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Plastics and rubber machines — Two-roll mills — Safety requirements

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National foreword

This British Standard is the UK implementation of EN 1417:2014. It supersedes BS EN 1417:1996+A1:2008 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MCE/3/2, Rubber and plastics machine - Safety.

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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Kunststoff- und Gummimaschinen - Walzwerke - Sicherheitsanforderungen

This European Standard was approved by CEN on 7 November 2014.

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CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

Foreword

This document (EN 1417:2014) has been prepared by Technical Committee CEN/TC 145 “Plastics and rubber machines”, the secretariat of which is held by UNI.

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of an identical text or by endorsement, at the latest by June 2015, and conflicting national standards shall be withdrawn at the latest by June 2015.

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 supersedes EN 1417:1996+A1:2008.

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.

Compared with EN 1417:1996+A1:2008, the following significant technical changes have been made:

- a distinction has been made between large, intermediate and small two-roll mills;
- automatic separation has been made mandatory for two-roll mills equipped with a trip bar; however, mill roll reversal can be associated with automatic separation;
- the performance levels of safety related parts of control systems have been specified in accordance with EN ISO 13849-1:2008;
- the simplification of the definition of the stopping angle;
- technical developments in safeguards have been taken into account e.g. light curtains, positioning of interlocking guards;
- the addition of requirements regarding emergency stops;
- the addition of hazards due to electromagnetic interference;
- the addition of a noise test code.

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, Former Yugoslav Republic of Macedonia, 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 machinery concerned and the extent to which hazards, hazardous situations and events are covered are indicated in the scope of this document.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

1 Scope

This European Standard deals with all significant hazards, hazardous situations and events relevant to two-roll mills for the processing of rubber and/or plastics, when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer (see Clause 4).

This European Standard covers two-roll mills as defined in 3.1.

This European Standard does not deal with the design of a local exhaust ventilation system that may be necessary in specific applications of the machine not known by the manufacturer.

This European Standard is not applicable to two-roll mills manufactured before the date of its publication as a European Standard.

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 349:1993+A1:2008, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

EN 574:1996+A1:2008, *Safety of machinery — Two-hand control devices — Functional aspects — Principles for design*

EN 953:1997+A1:2009, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

EN 60204-1:2006, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2005, modified)*

EN 61000-6-2:2005, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments (IEC 61000-6-2:2005)*

EN 61000-6-4:2007, *Electromagnetic compatibility (EMC) — Part 6-4: Generic standards — Emission standard for industrial environments (IEC 61000-6-4:2006)*

EN 61496-1:2013, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests (IEC 61496-1:2012)*

EN 61496-2:2013, *Safety of machinery — Electro-sensitive protective equipment — Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs) (IEC 61496-2:2013)*

EN ISO 3744:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane (ISO 3744:2010)*

EN ISO 3746:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane (ISO 3746:2010)*

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

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

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

EN ISO 9614-2:1996, *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 2: Measurement by scanning (ISO 9614-2:1996)*

EN ISO 11201:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections (ISO 11201:2010)*

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 11204:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions applying accurate environmental corrections (ISO 11204:2010)*

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

EN ISO 13732-1:2008, *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 13849-1:2008, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2006)*

EN ISO 13850:2008, *Safety of machinery — Emergency stop — Principles for design (ISO 13850:2006)*

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

EN ISO 13856-2:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 2: General principles for design and testing of pressure-sensitive edges and pressure-sensitive bars (ISO 13856-2:2013)*

