



BSI Standards Publication

Safety of machinery — Safety requirements for machinery and equipment for continuous casting of steel

National foreword

This British Standard is the UK implementation of EN 14753:2022. It supersedes BS EN 14753:2007, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MCE/23, Safety of metal producing mills.

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

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© The British Standards Institution 2022
Published by BSI Standards Limited 2022

ISBN 978 0 539 04637 3

ICS 77.180

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 August 2022.

Amendments/corrigenda issued since publication

Date	Text affected
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English Version

Safety of machinery - Safety requirements for machinery and equipment for continuous casting of steel

Sécurité des machines - Prescriptions de sécurité pour
les machines et équipements de coulée continue de
l'acier

Sicherheit von Maschinen - Sicherheitsanforderungen
für Maschinen und Einrichtungen zum Stranggießen
von Stahl

This European Standard was approved by CEN on 12 December 2021.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 14753:2022) has been prepared by Technical Committee CEN/TC 322 “Equipment for making and shaping of metals - Safety requirements”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2022, and conflicting national standards shall be withdrawn at the latest by September 2022.

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

This document supersedes EN 14753:2007.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

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Introduction

This document is a type-C standard as stated in EN ISO 12100:2010.

This document is not applicable to continuous casting machines (according to the Scope) manufactured before the date of its publication.

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

Where for clarity an example of a preventative measure is given, this should not be considered as the only possible solution. Any other solution leading to the same risk reduction is permissible if an equivalent level of safety is achieved.

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.

It is assumed that continuous casting machines are operated and maintained by suitably trained personnel.

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

- machine and/or plant manufacturers (small, medium and large enterprises);
- health and safety bodies (regulators, accident prevention organizations, 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 and/or plant users/employers (small, medium and large enterprises);
- service providers, e.g. for maintenance (small, medium and large enterprises).

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

1 Scope

This document applies for plant (containing machinery and equipment) used in the process of continuous casting of liquid steel (hereafter referred to as continuous casting machine, CCM) as defined in 3.1.

This document deals with all significant hazards, hazardous situations and events relevant to machinery and equipment for the continuous casting of steel, when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer (see Clause 4).

This document specifies the safety requirements to be met during design, assembly, transport, commissioning, operation, maintenance (as described in Clause 5) and decommissioning of the equipment.

This document assumes that the machinery and equipment of the plant is operated and maintained by adequately trained and competent personnel (see 7.5). Manual intervention for setting, adjustment and maintenance is accepted as part of the intended use of the plant.

This document assumes that the machinery is used with adequate workstation lighting conforming to EN 12464-1.

National regulations regarding lighting should be considered and could differ from requirements of EN 12464-1.

This document applies to:

- CCM for the transformation of molten liquid steel into solid products in sections (e.g. square, rectangular, beam blank, circular);
- CCM's from the point where overhead cranes or other transport systems deposit ladles to CCM (e.g. in a ladle turret, ladle car or ladle stand);
- via casting process and solidification process;
- via cutting and marking equipment;
- thru the run-out-area where the cut product is finished, collected and removed from that area.

This document does not cover safety requirements for:

- horizontal-CCM for steel;
- auxiliary plants (auxiliary plants that are outside of the limits of the CCM);
- ladles and ladle transport;
- cranes;
- winches and hoists;
- conveyors or handling systems;
- workshop equipment (mould and segment shop, tundish workshop);
- gas burners, e.g. as a part of pre-heating stations.

This document can be used in case of modernization for the parts to be modernized.

This document is not applicable to CCM's 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.

