
**Continuous surface miners (CSM) —
Safety requirements**

Mineurs continus de surface — Exigences de sécurité

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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.

This document was prepared by Technical Committee ISO/TC 82, *Mining*.

Introduction

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

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

- machine manufacturers (small, medium and large enterprises);
- health and safety bodies (regulators, accident prevention organisations, market surveillance etc.)

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

- machine users/employers (small, medium and large enterprises);
- machine users/employees (e.g. trade unions, organizations for people with special needs);
- service providers, e.g. for maintenance (small, medium and large enterprises);
- consumers (in case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

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 -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.

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Continuous surface miners (CSM) — Safety requirements

1 Scope

This document deals with safety requirements for continuous surface miners (CSM). It specifies common requirements for the design and construction of CSM to protect workers from accidents and health hazards that can occur during operation, loading, transport and maintenance.

This document deals with known significant hazards, hazardous situations or hazardous events relevant to CSM, when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer (see [Annex A](#)).

This document also specifies the appropriate technical measures to eliminate or reduce risks arising from the significant hazards as identified in [Annex A](#).

This document is not applicable to CSM 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 2860, *Earth-moving machinery — Minimum access dimensions*

ISO 2867, *Earth-moving machinery — Access systems*

ISO 3411, *Earth-moving machinery — Physical dimensions of operators and minimum operator space envelope*

ISO 3449, *Earth-moving machinery — Falling-object protective structures — Laboratory tests and performance requirements*

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

ISO 3471:2008, *Earth-moving machinery — Roll-over protective structures — Laboratory tests and performance requirements*

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

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

ISO 4414, *Pneumatic fluid power — General rules and safety requirements for systems and their components*

ISO 6682, *Earth-moving machinery — Zones of comfort and reach for controls*

ISO 6750, *Earth-moving machinery — Operator's manual — Content and format*

ISO 8643, *Earth-moving machinery — Hydraulic excavator and backhoe loader lowering control device — Requirements and tests*

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

ISO 10263-4, *Earth-moving machinery — Operator enclosure environment — Part 4: Heating, ventilating and air conditioning (HVAC) test method and performance*

ISO 10265, *Earth-moving machinery — Crawler machines — Performance requirements and test procedures for braking systems*

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

ISO 10533, *Earth-moving machinery — Lift-arm support devices*

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

ISO/TR 11688-1, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning*

ISO/TR 11688-2, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 2: Introduction to the physics of low-noise design*

ISO 11862, *Earth-moving machinery — Auxiliary starting aid electrical connector*

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

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

ISO 12509, *Earth-moving machinery — Lighting, signalling and marking lights, and reflex-reflector devices*

ISO 13766, *Earth-moving machinery — Electromagnetic compatibility*

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 16528-1, *Boilers and pressure vessels — Part 1: Performance requirements*

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

UNE/CR 1030-1, *Hand-arm vibration. Guidelines for vibration hazards reduction. Part 1: Engineering methods by design of machinery*

3 Terms and definitions

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

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

- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 continuous surface miner CSM

self-propelled mining machine that, in surface mining operations, removes minerals in layers by the use of a cutting drum

3.2 operating mass

mass of the base machine with all standard equipment, with an operator (75 kg), with full fuel tank and all fluid systems at levels specified by the manufacturer and, when applicable, with sprinkler water tank half full

Note 1 to entry: The operating mass can also include a cabin, a ROPS and other ancillary equipment.

3.3**cutting drum**

power driven rotating body that is equipped with cutting tools

3.4**ROPS for moveable cabins****roll over protective module****ROPM**

system of structural members, the primary purpose of which is to reduce the possibility that a seat-belted operator in a moveable cabin be crushed in the event of a machine roll-over, and the strength of which is self-contained and is not dependent upon attachment to the machine

4 Safety requirements and/or protective/risk reduction measures**4.1 General**

CSM 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 ISO 12100 for relevant but not significant hazards which are not dealt with by this document (e.g. sharp edges).

