

BS EN 15949:2012



BSI Standards Publication

Safety of machinery — Safety requirements for bar mills, structural steel mills and wire rod mills

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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 secretary.

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Published by BSI Standards Limited 2012

ISBN 978 0 580 67490 7

ICS 25.120.20; 77.180

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 March 2012.

Amendments issued since publication

Amd. No.	Date	Text affected
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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 15949

February 2012

ICS 25.120.20; 77.180

English Version

**Safety of machinery - Safety requirements for bar mills,
structural steel mills and wire rod mills**

Sécurité des machines - Exigences techniques de sécurité
pour machines de train à barre, train à profilés et train à fil

Sicherheit von Maschinen - Sicherheitsanforderungen an
Stab-, Formstahl- und Drahtwalzwerke

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Foreword

This document (EN 15949:2012) 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of an identical text or by endorsement, at the latest by August 2012, and conflicting national standards shall be withdrawn at the latest by August 2012.

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

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

For relationship with EU Directive(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, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

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

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

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.

Where for clarity an example of a preventative measure is given in the text, 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.

This European Standard assumes that the equipment is operated and maintained by trained personnel.

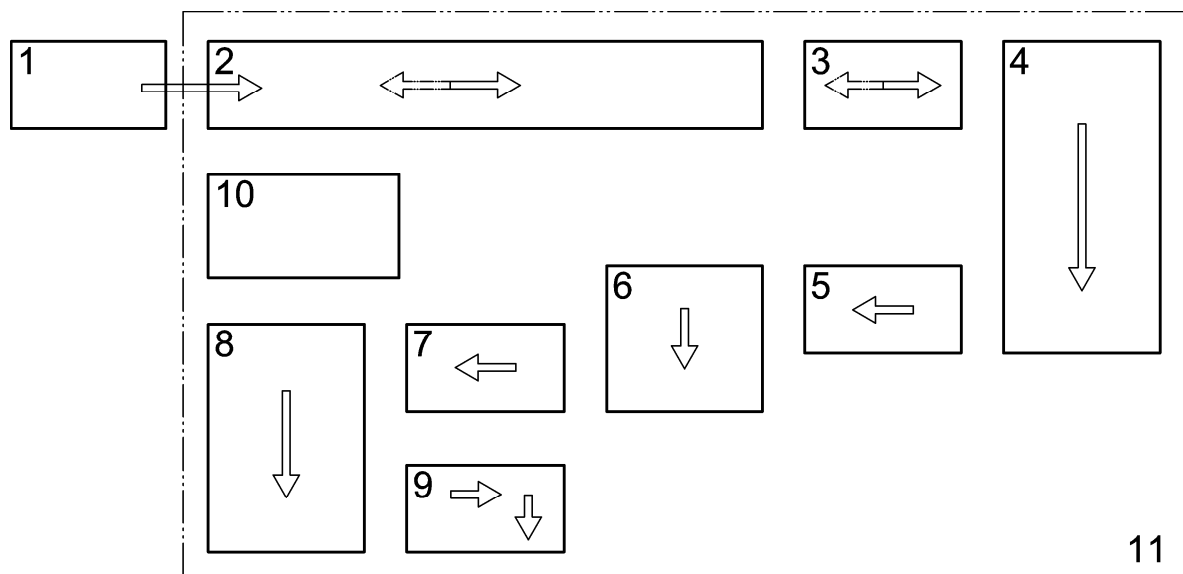
1 Scope

This European Standard defines the general safety requirements for hot rolling mills for long products as defined in 3.1.

This European Standard deals with significant hazards, hazardous situations and events relevant to hot rolling mills for long products. It deals not only with circumstances where the machinery is used as intended, but also includes other conditions foreseen by the manufacturer, such as foreseeable faults, malfunctions or misuse (see Clauses 4 and 5).

This applies also to hazards arising during various phases of the life of the machinery and equipment as described in 5.4 of EN ISO 12100:2010.