- EN 298, *Automatic burner control systems for burners and appliances burning gaseous or liquid fuels*
- EN 614-1, *Safety of machinery - Ergonomic design principles - Part 1: Terminology and general principles*
- EN 614-2, *Safety of machinery - Ergonomic design principles - Part 2: Interactions between the design of machinery and work tasks*
- EN 842, *Safety of machinery - Visual danger signals - General requirements, design and testing*
- 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 894-2, *Safety of machinery - Ergonomics requirements for the design of displays and control actuators — Part 2: Displays*
- EN 894-3, *Safety of machinery - Ergonomics requirements for the design of displays and control actuators — Part 3: Control actuators*
- EN 981, *Safety of machinery - System of auditory and visual danger and information signals*
- EN 1299, *Mechanical vibration and shock - Vibration isolation of machines - Information for the application of source isolation*
- EN 1837, *Safety of machinery - Integral lighting of machines*
- EN 12198-3, *Safety of machinery - Assessment and reduction of risks arising from radiation emitted by machinery - Part 3: Reduction of radiation by attenuation or screening*
- EN 12464-1, *Light and lighting - Lighting of work places - Part 1: Indoor work places*
- EN 12254, *Screens for laser working places - Safety requirements and testing*
- EN 13480-1, *Metallic industrial piping - Part 1: General*
- EN 13480-2, *Metallic industrial piping - Part 2: Materials*
- EN 13480-3, *Metallic industrial piping - Part 3: Design and calculation*
- EN 13480-4, *Metallic industrial piping - Part 4: Fabrication and installation*
- EN 13480-5, *Metallic industrial piping - Part 5: Inspection and testing*
- EN 13861, *Safety of machinery - Guidance for the application of ergonomics standards in the design of machinery*
- EN 60204-1:2018, *Safety of machinery - Electrical equipment of machines - Part 1: General requirements (IEC 60204-1:2016, modified)*

EN 60447, *Basic and safety principles for man-machine interface, marking and identification - Actuating principles (IEC 60447)*

EN 60825-1, *Safety of laser products - Part 1: Equipment classification and requirements (IEC 60825-1)*

EN 60825-4, *Safety of laser products - Part 4: Laser guards (IEC 60825-4)*

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

EN 61310-2, *Safety of machinery - Indication, marking and actuation - Part 2: Requirements for marking (IEC 61310-2)*

EN 61496-1, *Safety of machinery - Electro-sensitive protective equipment - Part 1: General requirements and tests (IEC 61496-1)*

EN 62061, *Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems (IEC 62061)*

EN 62598, *Nuclear instrumentation - Constructional requirements and classification of radiometric gauges (IEC 62598)*

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

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

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

EN ISO 7010, *Graphical symbols - Safety colours and safety signs - Registered safety signs (ISO 7010)*

EN ISO 7731, *Ergonomics - Danger signals for public and work areas - Auditory danger signals (ISO 7731)*

EN ISO 11064-1, *Ergonomic design of control centres - Part 1: Principles for the design of control centres (ISO 11064-1)*

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

EN ISO 11553-1, *Safety of machinery - Laser processing machines - Part 1: Laser safety requirements (ISO 11553-1)*

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

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

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

EN ISO 13849-1:2015, *Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2015)*

EN ISO 13850:2015, *Safety of machinery - Emergency stop function - Principles for design (ISO 13850:2015)*

EN ISO 13854, *Safety of machinery - Minimum gaps to avoid crushing of parts of the human body (ISO 13854)*

EN ISO 13855, *Safety of machinery - Positioning of safeguards with respect to the approach speeds of parts of the human body (ISO 13855)*

EN ISO 13857, *Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857)*

EN ISO 14118:2018, *Safety of machinery - Prevention of unexpected start-up (ISO 14118:2017)*

EN ISO 14119, *Safety of machinery - Interlocking devices associated with guards - Principles for design and selection (ISO 14119)*

EN ISO 14120, *Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards (ISO 14120)*

EN ISO 14122 (all parts), *Safety of machinery - Permanent means of access to machinery (ISO 14122)*

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

ISO 7745, *Hydraulic fluid power — Fire-resistant (FR) fluids — Requirements and guidelines for use*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010 and the following apply.

3.1 continuous casting machine

CCM

equipment for pouring liquid steel by one or more strands

Note 1 to entry: The CCM can be vertical, bow-shaped or mixed type.

3.2 casting platform

area where liquid steel is poured

3.3 cooling chamber strand guiding area

closed area located underneath the casting platform from where steam, generated through the casting process, is exhausted

Note 1 to entry: Within this area, thermal hazards due to liquid steel (e.g. due to breakout of strand) or high temperature (caused by liquid/solidified steel) and/or steam (caused by water cooling) exist.