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

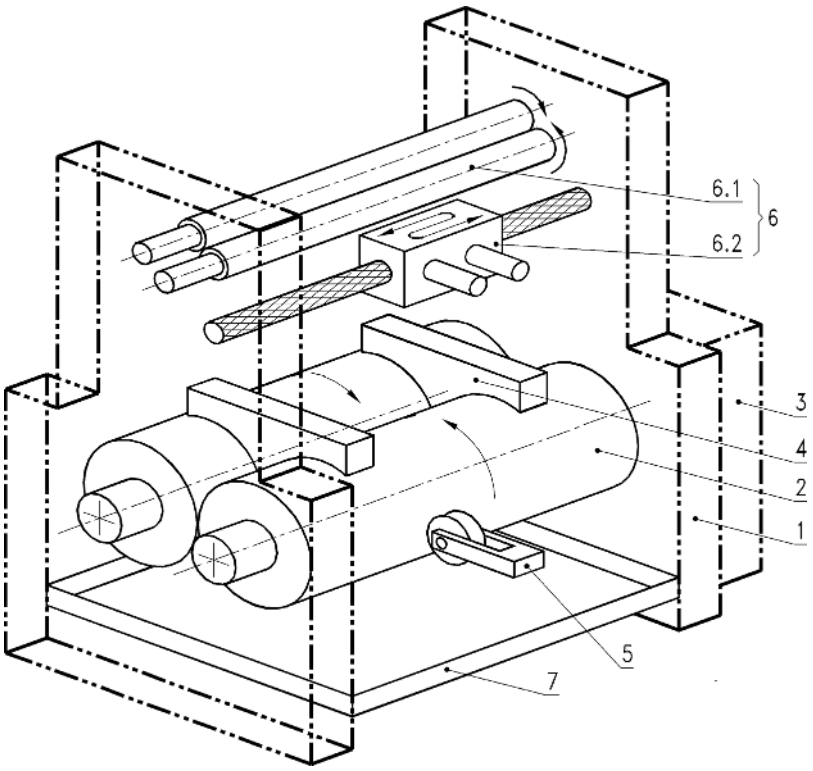
EN ISO 14119:2013, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection (ISO 14119:2013)*

3 Terms and definitions

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

3.1
two-roll mill
machine with two counter-rotating cylinders (known as mill rolls) which are not covered, which may be smooth or grooved, and whose axes are on substantially the same horizontal plane

Note 1 to entry: See Figure 1:



Key

1	frame	6	stock blender
2	mill roll	6.1	stock blender rolls
3	drive and transmission unit	6.2	stock blender carriage
4	stock guide	7	mill tray
5	strip cutting device		

Figure 1 — Principal parts of a two-roll mill

3.1.1
large two-roll mill
two-roll mill with a mill roll diameter D ≥ 400 mm

3.1.2
small two-roll mill
two-roll mill with a mill roll diameter D ≤ 200 mm

3.1.3
intermediate two-roll mill
two-roll mill with a mill roll diameter 200 mm < D < 400 mm

3.2
principal crushing zone
zone extending over the full length of the mill rolls indicated by V in Figure 2

Dimensions in mm

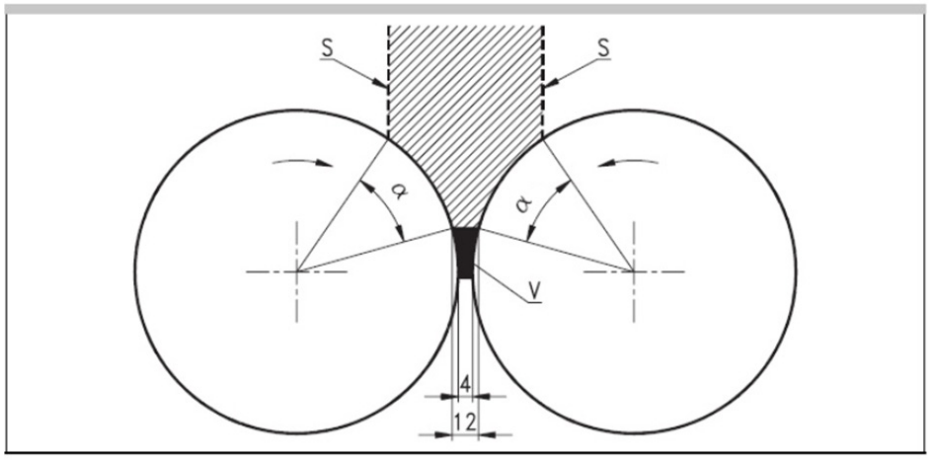


Figure 2 — Principal crushing zone V, safety limits S and stopping angle α

3.3
stopping angle α
angle through which the mill rolls rotate from the stop signal triggered by a protective device until the mill rolls have come to rest with the machine unloaded, and running at maximum rated speed

3.4
safety limit
vertical plane indicated by Line S in Figure 2 demarcating the zone which is unsafe for operators who can reach into it without actuating the trip bar

3.5
stock guide (also known as “ear”)
part which prevents material being processed from going beyond the mill roll end

Note 1 to entry: See Figure 1, Location 4.