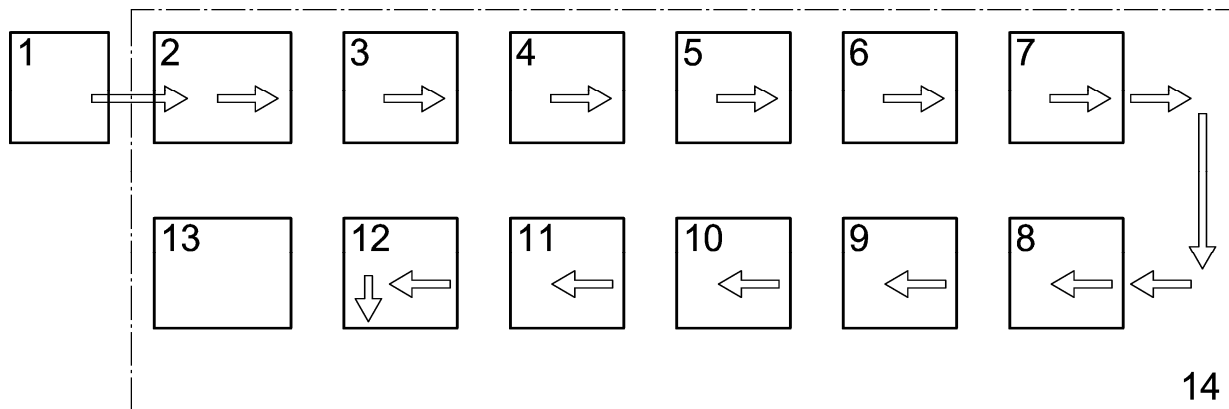
This European standard applies to: Machinery and equipment used for the manufacturing of metal rolled long products from the material supply from (1), via the rolling mill process equipment (2) to (9) including preparation area (10) (exemplary layout is given in Figure 1).



Key

- | | | | |
|---|--|----|---|
| 1 | e.g., continuous casting machine (according to EN 14753) or furnace (according EN 746-1) | 7 | saws, shears, abrasive cutting machines |
| 2 | mill stands | 8 | piling machine |
| 3 | roller tables | 9 | binding and loading area |
| 4 | cooling beds | 10 | preparation area |
| 5 | straightening machines | 11 | border of the rail / section rolling mill |
| 6 | collecting beds | ⇒ | product flow |

Figure 1 — Exemplary layout of a rail / section rolling mill



Key

1	e.g., continuous casting machine (according to EN 14753) or furnace (according EN 746-1)	8	cooling line
2	roughing mill area	9	laying head
3	intermediate mill area	10	loop cooling conveyor
4	cooling line	11	coil station
5	shearing group	12	coil handling
6	wire rod block	13	preparation area
7	snap shear	14	border of the bar / wire rod mill
			product flow

Figure 2 — Exemplary layout of a bar / wire rod mill

The following equipment is excluded:

- a) furnaces in accordance with the EN 746 series;
- b) continuous casting machines according to EN 14753;
- c) hook conveyors according to EN 619;
- d) roll and guide shop equipment (e. g., machine-tool);
- e) storage equipment (e.g., high-bay warehouses);
- f) cranes, fork lifts, trucks and railway trucks and other vehicles.

This document is not applicable to rolling mills for long products, which are manufactured before the date of its publication as an EN document.