3.4**crop and/or sample collecting system**

device to collect crops or samples

3.5**cutting equipment**

equipment to cut the product to desired length

3.6**run-out-area****cooling bed and product collecting system**

area following the cutting system with devices to transport, cool down, finish, mark and/or collect the products

3.7**dummy bar system**

device to start casting

3.8**electromagnetic braking device****EMBR**

device to brake liquid steel movement in the mould

3.9**electromagnetic mould stirring device****EMS**

device to stir the liquid steel

3.10**electromagnetic strand stirring device**

device to stir the liquid steel in the solidification area

3.11**ladle**

vessel to collect, transport and discharge molten steel

3.12**emergency launder, emergency ladle**

system to convey and collect liquid steel in case of uncontrolled steel flow from ladle

3.13**tundish emergency system**

system to stop or convey and collect liquid steel in case of uncontrolled steel flow from tundish

3.14**ladle supporting system**

installed on the casting platform to move and/or support the ladles received from the charging area into casting position

3.15**ladle/tundish shrouding system**

movable protection for liquid steel stream between ladle to tundish

3.16

slide gate

stopper rod

system installed on the ladle/tundish to control the liquid steel flow

3.17

deburring system

equipment to remove and collect burrs from the product

3.18

skull

solidified, random shaped piece of steel/slag

3.19

emergency cutting by manual torch

manual cutting by hand with a torch lance during casting process in a defined emergency cutting area

3.20

marking system

equipment to mark the product

3.21

mould

device that solidifies the strand shell

3.22

mould level control system

system to control the steel level in the mould

3.23

oscillating device

device for oscillating movement of the mould

3.24

transfer system

device to transfer the strand product, e.g., roller table

3.25

scale collecting system

device to collect scale

3.26

slag detecting system

system to detect the slag flow from the ladle into the tundish

3.27

strand guide system

device to support the steel product of each strand

3.28

submerged entry nozzle

SEN

device to pour the steel from the tundish into the mould

3.29**tundish**

trough to collect the liquid steel poured from the ladle and/or distribute it to the strand(s)

3.30**tundish launder and slag box system**

system installed on the casting platform to collect and/or divert liquid steel poured out of the ladle/tundish in case of failure of the level control system

3.31**tundish supporting system**

system, installed on the casting platform, that contains the tundish and carries it between parking/preheating and casting position

3.32**withdrawal and straightening system**

device to withdraw and straighten the strands and transfer them to the cutting machine area

3.33**safety layout**

graphical description of plant-related equipment with regard to safety

3.34**safeguard(ing)**

guard or protective device

[SOURCE: EN ISO 12100:2010, 3.26]

3.35**route way**

provisional, marked and freely accessible paths in the area of the CCM on which also unauthorized persons (see 3.40) can be present

EXAMPLE Sidewalks or visitor walkways.

3.36**emergency position**

position where the ladle and/or tundish is moved in case of an emergency

3.37**protected area**

area where persons find protection

3.38**trained person(nel)**

skilled person with system knowledge, background knowledge, experience and/or ability to perform a specific task and are aware of the hazards related to their duties

3.39**authorized person(nel)**

trained person who is instructed by the user to perform a specific task on a specific equipment

3.40

unauthorized person

person not permitted to enter certain areas or to perform certain actions in the area of the CCM in relation with the operation and/or maintenance equipment, because not having the required specific knowledge and skill, and/or not being properly equipped, in order to avoid the related hazards

3.41

maintenance

combination of service, inspection, reconditioning and functional test of the equipment

Note 1 to entry: The purpose is to preserve the working condition or returning to this condition so that the CCM is able to perform the required function (including safety requirements).

3.41.1

service

measure to maintain the nominal condition

Note 1 to entry: The nominal condition can be maintained in general without dismantling/disassembling major parts of the equipment, e.g. cleaning, lubrication of the work equipment as well as addition or replacement of agents or by replacing tools or operational changing parts.

3.41.2

inspection

measure to observe and assess the current condition as well as fault finding

Note 1 to entry: Measures, e.g. measuring, testing, diagnostics including the determination of the causes of wear or damage and the derivation of the necessary consequences for the continued use.

