INTERNATIONAL STANDARD

ISO 19225

First edition
2017-05

Underground mining machines — Mobile extracting machines at the face — Safety requirements for shearer loaders and plough systems

Machines d'exploitation de mines et carrières souterraines — Machines mobiles d'abattage de front de taille — Exigences de sécurité imposées aux haveuses à tambour(s) et aux rabots

Reference number
ISO 19225:2017(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html

The committee responsible for this document is ISO/ TC 82, *Mining*.

Introduction

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

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

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

The machines concerned work with tools for cutting minerals such as coal, ore, salt and surrounding rock, at a fixed or variable height and are guided on armoured face conveyors or their attachments. Shearer loaders have built-in haulage systems. They can be directly operated by one or more drivers or be remotely or program controlled. Plough systems are remotely controlled. Wireless remote control systems of shearer loaders are used in the immediate environment of the machines.

Underground mining machines — Mobile extracting machines at the face — Safety requirements for shearer loaders and plough systems

1 Scope

This document specifies safety requirements to minimize the hazards listed in Clause 4 that can occur during the assembly, use, maintenance, repair, decommissioning, disassembly and disposal of shearer loaders and plough systems when used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer, in underground mining.

This document does not cover any hazards resulting from explosive atmospheres. Requirements for explosive atmospheres can be found in ISO/IEC 80079-38.

This document is not applicable to machines that are manufactured before the date of its publication.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3457:2003, *Earth-moving machinery — Guards — Definitions and requirements*

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

ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components*

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

ISO 7731:2003, *Ergonomics — Danger signals for public and work areas — Auditory danger signals*

ISO 9244, *Earth-moving machinery — Machine safety labels — General principles*

ISO 9355-1, *Ergonomic requirements for the design of displays and control actuators — Part 1: Human interactions with displays and control actuators*

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

ISO 12922, *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 13732-1, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces*

ISO 13849-1, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 13850, *Safety of machinery — Emergency stop function — Principles for design*

ISO 14120, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

ISO/IEC 80079-38, *Explosive atmospheres — Part 38: Equipment and components in explosive atmospheres in underground mines*

IEC 60204-1:2005, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60204-11, *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 60529, *Degrees of protection provided by enclosures (IP code)*

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

IEC 61310-1, *Safety of machinery — Indications, marking and actuation — Part 1: Requirements for visual, auditory and tactile signals*

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

IEC 61439-2, *Low-voltage switchgear and controlgear assemblies — Part 2: Power switchgear and controlgear assemblies*

IEC 61439-4, *Low-voltage switchgear and controlgear assemblies — Part 4: Particular requirements for assemblies for construction sites (ACS)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
remote control
operating mode where the operator controls the moving machine from a fixed position outside of the working area of the machine

3.2
radio control
operating mode where the operator controls the moving machine from within the working area of the machine by means of mobile radio transmitters

3.3
working area
operating area of the machine, consisting of the face and the roadway junctions

3.4
load attachment point
means of attachment for devices to enable them to carry a load

3.5
transport units
parts or subassemblies which, for transportation reasons, are not fitted to the complete machine until the point of use

3.6
energizing
introducing power to the machine without starting or operating of the machine

3.7
starting
activating the machine without necessarily causing the machine to move

Note 1 to entry: For example, a shearer loader is started up when the hydraulic pump drive is switched on but externally the machine has clearly not yet moved.

3.8
cutting cycle
operation of the shearer or plough, from one end of the face to the other and back, including the face-end operations

4 List of significant hazards

This clause lists the hazards, hazardous situations and events, as far as they are dealt with in this document, identified as significant for shearer loaders (see Figure 1) and plough systems (see Figure 2) and which require an action to eliminate or reduce the risk, see Table 1.

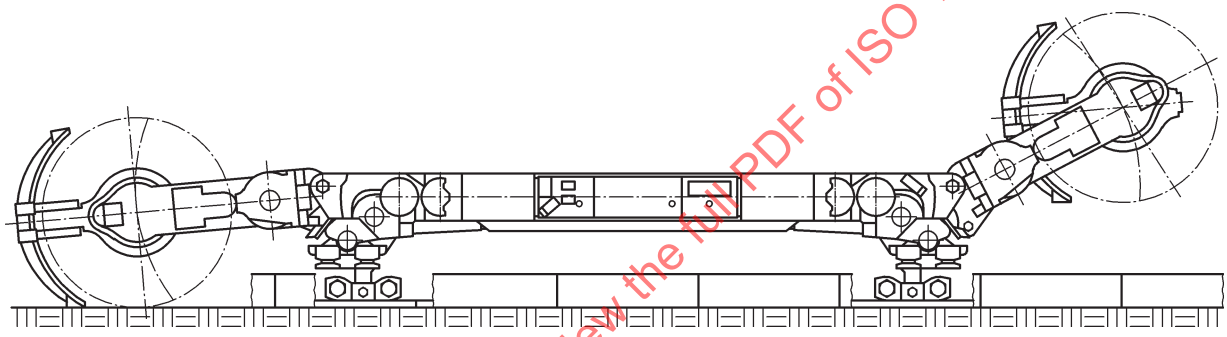


Figure 1 — Shearer loader (side view)