4.2 Lighting, signalling and marking lights and reflex-reflector devices

Lighting, signalling and marking lights and reflex-reflector devices, if available, shall comply with the applicable clauses of ISO 12509.

4.3 Operation and handling**4.3.1 Uncontrolled movements**

Movements of the machine, its equipment, or its attachments from the holding position (except for setting controls by the operator), e.g. due to drifting and/or creeping (e.g. caused by leakage of oil) shall only be possible in such a way that these movements do not create a hazard to exposed persons.

4.3.2 Retrieval, transportation, lifting and towing**4.3.2.1 General**

If applicable, devices shall be available so that they can be used for retrieval, tie-down, lifting and towing.

4.3.2.2 Lifting (slinging) points for lifting and loading

Lifting points (e.g. lugs, lifting-eyes or lifting-lugs) shall be fitted to ensure safe loading, retrieval and transportation.

NOTE ISO 15818 deals with lifting and tie-down attachment points.

The equipment shall facilitate reliable fitting of load handling devices and shall be arranged to allow safe lifting and recovery of the machine.

If necessary, the method of lifting heavy attachments, machine components and machines which are transported shall be described in the information for use.

Lifting points shall be easily identified on the machine (e.g. coloured marking or symbol 9.47 of ISO 6405-1:2017) and described in the information for use.

4.3.2.3 Tie-down points

Tie-down points shall be provided for the safe transportation of the machines.

NOTE ISO 15818 deals with lifting and tie-down attachment points.

Tie down points shall easily be identified on the machine (e.g. coloured marking or symbol 9.50 of ISO 6405-1:2017) and described in the information for use.

4.3.2.4 Retrieval points

Machine-mounted retrieval devices shall meet the performance requirements of ISO 10532.

4.3.3 Steering system

CSM shall be provided with a steering system that ensures safe steering with consideration of the rated speed of the machine and its stopping capability. The steering shall be such that the movement of the steering control corresponds to the intended direction of steering.

4.3.4 Braking system

CSM shall be equipped with a braking system according to ISO 10265.

4.3.5 Storage facilities

Easily accessible storage facilities for the information for use and for any special tools required by the operator shall be provided.

NOTE Storage is not required for special tools required for lifting and handling.

4.4 Operator stations

4.4.1 General

The operator's station shall meet the following minimum requirements:

- the operator's space envelope shall conform to ISO 3411;
- the edges shall be shaped in accordance with ISO 12508;
- the engine exhaust system shall release the exhaust gas away from the operator and from the air inlet into the cabin;
- the floor material shall be slip-resistant;
- the CSM shall be designed so that the operator has sufficient visibility from the operator's station, in relation to the travel and the work areas of the machine that are necessary for the intended use of the machine;
- if the above requirements cannot be met by direct view and where hazards due to restricted visibility exist, indirect visibility devices shall additionally be provided.

4.4.2 Operator's station with cabin

If a cabin is fitted, it shall meet the following minimum requirements:

- the operator shall be protected against foreseeable environmental and extreme climatic conditions. Provisions shall be made for installation of the following systems: adjustable heating and ventilation, and defrosting, if required;

- it shall be possible to keep doors and articulated windows and hoods opened or closed;
- an emergency exit shall be provided and marked if the cabin is provided with only one access door. Roof windows can also be used as an emergency exit. If the emergency exit shall be realized by a hammer pane breaker, this shall be provided and stored in the cabin, accessible to the operator;
- front windows shall be provided with motor-driven wipers, washers and a demister. This requirement shall apply for all directions of travel considered in the design of the machine;
- inner lighting shall be provided, capable to function with the engine stopped;
- if a heating and ventilation system is fitted, it shall comply with ISO 10263-4;
- windows, including roof windows, shall be made of safety glass or other material which provides similar performance (see e.g. ECE R43).

4.5 Roll-over protective structures (ROPS)

4.5.1 General

It shall be possible to equip CSM with a roll-over protective structure (ROPS). The ROPS shall comply with ISO 3471.

