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BSI Standards Publication

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

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National foreword

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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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of an identical text or by endorsement, at the latest by August 2012, and conflicting national standards shall be withdrawn at the latest by August 2012.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.

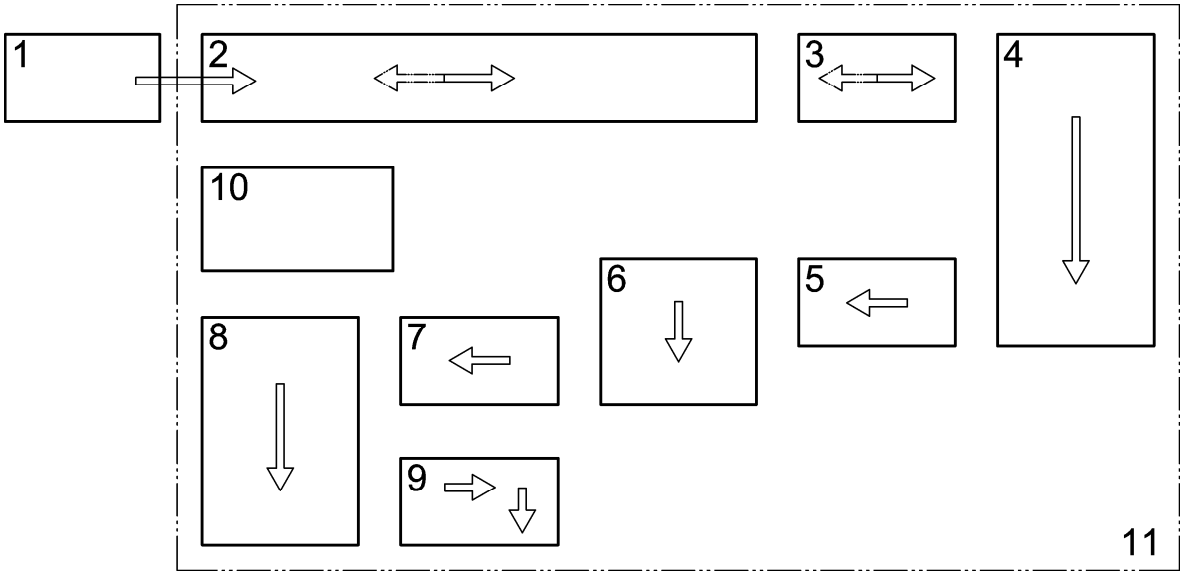
1 Scope

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.

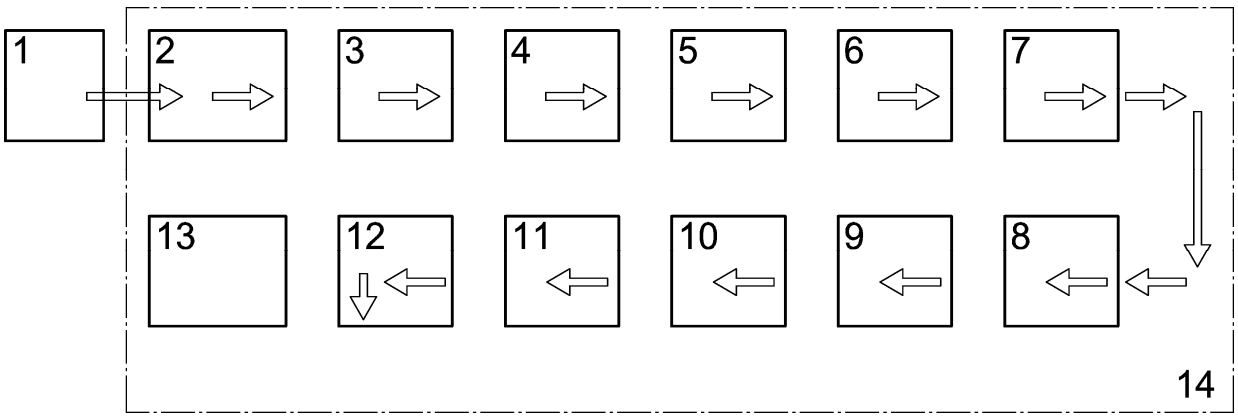
This European standard applies to: Machinery and equipment used for the manufacturing of metal rolled long products from the material supply from (1), via the rolling mill process equipment (2) to (9) including preparation area (10) (exemplary layout is given in Figure 1).



Key

1 e.g., continuous casting machine (according to EN 14753) or furnace (according EN 746-1)
2 mill stands
3 roller tables
4 cooling beds
5 straightening machines
6 collecting beds
7 saws, shears, abrasive cutting machines
8 piling machine
9 binding and loading area
10 preparation area
11 border of the rail / section rolling mill
⇨ 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
		9	laying head
2	roughing mill area	10	loop cooling conveyor
3	intermediate mill area	11	coil station
4	cooling line	12	coil handling
5	shearing group	13	preparation area
6	wire rod block	14	border of the bar / wire rod mill
7	snap shear	⇨	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 for automated adjustments with reduced speed	0	>0	0
Pressure (control fluids) (ON/OFF)	ON	ON only for allowed commands OFF for the remaining commands	ON	ON	OFF
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 whiles 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;

f) machine parts, such as electric motors, should be located on top of structural supports and shelves rather than suspended; this removes the need for manually supporting the item until it is in a secured position;

g) the positioning of electric junctions, fluid power and electrical connections and similar, can adversely affect a workers posture during installation and subsequent maintenance; the location of such items shall ideally be between 400 mm and 1,600 mm above the workers standing level;

h) foot pedals can place an asymmetrical strain on the operators back, and other controls are preferable. Where a seated operator shall use foot pedals and hand levers, the seat and the levers shall be individually adjustable to ensure good posture;

i) EN ISO 6682 can be used as a guide for placement of foot and hand operated controls;

j) slip-resistant surfaces, see 5.1.5;

k) noise protection, see 5.1.22;

l) vibration protection, see 5.1.23;

m) heat protection, see 5.1.16;

n) lighting of the working areas shall be in accordance with EN 12464-1;

o) good visibility to the working/operating area.

5.1.22 Noise

5.1.22.1 Noise reduction at source by design

When designing a machine, technical measures for reducing noise at source at the design stage shall be considered, see EN ISO 11688-1. Examples for general measures which should be considered are:

a) reduce impact energy (e.g. by reducing the height of fall);

b) reduce power of impact (e.g. by dampened impact);

c) reduce noise of gas flow (e.g. low-noise nozzles, sound absorbers);

d) use internal damping (e.g. cast instead of steel plate structures, sandwich plate);

e) dampening of structure-borne noise (e.g. by coating or sandwich plate);

f) insulation of structure-borne noise (e.g. by installation of masses), vibration isolated mounting (e.g. by spring elements and dampers);

g) acoustic short circuit (e.g. perforated plate/lattice boxes).

The criterion for assessing the efficacy of measures to reduce noise at source are the actual noise emission values from the machine in relation to other machines of the same family and not the nature of the measures themselves.

NOTE EN ISO 11688-2 gives useful information on noise generation mechanisms.

5.1.22.2 Noise reduction by protective measures

The secondary noise control can be achieved (e.g. by the increase of noise dampening and insulation, physical separation for noise source and receiver, sound-insulated control rooms, separate rooms/cellars for hydraulic pumps and water distribution systems). Examples are reductions by using:

a) total or partial enclosures;

b) shields;

c) silencers;

d) increased distance between source and operator.

NOTE The efficacy of such protective measures can be estimated, e.g. by using EN ISO 11546 (all series) (for enclosures), EN ISO 11691 and EN ISO 11820 (for silencers) and EN ISO 11821 (for shields).

5.1.22.3 Noise reduction by information

If noise reduction at source and/or by protective measures is not sufficient, further protection of the operator is necessary. For recommendations to the user, see 7.4.2, 5th indent.

5.1.22.4 Noise sources and examples of noise reduction measures

Table 2 shows the main noise sources of long product rolling mills and exemplary design or protective measures. This table is not exhaustive, alternative technical measures for noise reduction with identical or greater efficacy can be used.

Table 2 — Main noise sources of long product rolling mills equipment and exemplary noise reduction measures

Noise source	Examples of noise reduction measures
1 Rolling mills for long products, e.g. — Bar mills — Bloom and Billet mills — Wire rod mills (steel and non-ferrous) — Section mills	— Automate process to reduce exposure to noise (e.g. remote diagnostics, measuring, controls) — Permanent places of work as far away from major sources of noise as possible — Accommodate operating staff in central sound-insulated control rooms with video monitoring of the plant — Avoid large, smooth surfaces, or use sandwich plates or foam — Build low-noise main drives or enclose them
2 Hydraulics	— Use low-noise drives — Use low-noise control elements — Degassing of hydraulic oil — Install drives in sound-insulated rooms (cellar, sound-absorbing cabins)
3 Pneumatics (e. g., blow-off system)	— Pressure reduction — Provide air outlets with sound absorbers — Use low-noise nozzles (multi-tube nozzles) — Enclose or mount compressors in sound-insulated rooms away from workplaces
4 Electrical equipment	— Insulation of frequency converters (e. g. separate rooms)
5 Moving product on roller tables	— Provide low-noise drives — Adapted roller table speed — End stopper with dampening material
6 Exhaust or ventilation systems	— Low-noise fans — Install drives in sound-insulated rooms

Table 2 *(continued)*

Noise source	Examples of noise reduction measures
7 Saws, shears and abrasive cutting	— Enclosures — Scrap box in cellar — Scrap-openings as small as possible — Sound absorbing entry and exit tunnels
8 Descaling units	— Housing

5.1.23 Vibrations

Vibrations shall be considered at the design stage, see EN 1299.

Harmful hand-arm vibration at long product rolling mills cannot be expected.

Where the risk of whole-body vibration is given, measurement according to EN 1032 shall be made.

5.1.24 Loss of energy

In case of loss of energy (hydraulic, pneumatic, electric) all components shall take a safe position.

Where applicable, an emergency power supply shall be provided which meets the requirements of EN 50171.

In case of re-supply of energy after interruption, any uncontrolled re-start shall be avoided according to EN 1037.

The control systems and devices shall meet the requirements of 9.4 of EN 60204-1:1997 and EN ISO 13849-1.

5.1.25 Product monitoring systems

If a product monitoring systems is a safety related control systems, Annex A shall be applied.

5.1.26 Linked Equipment

For the equipment linked to long product rolling mills, e.g.:

a) exhausting systems (e.g. de-dusting system),

b) energy supply (e.g. electrical power, compressed air, gases, steam),

c) auxiliary equipment and systems,

respective instructions and safety measures for the take-over-points shall be given in the information for use.

5.2 List of significant hazards, hazardous situations, safety requirements and/or measures

Table 3 is developed to allow the designer and manufacturer of the equipment to apply a logical approach for checking the design against the list of significant hazards with respect to long product rolling mills.

Table 3 is structured as follows:

a) Column 1 identifies the significant hazards;

b) Column 2 describes the hazardous situations;

c) Column 3 specifies the safety requirements and/or measures to avoid or minimize the hazards and hazardous situations; they are shown as combined measures or as options;

d) Column 4 makes reference to the relevant clauses or standards defining the measures. All references shown are applicable to each of the measures except where this is otherwise indicated;

NOTE When implementing safety requirements and/or measures it has to be considered that different hazards may appear at the same time.

e) Column 5 identifies the verification methods to be used to demonstrate conformity; verification may involve more than one of the following methods:

1) V: Visual inspection verifies the required features of the components.

2) P: A test/check verifies that the features provided perform their function in such a way that the requirement is met.

3) M: Measurement verifies that requirements are met to the specified limits.

4) D: Drawings and/or calculations verify that the design characteristics of the components provided meet the requirements.

