1 Para 1			x		
5.16.1 Para 2	x			x	
5.16.1 Para 3			x		
5.16.2	x		x		
5.17 Para 1	x				
5.17 Para 2	x				
5.17 Para 3	x				
5.17 Para 4	x				

7 Information for use

7.1 General

On delivery of the tunnelling machinery the manufacturer shall provide information on its safe operation and maintenance. This shall be drawn up according to 6.4 of EN ISO 12100:2010.

7.2 Signals and warning devices

Warning signs shall be provided to indicate hazardous locations, for example:

— moving parts;

— risk of trapping;

— electrical shock hazard;

— noise;

— stored energy (accumulators, brakes).

Warning signs, see 5.2.1.2 shall be made of non-corrosive material, the text shall be durable and the warning signs shall be permanently fastened. The text shall be in one of the official languages of the area or the country of first use.

All symbols used on the machines shall be as specified by the corresponding International and European Standards, in particular EN 61310-1, ISO 3864-1, ISO 3864-2, ISO 3864-3 and ISO 6405-1.

Warning devices, see 5.5.4, 5.6.3, 5.8.4.1 shall be unambiguous and easily perceived.

7.3 Accompanying documents

7.3.1 General

The instructions accompanying the machinery shall be either ‘Original instructions’ or a ‘Translation of the original instructions’, in which case the translation shall be accompanied by the original instructions.

All machinery shall be accompanied by instructions in the official Community language or languages of the Member State in which it is placed on the market and/or put into service.

On the front cover or first page of the instruction handbook the following information shall be given as a minimum:

— title of handbook, with revision number and date of revision;

— type designation of machine, model, serial number if applicable;

— name and full address of the manufacturer and where applicable the name and address of authorised representative.

The instruction handbook shall be in accordance with 6.4 of EN ISO 12100:2010. In particular the following information and instruction shall be provided:

— information relating to the machine itself and its transport, handling, storage, commissioning and avoidance of misuse of the machine in the instruction handbook as described in 7.3.2;

— operating instructions for the machine in the operator's handbook as described in 7.3.3;

— maintenance instructions for the machine in the maintenance handbook as described in 7.3.4.

This standard specifies only the safety related content of these documents.

They are part of the machine and are important for the safe and proper operation, maintenance and service of the machine. The text shall be simple, adequate and complete. The information shall be comprehensive and explicit.

All information concerning personal safety shall be printed in a type conspicuously different from the rest of the text.

7.3.2 General information

The instruction handbook shall contain:

— the same information as plated on the machine, see 7.4;

— a precise description of the machine's range of application, explicitly stating the geological conditions in which it is designed to operate;

— description of residual risks and warnings how to avoid these risks;

— a statement that operators shall be given practical training in the operation of the machine with special emphasis on the above safety precautions including what to do in the event of fire;

— a machine overview in the form of drawings, photographs, electric, hydraulic and pneumatic circuit diagrams, all of which shall be sufficiently large and clear;

— a list of all main components identified by name, function, location on and relationship to the whole machine;

— an instruction of measures to be taken in case of the occurrence of flammable or explosive gas;

— a list of checks to be carried out regularly by the operator or maintenance personnel;

— a statement of the limits of controlled movement (see 5.2.2);

— permissible gradients for operation of machine (see 5.2.2. and 5.5.8);

— permissible slope angles within which overturning is not a significant hazard (see 5.2.2);

— instructions for assembly and disassembly;

— a definition of the areas of the machine to which access is foreseeably required to operate and maintain the machine (see 5.2.3);

— a list of servicing points shall be provided at which no working platform is provided and an alternative means of access is required (see 5.2.3);

— information regarding the size and the type of ventilation system, atmospheric monitoring system and dust suppression system, for which provision has been made (see 5.6);

— information on the performance of the dust suppression system including minimum flow rate and pressure, bit tip speed of the drum (see 5.6.1.2);

— a statement of the provision made for dust extraction on the machine (see 5.6.1.3);

— a statement of typical parameters for an external dust extraction system (see 5.6.1.3);

— a statement of the requirements for the electrical supply in the tunnel to the machine (see 5.8.2);

— noise emission declaration according to Annex A:

— information on hand-arm and whole-body vibration emission as follows:

  — weighted root mean square acceleration emission of the machine to which the arms are subjected, if it exceeds 2,5 m/s^2. Where it does not exceed 2,5 m/s^2, this shall be mentioned.