3.41.3

reconditioning

measure to return to the nominal condition

Note 1 to entry: Foreseeable measures to replace worn parts or parts having expired the foreseen lifetime (could require dismantling/disassembling). These parts should meet manufacturers' specification.

3.41.4

functional test

checking the functionality of the exchanged or repaired parts

Note 1 to entry: It is maybe required to carry out adjustment work, e.g. test runs, verifying safety functions.

3.42

repair

non-regular work, not foreseeable, required to re-establish the nominal condition

Note 1 to entry: Measure to replace damaged parts, requires in general dismantling/disassembling.

3.43

pulpit

room in which the control desk and monitoring facilities for a CCM are located

3.44

control stand

free standing control desk (usually situated adjacent to the machine or equipment), used as a temporary workstation

3.45**portable control device**

control unit connected to the control system, e.g., to position equipment more precisely

3.46**enabling control device**

additional manually actuated device used in conjunction with a start control which, when continuously actuated, permits machine function

[SOURCE: EN ISO 12100:2010, 3.28.2]

3.47**hold-to-run control device**

control device which initiates and maintains machine functions only as long as the control device is actuated

[SOURCE: EN ISO 12100:2010, 3.28.3]

3.48**control mode**

single machines or groups of linked machines of a CCM can function under different control modes

Note 1 to entry: This document distinguishes between control mode(s) and operating mode(s) because there is neither a common understanding nor a definition in EN ISO 12100 and EN 60204-1. The operating modes (see 3.49) corresponds to the “control mode” of EN ISO 12100:2010, 6.2.11.9.

3.48.1**manual control mode****3.48.1.1****hold-to-run control**

every function is initiated by an operator by means of a button or equivalent device according to EN ISO 12100:2010, 3.28.3

Note 1 to entry: Release of the button/device stops the function (e.g. movement) immediately.

3.48.1.2**single function**

functions are started and/or stopped by an operator

3.48.2**semi-automatic control**

sequence of functions released once by an operator

Note 1 to entry: The released sequence is automatically stopped at its end. For the initiation of another sequence, a new command by the operator is required.

3.48.3**automatic control**

cycles of successive or parallel sequences, once initiated by the operator

Note 1 to entry: If no interruption takes place by an operator, the sequences are repeated as long as the running conditions are met.

3.49

operating mode

state of the control system allowing to operate the CCM under defined conditions

Note 1 to entry: Such conditions (modes) are, e.g. production, safe stop, enabling, inching, adjustment, inspection.

Note 2 to entry: The safety level of the operating mode(s) is defined as result of the risk assessment.

3.49.1

special mode

3.49.1.1

enabling (mode)

operating machine functions with an additional enabling control device

Note 1 to entry: See EN ISO 12100:2010, 6.2.11.9 and EN 60204-1.

3.49.1.2

inching (jog) mode

operating machine functions using a hold-to-run control device

3.49.2

safe stop (mode)

movement of the involved equipment is prevented through the control system

Note 1 to entry: The safety level of the safe stop is defined as result of the risk assessment.

Note 2 to entry: Safe stop is not sufficient as a safety measure to perform reconditioning or repair work because isolation of the equipment from the relevant energy sources is not realized.

Note 3 to entry: Residual risks, e.g. by stored energy must have been secured by other means.

Note 4 to entry: Safe stop mode may also include switching off additional devices, e.g. X-ray.

3.49.3

normal production mode

machine is ready to produce or producing as intended

Note 1 to entry: Production, material handling and activities supporting these processes are covered.

Note 2 to entry: Maintenance according to 3.20 is not covered.

3.50**reduced speed**

speed, reduced to minimize the hazardous potential without safety monitoring of speed

Note 1 to entry: In case of failure, an increase in speed may occur.

Note 2 to entry: Applies to linear or rotational speed.

Note 3 to entry: Speed reduced without an enabling device means, that the movement is so slow that the operator can move away from this dangerous movement in time. Based on a risk assessment, an enabling device may therefore be required in some cases, even at a reduced speed (e.g. in narrow spaces).

Note 4 to entry: Examples of reduced speeds include speeds of less than 10 mm/s for presses, less than 250 mm/s for robots, less than 250 mm/s for all non-shearing movements and less than 33 mm/s for shearing or crushing movements.

