BRITISH STANDARD

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1552:2003

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

The European Standard EN 1552:2003 has the status of a British Standard

ICS 73.100.30

National foreword

This British Standard is the official English language version of EN 1552:2003.

The UK participation in its preparation was entrusted by Technical Committee MRE/1, Mining mechanical equipment and machinery, to Subcommittee MRE/1/2, European Standards for mining machines, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

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English version

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 robots

Bergbaumachinen unter Tage - Mobile Abbaumaschinen im Streb - Sicherheitsanforderungen für Walzenlader und Hobelanlagen

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CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

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

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

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Foreword

This document (EN 1552:2003) has been prepared by Technical Committee CEN/TC 196, "Machines for underground mines - Safety", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2003, and conflicting national standards shall be withdrawn at the latest by October 2003.

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 EC Directive(s), 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, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This European Standard is a type C standard as stated in EN 1070.

The machinery and the extend 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.

1 Scope

1.1 This European Standard specifies safety requirements which shall be met to minimize the hazards listed in clause 4 that may occur during the assembly, use, maintenance, repair, decommissioning, disassembly and disposal of shearer loaders and plough systems when operated in accordance with the manufacturer's requirements in underground mining.

The machines 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 may 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.

1.2 This European Standard does not cover any hazards resulting from the electrical equipment associated with the machine. It does not contain any requirements relating to dust suppression or firedamp hazards. . Hazards due to noise are also excluded from this standard, but a separate standard is in preparation where hazards due to noise will be addressed.

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. 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.

It does not cover face conveyors, spill plates and auxiliary devices such as lasers etc.

It is intended for manufacturers producing and marketing complete machines, and for manufacturers assembling machines or parts of machines from different origins or assembling machines for their own use. These are called "manufacturers" in this European Standard.

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

2 Normative references

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

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

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

EN 457:1992, *Safety of machinery – Auditory danger signals – General requirements, design and testing (ISO 7731:1986, modified)*

EN 563, *Safety of machinery – Temperatures of touchable surfaces – Ergonomics data to establish temperature limit values for hot surfaces*

EN 853, *Rubber hoses and hose assemblies – Wire braid reinforced hydraulic type – Specification*

EN 857, *Rubber hoses and hose assemblies – Wire braid reinforced compact type for hydraulic applications – Specification*

EN 894-1, *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, *Safety of machinery – General requirements for the design and construction of fixed and movable guards*

EN 954-1:1996, *Safety of machinery – Safety related parts of control systems – Part 1: General principles for design*

EN 982:1996, *Safety of machinery – Safety requirements for fluid power systems and components – Hydraulics*

EN 1050:1996*, Safety of machinery - Principles for risk assessment*

EN 1070, *Safety of machinery – Terminology*

EN 61310-1, *Safety of machinery – Indications, marking and actuation – Part 1: Requirements for visual, auditory and tactile signals (IEC 61310-1:1995)*

3 Terms and definitions

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

3.1
remote control console
plough systems are generally controlled from a fixed remote control console. It is situated either on the surface or underground and is usually out of the line of sight of the plough system.

3.2
load attachment point
means of attachment for devices to enable them to carry a load, e.g. a threaded hole for a transport ring.

3.3
transport units
parts or subassemblies which, for transportation reasons, are not fitted to the complete machine until the point of use.

3.4
starting
energizing the machine drive or first of the drives without necessarily causing the machine to move. 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.

4 List of significant hazards

This clause contains all the significant hazards, hazardous situations and events, as far as they are dealt with in this standard, identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk. The hazards mentioned relate to annex A of EN 1050:1996.

NOTE The working conditions in mines are different from those in other branches of industry.

The hazards are divided into two groups for the following types of machines.