3.6
strip cutting device
device equipped with rotating discs or stationary blades to cut off strips of processed material from a mill roll

Note 1 to entry: See Figure 1, Location 5.

3.7
stock blender
equipment used to continuously recirculate the material being processed to obtain a uniform mixing, distributing it with a reciprocating motion along the length of the mill rolls

Note 1 to entry: See Figure 1, Location 6.

3.8
mill tray
equipment for catching material which falls under the mill rolls

Note 1 to entry: See Figure 1, Location 7.

3.9
recovery conveyor belt
equipment for recirculating material which falls under the mill rolls

Note 1 to entry: See Figure 5.

3.10
retractable plough
equipment which can be moved towards the mill roll in order to cut and turn over the material, and which can be retracted

Note 1 to entry: See Figure 4.

4 List of significant hazards

This clause contains all the hazards, hazardous situations and events identified by risk assessment as significant for this type of machinery.

Where appropriate, the locations of the hazards listed in Table 1 are shown in Figures 3, 4 and 5.

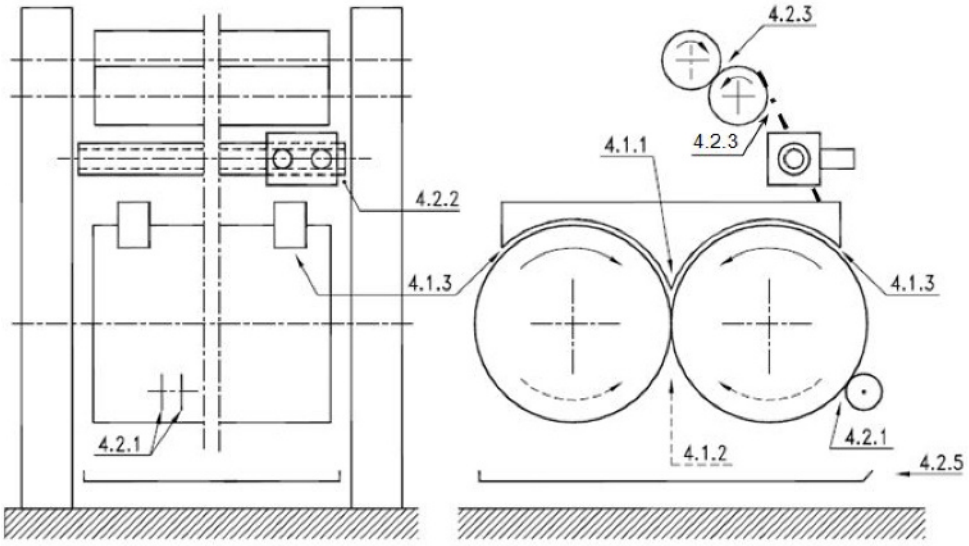


Figure 3 — Location of mechanical hazards on a two-roll mill shown with a strip cutting device and a stock blender

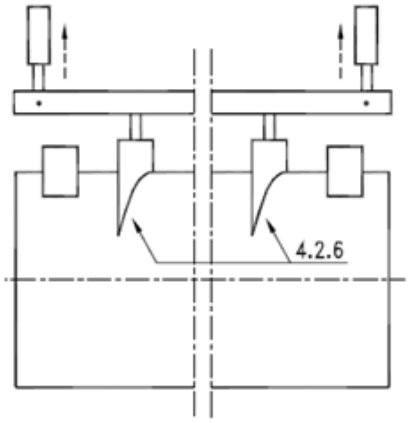


Figure 4 — Location of mechanical hazards on a two-roll mill with retractable ploughs