3.51**safely-limited speed****SLS**

exceeding of a predefined speed limit is safety-related prevented according to EN 61800-5-2:2017, 4.2.4.5

Note 1 to entry: Linear or rotational speed.

3.52**unexpected [unintended] start-up**

any start-up caused by:

- a start command which is the result of failure in, or an external influence on the control system;
- a start command generated by inopportune action on a start control or other parts of the machine, as e.g. a sensor or a power control element;
- restoration of the power supply after an interruption;
- external/internal influences (gravity, wind, self-ignition in internal combustion engines, etc.) on parts of the machine

Note 1 to entry: Automatic machine start-up during operation is not unintended but can be considered to be unexpected from the point of view of the operator. Prevention of accidents in this case involves the use of safeguarding.

Note 2 to entry: Definition according to EN ISO 14118:2018, 3.2.

3.53**remote access**

access from remote location via interface to control systems of the CCM, e.g. for software update

3.54**casting sequence**

continuous casting of multiple heats (ladles) consecutively out of one or more tundish

3.55**ionizing radiation**

x-ray radiation or radiation emanating from radioactive sources

3.56

laser radiation

coherent optical radiation

Note 1 to entry: See EN 60825.

3.57

EMF

electromagnetic fields

Note 1 to entry: EMF are static electrical, static magnetic as well as time-varying electrical, magnetic and electromagnetic fields with frequencies up to 300 GHz.

3.58

casting box

protection casing for liquid steel between ladle and tundish

3.59

trouble shooting

form of problem detection and solving often applied to repair failed products or processes on machines or systems

4 Molten steel being transformed into solid products Significant hazards and risk assessment

4.1 General

The hazards, hazardous situations and events identified by risk assessment as significant for CCM's and which require action to eliminate or reduce the risk are listed in Annex F and in Clause 5.

In general, risks and associated hazards are production and plant related. Due to the design variety of CCM's, an individual risk assessment shall be carried out in any case, considering the special features of the CCM in question and considering the safety requirements specified in this document. The relevant required Performance Levels (PL_r) or Safety Integrity Levels (SIL_r) for control devices covering safety functions shall be selected according to this individual risk assessment.

Machinery shall comply with the safety requirements and/or protective/risk reduction measures of Clause 5. In addition, the machine shall be designed according to the principles of EN ISO 12100:2010 for relevant but not significant hazards which are not dealt with by this document.

If combinations of machines and/or machine functions described at different parts of the standard are located in the same danger zone, the different measures shall be considered together.

4.2 Interfaces to the linked/integrated equipment

The individual risk assessment shall include the interfaces to the linked/integrated equipment (see also 5.2.3). For this equipment respective instructions and safety measures including control requirements for interfaces shall be given in the information for use.

5 Safety requirements and/or protective/risk-reduction measures

5.1 General

Life phases of a CCM are the following (see Figure 1):

a) manufacture:

- at the manufacturer's premises: design, manufacture, pre-assembly, transport;
- transport to facility installation site;
- on site: assembly, commissioning (in acc. with EN ISO 12100), trial runs;
- putting into service (first use for its intended purpose, CE marking issued);

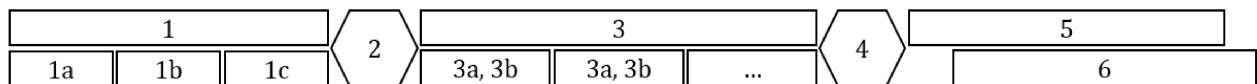
b) operation by plant operator (operating modes according to 3.49);

c) disabling and disassembly:

Usually, a CCM has a service life of several decades. During the years, CCM's are repeatedly modernized and adapted to changed technical requirements. Thus, the condition of a CCM at the date of disabling is not known. Therefore, the user should carry out a risk assessment for this life phase as close as possible to this date;

d) disposal:

Usually, a CCM has a service life of several decades. At the time of commissioning, the laws and regulations valid at the date of disposal are not known. Therefore, the user should carry out a risk assessment for disposal shortly before disposal of the CCM (see 7.4).