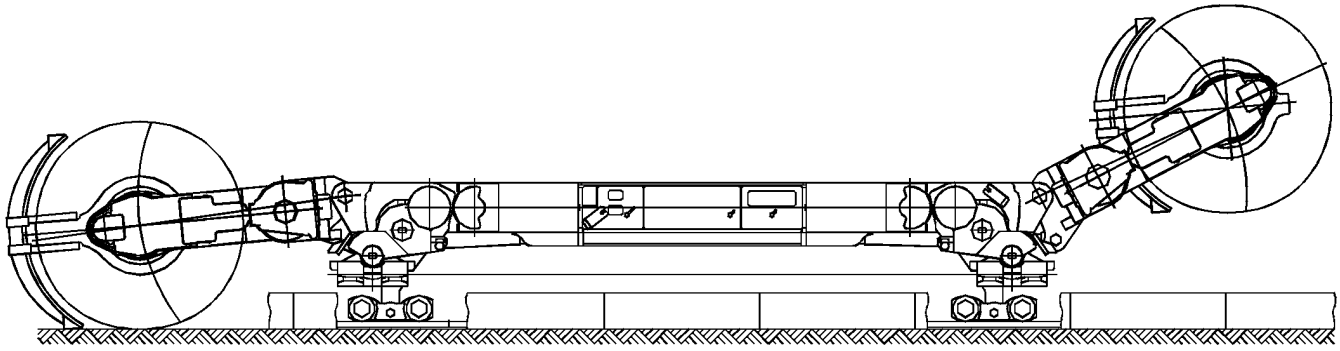


Figure 1 —Shearer loader (side view)

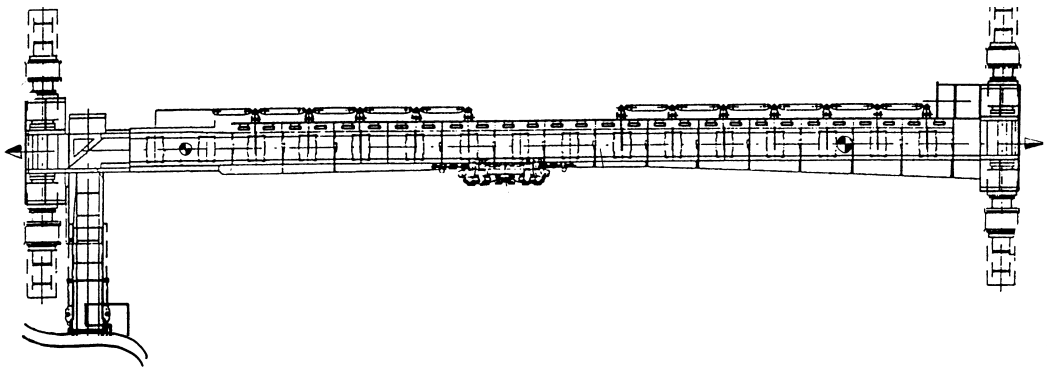


Figure 2 — Plough system (top view)

Table 1 — List of significant hazards with associated requirements

Hazard		Shearer loader	Plough	Sub-Clause
4.1 Mechanical hazards	- crushing or shearing between machine parts or between machine parts and their surroundings	**X**	**X**	5.5; 5.7; 5.11 7.2.5
	- drawing into moving cutting tools, drive wheels, trailing cables and chains	**X**	**X**	5.11 7.2.5
	- spalling of cut material or cutting tools	**X**	**X**	5.1 7.5.2
	- skidding or inadvertent movement of the machine	**X**		5.4; 5.6; 5.7
	- whipping or breaking chains	**X**	**X**	5.11
	- insufficient stability	**X**		5.2 7.2.2
4.2 Thermal hazards	- scalding by fluids	**X**		5.9; 5.11
	- burning due to hot surfaces	**X**	**X**	5.11
4.3 Fire protection		**X**	**X**	5.10
4.4 Hazards generated by materials and other substances released when machinery is used	- fluids harmful to health	**X**		5.8
4.5 Hazards generated by neglecting ergonomic principles in machine design	- controls that cannot be operated when operator is wearing protective gloves	**X**	**X**	5.3
	Unhealthy postures or exessive effort	**X**	**X**	5.12
4.6 Hazards generated by power supply faults and other failures	- spraying of fluids at high pressure	**X**	**X**	5.8; 5.9

	- hydraulic pressure drop	**X**	**X**	5.7
	- lowering of ranging arms	**X**		5.7
	- control system failure	**X**	**X**	5.7
	- falling objects	**X**	**X**	5.12
4.7 Hazards generated by temporary absence of protective measures	- absence of protective devices or short-out of control or similar devices during maintenance or repair	**X**	**X**	5.12
4.8 Errors of fitting	-	**X**	**X**	5.13
4.9 Spillage of fluids		**X**	**X**	5.13

5 Safety requirements/protective measures

5.1 General

Machinery shall comply with the safety requirements and/or protective measures of this clause.

In addition, the machines shall be designed according to the principles of EN 292 for hazards relevant but not significant which are not dealt with by this document (e.g. sharp edges)

NOTE As a result of the mode of operation and depending on the ambient conditions, there is a risk, when using the machines, of parts of the mineral to be won or of the surrounding rock being thrown into the travel way, of parts becoming 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 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 control.