NOTE 1 Experience has shown that the magnitude of hand-arm vibration on the control levers of road headers and continuous miners with a ride-on operator is in general significantly below 2,5 m/s^2. In this case it is sufficient to mention that the acceleration is below this limit.

— weighted root mean square acceleration emission of the machine to which the body is subjected, if it exceeds 0,5 m/s^2. Where it does not exceed 0,5 m/s^2, this shall be mentioned. The particular operating conditions of the machine relevant for the determination of this single value shall be indicated.

NOTE 2 This single whole-body emission value is determined under particular operating conditions and is therefore not representative of the various conditions in accordance with the intended use of the machine. Consequently this single whole-body vibration emission value declared by the manufacturer in accordance with this European Standard is not intended to determine the whole-body vibration exposure to the operator using this machine.

In addition the instruction handbook may contain the following information, representative for the whole body vibration emission at the operating conditions in accordance with the intended use of the machine.

— this machine is equipped with an operator‘s seat, which meets the criteria of EN ISO 7096 representing vertical vibration input under severe but typical operating conditions. This seat is tested with the input spectral class EM...[1]) and has a seat transmissibility factor SEAT = ...[2]).

NOTE 3 The whole-body vibration emission of the machine under representative operating conditions (according to the intended use of the machine) varies from below 0,5 m/s2 to a maximum short term level for which the seat is designed in order to meet EN ISO 7096, which is ….m/s2 [3]) for this machine.

NOTE 4 This method to determine the expected range of whole-body vibration emission is related to representative measurement data obtained for elaborating EN ISO 7096.

NOTE 5 According to the state of the art the appropriate design of the operator's seat is the most effective construction measure to minimize whole-body vibration emission of a particular machine family.

— uncertainty associated to each of the measured values;

— information on the personal protective equipment to be provided, in particular adequate hearing protectors;

— information about further protective measures for noise reduction;

— instructions on the handling and transportation of the machine in shafts and inclines;

— instructions on the procedures to be followed in case of breakdowns or blockages;

— information on the type and weight of arch support elements (if relevant);

— information on attachment points for retrieving and towing, see 5.14.2;

— information on tie-down points, see 5.14.3;

— information on method of lifting heavy attachments, components etc, see 5.14.4.

7.3.3 Operating instructions

The operator's handbook shall inform the operator how to use the machine. All instructions which are important for safe machine control and operation shall be included, e.g. pre-start checks, start up, normal running, emergency procedures and shut down.

---

1) Selected by the manufacturer from a representative similar machine listed in Table 4 of EN ISO 7096:2008.

2) Given by the seat manufacturer.

3) Maximum short term level awS12 max will be determined as follows: awS12 max = SEAT x a*wP12; machine specific value: a*wP12, see Table 4 of EN ISO 7096:2008.

The handbook shall contain operating instructions covering:

— only trained personnel shall operate the machine;

— complete instructions for the intended operation and reasonably foreseeable misuse of the machine;

— a description of the controls and their function;

— an explanation of any symbols used;

— list and location of the warning signs, warning devices and symbols displayed on the machine;

— a specification of how and where the emergency stops according to 5.5.3.3 are installed and function;

— special warnings to the operator or other personnel of such risks as moving parts, squeezing and high voltage;

— detailed instructions covering the use of guards;

— instruction that while work is carried out on the cutter head of a machine the cutter head motor shall be isolated;

— information on the fire extinguishing procedures;

— information on operating limits;

— procedures to follow in case of ingress of flammable gas;

— observation of the machine when operating the remote control unit.