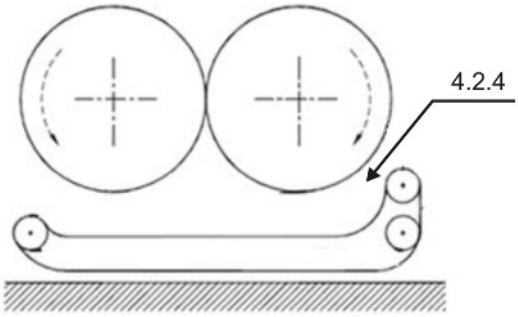


Figure 5 — Location of mechanical hazards on a two-roll mill with a recovery conveyor belt

Table 1 — List of significant hazards

	Significant hazards	Applicable subclauses in Clause 5
4	**General hazards**	5.1
4.1	**Mechanical hazards related to the mill rolls:**	
4.1.1 4.1.2	Hazards of drawing-in and crushing between the mills rolls during normal (forward and reverse) operation	5.2.1.1 5.2.1.5 5.2.2.1 5.2.2.2 5.2.3.2 5.2.3.3 5.2.3.4 5.2.4
4.1.3	Hazard of drawing-in and crushing between the stock guides and the mill rolls	5.2.1.4
4.1.4	Hazards resulting from reduction of braking performance	5.2.1.2
4.1.5	Hazards of drawing-in and crushing in the drive mechanism of the mill rolls	5.2.1.3
4.2	**Mechanical hazards related to other equipment on large two-roll mills:**	
4.2.1	Hazard created by the strip cutting device: — cutting hazards due to involuntary contact with the cutting edges of blades or rotating discs; — cutting, shearing and crushing hazards caused by movements of the strip cutting devices (with cutting or non-cutting edges) and their actuating mechanisms	5.2.2.4
4.2.2	Hazard of crushing between the stock blender carriage and the machine frame	5.2.2.5
4.2.3	Hazard of drawing-in and crushing between the stock blender rolls and hazard of trapping between the rubber strip and the blender rolls	5.2.2.6
4.2.4	Hazard of drawing-in and crushing between the recovery conveyor belt and the mill roll, when the mill rolls are in reverse motion	5.2.2.7
4.2.5	Hazard of impact due to the forward movement of the mill tray	5.2.2.8
4.2.6	Hazard of drawing-in and crushing between the retractable ploughs and the mill roll	5.2.2.9
4.2.7	Hazard of crushing between powered stock guides and fixed parts	5.2.2.3

	Significant hazards	Applicable subclauses in Clause 5
4.3	**Hazards due to failure of the control system**	5.1.1
4.4	**Electrical hazards and hazards due to electromagnetic interference:** Electrical shock or burns caused by direct or indirect contact with live conductive parts Malfunction of the control circuits due to electromagnetic interference with the electrical equipment Electrical shock or fire due to electrostatic discharge	5.3
4.5	**Thermal hazards:** Burns and/or scalds caused by: — unintentional contact with hot machine parts or hot material; — fluids released from the heat conditioning system	5.4
4.6	**Hazards caused by gases, dusts or vapours hazardous to health:** Contact with and/or inhalation of harmful substances which may be released from the materials processed	5.5
4.7	**Hazards generated by neglecting ergonomic principles**	5.6
4.8	**Hazards generated by noise:** Hazards from high noise levels resulting for example in hearing impairment, tinnitus, tiredness, stress, loss of balance or awareness, interference with speech communications or with the perception of acoustic signals	5.7

5 Safety requirements and/or protective measures

5.1 General

5.1.1 Basic requirements

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

The electrical part of the control system shall be designed in accordance with EN 60204-1:2006, Clause 9 and in addition with the specific requirements given in this standard.

The safety related parts of the control system (SRP/CS) shall be designed in accordance with EN ISO 13849-1:2008. The required performance level (PL_r) for each safety function is specified in the relevant subclauses.

The hydraulic equipment and its components shall be designed in accordance with EN ISO 4413:2010.

The pneumatic equipment and its components shall be designed in accordance with EN ISO 4414:2010.

An interruption or a failure of the power supply shall not result in a loss of safety function until a complete stop is reached and restoration of the energy supply shall not result in the automatic restarting of the machine (see EN ISO 12100:2010, 6.2.11.4 and 6.2.11.5).