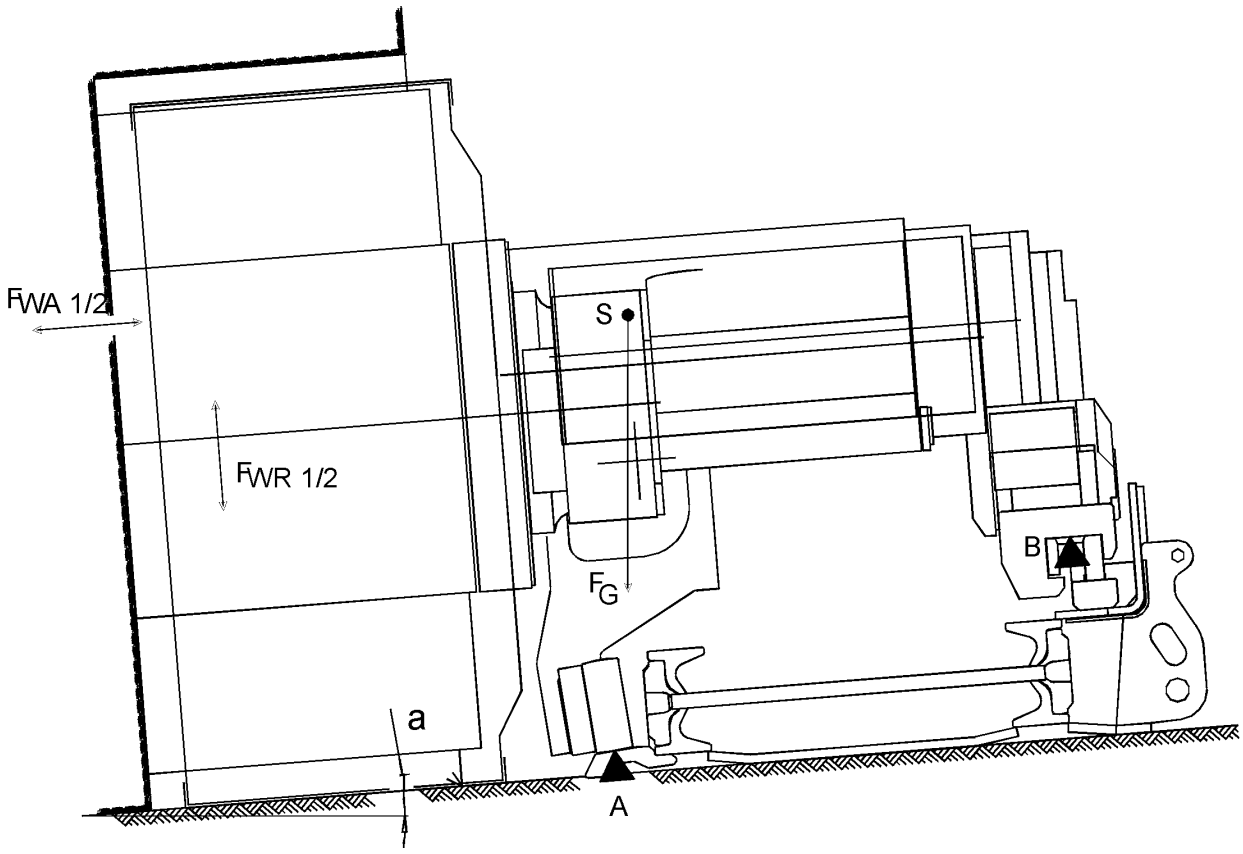
For the application of the European standards referred to in this standard (e. g. EN 457, EN 982), the manufacturer shall carry out an adequate risk assessment for the requirements thereof where choice is necessary

NOTE This specific risk assessment is part of the general risk assessment relating to the hazards not covered by this C standard.

5.2 Stability

The manufacturer shall specify limit values for the permissible tilting of the machines in all directions taking into account the maximum forces occurring in all operating conditions.

To evaluate the stability of shearer loaders, the reaction 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).



Key
A, B: Loading pads
S: Centre of gravity
F_G Machine weight
$\mathbf{F_{WR1,2}}$[1]: Forces on the cutting drums, radial
$\mathbf{F_{WA1,2}}$[2]: Forces on the cutting drums, axial
α: Angle of transverse dip

Figure 3 —Example of forces on the shearer loader

The manufacturer shall determine the magnitude and directions of the forces and distance to the loading points for each machine.

The line of action of the resultant of all the forces shall be within the loading pads A and B.

The permissible longitudinal gradient shall be determined in the same way as in the method described above. Special requirements for shearer loaders intended for inclined seams are described in 5.7.

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[1] 1and 2 as a function of the direction of rotation

[2] 1 and 2 as a function of the direction of rotation

5.3 Control devices

Control devices shall meet the requirements of EN 894-1. 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 shall be at least 10 mm in diameter and their distance shall be at least 9 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 EN 61310-1 shall be used for control devices and displays.