2 Normative References

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

EN 349, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

EN 614-1:2006+A1:2009, *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 626-1, *Safety of machinery — Reduction of risks to health from hazardous substances emitted by machinery — Part 1: Principles and specifications for machinery manufacturers*
- EN 842, *Safety of machinery — Visual danger signals — General requirements, design and testing*
- EN 894-1, *Safety of machinery — Ergonomic 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 953, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*
- EN 981, *Safety of machinery — System of auditory and visual danger and information signals*
- EN 1032, *Mechanical vibration — Testing of mobile machinery in order to determine the vibration emission value*
- EN 1037:1995+A1:2008, *Safety of machinery — Prevention of unexpected start-up*
- EN 1063, *Glass in building — Security glazing — Testing and classification of resistance against bullet attack*
- EN 1088, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*
- EN 1299, *Mechanical vibration and shock — Vibration isolation of machines — Information for the application of source isolation*
- EN 1591-1, *Flanges and their joints — Design rules for gasketed circular flange connections — Part 1: Calculation method*
- EN 1837, *Safety of machinery — Integral lighting of machines*
- EN 12094-1, *Fixed firefighting systems — Components for gas extinguishing systems — Part 1: Requirements and test methods for electrical automatic control and delay devices*
- EN 12198-1, *Safety of machinery — Assessment and reduction of risks arising from radiation emitted by machinery — Part 1: General principles*
- 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 12254, *Screens for laser working places — Safety requirements and testing*
- EN 12464-1, *Light and lighting — Lighting of work places — Part 1: Indoor work places*
- EN 13478, *Safety of machinery — Fire prevention and protection*
- EN 13480-2, *Metallic industrial piping — Part 2: Materials*
- EN 13480-3:2002, *Metallic industrial piping — Part 3: Design and calculation*
- EN 13480-4:2002, *Metallic industrial piping — Part 4: Fabrication and installation*
- EN 13861, *Safety of machinery — Guidance for the application of ergonomics standards in the design of machinery*
- EN 15004-1, *Fixed firefighting systems — Gas extinguishing systems — Part 1: Design, installation and maintenance (ISO 14520-1:2006, modified)*

EN 50171, *Central power supply systems*

EN 60204-1:2011, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 44/617/CD:2010)*

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

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

EN 60825-1:2008, *Safety of laser products — Part 1: Equipment classification, requirements and user's guide (IEC 60825-1:2007)*

EN 60825-4, *Safety of laser products — Part 4: Laser guards (IEC 60825- 4:2006)*

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

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

EN 61496-1/A1, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests (IEC 61496-1:2004/A1:2007 + corrigendum Jul. 2008)*

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

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

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

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

EN ISO 10218-1, *Robots and robotic devices — Safety requirements for industrial robots — Part 1: Robots (ISO 10218-1:2011)*

EN ISO 11064-1, *Ergonomic design of control centres — Part 1: Principles for the design of control centres (ISO 11064-1:2000)*

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

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

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

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

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

EN ISO 13855, *Safety of machinery — Positioning of safeguards with respect to the approach speeds of parts of the human body (ISO 13855:2010)*

EN ISO 13857, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs* (ISO 13857:2008)

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

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

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

EN ISO 14122-4, *Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders — Amendment 1* (ISO 14122-4:2004 + Amd 1:2010)

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

ISO 6183, *Fire protection equipment — Carbon dioxide extinguishing systems for use on premises — Design and installation*

ISO 7000, *Graphical symbols for use on equipment — Index and synopsis*

3 Terms and definitions

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

NOTE Definition used in EN and ISO standards referred to in this European Standard are also valid for this European Standard.

3.1

rolling mill for long products

machinery and equipment where metal is hot rolled to long products, such as bar mills, bloom and billet mills, wire rod mills, section/rail mills as well as any area inside or outside the superstructure of the building where product is being handled or stored

Note 1 to entry: Examples of machines and equipment which are covered by this standard are listed in Annex F.