Table 3 — Significant hazards, hazardous situations, safety requirements and/or measures

Column 1	Column 2	Column 3	Column 4	Column 5
Significant hazard	**Hazardous situation**	**Safety requirements and/or measures**	**Reference**	**Verification**
5.2.1 General				
1 Combination of hazards	1.1 Unexpected movement during maintenance	1.1.1 Risk reduction by design (e.g. counter weight to achieve stability, low centre of gravity) or	5.1.19	D, V
		1.1.2 Where equipment has to be held in a defined position and the risk of unexpected movement is given, mechanical restraining devices shall be provided and	5.1.19	D,V
		1.1.3 Operating/maintenance instructions	7.4	D
	1.2 Cobbling products at wire rod mills	1.2.1 Continuous monitoring of (running) product by detecting systems (e.g. optical means like photocells, infrared or specific camera systems)	5.1.25	D, V
		1.2.2 Exit and entry monitoring at every part of the mill e.g. stands, groups of stands, shears, rolling blocks, cooling equipment, laying head (exception: coiler)	5.1.25	D, V
	1.3 Damage of cables or hoses	1.3.1 Provision of protecting devices (e.g. covers, power track, cable winding device, cable-holding trolley) for the cables and hoses supplying energy to the equipment	5.1.24	D, V
2 Slip, trip, fall	2.1 Icing at water cooled areas	2.1.1 Icing should be considered during planning of workplaces and walkways		
3 Damage to airways and lungs	3.1 Inhalation of dust	3.1.1 Ventilation or exhaust systems or other means	5.1.26	D, V, M

Table 3 — *(continued)*

Column 1	Column 2	Column 3	Column 4	Column 5
Significant hazard	**Hazardous situation**	**Safety requirements and/or measures**	**Reference**	**Verification**
4 Crushing, shearing, impact, drawing-in or trapping	4,1 Operator intervention at boundary positions between handling/tilting/lifting equipment and parts of equipment	4.1.1 Risk reduction by design avoiding accessible spaces and reducing operator intervention opportunities by filling in, e. g., space between roller table and mill stand and/or	5.1.6 5.1.7	D
		4.1.2 Provide guards	5.1.7	V ,D
5 Noise	5.1 Exposure to noise	5.1.2 Noise reduction at workplaces	5.1.22	M, P
		5.1.3 Operating/maintenance instructions	7.4	D
6 Vibration	6.1 Exposure to hand-arm and whole-body vibration	6.1.1 Vibration reduction at work stations	5.1.23	M, P
5.2.2 Bridges and underpasses				
1 Impact	1.1 Cobbled product occurs in a manner likely to endanger persons	1.1.1 Positioning in front (reversing mode) and behind mill stands and behind shears and roller straightening equipment at a distance where product cannot endanger persons or	5.1.4	V, D
		1.1.2 Providing of covers or protective cages or deflectors	5.1.5	
2 Slip, trip, fall	2.1 Fall from the bridge	2.1.1 Guard-rail/fencing and	5.1.8	V, D
		2.1.2 Provision of safe access	5.1.5	V, D
	2.2 Contamination or flooding by water, scale, lubricants or emulsion	2.2.1 Slip-resistant flooring materials (e. g., grating, chequer plate) easy to maintain and clean and	5.1.5	D
		2.2.2 Draining system and	5.1.15	V, D
		2.2.3 Use of stairs with suitable handrails	5.1.5	V, D
	2.3 Damage of bridges caused by vehicle, cranes or crane loads	2.3.1 Bridge fixed in position (e. g., by welding or bolting) and	5.1.3 5.1.4	V, D
		2.3.2 High visibility colouring	5.1.9	V, D
	2.4 Thermal stress distortion of bridges	2.4.1 Expansion joints and/or		V, D
		2.4.2 Heat shields		V, D
3 Burns, scalds	3.1 Thermal radiation. Ejection or fall down of scale or product. Hot pressurised water or steam.	3.1.1 Covering and/or	5.1.16	V, D
		3.1.2 Heat protection, e. g., by fine mesh grid	5.1.7 5.1.14 5.1.16 EN ISO 13732-1	V
5.2.3 High-pressure descaling units				
1 Ejection of parts	1.1 Ejected scale	1.1.1 Prevent ejection of scale by, e. g., chain screen	5.1.7	V, P, D
2 Slip, trip, fall	2.1 Water and scale present on floors	2.1.1 Cover the emission of scale, steam and water and diverting them to non hazardous areas and/or	5.1.7	V, D
		2.1.2 Slip resistant flooring materials (e. g., grating)	5.1.5	V, P, D

Table 3 — *(continued)*

Column 1	Column 2	Column 3	Column 4	Column 5
Significant hazard	**Hazardous situation**	**Safety requirements and/or measures**	**Reference**	**Verification**
3 Burns and scalds	3.1 Ejected hot pressurised water or steam	3.1.1 Cover the emission points of scale, steam and pressurised water	5.1.7	V, D
	3.2 Flailing hoses	3.2.1 Cover or	5.1.7	V, D
		3.2.2 Deterring/impeding device at safe distance and warning signs	5.1.4 5.1.8 5.1.9	V, D
	3.3 Thermal radiation	3.3.1 Heat shields	5.1.7 5.1.16	V, D
5.2.4 Roller tables and conveyors				
1 Crushing	1.1 Product projecting over the end of the roller table	1.1.1 Provide end stops or	5.1.7	V, D
		1.1.2 Looper or		V, D
		1.1.3 Emergency run-out (e.g., tunnel/ pipe for section mill)		V, D
	1.2 Reaching into chain or belt drives	1.2.1 Fixed enclosing guard for chains, sprockets, belts and pulleys	5.1.6.6	V, D
2 Entanglement	2.1 Access to rotating drive shafts	2.1.1 Provide guards	5.1.7 5.1.6.6	V, D
3 Drawing-in or trapping	3.1 Access to rotating rollers or to product in motion (generally)	3.1.1 Filling in of in-running nips or	5.1.6.6	V, D
		3.1.2 Fixed enclosing guards or distance guards or	5.1.7 5.1.6.6	V, D
		3.1.3 Guard rail, if product is transported only and travelling speed < 1,5 m/s	5.1.8	V, D
4 Impact	4.1 Product cobbling	4.1.1 Minimising of gaps in roller tables and		V, D
		4.1.2 Installation of guide tables and		V, D
		4.1.3 Product guides and	5.1.3	V, D
		4.1.4 Covers or protective cages or deflectors to ensure that the cobbled product is stored in / diverted to a non hazardous area and	5.1.7	V, D
		4.1.5 Operating/maintenance instructions: no crossing or standing on/nearby roller tables during the running process	7.4.3.3	V
5 Slip, trip, fall	5.1 Roller/apron gaps Contamination by grease, emulsion, scale	5.1.2 Prevent escape of grease, emulsion and scale and	5.1.7	V, D
		5.1.3 Slip resistant flooring materials (e. g., grating, chequer plate) easy to maintain and clean and	5.1.5	D
		5.1.4 Use of stairs with handrails for access and	5.1.8	V, D
		5.1.5 Operating/maintenance instructions: information on temporary walkways for access	5.1.4 7.4.3.3	V

Table 3 — *(continued)*

Column 1	Column 2	Column 3	Column 4	Column 5
Significant hazard	**Hazardous situation**	**Safety requirements and/or measures**	**Reference**	**Verifi-cation**
	5.2 Fall into	5.2.1 Covering of floor openings or	5.1.7	V, D
	— scale flume — emulsion pits	5.2.2 Guard-rails	5.1.8	V, D
6 Burns	6.1 Contact with hot products, hot machine parts in case of maintenance and trouble shooting and/or thermal radiation of products	6.1.1 Heat protection (e.g., movable heat shields for scrap removal) and/or	5.1.16	V, D
		6.1.2 Enclosing guard or	5.1.7	V, D
		6.1.3 Deterring/impeding device (guard-rail) at an appropriate distance and	5.1.8	V, D
		6.1.4 Operating/maintenance instructions: PPE	7.4.3	V
7 Burns, fall	7.1 Wire rod mills: Fall onto the conveyor	7.1.1 Provide guards or	5.1.7	V, D
		7.1.2 Guard rail, if product is transported only and travelling speed < 1,5 m/s	5.1.8	V, D
5.2.5 Rolling stands				
1 Crushing, shearing, squeezing ,	1.1 Automatically or semi-automatically controlled movements of changing devices (rolling stands, rolls, guides, tools)	1.1.1 Provide guards and/or	5.1.7	V, D
		1.1.2 Trip devices	5.1.6 5.1.12	V, P, D
	1.2 Hold-to-run controlled sequence of movement of changing devices (rolling stands, rolls, guides, tools)	1.2.1 Movements of the changing process shall be controlled by a hold-to-run control with full view of the danger zone and	5.1.18	P, D
		1.2.2 Clearance between changing devices and fixed structure (except the roll changing interface) or walls shall not be less than 500 mm and		P, D
		1.2.3 Mechanical restraint to prevent overrun of carriage to within 500 mm of fixed structures and	5.1.19	M, D
		1.2.4 Visible and audible warning devices and	5.1.9	D, P
		1.2.5 Operating/maintenance instructions	7.4.3.3	V, D
	1.3 Spindle falling during rolling stand or roll changing	1.3.1 Clamping device holding the spindle in a safe position and	5.1.19	V, P, D
		1.3.2 Operating/maintenance instructions	7.4.3.3	V, D
	1.4 Movement of parts, e. g., work roller tables, tilting and shifting devices, entry guides, cobble deflectors, during operation	1.4.1 Provide guards or	5.1.6 5.1.7	V, D
		1.4.2 Trip devices and	5.1.6 5.1.12	V, P, D
		1.4.3 Operating/maintenance instructions	7.4.3.3	V
2 Entanglement, drawing-in or trapping	2.1 Access to rotating drive shafts, couplings and rolls	2.1.1 Provide covering or	5.1.6.6	V, D
		2.1.2 Fixed guard (e.g., fence)	5.1.7	V,

Table 3 — *(continued)*

Column 1	Column 2	Column 3	Column 4	Column 5
Significant hazard	**Hazardous situation**	**Safety requirements and/or measures**	**Reference**	**Verification**
3 Impact	3.1 Product cobbling	3.1.1 Provide product guides and deflectors and/or		V, D
		3.1.2 Fixed or movable guards between stands and	5.1.7	V; D
		3.1.3 Automatic operation shall only be possible if guards are closed and	5.1.6	P
	3.2 Inspection under load	3.2.1 Operating/maintenance instructions	5.1.6.4 7.4.3.4	V
4 Ejection of parts	4.1 Rupture of product or parts	4.1.1 Provide fixed guards (e. g., covering for wire rod fast finishing block and downstream equipment up to laying head)	5.1.7	V, D
	4.2 Roll or product fracture	4.2.1 Shut-down of the mill or for continuous mills: start of the emergency scrapping shear, if available, and afterwards shut-down of the mill	Annex A	D
	4.3 Break of mechanical overload safety devices (e. g., breaker blocks, shear bolts)	4.3.1 Covering capable of containing ejected parts	5.1.7	V, D
5 Slip, trip, fall	5.1 Falling from machinery or into pits	5.1.2 Platforms with guard-rails, access ways or ladders on and in rolling mill stands and	5.1.3	V, D
		5.1.3 Covering of floor openings or	5.1.7	V, D
		5.1.4 Deterring/impeding device (guard-rail)	5.1.8	V, D
	5.2 Slipping and falling due to lubricants, water or scale	5.2.1 Slip resistant flooring, easy to maintain and clean and	5.1.5	V, D
		5.2.2 Restriction of lubricants, water, scale or		V
		5.2.3 Diversion into containers or to provided areas	5.1.15	V, D
6 Burns	6.1 Contact with hot surfaces of machinery (rolls) and/or process products	6.1.1 Guards and	5.1.6 5.1.7	V, D
		6.1.2 Operating/maintenance instructions: PPE	5.1.11 5.1.16 7.4.3.3	V
	6.2 Scrap removal	6.2.1 Movable or fixed radiation protection shields and	5.1.7 5.1.16	V
		6.2.2 Operating/maintenance instructions: PPE	5.1.11 7.4.3.3	V
	6.3 Dropping of scale or product parts	6.3.1 Avoid access by guards to such areas (e. g., scale flume)	5.1.6 5.1.7	V, D