Control devices for ranging arms, cowl, sloughing covers or horizon controls shall be designed as hold-to-run devices as described in EN 1070 automatically to the basic position after actuation; this also applies to the control devices of a transmitter if the machines are operated by means of radio or similar controls.

Shearer loaders are often operated by two people simultaneously, either each with a manual control unit on the left and right hand ends of the machine or 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 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 Starting

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

5.5 Start-up warning devices

Machines shall be equipped with start-up warning devices.

Start-up warning devices shall indicate the starting of the machine by means of an unmistakable warning signal which is clearly perceptible at the driver’s position, and in an area 10 m in front of and behind the shearer loader and in the case of the plough systems along the whole face and at the remote control console. The drives shall not start up less than 5 s after the beginning of the warning signal, but only as long as the warning signal is switched on. Audible signals or water sprays shall be used as the start-up warning device on the shearer loader.

Audible start-up warning devices shall meet the requirements of EN 457. At a distance of 0,5 m from the source of sound, the sound pressure level of the warning tone shall be at least 90 dB (A) (see 5.2 in EN 457:1992). The warning tone shall have intermittent characteristic. (see 8.3 in EN 457:1992).

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.

5.6 Stopping

5.6.1 Stopping in normal operation

Each drivers position on the shearer loader, each radio transmitter and each remote control console shall be equipped with a control device for stopping the entire machine. The stop control command shall override the start-up command.

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

5.6.2 Stopping at the end of the working range

Plough systems shall be equipped with overrun monitors. The plough drives shall stop automatically or change direction if one of the working range end points is reached. If the switching contacts of an odometer are used for

limiting the working range, the odometer shall be fitted with an adjustment device. When reaching the end of the working range, the travel display of the plough shall be synchronized by this adjustment device, i.e. reset to zero.

5.6.3 Stopping in an emergency

Each driver's position on the shearer loader shall be equipped with a device capable of stopping the machines in an emergency. It shall be designed so that all machine drives can be disconnected immediately and locked against start-up by actuating a switch. The device can 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 can be disconnected immediately.

NOTE Operating the stop switches or push button does not reduce the stopping time of the shearer loader. However, this is generally so short that additional measures would not reduce the hazard. Therefore, this is not EMERGENCY-STOP equipment within the meaning of EN 418.

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

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

5.7 Measures to prevent inadvertent movements

Shearer loaders capable of being used where the longitudinal gradient of the roadway exceeds 15° 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 the machine. Wear and function of each brake shall be monitored individually or being capable to verify individually.

Radio controlled machines shall stop automatically if the information transmitted is corrupted or the link between the transmitter and receiver is broken for longer than 1,25 s. Radio control systems shall have a Hamming distance ≥ 4 and CRC (cycling redundant check) data security.

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.

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 5.3.5.5 EN 982:1996) .

Shearer drums or other cutting tools that rotate when the machines are in operation shall be capable of being disconnected mechanically and remain disconnected from the drive motor when stopped if this motor also drives other cutting tools and/or haulage, lifting, loading devices etc.

5.8 Hydraulic equipment

The hydraulic equipment of the machines shall meet the requirements of EN 982 and shall be designed and constructed to operate with hydraulic fluids for which the fluid manufacturer has provided proof that they are not hazardous to health (See Bibliography "Luxembourg report")

Safety related hydraulic circuits shall comply with category 1 of EN 954-1:1996.

Hydraulic fluid tanks shall comply with 5.3.4.4 in EN 982:1996 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.

(See also ISO 4413:1998 for information)

5.9 Pipes and hoses

Hose pipes with at least two layers of wire braid as specified in EN 853 or EN 857 shall be used.

Pressurized pipes and hoses on the machines shall be routed in such a way that mechanical and thermal damage is avoided and they are accessible for inspection and maintenance.

In the area of the driver's or operator's position, the pipes and hoses shall be routed or guarded in such a way that the driver or operator is protected if the pipe or hose bursts.

5.10 Fire protection

Hydraulic equipment shall be designed and constructed to operate with hydraulic fluids for which the fluid manufacturer has provided proof that they are flame-retardant (See Bibliography annex A "Luxembourg report").

This does not apply to hydraulic equipment that:

— is designed so that it is impossible for the hydraulic fluid to be discharged in a jet

— e.g. external hoses are appropriately sheathed or protected, or

— is fitted with an on-board fire extinguisher or

— has a fluid volume of less than 10 l.

(See also ISO 7745:1989 for information).