3.2

product

metal to be or being hot rolled

3.3

preparation area

dedicated place to carry out the necessary maintenance activities and/or to prepare to use interchangeable equipment (e.g. roll change devices)

3.4

pulpit

enclosed room in which the control desk and monitoring facilities for a machine or equipment are located, used as a permanent work place

3.5

control stand

free standing control desk (usually situated adjacent to the machine or equipment), used as a temporarily work place

3.6

large machinery/equipment

interconnected equipment (size > 15 m) of long products rolling mills in which several components of the machinery or forming stages are linked by dedicated transport facilities (e. g., roller tables, cross-transfer systems)

3.7

cobbling

product leaving its intended path

3.8

trained personnel

persons with proven knowledge of systems, background, experience and ability to operate and/or maintain the equipment in the intended use and proper operation of the machinery/equipment

3.9

unauthorized person

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

3.10

maintenance

service, inspection and repair of machinery and equipment

3.11

inspection and adjusting under load

access of authorized personnel to danger zones under defined plant running conditions

3.12

modes of control

machinery and equipment used to roll long products (single machines or groups of interconnected parts) typically features three modes of control defined as follows:

a) manual mode

a function or sequence of functions is controlled by an operator by means of a hold-to-run control or equivalent device (see 3.28 of EN ISO 12100:2010)

b) semi-automatic mode

mode of operation of the machinery consisting of a series of automatic sequences (summary of functions) into which the whole working cycle is subdivided: at the end of each sequence, started by the operator and then controlled by a programmable electronic system (PES), the operation is automatically stopped, and a new command of the operator is needed to initiate the next sequence

c) automatic mode

process, e.g., a cycle of successive or parallel sequences, once initiated by the operator, is totally controlled by a PES; repetition of the working cycle of the machinery takes place (as long as the running conditions are met) without any operator intervention required

3.13

modes of operation

machinery and equipment used to roll long products (single machines or groups of interconnected parts) typically features different modes of operation, e.g., production, maintenance, adjusting, inspection, immobilization (see Table 1)

3.14

safety layout

description of line-related equipment with safety functions to ensure safe operation of the long product rolling mill avoiding hazards or hazardous situations for, e.g., unauthorized access or having another line-related safety function (for explanations, see 5.1.4)

4 List of significant hazards

This clause contains all 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 requires action to eliminate or reduce the risk. The risk identification was determined as follows:

- a) potentially hazardous situations having significant risks;
- b) the safety requirements and/or measures which shall be incorporated into the machinery/equipment;
- c) any special instructions which shall be communicated to the user.

The significant hazards and hazardous situations identified are listed in columns 1 and 2 of 5.2, Table 3.

In addition, the manufacturer shall carry out an individual risk assessment according Clause 4 of EN ISO 12100:2010 to identify any other significant hazard of the machine/equipment. Significant hazards identified in this individual risk assessment but not dealt with in this standard shall be reduced by applying the principles of EN ISO 12100.

In general, risks and associated hazards are production and plant-related. The main differences arise from the processing of different products and materials in different qualities and the surrounding (i.e. different combinations of machines, different boundary conditions, see Annex H). The resulting variety of "different plants" could not be covered in all details in a standard. To deal with these facts an individual risk assessment according to EN ISO 12100 for the long product rolling mill in question shall be carried out considering the safety requirements of this standard. The individual risk assessment shall also take into account the interfaces between the machinery and the environment (e.g. other machinery and/or buildings), see Annex H.

5 Safety requirements and/or measures

5.1 General requirements for design, planning and risk assessment

5.1.1 General

Long product rolling mills conforming to this standard shall comply with the safety requirements and/or measures set out in Clause 5 together with those set out in Annexes A and B and the information for use as defined in Clause 7.

This standard assumes that:

- a) installations are operated and maintained by trained personnel; manual intervention for setting, inspection, adjustment and maintenance is accepted as part of the normal use of the equipment;
- b) machinery is used with adequate workplace lighting conforming to EN 12464-1 or to local regulations.

Where the means of reducing the risk is by the physical arrangement or positioning of the installed machines, the manufacturer shall include in the information for use a reference to the reduction means to be provided and to any limiting value of the requirement, and, if appropriate, to the means of verification.

Where the means of reducing the risk is by a safe system of working the line, the manufacturer shall include in the information for use details of the system and of the elements of the information required by the operating personnel.