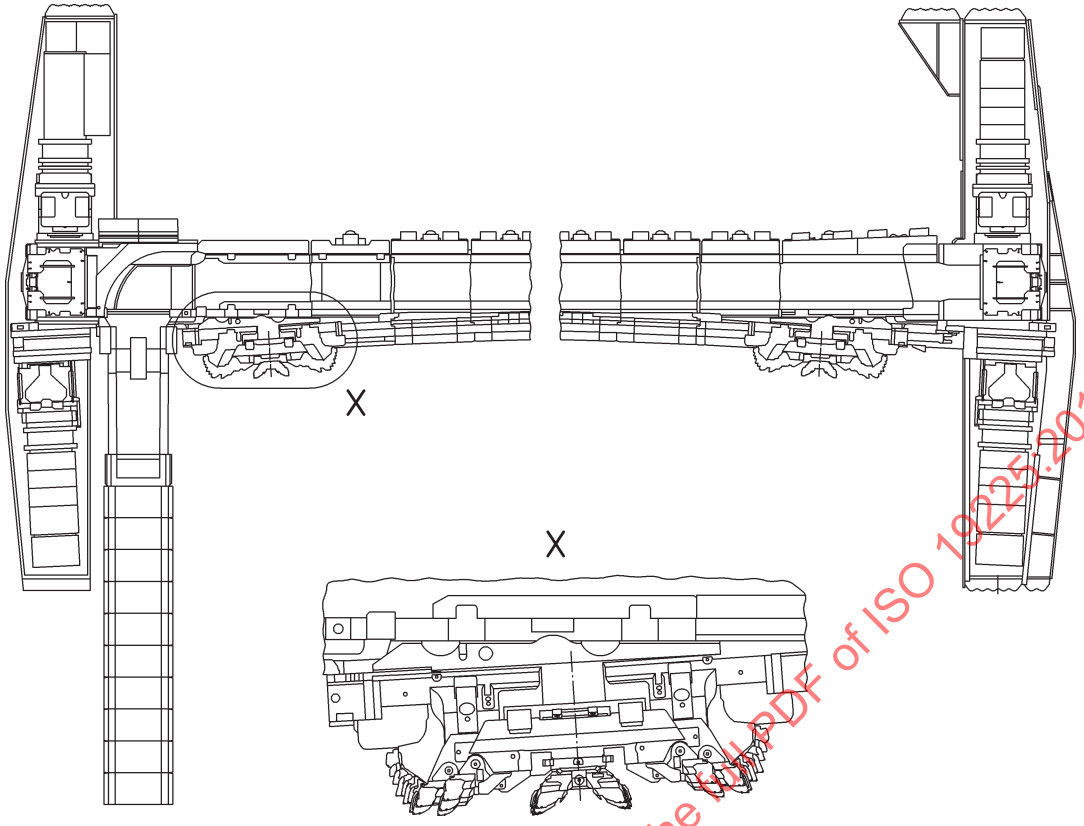


Figure 2 — Plough system (top view)

Table 1 — List of significant hazards with associated requirements

Hazard	Shear-er-loader	Plough system	Sub-clause
1. Mechanical hazards			
— crushing or shearing between machine parts or between machine parts and their surrounding	X	X	5.4.8 5.5 5.9 5.10 5.12 5.13
— drawing into moving cutting tools, drive wheels, trailing cables and chains	X	X	5.8.4 5.9 5.10
— skidding or inadvertent movement of the machine and parts of it	X	X	5.4.8
— whipping or breaking chains	X	X	5.9
— insufficient stability	X	X	5.3
2. Thermal hazards			
— scalding by fluids	X	X	5.9.3 5.10.1
— burning due to hot surfaces	X	X	5.2.2 5.9.3

Table 1 *(continued)*

Hazard	Shearer-loader	Plough system	Sub-clause
3. Fire hazards			
— burning due to open flames	X	X	5.11
4. Hazards generated by materials and other substances released when machinery is used			
— spalling of cut material or cutting tools	X	X	5.5
— fluids harmful to health	X	—	5.10.1
— dust harmful to health	X	X	5.6
5. Hazards generated by neglecting ergonomic principles in machine design			
— personal injury and damage to hoses and cables	X	X	5.2.1
— controls that cannot be operated when operator is wearing protective gloves	X	X	5.4.1
— unhealthy postures or excessive effort	X	X	5.4.1 5.12
— personal injury due to excessive noise	X	X	5.7
6. Hazards generated by power supply faults and other failures			
— spraying of fluids at high pressure	X	X	5.10
— hydraulic pressure drop	X	X	5.10.1
— control system failure	X	X	5.4
— falling objects	X	X	5.12
— injury due to electrical energy	X	X	5.8
7. Hazards generated by temporary absence of protective measures			
— personal injury or damage to machinery	X	X	5.4 5.7 5.8 5.10 5.13
8. Hazard due to errors of fitting			
— personal injury or damage to machinery	X	X	5.13

5 Safety requirements and/or protective measures

5.1 General

Shearer loaders and plough systems shall comply with the safety requirements and/or protective measures of this clause.

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

5.2 Contact surfaces

5.2.1 Sharp corners and edges

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

5.2.2 Hot surfaces

Where there is a risk of contact with hot surfaces in accessible areas, suitable measures shall be taken in accordance with ISO 13732-1.

This requirement does not apply to the excavation tools.