Table 3 — *(continued)*

Column 1	Column 2	Column 3	Column 4	Column 5
Significant hazard	**Hazardous situation**	**Safety requirements and/or measures**	**Reference**	**Verifi-cation**
7 Thermal radiation	7.1 Exposure to heat radiation while controlling (eye cataracts or burns)	7.1.1 Operating/maintenance instructions: PPE; remote measuring and testing device	7.4.3.3	V
8 Damage to skin, airways and lungs	8.1 Inhalation of aerosol or vapours	8.1.1 Ventilation or other means and	5.1.13	V, D
		8.1.2 Use of lubricants with lower toxic risk and	Annex B; B.2.2	V
		8.1.3 Operating/maintenance instructions: PPE	5.1.11 7.4.3.3	V
	8.2 Inhalation of dust	8.2.1 Ventilation or exhaust systems or other means (e. g., water curtain)	5.1.26	V
5.2.6 Rolling blocks (wire rod mills and high speed bar mills)				
1 Crushing, shearing, burning	1.1 Access to danger zone: Contact to product in rolling process and/ or cobbling product	1.1.1 Complete covering with interlocking guard during rolling process and	Annex A; A.2	V, D
		1.1.2 Adjustment only with hold-to-run-control and	5.1.18	V, D
		1.1.3 Provision of process monitoring, e.g. rip cords to initiate emergency shears when cobbling occurs in the block and	Annex A	V, D
		1.1.4 Provision of sufficient space (in the block) for cobbled product in order to ease scrap removal		V, D
5.2.7 Cross transfers, collecting beds and tilting devices				
1 Crushing, shearing, cutting	1.1 Movement of the entire device	1.1.1 Provide guards and/or	5.1.6 5.1.7	V, D
		1.1.2 Trip device	5.1.6 5.1.12	V, D
		1.1.3 Operating/maintenance instructions:	5.1.11	V
2 Burns, heat radiation and convection	2.1 Contact with hot surfaces of machinery and/or product	2.1.1 Provide guards and	5.1.6 5.1.7	V, D
		2.2.2 Operating/maintenance instructions: PPE	5.1.11 5.1.16 7.4.3.3	V
5.2.8 Pulpits and control stands				
1 Slip, trip and fall	1.1 Access to pulpits and control stands	1.1.1 Access between two levels only by stairs	5.1.5	V, D
	1.2 Escape from pulpits and control stands in case of danger	1.2.1 Safe escape way to a protected area and	5.1.2 5.1.4	V, D
		1.2.2 Escape ways for pulpits only built by stairs and	5.1.5	V, D
		1.2.3 Slip resistant flooring material and	5.1.5	D
		1.2.4 Marking of escape routes	5.1.9	V

Table 3 — (continued)

Column 1	Column 2	Column 3	Column 4	Column 5
Significant hazard	**Hazardous situation**	**Safety requirements and/or measures**	**Reference**	**Verification**
2 Heat, cold, draught, burns	2.1 Hot or cold work environment at pulpits	2.1.1 Thermal isolation or	EN ISO 11064-1	M, D
		2.1.2 Heat reflecting windows and/or	EN ISO 11064-1	M, D
		2.1.3 Air conditioning	EN ISO 11064-1	D
	2.2 Draught conditions at control stands	2.2.1 Provide fixed or movable protection walls	5.1.7	V
3 Impact, ejection of parts	3.1 Cobbling product	3.1.1 Location at a safe distance or		V, D
		3.1.2 Detection of cobbling product (e. g., by light beams or scanner) and emergency stop of main drive	5.1.25	P, D
	3.2 Roll or saw blade fracture. Break and ejection of parts (e. g., guides).	3.2.1 Location at a safe distance or		V, D
		3.2.2 Impact resistant glass/adequate product and walls	EN 1063	D
	3.3 Impact by vehicles, cranes or travelling load	3.3.1 Select a safe location and	5.1.2 5.1.3 5.1.4	V, D
		3.3.2 Collision protection (e. g., by fencing, bollards) robustly fixed in position and	5.1.2 5.1.3 5.1.4	V, D
		3.3.3 Firm fixture to the building structure and	5.1.3	D
		3.3.4 Marking of areas to be protected and	5.1.9	V
		3.3.5 Visibility colouring of pulpits and		V
		3.3.6 Operating/maintenance instructions: crane passage with load prohibited	7.4.3.3	V
4 Crushing, entangling, burning	4.1 Wire rod mills: Cobbling during process or cobbled product during scrap removal	4.1.1 Special armour plated housing for control stands adjacent to running product	5.1.7	V, D
5 Interference with, e. g., speech communication, acoustic signals in pulpits	5.1 Wrong information, operation error	5.1.2 Noise protected pulpits	5.1.22	M, D
		5.1.3 Operating/maintenance instructions: wearing of special PPE at control stands	7.4.3.3	V, D
6 Vibration	6.1 Transmission of vibrations	6.1.1 Design and construction of the pulpit in such a way that it is dampened and disconnected from vibration sources	EN 614-1: 2006+A1:2009; 4.4 EN 1299	D
7 Musculoskeletal damage	7.1 Bad design of work equipment	7.1.1 Design taking into account ergonomic principles, e.g., suitable and adjustable seats	5.1.21	V, D

Table 3 — *(continued)*

Column 1	Column 2	Column 3	Column 4	Column 5
Significant hazard	**Hazardous situation**	**Safety requirements and/or measures**	**Reference**	**Verification**
8 Impaired vision	8.1 Operator error caused by insufficient lighting or dazzle	8.1.1 Provide sufficient and non-dazzling lighting and	EN 614-1: 2006+A1:2009; 4.4	V, D
		8.1.2 Positioning of the light sources to minimize dazzling and/or	EN 1837	V, D
		8.1.3 Provide tinted glass/adequate material to prevent dazzle from outside		V, D
	8.2 Operator error caused by insufficient visibility or lack of visibility	8.2.1 All areas to be controlled shall be directly or indirectly (e.g., CCTV or mirrors) visible from the main pulpit		V
9 Mental over-load, fatigue of the operator, decrease in concentration	9.1 Overstressing caused by excessive number of screens and controlling instruments	9.1.1 Automatic operation where possible and	5.1.12 Annex A	D
		9.1.2 All safety related information requiring action by the operator shall be indicated at the main monitor and	EN 894-1, EN 894-2, EN 894-3	V, D
		9.1.3 Information that have to be observed permanently by the operator shall be shown on only one or two monitors	5.1.21	V
5.2.9 Measuring devices and display units				
1 Burns from lasers	1.1 Eye or skin contact (directly or by reflection)	1.1.1 Reflections shall be avoided by design and	EN 12254 EN 60825-4	D
		1.1.2 If possible, use of low energy lasers and a defined, controlled beam path or	EN 60825-1	P, D
		1.1.3 In case of high energy lasers, class 3 B or higher, interlocking guards or trip devices shall be provided to switch-off the laser or activate a beam trap and	5.1.7 EN 60825-1 Annex A; A.2	V, D,
		1.1.4 Optical warning device and	5.1.9	P, D
		1.1.5 Screens for laser working places and	EN 12254	V, D
		1.1.6 Safety marking and	5.1.9 EN 60825-1: 2008; 5; 6; Table D2	V, D
		1.1.7 Operating/maintenance instructions: PPE	5.1.11 7.4.3.3	V
2 Ionizing radiation sources	2.1 Radiation from — sealed radioactive sources, — X-ray generators.	2.1.1 Radiation protection: — Segregation of the ionizing radiation beam by the use of interlocked guards (enclosures) designed to prevent access and	5.1.7 5.1.12	D

Table 3 — *(continued)*

Column 1	Column 2	Column 3	Column 4	Column 5
Significant hazard	**Hazardous situation**	**Safety requirements and/or measures**	**Reference**	**Verification**
		— Mandatory enclosing of emitters (e. g., shutter mechanism)	5.1.7 5.1.12	D
		2.1.2 When installing sources, consideration shall be given to:		
		— Location and integrity of installation (physical damage to source housing location and installation shall be such that any radioactive source cannot be dislodged and consequently damaged by moving machinery/product) and	5.1.10	D
		— Emission warning device (optical) and	5.1.9	P, D
		— Warning signs outside of enclosure and	5.1.9	V
		— Operating/maintenance instructions: Written procedures for access and for work in or around the enclosure. In the maintenance and handling instructions of sealed radioactive sources give information on the action to be taken when replacing, removing and disposing of radioactive sources	7.4.3.3 7.5	V
3 Crushing	3.1 Touching of moving machine parts and/or moving equipment in automatic mode	3.1.1 Provide guards	5.1.6 5.1.7	V, D
5.2.10 Hot and cold saws, shears and abrasive cutting machines				
1 Crushing, shearing, cutting	1.1 Movement of sleds, movement of scrap/ chip receiving buckets or carriages. Closing of clamping devices. Motion of the entire machine.	1.1.1 Provide interlocking guards and/or	5.1.6 5.1.7	V, D
		1.1.2 Trip devices	5.1.6	V, D
	1.2 During maintenance (e. g., changing, adjusting/ setting)	1.2.1 Prevent unexpected movement (e. g., mechanical restraint devices)	5.1.19	V, D
	1.3 Touching of scrap	1.3.1 Operating/maintenance instructions: PPE, e. g., gloves	5.1.11	V
	1.4 Shears for wire rod mills and high speed bar mills: Movement of the machine, cutting movement, exit of cobbling product, ejection of parts	1.4.1 Complete covering with interlocking system (e.g., for doors) and if necessary cobble detecting system in the shear	5.1.7 Annex A; A.2	V, D
2 Impact	2.1 Dropping pieces of scrap or crop ends	2.1.1 Provide guards and	5.1.7	V, D
		2.1.2 Protect accesses to scrap chutes and pits in operation and	5.1.6	V, D
		2.1.3 Use of guiding and/or deflecting equipment (guard, safety catch)	5.1.7 5.1.19	V, D
3 Ejection of parts	3.1 Rupture of cutting tool	3.1.1 Provide covering	5.1.7	V, D
	3.2 Damage of the cutting device due to cobbled product	3.2.1 Dimensioning of the cutting device to withstand cobbled product and/or	5.1.7	D

Table 3 — (continued)

Column 1	Column 2	Column 3	Column 4	Column 5
Significant hazard	**Hazardous situation**	**Safety requirements and/or measures**	**Reference**	**Verification**
	a)	3.2.2 cobble detecting in the shear and/or	5.1.25	V, D
		3.2.3 provide covering	5.1.7	V, D
4 Fall	4.1 Falling into scrap pits/cellars	4.1.1 Deterring/impeding device (guard-rail) or	5.1.8	V, D
		4.1.2 Covering of floor openings	5.1.7	V, D
5 Cutting, musculoskeletal damage	5.1 Lifting of heavy loads when removing samples	5.1.2 Use of mechanical handling devices (e. g., crane, hoist)	5.1.21	V
	5.2 Contact with cutting burrs	5.2.1 Operating/maintenance instructions: PPE	5.1.11 7.5	V
6 Fire	6.1 Flying sparks, chips	6.1.1 Saw blade/abrasive disc hood and	5.1.7	
		6.1.2 Provide covering and	5.1.7	
		6.1.3 Operating/maintenance instructions: PPE	5.1.11 7.5	V
7 Noise	7.1 Exposure to noise	7.1.1 Noise protective housing and/or	5.1.7	
		7.1.2 Operating/maintenance instructions: PPE	5.1.11 7.5	V
5.2.11 Cooling lines				
1 Slip, trip, fall	1.1 Water and scale present on floors	1.1.1 Cover the emission of scale, steam and water and divert them to non hazardous areas and/or	5.1.7	V, D
		1.1.2 Slip resistant flooring materials (e. g., grating)	5.1.5	V, D
2 Burns and scalds	2.1 Ejected hot pressurised water or steam	2.1.1 Cover the emission points of scale, steam and pressurised water	5.1.7	V, D
	2.2 Flailing hoses	2.2.1 Provide covering or	5.1.7	V, D
		2.2.2 Deterring/impeding device at safe distance and warning signs	5.1.4 5.1.8 5.1.9	V, D
	2.3 Thermal radiation	2.3.1 Heat shields	5.1.7 5.1.16	V, D
5.2.12 Cooling beds				
1 Crushing, impact	1.1 Walking on the equipment during trouble shooting	1.1.1 Provide safe access and	5.1.5 5.1.6	V, D
		1.1.2 Slip resistant flooring materials (e.g., grating)	5.1.5	V, D
	1.2 Running-in product	2.1.1 Provide end stops and		V, D
		2.1.2 Provide guards around the cooling bed with interlocked doors, if necessary and	5.1.7	
		2.1.3 Emergency run-out		V, D

Table 3 — (continued)