4.5.2 Roll-over protective structures (ROPS) for moveable cabins / ROPM

On machines with moveable cabins, ISO 3471:2008 applies with the following exceptions:

- the ROPS / ROPM for the operator's station shall be regarded as a separate independent protective structure (not connected to the machine frame);
- only the vertical load test of ISO 3471:2008, 6.3, shall be applied in all planes;
- in the case of symmetrical design of the structure in one or more direction(s): front/rear, left/right, top/bottom, only one test is required in this/these particular direction(s);
- ISO 3471:2008, 8 h), does not apply.

4.6 Falling-object protective structures (FOPS)

CSM shall be so designed that a falling-object protective structure (FOPS) can be fitted, when the machines are intended for applications where there is a risk of falling objects.

If a FOPS is fitted, it shall comply with ISO 3449, Level II.

4.7 Operator's seat

The seat shall be adjustable to support the operator in a position that allows the operator to control the machine under all intended operating conditions.

Dimensions and adjustment of the seat shall comply with ISO 11112.

If a suspension system is fitted, it shall be adjustable to the operator's weight of at least from 55 kg to 110 kg.

4.8 Controls and indicators

4.8.1 General

The main controls and indicators (hand levers, pedals, switches, etc.) shall be designed and arranged so that:

- a) they are of easy access in accordance with ISO 2860, ISO 6682 and ISO 3411;
- b) their function is clearly identified (see ISO 6405-1) in the operator's station and explained in the information for use (see [Clause 6](#));
- c) the movement to activate the controls and indicators shall correspond to the intended effect or common practice unless otherwise required by application;
- d) when a control is designed and constructed to carry out several functions, e.g. keyboard, joystick control, the activated function shall be clearly identified.

4.8.2 Controls

4.8.2.1 Controls located on or close to hot surfaces

Controls shall not become warmer than 45 °C during operation at an ambient temperature of 25 °C and shall be situated sufficiently far away from warm areas to ensure that burns are prevented.

4.8.2.2 Inadvertent activation

Controls which can cause a hazard due to inadvertent activation shall be so arranged, deactivated or guarded that they cannot be activated inadvertently, e.g. when the operator gets into/out of the operator's station.

4.8.2.3 Pedals

Pedals shall have an appropriate size, shape and be adequately spaced. The pedals shall have slip-resistant surface and be easy to clean.

4.9 Starting

When starting the engine, no hazardous functions shall start automatically.

CSM shall be so designed that unauthorised access to engine start and operation is prevented.

Unauthorised engine start shall be prevented, e.g. by a lockable cabin, a lockable cover for the starter switch, a starter key-lock (see ISO 10264) or a lockable battery isolation switch.

4.10 Stopping

4.10.1 Emergency stop

An emergency stop shall be fitted within the zone of comfort as specified in ISO 6682. It shall stop all hazardous functions of the CSM. The emergency stop shall comply with ISO 13850.

4.10.2 Cutting drum

It shall be possible to stop the cutting drum separately.

4.11 Access systems to the operator's station and to maintenance points

Access systems shall comply with ISO 2860, ISO 12508 and ISO 2867.

Walkways to the operator's stations and platforms shall be provided with guard-rails if the vertical drop exceeds 1 m.

4.12 Protection

4.12.1 General

Hazardous areas which can be reached from the operator's stations and their access and from other machine-dependent work places shall be provided with protection devices according to ISO 14120.

4.12.2 Guards

4.12.2.1 General

Guards shall be designed to be securely held in place and to prevent access to hazardous areas and parts.

For safety distances between moving parts and protection devices, see ISO 3457 and ISO 13854.

4.12.2.2 Moveable guards

Guards in areas where frequent access for maintenance and inspection work is necessary, shall be moveable and, as far as possible, remain attached to the machine when opened.

Articulated guards shall be fitted with a support system to protect them from inadvertent closure.