5.3 Stability

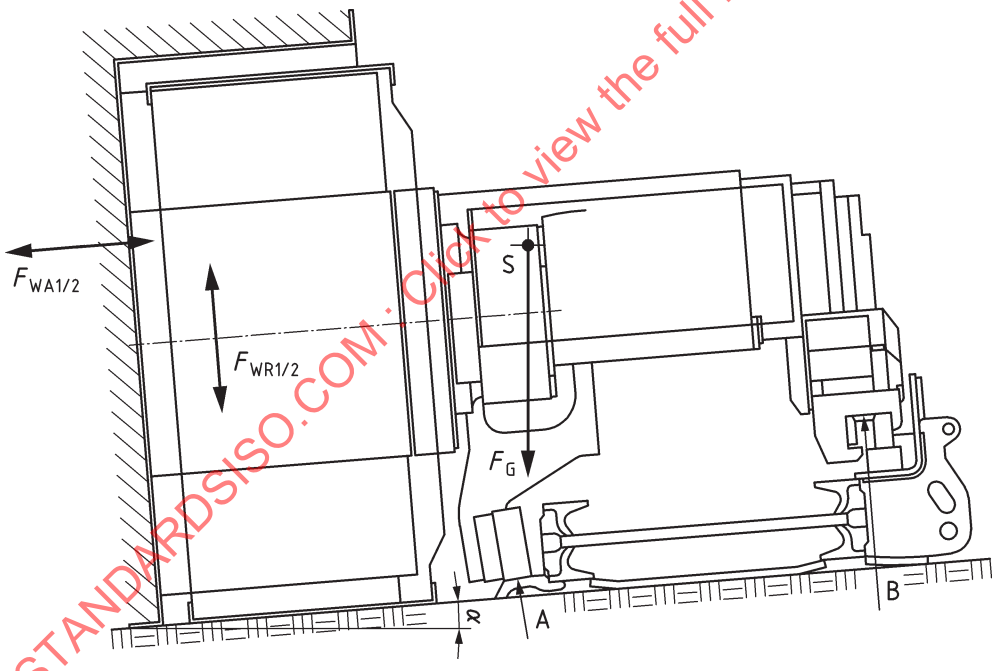
The manufacturer shall specify limit values for the permissible tilting of the machines in all directions. This is to avoid possible instability of the shearer during operation or while standing, which could cause injury to personnel within the area of the machine.

To evaluate the stability of shearer loaders, the forces acting on the two cutting drums and the weight of the machine simplified in the transverse plane to the machine are taken into account (see Figure 3).

The size of the forces and their directions as well as the distance to the bearing points A + B shall be determined by the manufacturer.

At least one of the bearing points A + B shall be designed as a form-fit bearing to absorb vertical as well as horizontal forces.

The maximum permissible inclination of the machine in longitudinal and transverse direction has to be determined by the manufacturer and indicated in the operating manual.



Key

A, B	loading pads
S	centre of gravity
F_G	machine weight
$F_{WR1,2}$ [a)]	forces on the cutting drums, radial
$F_{WA1,2}$	forces on the cutting drums, axial
α	angle of transverse dip

a) 1 and 2 as a function of the direction of rotation.

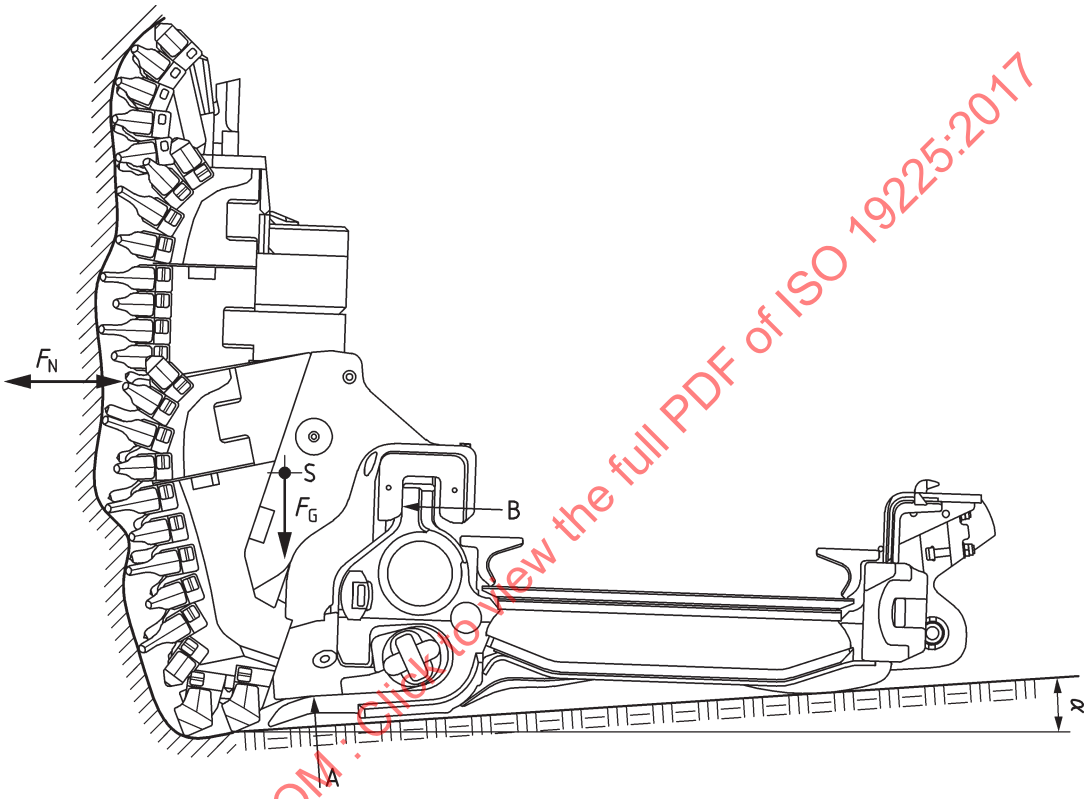
Figure 3 — Example of forces on the shearer loader

The coal plough (see Figure 4) runs on a special guidance, lying along the longwall face and attached to the armoured face conveyor pans.