7.3.4 Maintenance instructions

The handbook shall contain:

— instructions for carrying out safe maintenance operations, when possible with the machine in a “zero energy state” (including disconnecting the power supply, with provisions against reconnection, dissipation of accumulated energy, testing of safe state);

— instructions for carrying out safe maintenance and similar operations when the machine cannot be completely disconnected from the power supply or when accumulated energy cannot be released or when maintenance work can only be carried out with one or more motors running;

— instruction that while work is carried out on the cutter head, no work or tests of any electric or hydraulic system which could have an influence on the control systems of the cutter head, shall be carried out, see 5.17;

— instructions for the safe assembly and dismantling of parts which are heavy or difficult to handle. The weight of parts which are frequently replaced, e.g. picks, shall be stated;

— a list of parts, which are classified by the manufacturer to be of particular importance for safety with instructions for the frequency of checking and instructions for replacement;

— the spare part list shall contain all relevant safety related spare parts with an unambiguous identification and information of the location of the part to be replaced;

— special warnings about actions which can cause injuries to the maintenance personnel or other personnel;

— recommendations regarding the periodic testing of stop controls, emergency stops, gas warning systems, brake systems and audible warning systems. Specification of regular cleaning of equipment, e.g. transformers;

— table of daily, weekly and other scheduled planned maintenance intervals along with instruction on how the work is to be carried out safely including fire extinguishing systems;

— specification of hydraulic fluid;

— where a person is allowed to perform repair and maintenance work alone on the machine, it shall be shut down completely and the means of starting isolated by that person.

7.4 Marking

The minimum markings shall include:

— the business name and full address of the manufacturer and, where applicable, his authorised representative;

— designation of the machinery;

— CE marking[4)];

— year of construction, that is the year in which the manufacturing process is completed;

— designation of series or type, if any;

— serial or identification number, if any;

— total installed power rating in kW;

— rating information for main electrical supply;

— mass in kg of the most usual machine configuration.

Data plates shall be resistant to corrosion, the text shall be abrasion-proof and all plates shall be securely attached. The text shall be in the official language of the country or area of first use.

4) For machines and their related products intended to be put on the market in EEA, CE marking as defined in the applicable European directive(s), e. g. Machinery, Low voltage, Explosive Atmosphere, Gas appliances.

Annex A
(normative)

Noise test code

A.1 Scope

This noise test code specifies all the information necessary to carry out efficiently and under standardised conditions the determination, declaration and verification of the noise emission characteristics of road headers and continuous miners.

Noise emission characteristics include emission sound pressure levels at workstations and the sound power level. The determination of those quantities is necessary for:

— manufacturers to declare the noise emitted;

— comparing the noise emitted by machines in the family concerned;

— purposes of noise control at the source at the design stage.

The use of this noise test code ensures reproducibility of the determination of the noise emission characteristics within specified limits determined by the grade of accuracy of the basic noise-measurement method used.

NOTE The noise evaluation procedures as laid down in this European Standard aim at ensuring the reproducibility of the measurements of the noise emission of the machine. This determination does not necessarily reflect the noise emission during operation.

Comparison of the actual noise emission value with the range of noise emission values from other tunnelling machinery may be helpful to verify the effectiveness of the applied noise reduction measures in the design stage.

The noise emission values of machinery shall be documented by the noise declaration in the instruction handbook (see 7.3.1).

A.2 A-weighted emission sound pressure levels at workstations

A-weighted emission sound pressure levels shall be determined in accordance with one of the following basic standards:

— EN ISO 11201 (grade 2: engineering);

— EN ISO 11202 (grade 2: engineering or grade 3: survey);

— EN ISO 11204 (grade 2: engineering or grade 3: survey).

Preferred methods are grade 2 methods. If it is not possible to use grade 2 methods, the reasons shall be recorded and reported.

At the manufacturers place, three measurements shall be carried out and the energy average of the 3 values shall be taken as the final result.