Column 1	Column 2	Column 3	Column 4	Column 5
Significant hazard	**Hazardous situation**	**Safety requirements and/or measures**	**Reference**	**Verification**
	1.3 Product cobbling	1.3.1 New product shall not enter the area (e.g., stop of the unloading from the reheating furnace, scrapping of incoming product)		
2 Entanglement	2.1 Rotating drive elements, balancing masses and rollers	2.1.1 Provide guards	5.1.6 5.1.7	V, D
3 Drawing-in or trapping	3.1 Sprockets and chain guides	3.1.1 Provide guards	5.1.6 5.1.7	V, D
4 Slip, trip, fall	4.1 Contamination by fluids, grease and scale. Walking on equipment and adjacent areas. Open drive pits.	4.1.1 Minimizing drop out of lubricants by design and	5.1.13 5.1.14	V
		4.1.2 Slip resistant flooring materials (grating) and	5.1.5	V, D
		4.1.3 Provide access for cleaning purposes and	5.1.5 5.1.6	V, D
		4.1.4 Cover ducts and pits (grid)	5.1.5	V, D
	4.2 Water present on adjacent areas	4.2.1 Slip resistant flooring materials	5.1.5	V, D
		4.2.2 Operating/maintenance instructions: PPE	5.1.11 7.5	V
5 Burns	5.1 Thermal radiation. Touching hot surfaces.	5.1.2 Deterring/impeding device (guard-rail) and safety marking and	5.1.8 5.1.9 5.1.16	V, D
		5.1.3 Operating/maintenance instructions: PPE	5.1.11 7.5	V
6 Fire	6.1 Ignition of the scale/ grease mixture due to thermal radiation	6.1.1 Minimizing drop out of lubricants by design	5.1.13 5.1.14 5.1.20	V
5.2.13 Straightening equipment				
1 Crushing, shearing, squeezing	1.1 Automatically controlled movements of changing devices (straightening machine, mounting bushes/ straightening discs, tools)	1.1.1 Provide guards and/or	5.1.7	V, D
		1.1.2 Trip devices	5.1.6 5.1.12	V, P, D
	1.2 Semi-automatically controlled movement of changing devices (straightening machine, mounting bushes/straightening discs, tools)	1.2.1 Movements of the changing process shall be controlled by a hold-to-run control device with full view of the danger zone. If the final changing is done automatically it shall be started from a control stand with full overview of the danger zone and	5.1.18	P, D
		1.2.2 Clearance between changing devices and fixed structure or walls shall not be less than 500 mm and		P, D

Table 3 — (continued)

Column 1	Column 2	Column 3	Column 4	Column 5
Significant hazard	**Hazardous situation**	**Safety requirements and/or measures**	**Reference**	**Verifi-cation**
		1.2.3 Mechanical restraint to prevent overrun of carriage to within 500 mm of fixed structures and	5.1.19	M, D
		1.2.4 Visible and audible warning devices and	5.1.9	D, P
		1.2.5 Operating/maintenance instructions	7.4.3.3	V, D
	1.3 Movement of parts, e. g., roller tables, entry guides, cobble deflectors during operation	1.3.1 Provide guards and	5.1.6 5.1.7	V, D
		1.3.2 Operating/maintenance instructions	7.4.3.3	V
	1.4 Unexpected movement due to stored energy during maintenance and trouble shooting	1.4.1 Risk reduction by design (e. g., counter weight to achieve stability, low centre of gravity) or		D
		1.4.2 Mechanical restraint device to prevent unexpected movement and	5.1.19 EN 1037; 5.3.2, 6.3	V, D
		1.4.3 Operating/maintenance instructions: mechanical restraining devices are to be used	7.4.3.3 5.1.11	V
2 Cutting	2.1 Touching moving product	2.1.1 Provide guards and/or	5.1.6 5.1.7	V, D
		2.2.2 Photoelectric safety system, if frequent access is necessary	5.1.6 EN 61496-1/A1	P, D
3 Entanglement, drawing-in or trapping	3.1 Access to rotating drive shafts, couplings and mounting bushes/ straightening discs	3.1.1 Provide covering or	5.1.6.6	V, D
		3.1.2 Provide fixed guards (fences)	5.1.7	V,
4 Impact	4.1 Product cobbling	4.1.1 Product guides and deflectors		V, D
5 Ejection of parts	5.1 Rupture of product or parts	5.1.2 Provide fixed guards (e. g., covering)	5.1.7	V, D
5.2.14 Piling equipment				
1 Crushing, impact	1.1 Walking on the equipment during tool change (e. g. combs) or trouble shooting	1.1.1 Provide safe access and	5.1.5 5.1.6	V, D
		1.1.2 Slip resistant flooring materials (grating)	5.1.5	V, D
	1.2 Running-in product	1.2.1 Provide end stops		V, D
2 Entanglement	2.1 Rotating drive elements, balancing masses and rollers	2.1.1 Provide guards	5.1.6 5.1.7	V, D
3 Drawing-in or trapping	3.1 Sprockets and chain guides	3.1.1 Provide guards	5.1.6 5.1.7	V, D

Table 3 — (continued)

Column 1	Column 2	Column 3	Column 4	Column 5
Significant hazard	**Hazardous situation**	**Safety requirements and/or measures**	**Reference**	**Verification**
4 Slip, trip, fall	4.1 Contamination by fluids, grease and scale. Walking on equipment and adjacent areas.	4.1.1 Minimizing drop out of lubricants by design and	5.1.13 5.1.14	V
		4.1.2 Slip resistant flooring materials (grating) and	5.1.5	V, D
		4.1.3 Provide access for cleaning purposes	5.1.5 5.1.6	V, D
	4.2 Open drive pits	4.2.1 Cover ducts and pits (grid)	5.1.5	V, D
5 Noise	5.1 During product transport	5.1.2 Noise reduction by selection of adequate material/combination of materials (e.g., wear parts) and/or		V, D
		5.1.3 Operating/maintenance instructions: PPE		V
5.2.15 Binding machines				
1 Combination of hazards	1.1 Access to parts in automatic motion	1.1.1 Provide guards and doors with guard locking	5.1.6 5.1.7	V, D
	1.2 Strap/binding wire change	1.2.1 Hold-to-run control for threading and	5.1.18	V, D
		1.2.2 Safe deposit of strap/binding wire scrap		
	1.3 Falling of strap coils/wire binding coils	1.3.1 Provision of safe storage devices adjacent to the machine		
2 Musculoskeletal damage	2.1 Manual feeding with strap/binding wire	2.1.1 Provision of auxiliary lifting devices for strap coils/wire binding coils	5.1.21	
3 Cutting	3.1 Handling of strap/binding wire	3.1.1 Operating/maintenance instructions: PPE	5.1.11 7.4.3.4	
4 Noise	4.1 Pneumatic driven equipment	4.1.1 Noise dampening measures, e. g., silencer and	5.1.13 5.1.22.1	
		4.1.2 Operating/maintenance instructions: PPE	5.1.11 7.4.3.4	
5.2.16 Marking machines				
1 Crushing, impact, drawing-in	1.1 Contact with moving parts or product in automatic mode	1.1.1 Prevent access to the device by guards	5.1.5, 5.1.6	D, V
	1.2 Contact with moving parts or product in manual mode	1.2.1 Hold-to-run control	5.1.18	
	1.3 Contact with moving parts of a robot	1.3.1 Safety requirements of a specific standard shall be considered	EN ISO 10218-1	D, V,
2 Slip, trip, fall	2.1 Leakage of the solvent tank, ink tank or piping system	2.1.1 Provide collecting tray under the box and		D, V

Table 3 — (continued)

Column 1	Column 2	Column 3	Column 4	Column 5
Significant hazard	**Hazardous situation**	**Safety requirements and/or measures**	**Reference**	**Verifi-cation**
		2.1.2 Operating/maintenance instructions	7.4, 7.5	V
3 Noise	3.1 Pneumatic marking equipment	3.1.1 Noise dampening measures, e. g., enclosure and/or	5.1.13 5.1.19	
		3.1.2 Operating/maintenance instructions: PPE	7.5	
5.2.17 Loading equipment/collecting tables				
1 Crushing, impact	1.1 Contact with moving parts or product in automatic mode	1.1.1 Provide interlocking guards with guard locking	5.1.5, 5.1.6	D, V
	1.2 Contact with moving parts or product in manual mode	1.2.1 Hold-to-run control and	5.1.18	
		1.2.2 Prevention of running-in product		
	1.3 Product projecting over the end of the equipment	1.3.1 Provide end stops		V, D
2 Entanglement	2.1 Rotating drive elements, balancing masses and roller drives	2.1.1 Provide covers	5.1.6 5.1.7	V, D
3 Drawing-in or trapping	3.1 Sprockets and chain guides	3.1.1 Provide covers	5.1.6 5.1.7	V, D
4 Slip, trip, fall	4.1 Contamination by fluids, grease and scale. Walking on equipment and adjacent areas.	4.1.1 Minimizing drop out of lubricants by design and	5.1.13 5.1.14	V
		4.1.2 Slip resistant flooring materials (grating) and	5.1.5	V, D
		4.1.3 Provide access for cleaning purposes	5.1.5 5.1.6	V, D
	4.2 Open drive pits	4.2.1 Cover ducts and pits (grid)	5.1.5	V, D
5.2.18 Preparation area for stands, rolls, guides, straightening rollers				
1 Crushing, squeezing, impact	1.1 Contact with moving parts in automatic mode	1.1.1 Provide interlocking guards with guard locking and	5.1.5, 5.1.6	D, V
		1.1.2 Warning devices	5.1.9	
	1.2 Contact with moving parts in manual mode	1.2.1 Hold-to-run control and	5.1.18	
		1.2.2 Prevention of running-in devices		
2 Slip, trip, fall	2.1 Contamination by fluids, grease and scale	2.1.1 Minimize drop out of lubricants by design and	5.1.13 5.1.14	V
		2.1.2 Slip resistant flooring materials (grating) and	5.1.5	V, D
		2.1.3 Provide access for cleaning purposes	5.1.5 5.1.6	V, D
	2.2 Open drive pits	2.2.1 Cover ducts and pits (grid)	5.1.5	V, D

Table 3 — (continued)

Column 1	Column 2	Column 3	Column 4	Column 5
Significant hazard	**Hazardous situation**	**Safety requirements and/or measures**	**Reference**	**Verification**
5.2.19 Laying heads for wire rod mills				
1 Crushing, entangling, burning	1.1 Wire break leads to eruption of product	1.1.1 Provide protection hood	5.1.7	
	1.2 Contact to product in process	1.2.1 Provide guards (fencing)	5.1.7	
5.2.20 Collecting chambers for wire rod mills				
1 Burning, fall	1.1 Fall into chamber	1.1.1 Provide guards	5.1.7	
5.2.21 Cooling boxes for wire rod mills				
1 Crushing, entangling, burning	1.1 Contact to product in rolling process and/ or cobbling product	1.1.1 Complete covering with interlocking guard during rolling process	5.1.7	
5.2.22 Pinch rolls for wire rod mills				
1 Crushing, entangling, burning	1.1 Contact to product in rolling process and/ or cobbling product	1.1.1 Complete covering with interlocking guard during rolling process	5.1.7	

6 Verification of the safety requirements and/or measures

It is necessary to verify that all requirements of this standard have been incorporated in the design and manufacturing of long product rolling mills.

The verification required is defined in Table 3 of 5.2. Verification of electrical safety shall be made according to EN 60204-1 and for the noise according to the noise test code given in Annex C.

Verification should take place after completion of commissioning.

If partial disassembly is necessary, e.g., to gain access it shall not affect the function being verified. Safety devices put out of operation for verification shall be restored before verification is completed.

7 Information for use

7.1 General

An instruction handbook shall be provided according to 6.4 of EN ISO 12100:2010.

In addition to these requirements, the instruction handbook shall include the following information:

a) name and address of the manufacturer or where applicable the authorized representative;

b) declaration of series or type;

c) EC declaration of conformity;

d) information on noise emission, see 7.4.2;

e) vibration total value to which the hand-arm system is subjected, if it exceeds 2,5 m/s^2; where this value does not exceed 2,5 m/s^2, this must be mentioned;

f) highest root mean square value of weighted acceleration to which the whole body is subjected, if it exceeds 0,5 m/s^2 according to 5.1.23; where this value does not exceed 0,5 m/s^2, this must be mentioned;

g) uncertainty of measurement.

NOTE 1 Experience has shown that the magnitude of hand-arm vibration of these machines is in general significantly below 2,5 m/s^2.