In that way plough bodies are restraint-guided with one degree of freedom aligned in the face direction.

Through the compulsory guide a plough body cannot leave the guidance, even in case of very high loads acting on that body.

In situations where the plough body is decisively higher than the plough body guidance, the use of additional stabilizers might be necessary.



Key

A	loading and gliding pad
B	plough body guidance
S	centre of gravity
F_G	machine weight
F_N a)	forces on the cutting plough body
α	angle of transverse dip

a) Lateral forces as a function of plough body movement.

Figure 4 — Example of forces on the plough

5.4 Control devices and systems

5.4.1 General requirements

Control devices and systems shall be designed and built to meet the high demands of an underground environment and to be reliable in service.

They shall be able to withstand shock loads of 15 g/11 ms, along with ambient air temperatures of up to 40 °C, and up to 100 % humidity.

Control devices shall meet the requirements of ISO 9355-1. They shall be set out clearly and designed so that they can be actuated easily and safely by the operator even when wearing gloves. Pushbuttons on hand-held devices shall be at least 14 mm in diameter and the distance between buttons shall be at least 3 mm.

The direction of movement and control effect of the control devices shall be logical. Control devices shall be permanently and unambiguously marked.

The colour coding as specified in IEC 61310-1 shall be used for control devices and displays.

Control devices for ranging arms, lump breaker, cowls and sloughing covers shall be designed as hold-to-run devices, as described in ISO 12100, automatically self-releasing to the basic position after actuation; this also applies to the control devices of a transmitter if the machine is operated by means of radio or similar controls.

If shearer loaders are operated by two people simultaneously, with two radio-transmitters, the functions "raise/lower left-hand ranging arm" and if appropriate "slew left hand cowl" shall only be initiated from the left-hand control unit, and the corresponding right-hand side functions of the machine from the right-hand control unit. The same applies for any other functions, with the exception of the shearer loader haulage drives which can be controlled by both operators. Contradictory simultaneous commands shall result in the machine stopping.

5.4.2 Safety and reliability of control systems

Control functions of machinery shall be divided into operational functions and safety-related functions. While operational functions shall comply with good engineering practice, for safety-related functions increased requirements in respect of reliability shall be met.

Safety-related functions may be performed either by separate safety control equipment or by devices or subsystems of the operational control system. In the latter case, the operational control system (or at least parts of it) shall meet the requirements of safety-related functions.

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

5.4.3 Design of control systems

5.4.3.1 General

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

Hydraulic control systems shall be designed as per ISO 4413.

Ergonomic requirements of ISO 9355-1 shall be addressed.

5.4.3.2 Energizing

The machines shall be fitted with devices to prevent unauthorized energizing, e.g. lockable control devices or levers attached to immobilization switches that can only be removed in the OFF position.

5.4.3.3 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 is.

5.4.3.4 Start-up warning devices

Start-up warning devices for shearer loaders shall indicate the starting of the cutting drums by means of an unmistakable warning signal which is clearly perceptible at the driver's position, and in an area extending 10 m in front of and behind the shearer loader.

Start-up warning devices for plough systems shall indicate the starting of movement by means of an unmistakable audible warning signal which is clearly perceptible along the whole face.

For shearer loaders and plough systems, the drives shall not start up less than 5 s after the beginning of the warning signal, and only start up while the warning signal is activated.

Audible signals or water sprays shall be used as the start-up warning device on the shearer loader. Water sprays that may themselves generate a hazard shall not be used as a start-up warning device. A water jet is regarded as hazardous if the product of its flow rate and pressure exceeds a value of 330 bar l/min at a minimum flow rate of 15 l/min.

Audible start-up warning devices shall meet the requirements of ISO 7731. At a distance of 0,5 m from the source of sound, the sound pressure level of the warning tone shall be at least 78 dB (A) (see 4.2 in ISO 7731:2003). The warning tone shall have intermittent characteristic (see 6.3 in ISO 7731:2003).

5.4.3.5 Stopping

5.4.3.5.1 Stopping in normal operation

Each machine mounted control panel, radio-transmitter and remote control console shall be equipped with a control device for stopping all motors. The stop control command shall override the start-up command.

The shearer shall be capable of coming to a controlled stop while travelling at maximum speed down the maximum operating gradient.

5.4.3.5.2 Stopping at the end of the working range

For plough systems, a mechanical stop at the face-ends is required.

Plough systems shall be equipped with overrun monitors based on a detection of the plough position in the face. The plough drives shall stop automatically if one of the working range end points is reached.

For shearer loaders, a mechanical stop is required to be fitted to the haulage rack at the face-ends. In addition to this, a position detection system may be installed to control the speed of the shearer when approaching the face-end positions.