The start of an operation shall be possible only when all safeguards are in place and functional (see EN 60204-1:2006, 9.2.5.2).The machine shall only be started by actuation of the start device provided for that purpose.

The release of the brake shall be interlocked with the control circuit in accordance with $PL_r = d$ of EN ISO 13849-1:2008, so that the powered rotation of the mill rolls is prevented as long as the brake is released.

An operational stop device (e.g. a push button) shall be provided to stop the mechanical movements.

5.1.2 Emergency stop

Emergency stop devices shall be positioned on the control panel and on each working side of the two-roll mill and shall conform to EN ISO 13850:2008 and to category 0 or 1 according to EN 60204-1:2006, 9.2.2, whichever provides the best stopping performance.

Actuation of emergency stop devices shall stop all movements of the mill rolls and associated equipment; however, actuation of emergency stop devices on machines equipped with a trip bar or trip devices shall cause the effects as in 5.2.2.1.5, 5.2.2.1.6 and 5.2.3.3.

Emergency stop devices shall stop the hot fluid supply except when an adequate manual shut-off actuator is installed.

Where two-roll mills are designed to be incorporated in a production line, the control circuit should be designed so that the two-roll mill can be connected with the emergency stop circuit of the production line. If an emergency stop on the production line is activated it should not cause an automatic reversal of the mill rolls (see 5.2.2.1.5). However, it should make the intentional mill roll reversal possible as specified in 5.2.2.2.1.

See also 7.2.1.

5.2 Mechanical hazards

5.2.1 Requirements applicable to all types of two-roll mills

5.2.1.1 Hazards of drawing-in and crushing between the mills rolls during normal (forward and reverse) operation

Where practical, access to the principal crushing zone, as defined in 3.2, shall be prevented by guards. See also 5.2.2.1, 5.2.3 and 5.2.4.

Guards shall be designed in accordance with EN 953:1997+A1:2009 and positioned according to EN ISO 13857:2008, Table 2, Table 3 and/or Table 4.

The selection of the types of guards shall be made in accordance with EN ISO 14119:2013, Clause 7.

Interlocking guards shall be positioned in accordance with EN ISO 13855:2010, taking into account the braking performance achieved by either a spring operated brake or a braking system, excluding electronic braking, with an equivalent braking performance when operating without a power supply. The overall system stopping performance (see EN ISO 13855:2010, 3.1.2) shall be calculated taking power failure into account. The safety function shall be in accordance with $PL_r = d$, category 3 of EN ISO 13849-1:2008. If EN ISO 13855:2010 cannot be respected, interlocking guards with guard locking shall be adopted. The

unlocking signal for the guard locking shall be in accordance with PL_r = c of EN ISO 13849-1:2008. The safety function shall be in accordance with PL_r = d of EN ISO 13849-1:2008.

Where it is possible to stand between the guard in its closed position and the mill rolls, a dedicated manual reset actuator shall be designed and located in accordance with EN ISO 13849-1:2008, 5.2.2.

5.2.1.2 Hazards resulting from reduction of braking performance

The braking system shall be so designed that in the case of a power failure a braking action will automatically bring the mill rolls to rest.

If the braking system consists solely of a mechanical friction brake, the thermal characteristics shall be sufficient to allow rapid dissipation of the heat produced by the braking action.

5.2.1.3 Hazards of drawing-in and crushing in the drive mechanism of the mills rolls

Access to the dangerous area of the drive mechanism shall be prevented by one or more of the solutions in 5.2.1.1. The safety function, if any, shall be in accordance with PL_r = c of EN ISO 13849-1:2008.

5.2.1.4 Hazard of drawing-in and crushing between the stock guides and the mill rolls

The gap between the mill rolls and the stock guides shall not exceed 4 mm during normal operation and the working position of the stock guides shall be detected. Operation of the mill shall be possible only if the stock guides are in the working position. This safety function shall be in accordance with PL_r = c of EN ISO 13849-1:2008.

5.2.1.5 Additional safety requirements for emergency release of persons

Two-roll mills shall be equipped with a manually operated mechanism to allow separation and/or reversal of the mill rolls even in the event of power failure.

If the two-roll mill is equipped with automatic separation, as specified in 5.2.2.1.5 then a manually operated mechanism is not necessary.