NOTE 2 This single whole-body vibration emission value determined under particular operating condition is not representative for the various conditions in accordance with the indented use of the machinery. Consequently, this single whole-body vibration emission value declared by the manufacturer in accordance with this European Standard is not indented to determine the whole-body vibration exposure to the operator of the machinery.

NOTE 3 Information to the uncertainty of vibration measurement and the declaration of verification of vibration values are given in EN 12096.

7.2 Warning devices and safety signs

Warning devices and safety signs shall be in accordance with 5.1.9.

7.3 Minimum marking

The following information shall be attached clearly and durably to long product rolling mills (e.g. in the pulpit):

a) name and address of manufacturer and where applicable the name and address of the authorized representative;

b) designation of the machinery;

c) designation of series or type, if any;

d) mandatory marking[1)];

e) serial number/machine number, if any;

f) year of construction, that is the year in which the manufacturing process is completed.

In accordance with EN 60204-1, the auxiliary electrical equipment shall be fitted with durable plates containing data, including casing protection grade.

7.4 Accompanying documents

7.4.1 Instruction handbook

An instruction handbook for each machinery/equipment shall be provided by the manufacturer. In this manual, the characteristics and measures to the specific machine/equipment shall be designated. The following items describe exemplary the structure and content of an instruction handbook and shall be completed or extended in consideration of the specific equipment.

7.4.2 Machine/equipment declaration

If applicable, the following information shall be given:

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1) For machines and their related products intended to be put on the market in EEA, CE marking as defined in the European applicable directive(s), e.g. Machinery, Low Voltage, Explosive Atmosphere, Gas appliances.

a) name and address of manufacturer, and where applicable the name and address of the authorized representative;

b) designation of series or type;

c) EC declaration of conformity;

d) technical documents (circuit diagrams, data sheets, information/reference for spare parts);

e) for intended use, details to interfaces of additional/optional machinery;

f) for non-intended use (e.g. forbidden use of specific auxiliary equipment, prohibition of specific products);

g) information about noise emission according to Annex C of this standard, where necessary recommendation to e.g.,

   1) implement enclosures, screens by the user,

   2) use of cabins for the personnel,

   3) wear hearing protection,

   4) visual sign posting of noisy areas;

h) description of auxiliary equipment and the installation of the control system of these (e. g., emergency stop, effect of the safety devices).

7.4.3 Detailed information/instructions

7.4.3.1 Safety layout

According to 5.1.4.

7.4.3.2 Instruction for transportation, assembly and disassembly of the equipment

If applicable, the following information shall be given:

a) instructions for safe lifting (e.g. transport rig, ring bolt, centre of gravity);

b) transportation weight;

c) transport safety devices and removal of these before commissioning;

d) instructions for correct connection of take-over-points;

e) unauthorised reconstruction and modification;

f) plant layout/installation conditions (e.g. foundation guide drawings), requirements to the building);

g) reference to installation/assembly of the machinery or single parts of the machine particularly where machine position or adjacent elements of the building provide safeguards or risk reduction;

h) details on the fume and dust emission and arrangements provided for connection to extraction system.

7.4.3.3 Information about commissioning/assembly and de-commissioning/dismantling of the equipment

Detailed information shall be given concerning associated significant risks and necessary remedial measures. In particular, it shall include the following details:

a) energy supplies (electric, hydraulic, pneumatic);

b) filling amounts;

c) specification of fluids;

d) fitting of special devices;

e) safe starting, operation and shut-down;

f) inspection and proofing of safety devices before commissioning;

g) unauthorised reconstruction and/or modification with regard to intended use;

h) residual risks in areas surrounded by guards and guard-rails;

i) instruction for de-commissioning/dismantling (e.g. advice on characteristic hazards like disposal of high pressure fluids, emptying instructions, handling of radioactive materials, etc);

j) reference to qualification of operation personnel;

k) instruction for flooding in case of leakage;

l) information concerning the need of PPE and use.

7.4.3.4 Operation instructions concerning the equipment

The following operation instructions concerning the equipment shall be given:

a) available safety devices;

b) instruction on safety devices;

c) regular inspection of safety devices;

d) use of mechanical restraint devices during maintenance and troubleshooting;

e) characteristic hazards (e.g. current, hydraulic, especially references to setting up and re-commissioning after setting up);

f) processing materials which generate fume or dust hazardous to human health including cleaning requirements;

g) description of safety related control systems;

h) references about the qualification level of operators;

i) instruction and training to be given to the operator on how to operate the machine;

j) action in the event of faults or irregularities and abnormal operation;

k) references to residual hazards for example:

   1) vibration,

   2) radiation,

   3) inspection under load,

   4) hot surfaces in the working area,

5) ejection of product,

6) ejection of parts of the machine, e. g., parts of saw blades, parts of abrasive cutting blades,

7) ejection of fluids,

8) areas surrounded by guards and guard-rails;

l) references to particular hazards in case of access on special occasions (e.g. maintenance, trouble-shooting) shall be pointed out in the instruction handbook and on the machine by markings/symbols referring to the nature of hazard (see EN 61310-1); if the protective devices are not operational during this action, the necessary actions shall be indicated;

m) references to hazards due to:

1) non-relieved pressures,

2) malfunction of programmable electronic systems,

3) temperature,

4) fire.

7.5 Maintenance manual

In this manual, the measures to the specific machine/equipment shall be designated.

The maintenance manual shall contain instructions for:

a) the testing to be carried out;

b) maintenance work;

c) criteria for repair work;

d) isolation, elimination or reduction to a non-hazardous level of energy sources;

e) protective measures against hazardous situations;

f) those maintenance activities that require special knowledge or qualification;

g) a periodical inspection programme of the safety devices, and the frequency of these inspections shall be defined at the design stage according to the reliability, nature and importance of the device;

h) preventive measures (e.g. replacement of wear parts, lubrication, etc.);

i) error messages of the control system and the actions resulting from this;

j) which parts of the system(s) shall be switched off during repair work;

k) instructions on existing residual energy (hydraulic reservoir, etc.) and its reduction, where necessary;

l) electrical isolation and grounding required during maintenance and repair;

m) warning in case of hot surfaces;

n) references to residual hazards for example:

1) radiation,

2) hot surfaces in the working area,

3) stored energy,

4) ejection of product,

5) ejection of parts of the machine,

6) ejection of fluids,

7) access to hazardous areas after removal of guards and guard-rails.

The maintenance manual shall contain:

o) the safety layout;

p) specification of spare parts when these affect the health and safety of the operators (e.g. with reference to drawings or circuit diagrams);

q) fault lists indicating causes of trouble and measures to be taken.

For further examples of safety instructions given by the manufacturer for maintenance work, see Annex E.

Annex A
(normative)

Safety requirements and/or measures for control systems at long product rolling mills

A.1 General

General and specific requirements and additional measures for electrical equipment, safety related control systems and shut down equipment to be selected are described below. The special conditions for complex installations are to be taken into account by the manufacturer.

The manufacturer shall identify through an individual risk assessment (see Clause 4 of EN ISO 12100:2010) which electrical hazards are significant for equipment (see Clause 4 of EN 60204-1:2009) and the quoted effects of Table A.1.

All necessary measures shall be taken in order to preclude electrical hazards at the machines. The relevant clauses of EN 60204-1 shall be complied with.

The risk assessment shall determine the IP class according to EN 60529 of any electrical equipment to be used, for details see 10.1.3 and 12.3 of EN 60204-1:2009.

NOTE The IP-code classification only takes into account the ingress of water and not of other fluids.

Where access to a danger zone is required for any reason during normal operation, the safety related control system of the equipment shall be in accordance with the appropriate performance level and category given in EN ISO 13849-1. The selection of the appropriate performance level and category shall be based on the individual risk assessment and in compliance with 6.2 and Table 10 of EN ISO 13849-1:2006. If the access is required for the operations described as examples in Annex A of EN 1037:1995+A1:2008, the measures defined in EN 1037 shall be employed (see 5.4, 5.5 and 5.6 of EN 60204-1:2009).

A.2 Special requirements for controls

When designing the control system the cycle time of the programmable logic control (PLC) system should be taken into account because it takes some time for the PLC to scan input, process data and set output. Depending on where the PLC “looks” at the time of the signal input the delay caused by the PLC will randomly vary. Often such a variation can cause additional hazards. It is advisable to use an interrupt function to get constant quick response from the PLC for functions that can cause hazards (e.g. by hold-to-run control).

Controls frequently include safety functions; in which case they are classified under the general term "safety-related parts of controls" of EN ISO 13849-1. Safety-related controls shall at least be designed corresponding to required performance level PLr=c in conjunction with at least category 1 according EN ISO 13849-1.

Where access to a danger zone is required during production, i.e. for inspection and tuning under load (see 5.1.6.4) the protective devices shall correspond at least to required performance level PLr=d with use of at least category 3.

A.3 Special requirements for shut-down equipment

A.3.1 Stop functions/emergency stop functions

In conformity with the requirements of EN ISO 13850, 10.7 and 10.8 of EN 60204-1:2009 and EN 1037, the stop and emergency stop functions in A.3.5 shall be applied.

Furthermore, the following shall be applicable to stop and emergency-stop functions:

a) with interlinked plant forming a production line, it shall be ensured that both the upstream and downstream equipment is shut down. Where stored energies can be a source of danger, they shall be eliminated, isolated or reduced to a level which does not cause a risk. Where required, power shall remain available for certain purposes;

b) preserve the effectiveness of safety devices or equipment with a safety-related function (4.1.2 of EN ISO 13850:2006);

c) preserve the integrity of facilities provided for rescuing stranded personnel from the danger zone (4.1.1 of EN ISO 13850:2006);

d) carry out mechanical movements of machinery for releasing trapped personnel or rescuing injured persons.

Design of the control actuator for the shutdown functions shall be such as to ensure that:

e) there can be no confusion (e.g. by colour and marking, 10.2.1 of EN 60204-1:2006);

f) inadvertent actuation is eliminated/avoided;

g) the control actuators are at all times available and readily and safely accessible (4.4.1 of EN ISO 13850:2006);

h) reactivation shall only be possible by a reset-order.

A.3.2 Specific hazards at mechanical equipment

High accumulated energy exists within the production process because the movement of product, handling equipment, other machinery used and the tools themselves all involve the high speed movement of substantial masses. As a result, it can take a substantial amount of time for the movement of machinery and product to come to a halt. Consequently, product, tools, etc. can have moved a considerable distance before motion is arrested.

Because of the wide range of different types of equipment, differences in drives and control systems, a range of different control systems are needed to bring the plant to a standstill. As indicated above, there remains a risk even when drive power to the plant is switched off because of the high masses and speeds involved. For precautions, see 5.1.6.2.

A.3.3 Selection of stop functions

An uncontrolled stop of the long product rolling mill may lead to severe mechanical damage to the plant and to the dangerous uncontrolled ejection of product and parts of machinery. For this reason, it may be necessary for alternative means of shutdown to be provided, (e.g. quick-stop) in addition to an emergency stop. This alternative means provided may be in the form of one or more manual operations to shut down the separate items of a plant. The selection of stop functions shall be in accordance with Table A.1.

A.3.4 Emergency stop areas

When designing a plant, it shall be determined how the plant shall be subdivided into individual emergency stop areas. The decisions made will be dependent on what parts of the plant machinery can be operated separately and what risks can arise from shutting down independent parts of the plant when other parts are left running.

According to 4.1.1 of EN ISO 13850:2006, any emergency stop system shall be designed in a manner to clearly indicate which emergency-stop controls are assigned to what area.

The size of such plants and their complexity make special demands on protective measures during partial shutdown and restarting.

Therefore, time-delayed visible and audible warning devices (see EN ISO 7731 and EN 842) are to be provided for the re-start of large installations. Key-operated switches should be provided for the personal safety of maintenance staff for defined plant sections.

A.3.5 Stop functions for electrical equipment

Table A.1 shows a compilation of different kinds of applicable stop functions. On the basis of the assessment of all risks, the manufacturer shall select the categories according to EN 60204-1 regarding the given examples and the quoted effects in Table A.1.