In real tunnel conditions it is not possible with the current state of the art to correct the A-weighted sound pressure levels measured at the operating position for environmental influences. Therefore for measurements in real tunnel conditions, only EN ISO 11202 shall be used. No environmental correction shall be applied.

The position at which to measure the sound pressure levels shall be:

— main operator control station;

— remote control positions as defined by the manufacturer;

— bolter operator control station if relevant.

A.3 A-weighted sound power level determination

A.3.1 A-weighted sound power levels

In the case of road headers and continuous miners there is no experience with the determination of A–weighted sound power levels according to the current state of the art for measurements in real tunnel conditions.

The A-weighted sound power levels measured at place of manufacture shall be determined in accordance with one of the basic standards:

— EN ISO 3744 (grade 2: engineering);

— EN ISO 3746 (grade 3: survey);

— EN ISO 3747 (grade 2: engineering and grade 3: survey).

At the manufacturers place, the sound power levels shall be determined 3 times and the energy average of the 3 values shall be taken as the final result.

A.3.2 Measurement procedure for large machines

For machines that are either higher than 2,5 m or longer than 8 m (as defined in the information for use) instead of determining the sound power level, A-weighted emission sound pressure levels shall be determined at a path around the machine at 1 m from the surface of the machine and at 1,6 m height. The A-weighted emission sound pressure levels shall be determined according to one of the standards referred to in A.2.

The horizontal distance between 2 microphone positions shall not exceed 2 m.

A.4 Installation and mounting conditions of the machines

The typical installation and mounting conditions shall be those recommended by the manufacturer.

The installation and mounting conditions shall be identical for the determination of both sound power levels and emissions sound pressure levels at workstations, and for declaration purposes.

The machine shall be mounted as it normally is at the manufacturers place, when measured according to A.3.2.

A.5 Test conditions of the machine

A.5.1 General

Before carrying out any measurement, the engine and the hydraulic system of the machine shall be brought to its normal working temperature following the instruction of the manufacturer and all relevant safety-related procedures given in the instruction handbook shall be carried out.

If bolt drilling equipment is fitted, it shall not be in operation during the noise test.

NOTE Noise test code for drilling equipment is provided in EN 16228–1 and EN 16228–2.

For measurements in cabs, windows and doors shall be closed. For safety reasons the operator shall be present during the measurement.

The on-board diesel power pack on the machine shall not be in operation during the test.

Dust extraction equipment shall not be in operation unless it is an integral part of the machine.

A.5.2 Operating conditions at the place of manufacturer

The measurement shall be done in operating conditions for which the highest noise emission is expected.

The following devices shall be in operation:

— empty conveying system including loading device;

— hydraulic pump(s) at working pressure;

— dust extraction equipment, if it is an integral part of the machine.

The operating conditions during noise tests shall be identical for the determination of both the sound power level and emission sound pressure levels at specified positions.

The measurement time shall not be less than 15 s.

NOTE The test conditions set out in this clause do not represent operating conditions underground because there is no process noise from cutting rock and no material on the conveyor. The noise from the cutting is not part of the test because it varies in an unpredictable manner with the properties of rock. However the test conditions defined ensure reproducibility and comparability of the measured values.

A.5.3 Operating conditions in a tunnel environment

The following devices shall be in operation:

— cutter head;

— conveying system including loading device;

— hydraulic pump(s) at working pressure;

— dust extraction equipment, if it is an integral part of the machine.

The test shall be carried out for one cutting sequence without interruption with a duration of at least 5 min.These measurements cannot be carried out in an explosive atmosphere. Results of measurements carried out on a similar machine shall be declared instead.

A.6 Information to be recorded and reported

Requirements concerning information to be recorded given in the basic standards used shall apply with the following additions:

— description of the test environment;

— rock compressive strength and tunnel dimensions, when measured in a tunnel environment;

— cutter head speed;

— conveying speed;

— hydraulic pump(s) working pressure;

— type of dust extraction equipment, if it is an integral part of the machine;

— A-weighted sound power level from each of the 3 measurements and the resulting sound power level as emission value;

— A-weighted sound pressure levels from each of the 3 measurements at the operator position(s) and the resulting emission sound pressure level;

— A-weighted sound pressure levels measured at workstations in the tunnel;

— place, date of measurement, person responsible.