If special tools are necessary they shall be supplied by the manufacturer.

See 7.2.1.

5.2.2 Specific requirements applicable to large two-roll mills (D ≥ 400 mm)

5.2.2.1 Prevention of access to the principal crushing zone

5.2.2.1.1 General

Where it is not practical to use guards, then access to the principal crushing zone, as defined in 3.2, shall be prevented by a mechanically actuated trip device in the form of a trip bar (see Figure 6).

5.2.2.1.2 Prerequisites for the installation of a trip bar

a) Installation of the machine:

The top of the mill rolls shall be at a height of not less than 1 300 mm above the normal standing level of the operator (see 7.2.2).

b) Braking performance:

The maximum stopping angle α (see 3.3) shall be 60°.

When this requirement cannot be fulfilled, a trip bar may only be used if the two-roll mill is installed within an enclosing guard and the opening of an access door in this enclosing guard is not possible until the speed has been reduced so as to achieve a stopping angle not exceeding 60°.

c) Measuring device:

Large two-roll mills shall be equipped with a device for the automatic measuring of the stopping angle.

For machines equipped with both a mechanical and an electronic braking system, the machine shall be designed such that the measurement of the braking performance is carried out using the mechanical braking system alone.

The control circuit shall be designed in such a way that the machine cannot be restarted in the event of a negative test result or if the test has not been carried out within the time foreseen by the manufacturer i.e. at least once per week.

See 7.2.2 and 7.3.2.

5.2.2.1.3 Positioning of the trip bar

a) The trip bar shall extend over the full length of the mill rolls.

b) It shall be positioned as follows:

1) a height a 1 200 ± 50 mm above the operator's normal standing level (see Figure 6);

2) a horizontal distance b between the nip and the bar in its switching position (see Figure 6). Distance b shall not be less than the value calculated by the following formula:

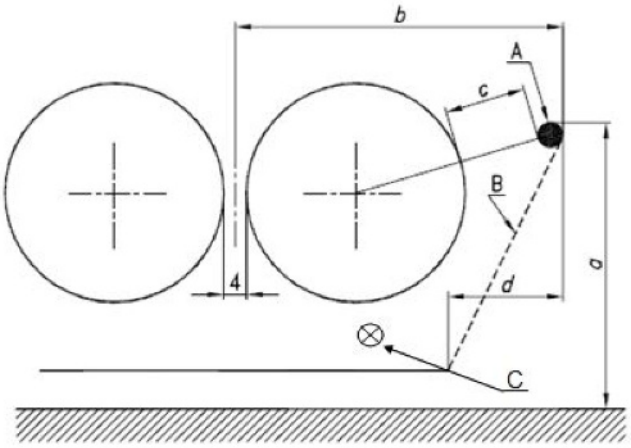
$$b = \frac{D}{2}[1 - \cos(60° + \arccos\frac{D-8}{D})] + 802$$

where

D is the diameter of the mill rolls in mm.

The resulting dimension *c* (see Figure 6) shall not be less than 300 mm. For dimensions greater than 400 mm, see 5.2.2.1.7.

Dimensions in millimetres



Key

A trip bar

B complementary guard

C electro-sensitive protective equipment (ESPE)

a height of the trip bar

b horizontal distance between the nip and the trip bar in its switching position

c gap between the trip bar and the mill roll

d horizontal distance between the trip bar and the mill tray

Figure 6 — Positioning of the trip bar (example)

5.2.2.1.4 Actuation of the trip bar

The trip bar, designed for involuntary actuation by the upper body, shall meet the minimum following requirements:

— it shall be actuated by a displacement not exceeding 10 mm both towards the mill roll and away from it;

— actuation of the bar shall not require a force greater than 200 N;

— the bar shall be equipped with at least one position sensor at each end.

Actuation of the trip bar shall stop the movement of the mill rolls according to category 0 or 1 of EN 60204-1:2006, 9.2.2, whichever provides the best stopping performance. The safety function shall be in accordance with PL_r = d, category 3 of EN ISO 13849-1:2008.

The return of the trip bar to its rest position shall not cause restarting.