Table A.1 — Stop functions

Function	**Stop-Category** according to EN 60204-1	**Setting**	**Location (examples)**	**Effect**
Emergency off	Category 0	— Red mush-room push-button before yellow back-ground and with reclosing lockout (lock) — Main switch — Mechanical device against unintended use might be necessary	— Transformer room — Computer room — Rectifier room — Switch cabinet feeder panel — Not adjacent to oper-ational control desks with category 1 emergency stop (EN ISO 13850) — Separated devices of category 0 emergency stops for different parts of the equipment might be necessary (e.g. for the hydraulic system)	— Immediate power-off — Uncontrolled shut-down — All accumulators which might cause self-starting are relieved — Shut-down of all drives — Application of mechanical brakes — Potentially, rescue of persons by moving units into an open position might not be possible — Cobbling product possible — Ejection of pieces of the rolled product possible — Reactivation shall only be possible by a reset order
Emergency stop	Category 1	— Red mush-room push-button before yellow back-ground and with reclosing lockout (lock) — Main switch — Mechanical device against unintended use on control panels necessary	— Main control desk — Auxiliary control panel — Separated devices of category 1 emergency stops for different parts of the equipment might be necessary (e. g., for the hydraulic system)	— Shut-down of main drives by electric braking (current limit) and/or mechanical braking — Shut-down of auxiliary drives while maintaining operation with self-resetting control. Energy supply is maintained up to the standstill, then power-off — Mechanical damage possible — Potentially, rescue of persons by moving units into an open position might not be possible (see A.3.1) — Cobbling product possible — Ejection of pieces of the rolled product possible — Reactivation shall only be possible by a reset-order

Table A.1 *(continued)*

Function	**Stop-Category** according to EN 60204-1	**Setting**	**Location (examples)**	**Effect**
Normal stop	Category 1	— Push-button or key-operated switch (colour according 10.2.1 of EN 60204-1: 2006) — Monitor-controlled	— Main control desk — Auxiliary control panel	— Stopping of the complete installation: 1st step: production stop 2nd step: interruption of energy supply
Quick stop	Category 2 This does not meet the requirements of an emergency stop or normal stop	— Push-button (colour according 10.2.1 of EN 60204-1: 2006)	— where required	— Maximum possible negative acceleration during shut-down — All operating conditions are maintained — Energy supply remains on during standstill — Possibly automatic standstill monitoring
Production stop (Stop function for normal operating conditions)	Category 2 This does not meet the requirements of an emergency stop or normal stop	— Push-button (colour according 10.2.1 of EN 60204-1: 2006)	— Main control desk and every auxiliary control panel — Usually combined with category 1 emergency stop (see above)	— Stop function for normal operating conditions — All operating conditions are maintained — Energy supply remains on during standstill — Possibly automatic standstill monitoring

Annex B
(normative)

Fluid systems

B.1 Significant hazards

Risks identified as significant as a result of using the equipment were considered when this annex was prepared.

The significant hazards and hazardous situations are shown in Table B.1 together with the appropriate safety requirements and/or measures. This table contains the hazards identified as significant for long product rolling mills and which require measures to eliminate or reduce risks. For easy reference, Table B.1 also indicates the corresponding additional preventative measures in conjunction with B.2 if necessary.

Manufacturers shall identify through their own risk assessment (see Clause 4 of EN ISO 12100:2010) which of the hazards listed below are significant for custom-made equipment. Additional significant risks identified in the individual risk assessment shall be dealt with according to EN ISO 12100.

B.2 Safety requirements and/or measures

B.2.1 General

Equipment shall comply with the safety requirements and/or measures of B.1 and B.2. In addition, the equipment shall be designed according to the principles of EN ISO 12100 for hazards relevant but not significant which are not dealt with by this European Standard.

If more than one measure is necessary to safeguard a hazard then all the necessary measures shall be used. When selecting the safety requirements and/or measures it has to be considered that different hazards may appear at the same time.

Hydraulic fluid systems shall meet the requirements of EN ISO 4413.

B.2.2 General design requirements

If applicable, the manufacturer of the equipment shall design the systems to provide practical solutions for the following:

a) accessibility,

b) visibility of operation,

c) maintenance and cleaning clearances,

d) movement of machine and product,

e) safety in operation,

f) health and safety at workplace,

g) prevention of pollution and

h) fire protection.

Fluid systems carrying or containing fluids which are likely to solidify and/or have high or low viscosity shall be protected against the effects of extreme temperature which can influence the functionality of the fluid and can subsequently lead to potential damage of parts of the equipment.

Sufficient ventilation and/or other means shall be provided for cooling/lubrication systems to minimize hazardous effects.

Where the risk of spilling of fluids in case of leakage at permanent workplaces or nearby hot metal is given, covering of flanges, fittings and hoses shall be provided.

Fluids (e.g. lubricants, hydraulic fluids) could be harmful. The manufacturer shall take care of the chemical composition of the fluids and shall inform the user accordingly (see 7.4.3.3, 3rd indent).

The manufacturer shall state that drains, which form part of the equipment, shall discharge into a suitable isolated sump.

B.2.3 List of significant hazards, hazardous situations, safety requirements and/or measures

Table B.1 is a comprehensive presentation of identified significant hazards for hydraulic, pressure water and lubrication systems (column 1 of Table B.1), the situations that give rise to the hazards (column 2 of Table B.1), the safety requirements to reduce risks (column 3 of Table B.1), reference to appropriate standards (column 4 of Table B.1) and means of verifying the implemented safety requirements and/or measures (column 5 of Table B.1). See 5.2 for further information with regard to the columns and verification.

Table B.1 — List of significant hazards, hazardous situations, safety requirements and/or measures

Column 1	Column 2	Column 3	Column 4	Column 5
Significant Hazards	**Hazardous Situation**	**Safety Requirements and/or Measures**	**References**	**Verification**
B.2.3.1 Hydraulic, pressure water and lubrication systems				
1 High pressure fluid ejection which may cause injury to persons	Hose or pipe break due to:			
	1.1 inadequate dimensions of hoses, pipes and fittings	1.1.1 Use of adequately dimensioned hoses, pipes and fittings and	EN 13480-3 EN 1591-1	D
		1.1.2 Selection of component material	B.2.3 EN 13480-2	D
	1.2 vibration	1.2.1 Vibration reduction at source or	EN 1299	D, M
		1.2.2 Positioning equipment at a distance from vibration source to eliminate vibration damage or	EN 1299	D, M
		1.2.3 Provision of isolation/damping measures and/or	EN 1299	D
		1.2.4 Dimensioning taking into account the vibration load	EN 13480-3	D
	1.3 reversed bending stress	1.3.1 Selection of material, dimensioning and bending radii, taking into account the fatigue strength	B.2.3 EN 13480-2 EN 13480-3	D
	1.4 mechanical stress, kinking	1.4.1 Dimensioning taking into account mechanical stress and kinking and	B.2.3	D

Table B.1 *(continued)*

Column 1	Column 2	Column 3	Column 4	Column 5
Significant Hazards	**Hazardous Situation**	**Safety Requirements and/or Measures**	**References**	**Verification**
		1.4.2 Protected location, e.g. by distance and	B.2	V, D
		1.4.3 Protection against mechanical damage by covering	5.1.14	V, D
	1.5 thermal overload	1.5.1 Position at adequate distance from heat source and/or	B.2	V, D
		1.5.2 Covering against thermal radiation	5.1.14	V, D
	1.6 chemical reaction	1.6.1 Selection of compatible materials and fluids	B.2.3	D
		1.6.2 Taking corrosion into account when dimensioning wall thickness	B.2.3 EN 13480-3:2002; 4.3	D
		1.6.3 Use of inhibitors in fluids	B.2	D
	1.7 incorrect installation	1.7.1 Provide instruction for correct installation	EN 13480-4:2002; Clause 8	V, D
	1.8 incorrect welding	1.8.1 Provide instructions for correct welding and	EN 13480-4:2002; Clause 9	V
		1.8.2 Operating/maintenance instruction: welding shall be done only by trained welders or certificated welders	7.6	V
	1.9 Mechanical damage by cobbling product during scrap removal (e.g., welding or gas cutting)	1.9.1 Protected location or	5.1.6	D
		1.9.2 Protection against mechanical damage by covering or	5.1.7	V, D
		1.9.3 Use of deflectors	5.1.7	V, D
	1.10 Unexpected start-up during dismantling and repair	1.10.1 Automatic pressure relief in the related part of the pressure system (vessels, if applicable) when switching-off and	5.1.13 EN ISO 4413:2010; 5.4.3 EN ISO 13849-1	D, M
		1.10.2 If pressure relief is not provided automatically at least maintenance instructions shall be given and	7.6	V, D
		1.10.3 Measures to prevent start-up by third parties (e.g. key-operated switch) shall be implemented by providing trapped key interlocking of the pressure system where one of the locks is used to lock the venting system (or isolating device) in its open position and	Annex A; A.2 EN 1037 EN 60204-1:2006; 5.4, 5.5, 5.6	D, M
		1.10.4 Audible and visual warning device for restart	5.1.9 EN 981 EN 842	V, D, M
	1.11 Dismantling and repair operations	1.11.1 Attachment of measuring points with pressure relief facility and		D

Table B.1 *(continued)*

Column 1	Column 2	Column 3	Column 4	Column 5
Significant Hazards	**Hazardous Situation**	**Safety Requirements and/or Measures**	**References**	**Verification**
		1.11.2 Hoselines with quick disconnecting couplings which are not automatically shutting-off at both ends shall be disconnected only in de-pressurised state and	5.1.6 7.4.3.2	D
		1.11.3 Warning signs and	5.1.9	V, D
		1.11.4 Operating/maintenance instruction: indicate the need to disconnect the hoses only in depressurised state.	7.6 EN ISO 4413:2010; 5.4.6.5 EN ISO 4414:2010; 5.4.5.9	V
	1.12 Measurement and operational checks	1.12.1 Safe access for testing and inspection purposes	5.1.5 5.1.6 Annex A; A.2	V, D
2 Burns, fire, explosion	2.1 Combustion of fluids may cause release of substances hazardous to health and poisoning caused by fumes	Use of low-toxicity and PCB-free fluids in the hydraulic equipment and/or	B.2.2 EN 626-1 EN ISO 4413:2010; 5.4.5	D
		Consideration of low flammability fluids and/or		V
		Position at a distance from heat source so combustion does not occur or	B.2.2	V, D
		Covering against thermal radiation by heat shields	5.1.15	V, D
	2.2 Asphyxiation by CO2	Audible warning devices and	5.1.9	P, D
		Warning signs and	5.1.9	V
		Facility to manually override the automatic CO2 deployment and	Annex D	D, M
		Operating/maintenance instructions: use PPE after deployment	Annex D 5.1.11 7.4 7.5	V
	2.3 High pressure leaking through a defective pre-fill valve into the low pressure system	Provide a pressure relief valve and explosion relief panel on the low pressure vessel	EN ISO 4413:2010; 5.4	V, D
		Relief panel to be situated to eject to a safe area and vessel mountings designed to withstand recoil forces NOTE Any ejected fluid should be contained in a sealed area or tank.	B.2.2 EN ISO 4413 5.1.8	V, D
	2.4 High pressure may flow backwards from the accumulators over a defective check valve and pump into the tank	Provide means to de-energise a jet of fluid going into tank	EN ISO 4413	V, D

Table B.1 *(continued)*

Column 1	Column 2	Column 3	Column 4	Column 5
Significant Hazards	**Hazardous Situation**	**Safety Requirements and/or Measures**	**References**	**Verification**
	2.5 Overfilling of the high pressure accumulators may cause too high pressure	Provide safety valves and a "fail-safe" level control system. Ensure that the outlet of the safety valve(s) is (are) directed in a safe direction	EN ISO 4413	V, D, M
3 Impact	3.1 Maintenance work on pressurised air vessels	Provide means to depressurise compressed air vessels and fit pressure gauge	EN ISO 4414	V, D
		Operating/maintenance instructions: include instruction to exhaust vessels before work begins	7.6	V
	3.2 Maintenance work on pressurised pipes to the air vessels	Provide means to isolate and exhaust pipework and	EN ISO 4413:2010; 5.4.3	V, D
		Operating/maintenance instructions: advice the user not to weld pressurised pipes and vessels	7.6	V
4 Crushing, shearing, cutting	4.1 Safety equipment for the hydraulic control system in set-up mode	When using accumulators or pressure-controlled pumps a second element with mechanically limited flow capacity shall be applied in order to ensure correct setting of set-up mode. In addition, the main shut-off valve shall be equipped with switch position control and	EN ISO 12100:2010; 6.2.11.9 EN ISO 13849-1 A.2.4 EN 60204-1	D, M
		Hydraulic systems shall be designed and constructed that danger from any unexpected movement of components is prevented and	EN ISO 13849-1 EN 1037	V,
		Measures shall be taken to avoid unintentional hazardous movement of components. The hydraulic system to the main components shall be fitted with two valves installed in series and acting independently of one another	EN ISO 13849-1	V, D, M

Annex C
(normative)

Noise test code

C.1 Introduction

Long product rolling mills are not standard machines and are tailored to customers' specifications.