5.4.3.5.3 Stopping in case of an emergency

The machines shall be fitted with emergency stop devices which shall conform to ISO 13850.

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

They shall be designed so that all machine drives are disconnected and locked against start-up by actuating a switch. The device may also consist of a pullwire acting on a switch and extending over the whole length of the machine.

Radio-transmitters shall have a pushbutton by means of which all the machine drives are disconnected.

Each remote control console shall be equipped with a device conforming to ISO 13850 capable of stopping the machine in an emergency. They shall be designed so that all machine drives are disconnected and locked against start-up by actuating a switch.

Plough system control devices shall be provided with an interlock device so that all the plough system and face conveyor drives are stopped immediately if an emergency stop device is actuated.

Remote control consoles shall be provided with a latch-down on/off switch in accordance with ISO 13850 for stopping the complete system.

5.4.4 Failure of power supply

Re-establishment of the power supply after an interruption or fluctuation shall not lead to a hazardous situation. See IEC 60204-1:2005, 7.5.

5.4.5 Remote control

If the machine is capable of remote operator control from outside the working area, the control system shall meet the requirements of the following sub-clauses of IEC 60204-1:2005:

— 9.2.7.2 (control limitation);

— 9.2.7.4 (use of more than one operator control station).

A remotely controlled machine shall be equipped with devices for stopping all operations automatically and in a safe manner for preventing potentially dangerous operation in the following situations:

— if the data transmission is interrupted;

— 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 controls when it has been determined that it is safe to do so.

The instruction handbook (see Clause 7) shall contain a warning that the operator shall supervise the machine when operating the machine by remote control.

5.4.6 Radio control

If the machine is capable of radio operator control by wireless means within the working area of the machine, the control system shall meet the requirements of the following sub-clause of IEC 60204-1:2005:

— 9.2.7.2 (control limitation).

NOTE Radio control does not apply to plough systems.

A radio controlled machine shall be equipped with devices for stopping all operations automatically and in a safe manner for preventing potentially dangerous operation in the following situations:

— if the transmitter loses the connection to the receiver;

— 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 for longer than 1,25 s.

Once stopped, the machine shall not restart except by deliberate actuation of the controls when it has been determined that it is safe to do so.

The instruction handbook (see Clause 7) shall contain a warning that the operator shall supervise the machine when operating the machine by radio control.

5.4.7 Automatic control

5.4.7.1 Shearer loaders

The shearer loader control system may incorporate an “Automatic Control Mode”. This may be activated when the machine is operated with a radio control system or a remote control system.

One or more flashing lights at the machine, visible from the operator’s position, shall indicate the activated Automatic Control Mode.

When the Automatic Control Mode is activated, individual control functions of the machine through to control of complete cutting cycles may be executed by the machine automatically but under supervision of an operator.

The system shall allow the operator to be able to override the Automatic Control Mode. Manually issued commands by the operator shall have priority over automatic control commands.

The Automatic Control Mode operated machine shall revert to a safe status mode for preventing potentially dangerous operation in the following situations:

— if it receives a stop signal;

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

— if the transmitter loses the connection to the receiver when the machine is operated with a radio control system;

— if no validation signal between transmitter and receiver is detected for longer than 1,25 s when the machine is operated with a radio control system;

— if the data transmission between machine and remote control station is interrupted when the machine is operated with a remote control system;

— if no validation signal between machine and remote control station is detected when the machine is operated with a remote control system.

Once stopped, the Automatic Control Mode shall not restart except by deliberate actuation of the controls when it has been determined that it is safe to do so.

The instruction handbook (see Clause 7) shall contain a warning that the operator shall supervise the machine when operating the machine by automatic control.

5.4.7.2 Plough systems

Plough systems may be controlled from the drives or from areas outside the face. Switching on and off or changing the speed of a plough within the face may be controlled manually or automatically. When the automatic control mode is activated, the system shall stay under supervision of an operator.

Slowing down and stopping of the plough while approaching a face-end shall occur automatically in such a way as to avoid a mechanical collision between the plough body and the machine drive.

One or more flashing lights at the face-ends shall indicate an approach of the plough body to the drive.

Overload protection of the plough drives should be applied to minimize the danger of serious damage or haulage chain breaks due to rapid load surges or obstacles blocking the passage of the plough body.

The instruction handbook (see Clause 7) shall contain a warning that the operator shall supervise the plough system when operating the plough system by automatic control.

5.4.8 Measures to prevent inadvertent movements

5.4.8.1 General

Inadvertent movements include those listed in Table 2.

Table 2 — Inadvertent movements with associated preventive measures

Type of movement	Measures
moving of the whole machine	5.4.8.2 5.4.8.5
moving of the ranging arms	5.4.8.3 5.4.8.5
rotation of the drums	5.4.8.4 5.4.8.5
rotation of the cowls	5.4.8.5
movement of the lump breaker	5.4.8.3 5.4.8.5
movement of the sloughing covers	5.4.8.3 5.4.8.5

The switching of motors on or off, a break in the power supply or its restoration after a break, or any other change in the power supply to the machines shall not lead to inadvertent movements of the machines.

NOTE Additional guidance can be found in ISO 14118.