Key

- | | | | |
|----|---|----|--|
| 1 | manufacture (period of time) | 3 | operation (period of time) |
| 1a | design, manufacture, (pre-)assembly
(at the manufacturer's premises) | 3a | production |
| 1b | transport | 3b | setting, adjustment, maintenance, etc. |
| 1c | assembly, commissioning, trial run
(at the operator's site) | 4 | disabling (point in time) |
| 2 | putting into service (CE) (point in time) | 5 | disassembly (period of time) |
| | | 6 | disposal (period of time) |

Figure 1 — Schematic representation of the life phases of a CCM

5.2 Requirements for design, planning and risk assessment

5.2.1 General

CCM's conforming to this document shall comply with the safety requirements and/or protective/risk reduction measures set out in Clause 5 together with those set out in Annex A. The Information for use shall be according to Clause 7.

The manufacturer shall include in the instruction handbook information required for a safe operating procedure for the foreseen operating modes. Points for energy isolation and dissipation shall be described in accordance with EN ISO 14118 clearly.

It is assumed that CCM's are operated and maintained by trained personnel (see 3.38).

It is assumed that machinery is used with adequate work station lighting conforming to EN 12464-1 or to local regulations.

Where frequent access is planned by the manufacturer, permanent means of access shall be provided.

It is not required to provide permanent means of access to every part of the CCM where temporary activities may be necessary, e.g. for exceptional repair. The manufacturer shall provide in the Information for use instructions about temporary means of access to be used for exceptional access.

Safety devices shall be protected against damage. In particular, they shall be robust to withstand damages related to normal operation in the respective area, e.g. caused by thermal radiation, vibration, water condensation, dust, etc.

Surfaces for walking or standing shall be selected so that the risks of slips, trips and falls caused by scale, oil, emulsion and/or lubricant are avoided or minimized. Where required, they shall be protected against radiation and designed to withstand moving material, tools and jets of high-pressure fluids or gases.

Means of access, such as stairways, walkways, platforms, etc. shall be in accordance with EN ISO 14122 (all parts).

5.2.2 Planning of CCM

Even if the manufacturer is not responsible for the planning of the entire plant (e.g. halls, civil works) he shall take into account the following aspects, based on information from the user, in order to ensure good placement and safe operation:

- a) accessibility;
- b) possibility of escape;
- c) clearance gaps for maintenance and cleaning;
- d) movement of machinery and material;
- e) health and safety at the work station;
- f) prevention of emissions hazardous to health at the work station.

It is recommended to involve the user in the planning of the CCM (e.g. escape routes, fire extinguishers, etc.).

5.2.3 Linked equipment

The risk assessment shall consider the interfaces to mechanically and/or control-related linked equipment. Respective instructions and safety measures for the interfaces shall be given in the Information for use, e.g.:

- a) machinery/equipment/devices listed as not covered by Clause 1;
- b) fire alarm system and extinguishing system;
- c) energy and media supply (e.g. compressed air, gas, steam);
- d) auxiliary equipment and systems (e.g. measuring equipment/system);

e) material feeding and removal.

5.2.4 Structural assembly

The manufacturer shall undertake and record design calculations to show that the structural assembly (e.g. steel sections, auxiliaries) which forms part of the equipment is adequate to withstand the load under intended use.

5.2.5 Safety layout

The manufacturer shall prepare a safety layout of the CCM. The safety layout shows the spatial arrangement of safety-related elements and areas along the CCM and shall contain a key.

The safety layout shall be part of the Information for use. An unambiguous relationship shall be established between the information provided in the safety layout and the Information for use.

Specific issues, in particular interfaces like escape routes (of the plant/building) or fire extinguishing devices have to be jointly clarified between manufacturer and user.

Where applicable, the following shall be shown:

- a) danger zones (related to single and/or interconnected machinery);
- b) areas with specific residual risks (e.g. by the influence of asphyxiating gases, as due to a CO₂ extinguishing system);
- c) safeguards which prevent access to hazardous areas of the CCM;
- d) safety accesses;
- e) possibility of escape;
- f) local control devices or stands with safety-related functions;
- g) emergency stop devices;
- h) warning devices and safety signs;
- i) areas where no main routes are allowed.