A.7 Declaration and verification of noise emission values

Noise emission values shall be declared as dual number noise emission values according to EN ISO 4871.

At this point in time there is no detailed knowledge of the uncertainties. Till more experience has been gained, the following uncertainties shall be assumed. Uncertainty related to the measurement of A-weighted sound power level K_{WA} shall be taken as 3 dB.

Uncertainty related to the measurement of A-weighted emission sound pressure level K_{pA} shall be taken as 3 dB.

Declaration form:

Machine type reference:	Noise emission values, operating conditions, standards used and other data
Declared dual number noise emission values in accordance with EN ISO 4871	
A-weighted sound power level L_{WA} (ref. 1 pW) in decibels.	
Uncertainty K_{WA} in dB	3
A-weighted emission sound pressure level L_{pA} at workstations (ref. 20 uP) in decibels.	
Workstation 1	
Workstation 2	
Workstation 3	
Uncertainty in dB	3
cutter head speed in m/s	
conveying speed in m/s	
hydraulic pump(s) working pressure in bar	
type of dust extraction equipment, if it is an integral part of the machine	
place, date of measurement, person responsible	
Values determined at the manufacturer's place according to standard:	EN ISO … EN ISO … EN 12111:2013, Annex A
NOTE The sum of the measured noise emission value and its uncertainty represents an upper boundary of the range of values which is likely to occur in measurements.	

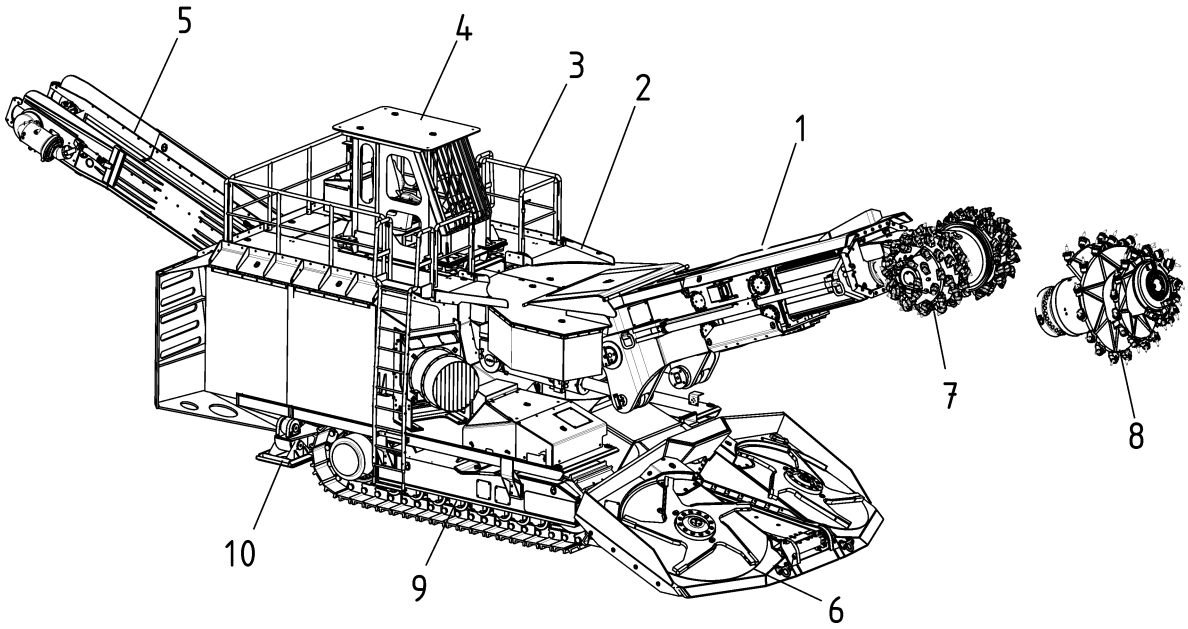
Noise emission values, operating conditions, standards used and other data, shall be added in the right-hand column of the declaration form.