This shall include protective measures used according to 6.2.11.9 and 6.2.11.10 of EN 12100:2010 to run a machine for essential operating reasons or in special mode with safety devices suspended or temporarily modified.

The manufacturer shall also include in the information for use all details required for a safe operating process under normal operating condition. He shall also describe the specific safety measures in case of special operating modes, e.g., maintenance, roll change and adjustment work.

The requirements also apply to under floor areas of the plant.

5.1.2 Planning of long product rolling mills

Manufacturers of long product rolling mills are normally not involved in planning the entire plant (e.g. halls, civil works). However, in any case they have to take into account the following aspects in order to ensure good placement and safe operation of the long product rolling mill:

- a) accessibility;
- b) clearance gaps for maintenance and cleaning;
- c) escape routes;
- d) movement of machinery and product;
- e) safe operation;
- f) health and safety at the workplace;
- g) prevention of emissions hazardous to health at the workplace.

5.1.3 Structural assembly

The manufacturer shall undertake and record design calculations to show that the structural assembly, e.g. steel sections, auxiliaries, lifting points and fixtures and service platforms, which form part of the equipment are adequate for safety functions under intended use.

5.1.4 Safety layout

The manufacturer shall prepare a safety layout document of the whole long product rolling mill. The aim of the safety layout is to give information (normally by means of one or more drawings) about the physical position along the long product rolling mill of safety related elements such as, e.g.:

- a) segregating devices (fences, trip devices, etc.) intended to prevent access to danger areas of the plant;
- b) doors and other points of access (where required with related locking and/or interlocking devices) to the plant;
- c) escape routes (if necessary, e.g., for large plants);
- d) emergency stop buttons and related emergency stop areas according to Annex A; A.3.4;
- e) warning devices and safety signs (warning signs for, e.g., forbidden access, X-rays);
- f) fire protection (according to 5.1.20);
- g) areas which can be influenced by asphyxiant gases according Annex D; D.1.

The safety layout shall be included into the manufacturer's instructions for use.

5.1.5 Access to working places

All parts of the equipment such as control stands, pulpits, underground areas, inspection and service floors, which personnel is required to have access to shall be easily and safely accessible.

Means of access, such as stairways, walkways, platforms, etc. shall be provided in accordance with EN ISO 14122-1, EN ISO 14122-2, EN ISO 14122-3 and EN ISO 14122-4. Where required, they shall be protected against heat radiation according to EN 12198-1 and designed to withstand or deflect moving product, tools and jets of high pressure fluids or gases. 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.

5.1.6 Access to danger zones

5.1.6.1 Access of unauthorized personnel

Access of unauthorized personnel to long product rolling mills is not permitted. In the information for use (e.g. safety layout), the manufacturer shall define those areas and inform the user.

5.1.6.2 Access of authorized personnel

In general, access to danger zones shall be avoided by guards. Access to danger zones is only permitted after the operation of the equipment has been stopped and the related risks (e.g., stored energy, temperature, radiation) have been isolated according to EN 1037. An exception is only possible taking into account the requirements of 5.1.6.3 and 5.1.6.4.

Where possible, remote monitoring (e.g. cameras, mirrors, probes, etc.) shall be used to prevent the need for personnel access.

The relevant category for control devices covering safety functions in relation with access of persons to danger zones during operation or maintenance, shall be selected according to Annex A.

5.1.6.3 Inspection and adjustment without product in process

For inspection and adjustment purposes, appropriate safety measures according to EN ISO 13849-1 and/or intervention procedures shall be applied to allow authorized personnel access to danger zones without product in process. For these specific actions, safety measures shall be considered, in particular:

- a) there shall be no product on the equipment where inspection and adjustment is to be done;
- b) conditions for access: guards according to 5.1.7, indication to the main pulpit, switching to manual control mode, switching off measuring devices (e.g., X-ray, laser) and electro-magnetic devices;
- c) conditions for adjustment: use of hold-to-run control according to 5.1.18 with full overview of the danger zone, operation at reduced speed;
- d) conditions for re-start: access doors shall be closed (taking care that no person is inside the danger zone) and reset-button has been pushed (or similar action).