5.2.6 Safety signs and warning devices

When machinery and equipment of CCM's present residual hazards to personnel, safety signs according to EN ISO 7010 and warning devices according to EN 61310-1 shall be used. They shall be so installed, that they are perceptible before accessing/reaching the zone where the danger exists.

An accumulation of safety signs and warning devices should be avoided as this reduces the effectiveness and thus attention of the individual devices.

The meaning of safety signs and warning devices shall be described in the Information for use (e.g. to the hazard it refers, indication of the affected area).

Plant-related warning devices shall be shown in the safety layout (see 5.2.5).

Graphical symbols shall be in accordance with ISO 3864-1 and/or EN ISO 7010.

Danger signals shall be in accordance with EN ISO 7731 and/or EN 842 and/or EN 981.

The manufacturer shall not rely upon safety signs and warning devices alone to reduce hazards in case of significant risks.

5.2.7 Personal protective equipment (PPE)

The manufacturer shall give information in the Information for use (see Clause 7) on the hazards that require the use of PPE (see Table 4).

5.2.8 Loss of energy and failure of controls

Possible hazards due to energy loss (hydraulic, pneumatic, electric) and/or failure of controls shall be considered in the risk assessment and respective measures shall be provided according to Table 4 and where required according to the individual risk assessment. An emergency energy supply (e.g. emergency power supply, pressure accumulator) can be used as temporary measure to bridge the gap till the CCM is in safe condition. Residual risks shall be listed in the Information for use together with compensational safeguarding measures.

In case of re-supply of energy after interruption, any unexpected start-up shall be avoided, see EN ISO 14118.

Safety-related control systems and devices shall comply with 5.2.21.

5.2.9 Workstations and assigned modes of operation

5.2.9.1 General

Workstations like control stands, pulpits, inspection stands and service floors, to which personnel is required to have access for operating the CCM, shall be easily and safely accessible. They shall be equipped with E-Stop Buttons according to EN 13850.

If risks can be caused by operating the equipment, e.g. during maintenance, good visibility from operators' position to the operated equipment shall be ensured. If direct visibility is not possible, visual aids (e.g. closed circuit television (CCTV), mirrors) shall be provided.

The overruling from different control stands or devices shall be prevented (according to EN 60204-1:2018, 9.2.4.4).

5.2.9.2 Characteristic tasks and conditions for exemplary operating modes

Table 1 shows characteristic tasks and conditions for exemplary operating modes and repair.

An example of different operating modes defined for segregated areas is shown in Annex D, Figure D.1.

Table 1 — Characteristic tasks and conditions for exemplary operating modes

	Operating modes (see 3.49)			Repair
	Special modes (e.g. enabling mode, adjustment)	Safe stop mode	(normal) Production	
Access to safeguarded area (see NOTE)	Allowed (under certain conditions, see 5.2.11)	Allowed (under certain conditions; see 5.2.11)	Denied (for exceptions see 5.2.11)	Allowed (under certain conditions; see 5.2.11.1 e))
Activity	e.g. service, replacing tools, adjusting operation	e.g. inspection, remove strand sticker	Production control from the pulpit	All activities do not require energy. (Functional test shall be carried out under safe conditions as per 5.2.11.9)
Machine operating status	No automatic controlled movements possible (see 3.48.3)	No movements possible	Normal production	Off
Kinetic energy	0	0	> 0	0
	> 0 (under certain conditions, see 5.2.11)			
Isolation and energy dissipation (according to EN ISO 14118:2018, 3.3)	No	No	No	Yes

Sources not mentioned in Table 1 (e.g. radiation sources) should be handled in conjunction with Table 4.

During safe stop mode additional measures have to be taken to isolate or dissipate potential energy, if necessary.

5.2.9.3 Control stand (fixed, local)

The location of the control stand shall be in an area where the operator is not endangered.

5.2.9.4 Portable control device (wired or wireless)

Where a direct view of an operator to an area is necessary, e.g. because of moving equipment, but a direct view or a view with the help of visual aids is not possible from a (fixed) control stand, a portable control device shall be provided. The same result can be achieved by means of a fixed control stand in combination with a portable enable control device.

If the portable control device contains emergency stop or enabling functions, any interruption of the connection between the portable control device and the control system shall stop the movement/function as quick as possible.