The noise emission of a long product rolling mill depends on many parameters and factors, in particular:

a) dimension, material and temperature of the product,

b) number of mill stands,

c) mode of operation,

d) speed of blowing air/compressed air, e.g. for cooling purposes,

e) number, size and operating pressures of hydraulic and water pumps and

f) falling height of product to be collected.

These parameters and factors cannot be standardised as they differ from one long product rolling mill to another.

In order that the test can be repeated, the precise operation procedures of the long product rolling mill have to be known. This is why this noise test code requires these procedures to be recorded, reported and declared in detail.

Long product rolling mills never operate at the manufacturers place. Noise emission measurement can only be carried out after commissioning is completed.

This noise test code specifies all the information necessary to carry out the determination, declaration and verification of noise emission characteristics for long product rolling mills efficiently and under standardised conditions.

In general, the noise emission of a machine is described by two quantities: the A-weighted emission sound pressure level at work stations and the A-weighted sound power level that are used by the manufacturer to declare the noise emitted. However, due to the size and complexity of a long product rolling mill, the noise emission of a long product rolling mill is described by the A-weighted emission sound pressure level at work stations and specified measuring points. The determination of these quantities is necessary for:

a) manufacturers to declare the noise emitted;

b) purposes of noise control at the source at the design stage.

NOTE Emission sound pressure levels in frequency bands may also be determined.

C.2 Determination of sound power level

There would be a need to determine the sound power level of a long product rolling mill because the A-weighted emission sound pressure level at some work stations is higher than 80 dB(A). However, limited access for safety reasons near a long product rolling mill in operation and high heat radiation make it impossible to determine the sound power level. Instead and because long product rolling mills are very large machines, A-weighted emission sound pressure levels at specified measuring points shall be determined in accordance with C.3.1.

Furthermore, for large machines/plants such as long product rolling mills it is permissible to determine and report the emission sound pressure level at specified measuring points instead of the sound power level.

C.3 Determination of emission sound pressure levels

C.3.1 Determination of the emission sound pressure level at specified measuring points

The measuring points shall be specified along a path around the machine at a height of 1,6 m above the floor or access level and at a distance of 1 m from the machine surface. They shall be spaced so that the difference in A-weighted emission sound pressure levels between adjacent measuring points does not exceed 5 dB. The number of measuring points will depend on the characteristic of the noise emission. For even distribution of sound pressure levels, a low number of measuring points may be required. However, there should be at least one measuring point at each side of the main components of the long product rolling mill. The measurement positions shall be recorded and reported.

The A-weighted emission sound pressure level shall be determined in accordance with EN ISO 11202:2010.

C.3.2 Determination of emission sound pressure level at work stations

The A-weighted emission sound pressure level shall be determined at all work stations (permanent or temporary).

The A-weighted emission sound pressure level shall be determined in accordance with EN ISO 11202:2010.

The regular work stations (permanent or temporary), shall be determined by the manufacturer with consultation of the user of the equipment but in all cases shall include the:

a) pulpits;

b) local control stands;

c) sampling and inspection points;

d) binding machine;

e) scrap discharge;

f) preparation area.

C.4 Measurement uncertainty

Total measurement uncertainty of A-weighted noise emission values is that given in EN ISO 11202:2010.

C.5 Operating conditions

Measurements shall be made under defined representative operating conditions for the main part of the production with regard to the product to be processed and sizes, such as, e.g.:

a) product and dimension;

b) rolling/roller table speed;

c) temperature of the product;

d) cutting system in operation;

e) number of stands in production;

f) product cooling system in operation;

g) operating pressures of fluid or pneumatic systems.

The installation and mounting conditions shall be those recommended by the manufacturer.

The operating conditions shall be recorded and reported.

C.6 Information to be recorded and reported

The information recorded when carrying out the test and the test report shall contain at least the following information:

a) manufacturer, kind of machine/plant, boundary and technical data and sizes;

b) operating conditions under which noise is measured (see C.5);

c) measurement results:

A-weighted emission sound pressure level at each work station (accompanied by a drawing showing the position of each work station on the long product rolling mill),

A-weighted emission sound pressure level at each specified measuring point (accompanied by a drawing showing these points on the long product rolling mill),

possible deviations to this noise test code or to EN ISO 11202:2010, with the justification for them;

d) precise position of work stations, specified measurement points and duration of measurement;

e) place and date of measurement, identifying information of the responsible person/body.

C.7 Declaration and verification of noise emission values

For long product rolling mills, only estimated values can be given as noise emission values before commissioning. The noise emission shall then be measured under the specific production conditions and declared after commissioning.

The following noise emission values shall be declared:

a) A-weighted emission sound pressure level at each work station (accompanied by a drawing showing the position of each work station on the long product rolling mill);

b) A-weighted emission sound pressure level at each specified measuring point (accompanied by a drawing showing these points on the long product rolling mill).

The noise declaration shall give detailed information on the operating conditions and parameters of the long product rolling mill during noise measurement and at least those indicated in C.5.

The declaration shall be made as dual-number noise emission values (measured value and associated uncertainty given separately). The noise declaration shall be made in such a way that the values can be verified according to 6.2 of EN ISO 4871:1996.

The noise declaration shall explicitly mention the fact that the noise emission values have been obtained according to the specifications of this noise test code and make reference to EN ISO 11202:2010. If this statement does not

apply, the noise declaration shall indicate clearly what the deviations are from these specifications and/or from the basic standard.

In case of verification of the declared noise emission values, this shall be done using this noise test code and under the same operating conditions as those used for declaration.

Table C.1 shows an example of a dual-number noise declaration. The given values are only for illustration.

Table C.1 — Example of declared dual-number noise emission values for work stations and specified measuring points

Plant Name	
Job Number	
Machine Type	
Date of readings	
Dimension of the product	
Nominal rolling speed (m/min)	
Productivity (ton/h)	
...	

DECLARED DUAL-NUMBER NOISE EMISSION VALUES

Declared A-weighted emission sound pressure level at work stations A to ...			
Measurement at work stations		**Measured value** L_{pA} [dB] (re 20 µPa)	**Uncertainty** K_{pA} [dB]
A	description of the work station		
B	description of the work station		
C	description of the work station		
...			

Declared A-weighted emission sound pressure level at measuring points around the long product rolling mill			
Specified measuring points		**Measured value** L_{pA} [dB] (re 20 µPa)	**Uncertainty** K_{pA} [dB]
1	specification/position of measuring point 1		
2	specification/position of measuring point 2		
...	...		
Values determined according to noise test code Annex C of EN 15949:2011 and measurement standard EN ISO 11202:2010			

NOTE The sum of a measured noise emission value and its associated uncertainty represents an upper bound of the range of values which can occur in measurements.

Annex D
(normative)

Protection of persons in case of using asphyxiant gases used in fire fighting systems

NOTE The national regulations and the requirements of the insurance companies have to be considered and could differ from the information given in Annex D.

D.1 General

When designing a bar mill, structural steel mill and wire rod mill, selecting and installing a fire fighting system using asphyxiant gases, the risk of asphyxiation shall be taken into account.

Areas which can be influenced by asphyxiant gases shall be indicated in the safety layout.

A critical concentration for asphyxiation occurs if the ratio of the used volume of the extinguishing gas to the volume of the working or operation area, where the object to be protected is located,

a) exceeds the critical limit of the extinguishing gases concentration or

b) remains under that of the oxygen concentration,

so that persons are endangered.

NOTE When using CO_2, this is the case, e.g. when the CO_2 concentration exceeds 5 vol.-% or the oxygen concentration is under 15 vol.-%.

D.2 Warning devices

For the warning of persons, fire fighting areas shall be equipped with acoustic and optic warning devices. Warning devices shall ensure the warning of persons entering or staying in the danger zone influenced by asphyxiant gases.

The sound of acoustic warning devices shall significantly differ from operational noise and exceed the environmental noise level according to 5.1.9. Optical warning devices should give significant signals by interrupted light up.

The fire fighting alarm of fire fighting equipment which can endanger persons during its use shall not be cut off before it is ensured that flooded areas cannot be accessed by non-authorised persons. This can be achieved by warning lamps or signal devices at the accesses to endangered areas or by closing of the accesses. These measures shall be kept until the flooded areas are aired and can be accessed without danger.

At fire fighting equipment which can endanger persons during its use, acoustic fire fighting alarm shall be given by at least two independent warning devices with:

a) separate energy sources,

b) separately installed cables and

c) separate alarm means.

Electric and pneumatic warning devices can be used.

There are two kinds of electric warning devices: protected or non-protected warning devices. Protected electric warning devices in combination with a pneumatic warning device shall be preferably used and shall be equipped with a protected electric supply and a protected feed line.

NOTE 1 Requirements for protected electric supply are given in 3.9 of DIN VDE 0833-1:2003. Protected feed lines can be achieved by constructing them as primary lines according to 3.4 of DIN VDE 0833-1:2003.

Energy supply for non-protected electric warning devices shall only be effected by low-voltage energy supply (220 - 240 volt net). It shall only be possible to cut off the feed line at the main distribution panel with a separate marked safety circuit.

The energy reserve for an alarm shall be sufficient for at least 30 min.

Pneumatic warning devices shall be equipped with a monitored energy reserve.

For CO_2 low-pressure fire fighting equipment separate energy sources are not necessary, if two pneumatic warning devices are used which are supplied by the extinguisher reservoir. For high-pressure fire fighting equipment with pneumatic alarm only, two separate reservoirs shall be installed.

For fire fighting equipment with pneumatic or mechanic fire detection and actuation, acoustic fire fighting alarm can be given by two electric warning devices. At least one of these warning devices shall be designed as protected warning device.

For fire fighting equipment reaching critical concentrations (see C.1) the functions of the warning and restraint devices shall be ensured even in case of interfering effects.

NOTE 2 Interfering effects are, e.g. over-voltage or electromagnetic influences leading to destruction or malfunction of electric/electronic devices in warning or triggering equipment and consequently to a unintended release of extinguishers.

D.3 Restraint devices

Fire fighting equipment causing risks to persons by flooding shall be equipped with restraint devices.

Restraint devices shall ensure that flooding is impossible unless the warning devices are actuated and a preliminary warning time has expired.

D.4 Preliminary warning time

For room protecting equipment, a preliminary warning time shall be actuated at each automatic or manual actuation of the fire fighting equipment.

The preliminary warning time shall be as long that dangerous areas can be left from each point without haste. It shall be at least 10 s.

For plant protecting equipment, or small fire fighting equipment, e.g. according to ISO 6183, a preliminary warning time shall be actuated, if the ratio of the used volume of extinguishing gas to the volume of the working or operation area where the object to be protected is located, exceeds the critical concentration.

This is also valid if several equipment of such kind is installed in one room and their actuating systems react together at the same event or are actuated by flooding.

This can be avoided by, e.g. locking the actuating system of equipment in the vicinity after first actuation. If during a second or consecutive actuation, the critical limit of extinguishing gases which endangers persons is exceeded or the oxygen concentration remains under the limit, restraint or warning devices shall be actuated.

D.5 Interrupt device for extinguishing gas

In special cases, it could be useful to install interrupt devices (push buttons) if it ensures the saving of persons before flooding is started. The position of the interrupt devices shall be placed in a safe area and shall be shown in the safety layout.

The actuation of the interrupt device shall be indicated at a permanent staffed place from which help can be organised. The indication shall stay until it is released.

After the release of the actuated interrupt device, the flooding shall not start before the preliminary warning time has expired. If the interrupt device is actuated for a period longer than the preliminary warning time, the flooding starts directly after the release of the interrupt device.

Once a flooding has started, it cannot be stopped by repeated actuation of the interrupt device.

Malfunctions in the supply of interrupt devices shall not start the fire extinguishing process. Such malfunctions shall be indicated in acoustic and optic manner.

Warning devices shall rest in function during actuation of the interrupt device.

D.6 Blocking devices

It shall be possible to block the actuation of fire extinguishing equipment during maintenance. Blocking shall be done mechanically in such a way, that the release of fire extinguishing means is prevented.