NOTE Workstations are defined in A.2.

Verification shall be done in accordance with EN ISO 4871:2009, 6.2, by using the same mounting, installation and operating conditions as used for the determination of the declared noise emission values of this machine.

Annex B
(informative)

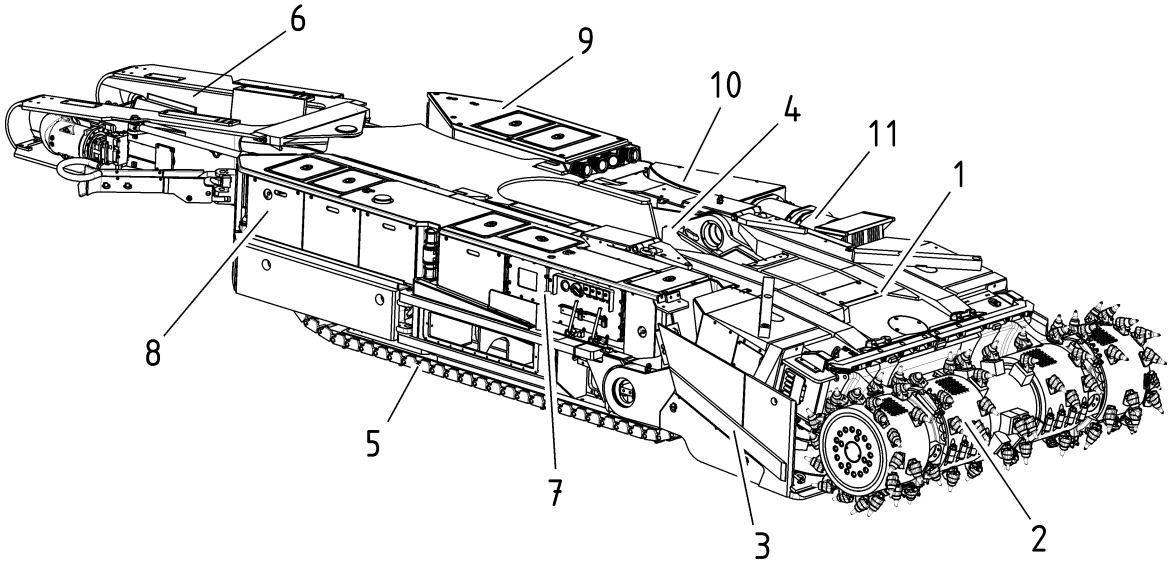
Figures



Key

1	cutter boom (telescopic)	6	loading device
2	turret	7	transversal cutter head
3	platform with railing	8	longitudinal cutter head
4	driver cabin (FOPS)	9	main frame with crawler equipment
5	chain conveyor	10	rear stabilizer