5.2.10 Enabling control device and hold-to-run control device

5.2.10.1 General

If safety functions and/or safety measures are not available for certain operations (e.g. access doors open, fences are not foreseen), then, where necessary, the manual control of such operations shall be carried out by start control devices together with enabling control devices (e.g. enabling button) and/or hold-to-run control devices.

5.2.10.2 Enabling control device

The enable control (enabling mode) shall be in accordance with EN ISO 12100:2010, 6.2.11.9 and EN 60204-1:2018, 9.2.3.9, and 10.9.

a) Requirements to enabling control devices:

- 1) does not trigger a movement, but only releases them;
- 2) requirements EN 60204-1:2018, 9.2.3.9 shall be complied;
- 3) loosing the enabling command (e.g. release a button) shall bring the movement to a standstill in the shortest possible time without causing additional hazards;
- 4) from the place of operation, the full overview over the released movements and thus potentially endangered persons, shall be given directly or with the help of visual aids. If the person does not have a full overview over the released movements (e.g. standing on the operating side of the equipment), the access to the not visible area (e.g. drive side of the equipment) is not permitted. But if an access to this area is necessary (full view over the released movements necessary), an additional enabling control device shall be provided and actuated;
- 5) the enabling button at a control stand shall have two switching positions, and three switching positions on a portable control device;

b) requirements to start control devices for initiation of movements:

- 1) together with an enabling control device, movements are triggered, but no automatic control can be started;
- 2) the start control device itself has no safety function.

5.2.10.3 Hold-to-run control device

5.2.10.3.1 Fixed hold-to-run control device

The following requirements shall be met:

- a) 5.2.9.1 and 5.2.9.2 shall be considered;
- b) the release shall bring the movement to standstill in the shortest possible time.

5.2.10.3.2 Portable hold-to-run control device

The following requirements shall be met:

- a) 5.2.9.4 shall be considered;
- b) the release shall bring the movement to standstill in the shortest possible time.

5.2.11 Access to and presence in danger zones

5.2.11.1 General

When access of authorized personnel to danger zones under operational conditions is necessary, appropriate safety measures and/or intervention procedures according to EN ISO 12100:2010, 6.3.2.4 shall be applied (see also 4.1).

In addition, the following shall be at least considered:

- a) in general, CCM's shall be safeguarded in such a way that hazardous situations arising from access of persons to the CCM shall be prevented. Access to the casting platform shall be according to 5.2.11.3;
- b) any type of safeguarding (see EN ISO 14120) shall be accessible for inspection and maintenance purposes and protected against damage under foreseeable conditions. In particular, it shall be sufficiently resistant to function reliably;
- c) where dangerous movements take place, e.g. material in motion, access shall be prevented by protective devices (e.g. interlocked doors) or allowed in a safe way according to d);
- d) conditions for staying/working in general (for casting platform see 5.2.11.3), at least:
 - hazardous movements/functions shall be stopped according to an individual risk assessment;
 - unexpected start-up/restart shall be avoided;
 - measures to prevent hazards due to stored energy shall be provided;
 - dangerous movements shall be carried out by a hold-to-run control and, where applicable, enabling operation with full view over the danger zone, see 5.2.10.2;
- e) for access to the plant (even to areas without a safety access according to 5.2.11.2, e.g. removed fixed guards) to carry out maintenance or repair, a concept for safe working procedures shall be defined and described in the Information for use;
 - 1) service, inspection and functional test, see 5.2.11.7 and 5.2.11.9;
 - 2) repair (see 3.42)/reconditioning, see 5.2.11.8;
- f) if possible, to minimize the necessity of entering danger zones during production, remote monitoring (e.g. cameras, mirrors and bearing vibration monitoring) shall be used;
- g) warning signs shall be installed so that they are also visible from outside of the danger zone;
- h) access to under floor areas shall be considered in the individual risk assessment;
- i) the manufacturer shall specify in the Information for use the conditions under which access to the danger zones of the CCM shall be permitted, including details about preventive measures like personal protective equipment (PPE), use of handling tools, etc.

Specific requirements and technical solutions for safety measures on different parts of the machine are given in 5.3.