5.4.8.2 Brakes

The manufacturer shall declare the maximum gradient for safe operation of the shearer without brakes and the maximum gradient for safe operation of the shearer with brakes. If the shearer is equipped with brakes:

— it shall be equipped with two independent brakes that are automatically actuated when the drives are disconnected or when there is a power loss;

— each individual brake shall be capable of stopping and holding the machine. Wear and function of each brake shall be monitored individually or it shall be possible to verify them individually;

— the shearer shall be capable of coming to a controlled stop while travelling at maximum speed down the maximum operating gradient.

5.4.8.3 Check valve

Hydraulic cylinders for positioning machine parts, e.g. ranging arms, shall be fitted with check valves that prevent any unintentional movements in the event of pressure loss between the hydraulic pump and the cylinder (see ISO 4413:2010, 5.4.7).

5.4.8.4 Mechanical disconnection

Shearer drums or other cutting tools that rotate when the machines are in operation shall be capable of being disconnected mechanically and shall remain disconnected from the drive motor when stopped.

5.4.8.5 Electrical isolation

Shearer loaders shall be provided with a means of immobilization that interrupts the power supply. It shall be provided with an easily accessible handle that is removable or lockable only in the off position.

5.5 Falling objects and ejected material

Where falling or ejected material from the face presents a significant safety hazard, sloughing covers mounted to the shearer body shall be provided.

As a result of the mode of operation and depending on the ambient conditions, there is a risk, when using the machines concerned, that parts of the mineral to be won or parts of the surrounding rock be thrown into the travel way, or that parts of the rock become detached from the roof or the side wall. The operator should be protected against these hazards. This is generally provided by the roof support or by the side spill plate of the conveyor and/or by personal protective equipment. The operator of a shearer loader can also be additionally protected, for example by a roof on the machine or by using remote or radio control.

5.6 Dust control

5.6.1 General

The manufacturer shall contribute to dust control, depending on the type of the machine (shearer loader or plough system). This shall be done either by dust reduction in dust produced or by dust suppression, or by a combination of both.

NOTE Dust is generated not only by the mode of operation of the machines, but also by the material to be extracted, the environment, the roof support and the conveyor. For example, equipping the machine with a water spray may not completely eliminate the hazard on its own.

5.6.2 Dust reduction

The manufacturer shall design the shearer loader and plough system to minimize the amount of dust produced.

NOTE Dust production can be reduced significantly by reducing cutting speed, or by changing the layout of the cutting tools.

5.6.3 Dust suppression

Both for shearer loaders and plough systems, the manufacturer shall provide effective water spraying systems.

NOTE 1 For shearer loaders, a water spraying system is typically incorporated with the cutting drums, interlocked with working parts, equipped with devices for monitoring and adjusting the operation modes without creating additional adverse factors (noise, vibration, etc.) exceeding the maximum permissible levels.

NOTE 2 For plough systems, normally an effective water spraying system is located on the canopies of shields and/or on armoured face conveyor spill plates.

Dust suppression with water spray systems shall not be used for the intended purpose in potash, gypsum and salt mines. In this case, the machine shall be marked accordingly.

5.7 Noise

5.7.1 General

Persons working on or near shearer loaders and plough systems are at risk of hearing damage and interference with speech communication, acoustic signals, etc. As far as practicable, shearer loaders

and plough systems shall generate noise levels as low as possible. Therefore, noise reduction shall be an integral part of the design process, taking into account measures at the source as very generally described in ISO/TR 11688-1.

Information on noise emission values shall be given to the user, see 7.3.5.

The determination, declaration and verification of the noise emission characteristics has to be carried out in accordance with Annex A.

NOTE Only a small amount of the noise emitted at the point of use of shearer loaders and plough systems is generated by the machines themselves. The noise level is affected more by the breaking mineral and the conveyors.

5.7.2 Noise reduction at the 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.

5.8 Electrical requirements

5.8.1 General

All electrical equipment shall comply with the relevant parts of IEC 60204-1 or IEC 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 main isolator which disconnects the machine from the power supply.

All switchgear shall comply with the requirements of IEC 61439-1, IEC 61439-2 and IEC 61439-4, as applicable, and with IEC 60947-1, and shall be installed in enclosures. These enclosures shall give protection to at least Class IP 54 in accordance with IEC 60529, and shall be arranged and built to protect the switchgear against mechanical damage.

5.8.3 Monitoring of circuits

5.8.3.1 Circuits not exceeding 1 000 V

Circuits not exceeding 1 000 V shall comply with IEC 60204-1.

In circuits not exceeding 1 000 V, a residual-current protective device with a fault current rating of an acceptable minimum or an insulation monitoring system shall be installed in accordance with the type of supply system.

NOTE Monitoring of the insulation status (earth fault) in power feeding circuits in accordance with national regulations is the responsibility of the user. Acceptable ratings of fault currents are given in national regulations.

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

5.8.3.2 Circuits exceeding 1 000 V

Circuits exceeding 1 000 V shall comply with IEC 60204-11.

NOTE IEC 60204–11 calls for monitoring the continuity of the earth wire in the supply cable. This monitoring is the responsibility of the user.

5.8.4 Cables

All conductors and cables shall comply with Clauses 12 and 13 of IEC 60204-1:2005. In addition, cables shall be oil and water proof and have low smoke and flame resistant characteristics.

Cables shall be routed and guarded so as to minimize the hazard of trapping or drawing in.

5.8.5 Bonding

For protective bonding, IEC 60204-1:2005, 8.2 applies.