4.12.2.3 Fixed guards

Guards in areas where access for maintenance and inspection work is rarely necessary may be fixed to the machine. Opening of such guards shall only be possible with tools or keys.

4.12.3 Cutting drum

The cutting drum shall be safeguarded according to the risk assessment. The information for use shall include instructions on the safe use of the cutting drum.

4.12.4 Lifting of components

When machine components (e.g. cutting drums or the machine body) must be raised for maintenance, a hydraulic or mechanical locking device to prevent unintended lowering shall be provided.

For example, flaps or engine hoods, and gas springs fulfil this requirement.

Mechanical locking devices shall comply with ISO 10533. The information for use shall include instructions on the use of the mechanical locking device.

Hydraulic locking devices shall comply with ISO 8643.

4.13 Pressurized systems

4.13.1 General

Pressurised systems shall be designed and manufactured to be able to resist their intended pressure loads. Hydraulic systems shall conform to ISO 4413. Pneumatic systems shall conform to ISO 4414.

4.13.2 Hydraulic lines

Pipes, fittings and hoses shall be installed, assembled and, if required, fixed so that damages, e.g. by contact with hot surfaces, sharp edges and other damaging areas, shall be minimised. Visual inspections of hoses and fittings shall be possible except for those located inside frames.

4.13.3 Hydraulic hoses

Pressure lines containing fluid with a pressure of more than 5 MPa (50 bar) and/or having a temperature over 50 °C passing near the operator's station (at a distance of 1,0 m or less from the operator) shall be installed or covered to comply with ISO 3457.

Any part or component that can divert a possible stream of fluid can be considered as a sufficient protection device.

4.13.4 Fuel tanks

Fuel tanks shall withstand an internal pressure of 30 kPa (0,3 bar) without permanent deformation or leakage.

It shall be possible to drain the fuel tanks. Inadvertent or unauthorized draining shall be protected.

4.13.5 Hydraulic tanks

Hydraulic tanks are not considered as pressure vessels.

It shall be possible to completely drain the hydraulic tanks. Inadvertent or unauthorized draining shall be protected.

4.13.6 Air tanks

Simple pressure vessels shall be designed and tested in accordance with ISO 16528-1.

4.14 Fire protection

The floor of the operator's station as well as the interior upholstery and insulation of the cabin and other machine parts where insulation material is used shall be made of fire-resistant materials. The maximum burning rate shall be 200 mm/min when tested in accordance with ISO 3795.

It shall be possible to equip CSM with fire extinguishers or extinguishing systems allowing the operators to have enough time to safely leave the machine in case of fire.

4.15 Hot components

Parts that are hot during operation shall be designed, constructed and arranged, or provided with a heat shield, so that the risk of contact with hot parts and surfaces in the vicinity of the main access, the operator's station and during maintenance is minimized (see ISO 13732-1).

4.16 Signal devices and warning signs

4.16.1 General

If residual hazards remain on a machine or its attachments, respective warning/safety signs and signals shall be affixed to the machine.

4.16.2 Warning and instruction signs

Warning and instruction signs shall comply with ISO 9244.

Signs with additional text shall be written in the same language as the instruction handbook.

4.16.3 Signal devices

Warning signals shall comply with ISO 12509 for visual devices, and with ISO 9533 for audible devices.

4.17 Electrical and electronic systems

4.17.1 General

Electrical components and conductors shall be installed so that damage from exposure to environmental conditions that can cause deterioration is avoided. Insulation of electrical components shall have flame-retardant properties. Electrical conductors shall be protected from abrasion.

Electrical wires/cables not protected by over-current devices shall not be strapped in direct contact of pipes and hoses containing fuel or flammable gas.

Electric wires and cables used to connect components in electric circuits shall be marked and identified.

4.17.2 Degree of protection

Depending on the location/installation of electrical and electronic components, a minimum degree of protection according to IEC 60529 is required. All components shall have a minimum degree of protection for the intended environmental and operational conditions.