5.11 Other hazard points

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 EN 953.

NOTE The particular conditions relating to mining should be taken into account.

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

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

Machine parts that may inadvertently be touched during operation shall be protected by covers if their surface temperature can exceed 85 °C in accordance with EN 563.

5.12 Load attachment points

Machines or parts of them with a mass more 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.

Filling, draining and sampling of fluids shall be possible in a hazard-free manner and without the loss of any fluid.

6 Verification of the safety requirements

NOTE The safety requirements can be verified by means of:

Calculation: check whether the calculations have been carried out in accordance with the requirements of the standard.

Design check: check whether the requirements of the standard have been adhered to in the design documentation.

Measurement: check whether the measurable parameters given in the standard have been adhered to.

Function test: check whether the machine or a certain part functions correctly under its specified working conditions.

Visual examination: check whether the parts or properties of parts required by the standard exist.

Table 2 indicates the checks to be carried out:

Table 2 — Verification data for safety requirements

Subclause	Calculation	Design check	Measurement	Function test	Visual examination
5.2	**X**				
5.3		**X**	**X**	**X**	**X**
5.4		**X**		**X**	**X**
5.5		**X**	**X**	**X**	**X**
5.6		**X**		**X**	**X**
5.7	**X**	**X**		**X**	
5.8		**X**		**X**	**X**
5.9	**X**	**X**		**X**	**X**
5.10		**X**			**X**
5.11	**X**	**X**	**X**		**X**
5.12	**X**	**X**			**X**
5.13		**X**		**X**	**X**

7 User information

7.1 Warning notices

If the safety requirements specified in clause 5 cannot be totally met by design measures and, therefore, the hazards listed in clause 4 cannot be eliminated with the result that residual hazards remain, warning signs are required on the machines, e.g.

— Eye-protectors shall be worn! etc.

The warning signs shall be designed and affixed so that they remain legible throughout the whole life of the machines.

7.2 Accompanying documents

7.2.1 General

Operating instructions for the machines shall be supplied which, where relevant, contain the information given in 7.2.1 to 7.2.6 of this standard.

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;

7.2.2 Information on transportation, handling and storage

— load attachment devices;

— special tools and ancillary devices;

— safety measures against sliding and tipping over.

7.2.3 Information on 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.

7.2.4 Information on 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 on the machine in accordance with 7.2.1;

— data on permissible gradients;

— symbols used.

7.2.5 Information on use

— the same information as given on the machines in accordance with 7.2.2;

— description of starting in normal operation

— description of the start-up warning device;

— description of stopping in normal operation

— 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, such as:

a) crushing or shearing between parts of the machines and surroundings;

b) drawing into moving cutting tools, drive wheels, trailing cables and chains;

c) spalling of cut material during cutting work;

d) inadvertent movement of the machine, e.g. of shearer loaders by the face conveyor chain;

e) whipping of chains;

f) dust and noise levels hazardous to health;

g) hot surfaces

h) fire risk

— information on inappropriate use, such as:

a) lifting of shearer loaders with the aid of the ranging arms;

b) transportation of materials by the machines;

c) transportation of personnel by the machines;

d) any kind of lifting work by the machines etc.

7.2.6 Information on maintenance and repairs

— information on residual risks, such as:

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

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

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

d) 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;

e) whipping of chains;

f) injury caused by hot surfaces or hot fluids;

g) 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 user 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.

7.2.7 Information on decommissioning, dismantling and disposal

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

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

7.2.8 Information for emergencies

— instruction to actuate the off switch in the event of a hazardous situation occurring suddenly;

— instruction to operate the fire extinguishing system, if provided, in the event of a fire.

7.3 Marking

The following information is required in addition to the minimum data specified in 5.4 of EN 292-2:1991:

— installed power of the motors;

— mass of the machine and its various sub-assemblies if they have to be transported separately on a regular basis;

Annex ZA
(informative)

Relationship of this European Standard with EC Directives

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

Machinery Directive 98/37/EC, amended by Directive 98/79/EC.

Compliance with this document provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

WARNING Other requirements and other EC Directives may be applicable to the products falling within the scope of this document.

Bibliography

[1] EN 418:1992, Safety of machinery - Emergency stop equipment, functional aspects - Principles for design

[2] ISO 4413:1998, Hydraulic fluid power - General rules relating to systems

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[5] Safety and Health Commission for the Mining and Other Extractive Industries, *Requirements and tests applicable to fire-resistant hydraulic fluids used for power transmission and control (hydrostatic and hydrokinetic). 7th Edition, Document No. 4746/10/91 EN. Luxembourg April 1994*

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