A separate manual reset shall be installed in a position giving full view of the danger zone. Actuating the reset shall not restart the machine.

5.2.2.1.5 Effects on the movement of the mill rolls

Actuation of the trip bar shall, whenever the mill rolls are in motion, cause the mill rolls to stop in an angle not greater than 60° even with the machine unloaded and running at maximum rated speed.

NOTE In practice the stopping angle is always considerably smaller than the one measured in the above conditions because, in operation, the machine is loaded and is not running at maximum rated speed.

Following the mill rolls coming to rest, one of the following actions shall occur:

— automatic separation of the mill rolls achieving a gap of at least 50 mm within 5 s; or

— automatic separation of the mill rolls achieving a gap of at least 30 mm within 3 s and automatic reversal of the mill rolls commencing in a time not greater than 2 s and achieving a rotation of 60° ± 5°. See also 5.2.2.2.2.

The separation shall be achieved, even in case of energy failure, using permanently stored energy e.g. springs, potential energy, etc. If this energy cannot be stored permanently e.g. in an accumulator a permanent monitoring function shall detect the energy level and stop the machine if a fault is detected. See also 5.2.1.5.

5.2.2.1.6 Effects on other movements and equipment

Actuation of the trip bar shall:

— cause the ESPE specified in 5.2.2.2.2 to become operational when the machine is equipped with automatic reversal:

— stop the stock blender carriage (see 5.2.2.5) in accordance with PL_r = c of EN ISO 13849-1:2008;

— stop the stock blender rolls in accordance with PL_r = c of EN ISO 13849-1:2008; in addition, on machines with automatic reversal of the mill rolls, it shall cause reversal of the stock blender rolls (see 5.2.2.6).

5.2.2.1.7 Complementary guards

If the gap between the trip bar and the mill roll or fixed machine parts located between the trip bar and the mill roll is greater than 400 mm (see Figure 6, dimension c), or if fixed machine parts located between the trip bar and the mill roll can be used as footholds to raise the normal standing level of the operator, then either a fixed guard or a movable guard interlocked with the forward movement of the mill rolls according to PL_r = c of EN ISO 13849-1:2008 shall be provided, extending from the trip bar to the mill tray (see Figure 6, Location B). This guard shall be so designed as to prevent footholds.

5.2.2.2 Hazard of drawing-in and crushing between the mill rolls during reverse operation

5.2.2.2.1 Intentional reverse movement

The intentional reverse movement of the mill rolls shall only be possible by means of:

— a hold-to-run control device (see EN ISO 12100:2010, 3.28.3) in accordance with PL_r = c of EN ISO 13849-1:2008, with a maximum speed limited to 5 m/min or positioned at least 2 m from the dangerous area, or

— a two-hand control device (see EN ISO 12100:2010, 3.28.4) in accordance with EN 574:1996+A1:2008, Type IIIA in accordance with PL_r = c of EN ISO 13849-1:2008 positioned in accordance with EN ISO 13855:2010 with a maximum speed limited to 5 m/min.

The control device shall be positioned to give a clear view of the danger area. If not possible, auxiliary vision devices shall be installed.

5.2.2.2.2 Automatic reverse movement

On two-roll mills equipped with automatic reversal of the mill rolls (see 5.2.2.1.5), access to the area beneath the mill rolls shall be prevented by one of the following:

— a fixed guard preventing access to the trapping zone created below the two-roll mill;

— an interlocking guard with or without guard locking in accordance PL_r = c of EN ISO 13849-1:2008 to prevent access until completion of the automatic reversal of the mill rolls;

NOTE These guards may be the same as those specified in 5.2.2.1.7.

— electro-sensitive protective equipment (ESPE) in accordance with EN 61496-1:2013, type 2 and positioned in accordance with EN ISO 13855:2010. This equipment shall be automatically monitored at least at each start-up, shall be operational only after the trip bar has been actuated (see 5.2.2.1.6, 1st dash) and shall, when actuated, either prevent or stop the automatic reverse movement of the mill rolls in accordance with PL_r = c of EN ISO 13849-1:2008. It shall be impossible to reach the danger zone without interrupting the ESPE.