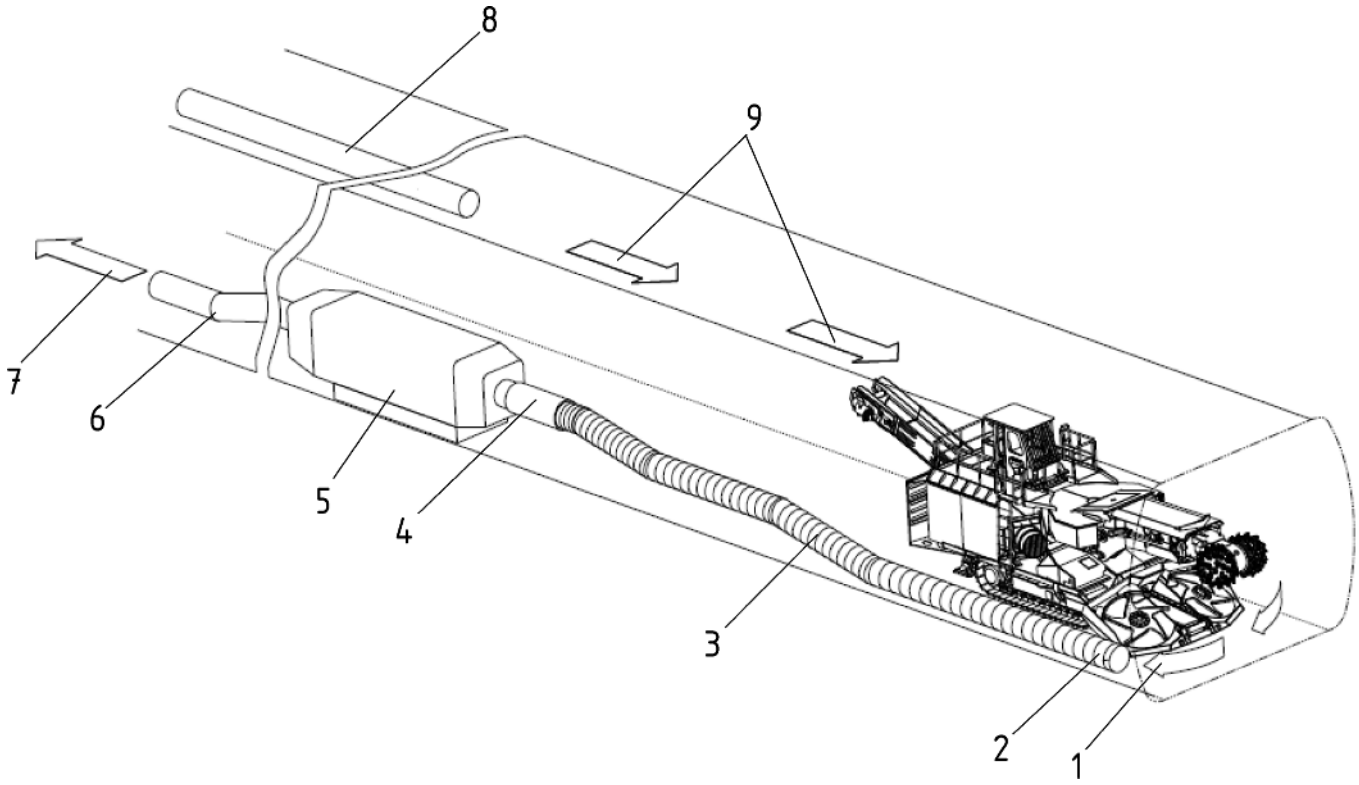
Figure B.1 — Example of road header



Key

1	cutter boom with e-motors	7	electric equipment
2	cutter drum with cutter gear boxes	8	hydraulic equipment
3	loading table	9	water supply
4	frame	10	dust scrubber
5	crawler tracks	11	fan
6	chain conveyor		

Figure B.2 — Example of continuous miner



Key

1	dust-laden air	6	blower-tubing
2	suction inlet	7	cleaned air
3	spiral-tubing	8	ventilation ducting
4	silencer	9	fresh air
5	dust-extractor with fan		

Figure B.3 — Example of dust extraction system

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC on machinery.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

The following is a list of standards which were significant in drafting this standard but which were not normatively or specifically referenced:

[1] EN 474-5:2006+A3:2013, *Earth-moving machinery - Safety - Part 5: Requirements for hydraulic excavators*

[2] EN 1710:2005+A1:2008, *Equipment and components intended for use in potentially explosive atmospheres in underground mines*

[3] EN 13478:2001+A1:2008, *Safety of machinery - Fire prevention and protection*

[4] Directive 94/9/EC:1994, *DIRECTIVE 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres*

[5] ISO 15380:2011, *Lubricants, industrial oils and related products (class L) — Family H (Hydraulic systems) — Specifications for categories HETG, HEPG, HEES and HEPR*

[6] ECE R 104, *Uniform provisions concerning the approval of retro-reflective markings for vehicles of category M, N and O*

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