The manufacturer shall specify in the information for use the safety measures provided and the conditions under which access to the danger zones shall be permitted, including details about safe systems of working, as well as adoption of precautions like PPE, use of handling tools, etc.

5.1.6.4 Inspection and tuning under load

The access of authorized personnel to danger zones under production but with defined plant running conditions is sometimes necessary for the following activities:

- a) due to possible product twist and/or oscillation, a check has to be done and in consequence a tuning of the guides while the plant is running (e.g. gap tuning of the guides) has to be carried out;

- b) check of the product dimensions, surface and shape (visual check and dimensional check). Consequently, an adjustment has to be carried out under no-load conditions;
- c) the inspection under a load shall be nevertheless restricted to the mill stands and straightening area and limited according to the following:
 - 1) product speed less than 3 m/s inspection can be performed even with the product still to be engaged by the mill stands or straightening machines under inspection;
 - 2) product speed between 3 and 10 m/s inspection can be performed only with the product already engaged by the mill stands or straightening machines under inspection;
 - 3) if product speed is more than 10 m/s inspection is not allowed except for wire rod and bar mills, if the product is completely guided (e. g., by tubes).

5.1.6.5 Physical barriers (e.g., guards, see 5.1.7) shall be provided to safeguard the danger zones; also safety devices (e.g., trip device, laser scanner), alone or in combination with guards can be used to achieve the required level of safety (see 6.3.3.3 of EN ISO 12100:2010) as defined in 5.1.6.4. If a trip device is used, EN ISO 13855 shall be considered.

5.1.6.6 Accessible rotating/moving parts

Accessible drive shafts, couplings, belts, chains, pulleys and sprockets shall be guarded in accordance with EN 953, if the safety distances according to EN ISO 13857 cannot be achieved.

Rotating shafts shall be marked so that it is visually evident when the shafts are in motion.

5.1.6.7 For all hazardous areas not directly or indirectly visible from the main control pulpit, where inspection activities are foreseeable and always allowed, a system shall be foreseen giving at least an indication at the main pulpit that personnel are in this area.

5.1.6.8 Access to segregated areas under different modes of operation.

Table 1 — Characteristic conditions of operating modes

	Modes of operation				
	Inspection (under load)	Adjusting	Immobilization	Production	Maintenance
Activity of the operator	Inspection, tuning	e.g., tool change, tuning, stand change adjusting operation	e.g., check, remove cobbled product	Production control from the pulpit	All activities do not require energy.
Machine operating status	Controlled production	No automatic movements possible, jog mode	No movements possible	Normal production	Off
Access to segregated area	Allowed (under certain conditions, see 5.1.6.4)	Allowed (under certain conditions, see 5.1.6.3)	Allowed (under certain conditions; see 5.1.6.3)	Denied	Allowed
Sensors status (ON/OFF)	ON	ON	ON	ON	OFF
Kinetic energy (0 / >0)	>0	0 manual adjustments are necessary	0	>0	0
		>0 for automated adjustments with reduced speed			
Pressure (control fluids) (ON/OFF)	ON	ON only for allowed commands	ON	ON	OFF
		OFF for the remaining commands			
Fluid flow stopped (e.g., pressure maintained but no movement possible, i.e., lockout/tag out)?	No	No	Yes	No	Yes
Fluid pressure depressurized?	No	No	No	No	Yes
Emergency stop active?	Yes	Yes	Yes	Yes	No
Access managed with light barrier?	Yes	Yes	Yes	Yes	No

NOTE 1 Special conditions for, e.g., changing rolls and guide/stand/straightener rolls and calibration in semi-automatic mode can be defined taking into account the requirements of Table 1.