4.17.3 Over-current protective devices

All electric equipment, except engine starter, shall be protected with an over-current device (e.g. fuse).

4.17.4 Batteries

The batteries shall be firmly attached in a ventilated space. The location shall have an easy access. The batteries shall be removable. The batteries shall be provided with handles and/or grips.

Batteries and/or battery locations shall be designed and built, or covered, to minimise the risk to the operator caused by battery acid or acid vapours, even in the event of overturning of the machine.

The positive connector shall be covered with insulation material.

The correct fitting of the battery cables to the battery connectors shall be marked (e.g. by + and - signs).

4.17.5 Battery disconnection

It shall be possible to disconnect the battery easily, e.g. by an accessible isolator switch.

4.17.6 Auxiliary starting aids

If connectors for auxiliary starting aids are provided, they shall comply with ISO 11862.

The connectors shall be located so that short circuits and sparks are avoided.

4.18 Conveyors

Conveyors shall be designed or provided with safeguards to protect persons from crushing and shearing hazards and from hazards caused by dust or unintentionally ejected material.

4.19 Electromagnetic compatibility (EMC)

CSM shall comply with the requirements of electromagnetic compatibility as specified in ISO 13766.

4.20 Noise

The principles of noise reduction according to ISO/TR 11688-1 and ISO/TR 11688-2 shall be taken into account. It is recommended to equip the machines with protective measures/devices to reduce the noise emitted.

NOTE ISO/TR 11688-2 gives useful information on noise generation mechanisms in machinery.

Depending on the material, the cutting procedure is the dominant noise source. Because no technical measures can be implied, organisational measures shall be recommended if required.

4.21 Vibration

The principle of vibration reduction, where relevant, shall be taken into account when designing CSM.

The information and technical measures to control vibration on the hand-arm system given in UNE/CR 1030-1 shall be taken into account.

4.22 Dust

CSM shall be designed in such a way that means to minimise the risk of dust (e.g. cabin or water sprinkling system) can be installed.

4.23 Cutting tool replacement

It shall be possible to replace the cutting tool of CSM with a minimal elevation of the cutting drum to prevent persons from standing under the drum, or CSM shall have a locking device controlling the cutting drum height according to [4.12.4](#).

CSM shall allow for rotation of the cutting drum at a limited speed and for a limited duration, with direct control of the rotation by the operator replacing the cutting tool.

The information for use shall contain the proper procedure and the safety requirements for the cutting tool replacement.

5 Verification of safety requirements and/or protective/risk reduction measures

All safety requirements and measures of [Clause 4](#) should have self-evident means for verification. If this means is not self-evident, either one or a combination of the following shall be used to verify that the requirements of [Clause 4](#) have been met:

- measurement;
- visual examination;
- as appropriate, testing by means of a method prescribed in this standard and referred to in any particular requirement.

The results of the verification, with the appropriate descriptions, calculations and test results, shall be compiled in a technical documentation.

6 Information for use

6.1 Instructions

The instructions shall be supplied with the machine. The format and content shall comply with ISO 6750 and ISO 12100:2010, 6.4.

The intended use of the machine, including its attachments, tools and accessories, under the conditions foreseen by the manufacturer shall be described. The correct assembly and use of attachments and accessories shall be stated in the instructions. Separate instructions, e.g. for interchangeable equipment, are acceptable.

Terms, definitions, units and symbols shall comply with the relevant international standards (see e.g. ISO 9244).

The instructions shall especially contain the following information:

- whether personal protection equipment is necessary;
- safety-relevant technical data, especially;
- advice on stability of the machine including attachments;
- information on the machine's specific ground pressure;
- description of the danger zones;
- the need for skilled personnel who has been trained on the use of the machine.

6.2 Marking

The minimum markings shall be legible and durable and shall include:

- the business name and full address of the manufacturer;
- the mandatory marking;
- the designation of series or type, if any;
- the serial or identification number, if any;
- the operating mass.

All data given shall indicate the configuration of the machine, as it is delivered by the manufacturer.