The actuation of the blocking devices shall be clearly indicated, e.g. optically.

D.7 Pipes

Pipes shall be electrical earthed.

D.8 Rooms and adjacent areas

Rooms to be protected by fire extinguishing equipment shall be designed to avoid the unintended escape of fire extinguishing agents to such an extent which endangers persons in adjacent rooms or areas.

Generally, the tightness of such rooms shall be checked, especially after reconstruction, new installations or change of installations.

If it is not possible to safeguard that escaping fire extinguishing agents also reach adjacent rooms or areas, these rooms or areas have to be integrated into the alarm system.

D.9 Escape routes

Rooms with the risk of fire shall have escape routes which shall be indicated in the safety layout.

D.10 Doors

Doors shall be self-locking, to be opened in the direction of escape and the opening from inside shall always be easily possible and without the use of auxiliary devices.

If due to operational reasons self-locking doors are kept open, these have to be equipped with locking devices which ensure automatic closing if the fire extinguishing equipment is actuated.

D.11 Marking

At all accesses to dangerous areas a warning sign in accordance with EN 61310-1 and an additional sign with the following inscription shall be fixed:

"Gas fire fighting equipment. In the case of fire alarm or release of extinguishing gas[2)] leave the room immediately".

D.12 Instruction handbook

The manufacturer of the fire-fighting equipment shall include an instruction handbook for fire extinguishing equipment with all information for safe operation. In particular, the instruction handbook shall include:

a) commissioning,

b) behaviour in the case of actuation,

c) maintenance and testing,

d) behaviour in the case of trouble,

e) behaviour during decommissioning.

2) Specification of the extinguishing gas used;

Annex E
(informative)

Example for manufacturer's safety instructions for maintenance at long product rolling mills

E.1 Precautions to reduce hazards caused by

E.1.1 Lack of instructions

Examples:

a) "The instructions in this technical documentation of the machinery and/or plant, in particular the “safety section", shall be observed and put into practice by the user";

b) "Internal company instructions are to be prepared taking into account the qualifications, experience, knowledge and abilities of the personnel entrusted with the work";

c) "In addition to the instructions in this technical documentation, generally applicable legal and other mandatory regulations relevant to accident prevention and environmental protection are to be observed and instructed";

d) "Maintenance work on/with the machine/plant may only be performed by personnel that have received adequate training and have proved competence";

e) "Only maintenance personnel with special qualifications in this field shall be allowed to work on electrical, hydraulic, pneumatic and supply-related equipment".

E.1.2 Visual or audible checks at machinery in motion

Examples:

a) "Visual or audible checks in automatic mode are only permissible for maintenance personnel for the areas and/or activities hereafter: ...";

b) "This work shall only be carried out by personnel with written approval by the responsible user";

c) "It may be necessary, that an additional person shall be assigned to supervise work progress and to assist these hazardous activities".

E.1.3 Unintentional movements during maintenance

Examples:

a) "The following measures may help to avoid hazardous situations caused by movements;

   1) firstly, stopping the dangerous movement by control devices provided for that purpose until the movement has come to a standstill;

   2) secondly, interruption of power supply for actuator and control elements of the area for maintenance check";

b) "Preventing unauthorised, erroneous and unexpected start-up through:

   1) locking the main control equipment,

2) removing the key from the main control desk,

3) separating plug-in connections,

c) securing parts that may change their position, e.g. by means of a brake, backstop, safety bolts, supports, scotches or check valve";

d) "Preventing the start of hazardous motions as a result of stored energy through depressurising, shutting off, relaxing and lowering (e.g. of flywheel masses)".

E.1.4 Work during standstill with safeguards disabled

Examples: “Permit-to-work” system

a) "A permit-to-work system is to be adopted for maintenance activities during plant shutdown. A written permit is to be issued by the plant manager to the person responsible for leading the maintenance activity, who shall examine the permit for important information and instructions and countersign the permit, thereby indicating that the contents have been read and understood";

b) "Repair work requiring removal or deactivation of safeguards may only be performed on the above conditions";

c) "All safeguards that have been removed shall be replaced after completion of the work. Work completion and safeguard replacement shall be verified, and confirmed by signature of the permit-to-work, before the plant is accepted back and start-up commenced".

E.1.5 Work with hazardous substances

The operating instructions should list any hazardous substances used, the risk they pose and the precaution/prevention to be taken. Maintenance staff must be informed about this.

Examples:

a) "The identity of the substances shall be checked before being used;

b) "With regard to the substances being used neutralising agents, absorbents etc. shall be provided ready for use";

c) "All personnel protective equipment required shall be kept ready and be used";

d) "Instruction of action required in case of a leakage shall be provided at the machine, at the pulpit and to the emergency staff of the plant".

e) Plant re-start

Examples:

f) "All safeguards and safety devices removed for maintenance shall be put back into place (see also E.1.4)";

g) "The working and traffic areas shall be cleared and restored to a clean state";

h) "All securing parts (e. g., safety bolts) shall be recovered in the plant-in-working-position";

i) "Re-start shall only be possible by a reset-order from the authorized personnel".

Annex F
(informative)

Machines and/or equipment covered by this standard but not limited to

F.1 Plants

a) Bar mills;

b) Bloom and Billet mills;

c) Wire rod mills (steel and non-ferrous);

d) Section/rail mills;

F.2 Equipment

a) Online billet welder;

b) Rolling mill stands;

c) Fast finishing block;

d) Roller tables;

e) Cross transfer, collecting beds, tilting devices;

f) Measuring devices;

g) Pinch roll;

h) Laying head/garret system;

i) Coil forming station;

j) Wire rod coil handling;

k) Hydraulic systems;

l) Straightening equipment;

m) Saws, shears and abrasive cutting machines;

n) Descalers;

o) Cooling lines;

p) Cooling beds;

q) Piling/bundling equipment;

r) Binding/strapping machines;

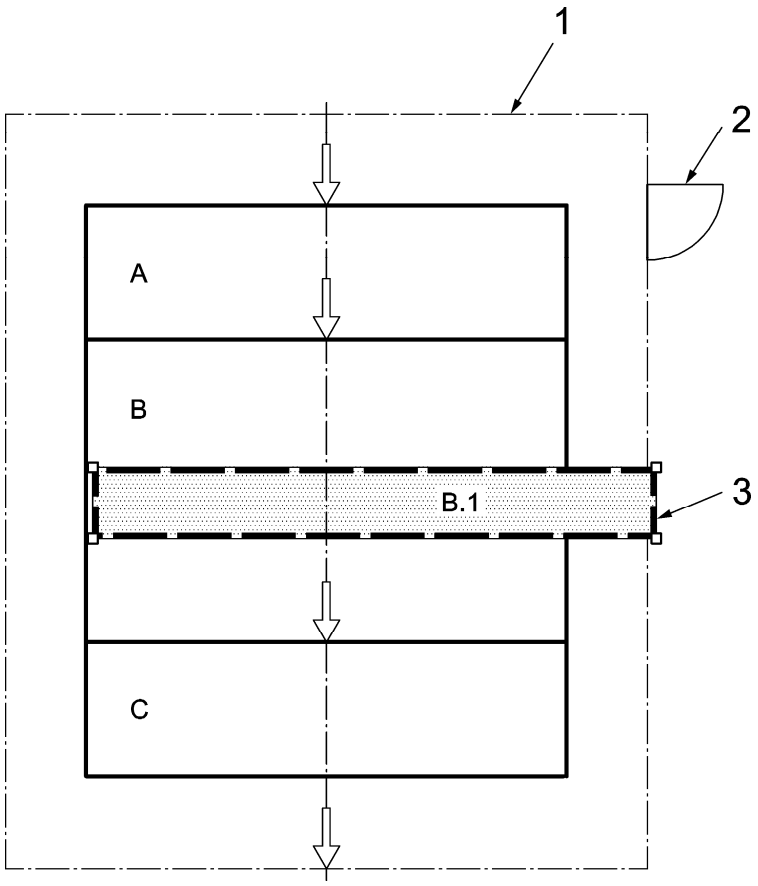
s) Marking machines;

t) Loading equipment;

u) Automatic preparation equipment.

Annex G
(informative)

Example for modes of operation in relation to segregated areas of long product rolling mills



Key

1 guard

2 door (normally locked)

3 e.g., light barrier and rope with signalisation to allow access during production, details see B.1

⇨ product flow

A segregated area; modes of operation: production (automatic mode) and maintenance

B segregated area; modes of operation: production (automatic mode) and maintenance

B.1 segregated area to allow adjusting if sensors are activated; modes of operation: production (automatic mode), maintenance and immobilization.

Immobilization mode allows personnel to reach the operating zone during production without stopping the production of other areas; the production of area B will only be stopped, if product reaches the border of B.1

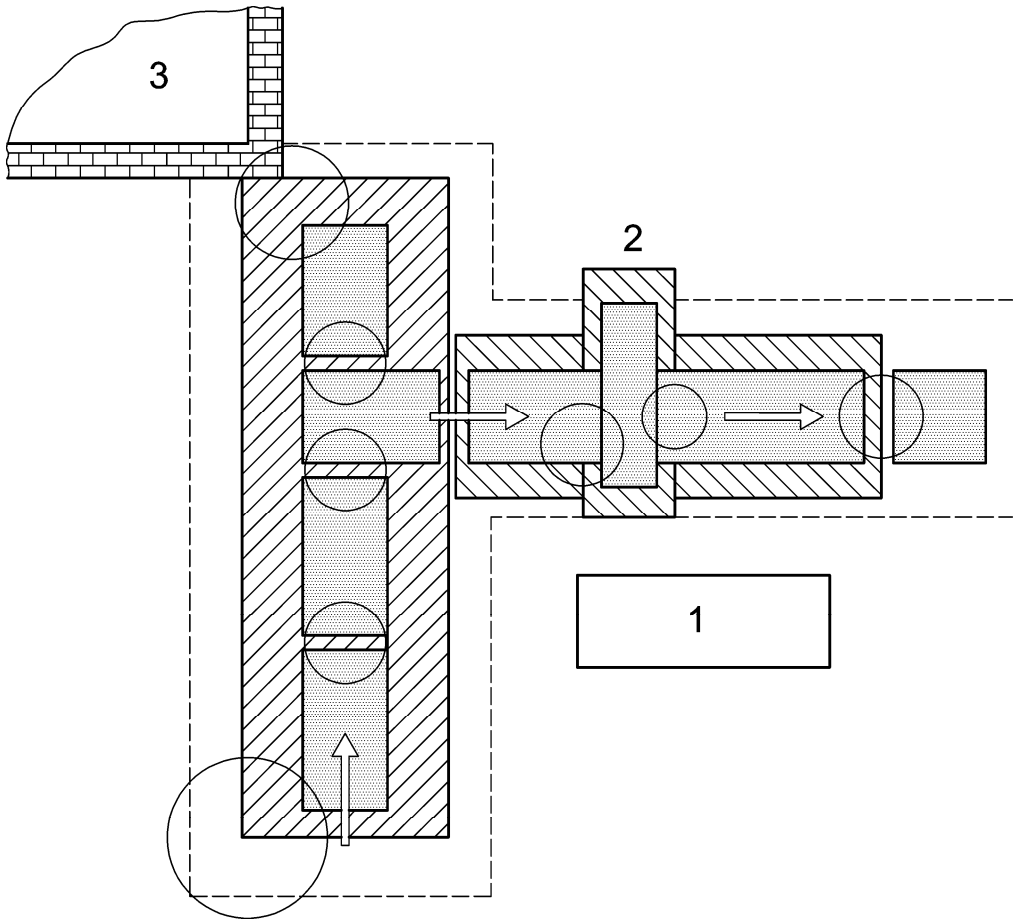
C segregated area; modes of operation: production (automatic mode) and maintenance

Figure G.1 — Schematic diagram of modes of operation in relation to segregated areas

Annex H
(informative)

Example for the risk analysis due to interfaces

According to the scope of this standard, hazards existing at the interfaces between single machines of a plant and/or adjoining parts of the building or other machines or plants near the border to the plant are not covered.



Key

1	main pulpit		machinery/equipment, e. g. delivered by different suppliers
2	driveside		function group
3	building		guard (e. g. interlocked guard with guard locking)
			Interface
			product flow

Figure H.1 — Diagram of a hypothetical plant indicating potentially hazardous interfaces

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide one means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC on machinery.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

WARNING: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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