NOTE 2 Cobble removal is carried out in the mode “immobilization”. In addition, the mode “adjusting” can be used to assist the removal, according to 5.1.10.

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

5.1.7 Guards

Guards used to prevent access to danger zones shall be selected as appropriate for the degree and frequency of access to be permitted, e.g., an enclosing guard or distance guard, fixed or movable with interlock. This selection shall be made according to EN 953. Interlock systems shall meet the requirements of EN 1088. The requirements of the guards shall conform to EN 953, EN ISO 13857 and EN 349.

There is no necessity for attaching (e.g. by screws) guards or guarding (e.g. covers) which could be removed only by auxiliary devices (e.g. cranes) due to the heavy weight.

With regard to the safety distances described in EN ISO 13857, the minimum height of distance guards (e.g. perimeter fences, protective structures) shall be at least 1.400 mm.

5.1.8 Guard-rails

Guard-rails are to be considered as means to deter or impede access to hazardous areas, i.e., a physical obstacle which only reduces the probability of access (but does not totally prevent it), offering an obstruction to free access (see 3.29 of EN ISO 12100:2010).

Therefore, guard-rails are not permitted as the sole measure of safeguarding hazardous areas in case of significant risks (e.g., from moving machinery or processed product). Guard-rails may only be used for cases where the hazards of slips, trips and falls are involved.

Guard-rails can be used as a measure to prevent unintentional access of unauthorised persons to zones where residual risks exist after more effective risk reduction measures have been used (e.g. zones where equipment with potentially dangerous movements can be operated only in manual mode by means of hold-to-run devices from control stands with full overview of the driven elements (see 5.1.18 of this standard)).

Guard-rails shall conform to EN ISO 14122-3.

5.1.9 Safety signs and warning devices

An acoustical and visible signal shall indicate the change from manual to any automatic or production mode.

Safety signs and warning devices according to EN 61310-1 and to EN 61310-2 shall be used.

Graphical symbols shall be in accordance with ISO 3864-1 and/or ISO 7000.

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

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

5.1.10 Safeguarding

Any kind of safeguarding (see 3.21 of EN ISO 12100:2010) shall be accessible for inspection and maintenance, and protected against damage under foreseeable conditions. In particular, it shall be sufficiently robust to operate reliably.

In general, it shall be possible to open access doors from inside the segregated areas.

Personnel working inside a segregated area (e.g., maintenance) shall be secured in that way, that the mode of operation (e.g., switching from maintenance to production mode) cannot be changed during their stay in that area. In addition, a clear overview over this area shall be provided (i.e. direct view or by CCTV).

If personnel is carrying out inspections and tuning under load, i.e., under normal operating conditions, the access door shall be interlocked after entering the area, whereas the door shall be opened from inside at any time by a push bar. In addition, a clear overview over this area shall be provided (i.e. direct view or by CCTV).

5.1.11 Personal protective equipment

The manufacturer shall give information in the information for use (see Clause 7) on the required attributes of any personal protective equipment (PPE, see column 3 of Table 3) needed to protect personnel from any residual risks remaining after applying the safety requirements.

5.1.12 Electrical equipment

Electrical equipment shall conform to EN 60204-1 and withstand the hazards identified in the risk assessment required at the design stage and taking into account the requirement set out in Annex A. Electrical equipment shall be tested according Clause 18 of EN 60204-1:2006.

Safety devices shall be protected against damages. In particular they shall be robust to withstand damages while continuous normal operation in the respective area.

5.1.13 Pneumatic and fluid systems

Pneumatic and fluid systems, e.g., hydraulic, cooling and lubrication systems, shall be designed to reduce risks from hazardous substances, fire, explosion, vibration and noise.

Hazards associated with pressure, temperature, ignition sources, and proximity to adjacent personnel shall be taken into account. Pneumatic and fluid systems shall be designed according to EN ISO 4414 for pneumatic systems and EN ISO 4413 and Annex B for fluid systems.