NOTE Functional bonding according to IEC 60204–1:2005, 8.3 can be required by regional regulations.

5.8.6 Lighting

All lighting facilities shall have a degree of protection against water ingress of at least IP 54 in accordance with IEC 60529, and shall be resistant to mechanical damage, for example by protective dome and cage.

5.9 Mechanical requirements

5.9.1 General

Crushing and shearing points, as well as rotating parts on the shearer loaders and chains and ropes subjected to a load, shall be safeguarded in personnel hazard areas by means of fixed covers on the shearer loader drive wheels, plough chains, etc. in accordance with ISO 14120.

5.9.2 Chains

5.9.2.1 Shearer loaders

Where chain haulage of the shearer is used:

a) the system should be designed so that there is no possibility of the chain entering the walkway area used for normal access along the longwall face;

b) if the system does not comply with the above paragraph [5.9.2.1 a)], then effective hold down or restraining devices shall be provided to prevent the chain from "flicking" up or across into the walkway.

Guarding shall be provided in the vicinity of any chain sprockets.

Chains shall have a breaking strength of at least 6 times the maximum load for which they are to be used.

The clearance between the armoured face conveyor chain and the shearer and its trapping shoes shall be such that inadvertent contact will not occur. This shall include an allowance for normal wear (to prevent the shearer from being hauled by the face conveyor).

5.9.2.2 Ploughs

The working force exerted by the plough system on chains, relative to nominal operation, shall not exceed 60 % of the breaking force of the chains.

Overload protection of the plough drives should be applied to minimize the danger of serious damage or the breaking of haulage chain due to rapid load surges or obstacles blocking the passage of the plough body. A plough system shall be capable of recognizing a chain break in order to be stopped as quickly as possible.

Guarding shall be provided in the vicinity of any chain sprockets.

5.9.3 Gearboxes

The oil temperature of gear boxes may be continuously monitored and can be provided with an alarm to prevent the overheating of oil.

5.10 Hydraulic systems and water systems

5.10.1 Hydraulic systems

Hydraulic pumps and motors, control systems and the interconnecting pipe work and hoses shall be designed and constructed according to ISO 4413. Adequate shielding in accordance with Clause 9 of ISO 3457:2003 shall be provided to protect persons in working areas.

Hoses and pipes shall be separated from electric power wiring wherever practical, and shall be guarded against hot surfaces and sharp edges to minimize the hazard of trapping, drawing in and possible hose bursts. Hydraulic fluid tanks shall comply with 5.4.5.2 of ISO 4413:2010 and shall be protected against corrosion and mechanical damage.

The filling apertures of hydraulic fluid tanks shall be clearly marked, easily accessible and designed so that any overflow or leakage of hydraulic fluid is prevented.

It shall be possible to collect the hydraulic fluid during draining.

Filler caps and drain points shall be secured against self-release.

Safety valves shall not discharge any hydraulic fluid except water into the atmosphere.

The machine shall be capable to work with low-flammability hydraulic fluids conforming to 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 minimized. 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 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 54 in accordance with IEC 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 with standards requiring similar performance.

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

5.10.2 Water systems

Hoses and pipes shall be separated from electric power wiring wherever practical, and shall be guarded against hot surfaces and sharp edges to minimize the hazard of trapping, drawing in and possible hose bursts.

All rubber hoses and hose assemblies should comply with ISO 6805.

NOTE Rubber hoses and hose assemblies can be covered in national regulations.

Electrically operated valves shall be protected to at least class IP 54 in accordance with IEC 60529.

5.11 Fire protection

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

NOTE 1 Guidance on fire hazard identification, risk assessment, fire detection, and prevention and protection measures is given in ISO 19353.

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

NOTE 3 When requested, fire fighting equipment can be installed on the machine.

NOTE 4 In coal mine applications, the dust suppression system of the cutting drums contributes to the reduction of the cutting tool temperature.

In particular the following shall be considered:

— to 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;

— where non-metallic materials are used, ISO/IEC 80079-38:2016, 6.2 applies.

5.12 Load attachment points

Machines or parts of them with a mass greater than 25 kg shall be equipped with load attachment points if there are no openings through which chains, ropes or hooks can be passed.

Load attachment points shall be arranged taking into account the centre of gravity of each particular load. They shall be suitable for commercially available load-carrying equipment with a safety factor of not less than 4 in each loading direction. They shall be easily identified.

If fitting of load attachment points is impossible or inadequate, provision shall be made for suitable devices to ensure that transportation, assembly and dismantling can be carried out safely. The use of these devices shall be described in the operating instructions.

5.13 Maintenance and repair

Errors during assembly or re-assembly of certain parts that could lead to hazards shall either be eliminated by the design of these parts (e.g. different type of connections for hydraulic fluid and water hoses) or the parts themselves and/or the adjacent parts shall be indelibly marked in order to avoid confusion, e.g. by engraving, imprinting or welding on a part number, where possible.

Filling, draining, sampling of fluids and interchanging of hydraulic components shall be possible in a hazard-free manner and with the minimum loss of fluid.

If special tools are necessary for maintenance and repair, the manufacturer or his representative shall provide those tools as part of the delivery.

6 Verification of the safety requirements and/or protective measures

Safety requirements and/or protective measures of Clauses 5 and 7 shall be verified according to Table 3, which includes the following types of verification:

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

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

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

d) 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);

e) 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;

f) special verification: the procedure being given in Table 3 or in the referred clause.