5.1.14 Software manipulation

Software shall be protected against unauthorised access and manipulation, e.g. by keywords on different levels. For software safety requirements see 4.6 of EN ISO 13849-1:2006.

5.1.15 Material to be discharged to drains

The manufacturer shall give information on the material to be discharged to drains. This information shall include connection means to waste discharge points and floor drains which form a part of the equipment. The information shall be included in the information for use.

5.1.16 Surface temperatures and heat radiation

Where the risk of heat radiation is given, protection walls/shields with isolating material shall be provided. EN 12198-3 shall be considered.

Surfaces which are accessible and could be touched shall have temperatures not exceeding the burn threshold for contact time and material specified in EN ISO 13732-1. Where these limits cannot be kept, additional measures shall be applied, e.g. insulation, distance guard, PPE. These measures shall be supplemented by warning instructions.

5.1.17 Pulpits and control stands

The pulpits and control stands shall be designed taking into consideration 5.2.8.

5.1.18 Hold-to run control

Where a hold-to-run control device is required in Table 3, it shall meet the following requirements:

a) Fixed hold-to-run control device:

- 1) if a fixed hold-to-run control device is used it shall be placed in an area that does not endanger the operator during the dangerous movements; and

- 2) the operator shall have full overview over the danger zone directly or by the help of visual aids (e.g. mirror, closed circuit television); and
- 3) release of a hold-to-run control device shall bring the movement to standstill in the shortest possible time.

b) Portable hold-to-run control device:

- 1) a portable hold-to-run control device shall control only motions which can be overlooked directly by the operator and which do not endanger him or other personnel;
- 2) release of a hold-to-run control device shall bring the movement to standstill in the shortest possible time.

5.1.19 Mechanical restraint devices

To avoid unexpected movements due to stored energy during maintenance and trouble shooting mechanical restraint devices shall be selected to hold the equipment/tool in a safe position. Those devices can be, e.g. safety bolts, latches, scotches and brakes.

Where automatically operated safety bolts are used, e.g. operated by hydraulic cylinders, they shall be monitored in their end position and any further operation shall only be possible if the correct position is confirmed.

Where safety bolts or latches to be set by hand they shall be clearly identifiable (e.g. different shapes) and installed directly on the equipment to be protected (e.g. with a chain). Mechanical restraint devices shall be placed only from a safe position.

Safety bolts shall be dimensioned to withstand the expected loads.

Where brake systems are used, they shall be mechanically applied in the holding position.

The mechanical restraint devices shall be kept in a safe position in case of loss of power supply and restart.

5.1.20 Fire protection

The necessity to install fire fighting systems at long product rolling mills (e.g. pulpit, hydraulic/electric rooms) shall be checked taking into account the processing conditions. For detailed information, see EN 12094-1, EN 13478, EN 15004-1 and Annex D.

5.1.21 Ergonomics

EN 13861 shall be used as a guideline for considering ergonomic aspects in the design of long product rolling mills. Particular consideration shall be given to EN 614-1, EN 614-2, EN 894-1, EN 894-2, EN 894-3, EN 60447 and EN ISO 11064-1.

Particular attention shall be paid to the following:

- a) dedicated lifting aids or anchoring points for common lifting devices shall be provided whenever frequent lifting or heavy tooling of machines is required;
- b) eyebolts or similar aids shall be fitted to heavy components to lift them; they shall also be fitted with handles, hand-holds or grips with a slip-resistant (e.g. knurled) surface;
- c) work areas used for manual handling of components shall be so designed that they are free of obstructions so that the operator is not hindered in his movements; the work area shall be sufficiently spacious to handle manual loads close to the body;
- d) the ideal placement for handwheels, levers, etc. to minimise physical effort is between 700 mm and 1,600 mm above the workers standing level;
- e) supporting structures provided to enable machinery parts to be assembled on site shall be designed and fabricated to ensure stability, and thereby minimise manual handling;