Table 3 indicates the checks to be carried out.

Table 3 — Verification of the safety requirements and/or protective measures

Sub-clause	Calculation	Design check	Measurement	Functional test	Visual examination
5.2.1		X			X
5.2.2			X		
5.3	X				
5.4.1		X			
5.4.2		X		X	
5.4.3.1		X		X	
5.4.3.2		X		X	
5.4.3.3		X		X	
5.4.3.4		X		X	
5.4.3.5.1		X		X	
5.4.3.5.2		X		X	
5.4.3.5.3		X		X	
5.4.4		X		X	
5.4.5		X		X	
5.4.6		X		X	
5.4.7.1		X		X	X
5.4.7.2		X		X	X
5.4.8.1	X	X		X	X
5.4.8.2	X	X		X	
5.4.8.3		X			X
5.4.8.4		X		X	
5.4.8.5		X		X	
5.5	X	X		X	X
5.6.1		X			X

Table 3 *(continued)*

Sub-clause	Calculation	Design check	Measurement	Functional test	Visual examination
5.6.2		X			X
5.6.3		X			X
5.7.1		X	X		
5.7.2		X	X		
5.8.1		X		X	
5.8.2		X		X	
5.8.3.1		X		X	
5.8.3.2		X		X	
5.8.4	X	X	X	X	
5.8.5		X		X	
5.8.6		X		X	X
5.9.1		X		X	X
5.9.2.1	X	X		X	X
5.9.2.2	X	X		X	X
5.9.3		X	X		
5.10.1		X		X	X
5.10.2		X		X	X
5.11		X		X	
5.12	X	X			X
5.13		X		X	X

7 Information for use

7.1 General

On delivery of the machinery the manufacturer shall provide information on its safe operation and maintenance. This shall be drawn up according to 6.4 of 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 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.

Safety signs shall be provided in accordance with ISO 9244 or ISO 3864-3.

Symbols for operator controls and other displays shall be in accordance with ISO 6405-1.

Warning devices shall be unambiguous and easily perceived.

7.3 Accompanying documents

7.3.1 General

Operating instructions for the machines shall be supplied which, where relevant, contain the information given in 7.3.2 to 7.3.8.

The accompanying documents shall contain the following information:

— title and date of issue;

— indication of the machine type, model or, where appropriate, serial number to which it relates;

— name and full address of the manufacturer or authorized representative.

7.3.2 Information for transportation, handling and storage

— load attachment devices;

— special tools and ancillary devices;

— safety measures against sliding and tipping over.

7.3.3 Information for assembly and commissioning

— fluid specifications and capacities;

— position of the filler and drain points;

— sketches and diagrams which enable the assembly personnel to carry out their tasks safely and efficiently.

7.3.4 Information about the machine

— general description of the machine in the form of sufficiently large and clear drawings and/or photographs, in addition to electrical, hydraulic and pneumatic circuit diagrams;

— list of main components, including their function and location;

— the same information as given about the machine in accordance with 7.3.1, second dash;

— data on permissible gradients;

— symbols used

— information describing the location of safety signs, the hazard being addressed, and how to avoid the hazard.

7.3.5 Information for operational use

— the same information as given about the machines in accordance with 7.3.1, second dash;

— description of starting in normal operation;

— description of the start-up warning device;

— description of stopping in normal operation;

— a warning that a restart shall be done only when it has been determined that it is safe to do so;

— a warning that the operator shall supervise when the machine is operated by remote control, radio control or in automatic control mode;

— information on the required training for the operating personnel;

— a statement that the machine is to be immobilized immediately if defects have been established;

— information on residual risks identified by risk assessment;

— information on inappropriate use, such as:

1) transportation of materials by the machines;

2) transportation of personnel by the machines;

3) any kind of lifting work by the machines, etc.;

— declaration of noise emission values.

7.3.6 Information on maintenance and repairs

— information on residual risks, e.g.:

1) crushing or shearing between parts of the machine and surroundings;

2) drawing into moving drive wheels, trailing cables, chains, etc.;

3) spraying of fluids at high pressure, e.g. after releasing hydraulic elements;

4) inadvertent movement of the machine or parts of it, e.g. being carried along by the conveyor chain, lowering of a ranging arm after release of the hydraulic cylinder, sliding of the machine during maintenance work on the brakes;

5) whipping of chains;

6) injury caused by hot surfaces or hot fluids;

7) temporary removal of protective or warning devices or temporary shorting out of control devices;

— information on the wear limits of safety-related parts, e.g. brake linings;

— information of maintenance to be carried out regularly and maintenance intervals; instruction not to operate machines again until defects causing the imminent hazard have been eliminated;

— instruction to maintain regularly devices in the machine to prevent or eliminate hazards, and to regularly check their operability, e.g. brake units and emergency switches;

— instruction to use only original spare parts or parts having proven equivalence on safety;

— spare part list with specifications of all spare parts, including identification and their location on the machine.

The manufacturer shall provide information about unavoidable hazards by means of suitable maintenance or repair instructions or warning signs, e.g. if covers have to be removed for maintenance purposes.

7.3.7 Information for decommissioning, dismantling and disposal

— information on hazards which may occur during decommissioning and dismantling and any preventive or safety measures required;

— details on correct disposal of the machines or their parts, including fluids.