5.2.2.3 Powered stock guides

Movement of powered stock guides shall only be effected:

— by a hold-to-run control device in accordance with PL_r = c of EN ISO 13849-1:2008 positioned at least 2 m from the dangerous area, or

— by a two-hand control device in accordance with EN 574:1996+A1:2008, Type I in accordance with PL_r = c of EN ISO 13849-1:2008 positioned in accordance with EN ISO 13855:2010.

5.2.2.4 Strip cutting device

5.2.2.4.1 Cutting hazards due to involuntary contact with the cutting edges of blades or rotating discs

Unless the cutting edges are inherently safe due to their location, they shall be protected against involuntary contact; see also 7.2.1.

5.2.2.4.2 Cutting, shearing and crushing hazards caused by movements of the strip cutting devices (with cutting or non-cutting edges) and their actuating mechanisms

a) Movement of the strip cutting devices from the rest position to the working position shall only be effected:

   1) manually, provided that both hands are required in order to achieve the movement; or

   2) by a hold-to-run control device according to PL_r = c of EN ISO 13849-1:2008 positioned at least 2 m from the strip cutting device in the rest position, or

   3) by a two-hand control device in accordance with EN 574:1996+A1:2008, Type I positioned in accordance with EN ISO 13855:2010.

b) Where rotating discs are used, access to cutting, shearing or crushing hazards due to their rotation against the mill roll shall be prevented by distance or by guards. If for operational reasons this is not achievable, see 7.2.1.

Where guards are used, they shall be interlocking guards with guard locking positioned as shown on Figure 6, location B. The interlocking shall be designed so that:

— it is not possible to open the guard before the strip cutting device is in its rest position or the mill rolls have come to rest; and

— the machine cannot be started until the strip cutting device is in its rest position or the guard is closed and locked.

The SRP/CS shall be in accordance with PL_r = c of EN ISO 13849-1:2008.

The setting of the strip cutting devices shall be performed:

— with the guard open after the mill rolls have come to rest, the setting movement of the strip cutting device being controlled by a hold-to-run control device according to PL_r = c of EN ISO 13849-1:2008 positioned at least 2 m from the strip cutting device in the rest position; or

— with the guard closed and the mill rolls running.

5.2.2.5 Stock blender carriage

Where the gap between the stock blender carriage and the machine frame can be reached (see EN ISO 13857:2008, Table 1) crushing hazards shall be prevented by one of the following:

— limiting the travel of the carriage to maintain the minimum gaps in accordance with EN 349:1993+A1:2008, Table 1 with respect to the finger, or

— mechanically actuated trip devices, e.g. sensitive edges in accordance with EN ISO 13856-2:2013.

The SRP/CS for this function shall be in accordance with PL_r = c of EN ISO 13849-1:2008.

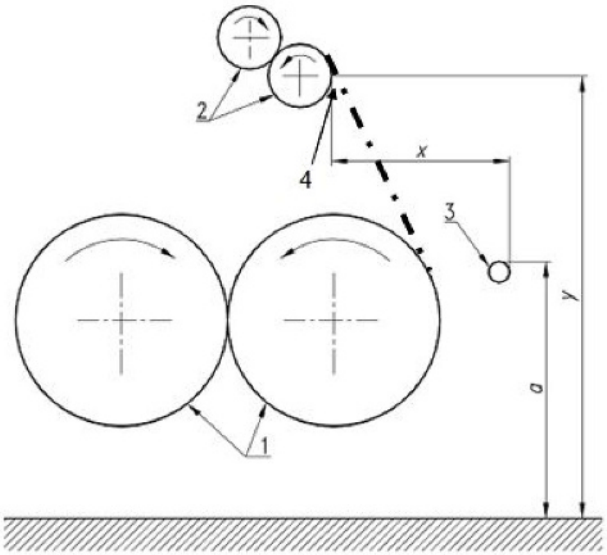
See also 5.2.2.1.6, 2nd dash.

5.2.2.6 Stock blender rolls

The stock blender rolls shall be positioned so that they cannot be reached without actuating the trip bar specified in 5.2.2.1.

This positioning shall be determined using EN ISO 13857:2008, Table 1, taking 1 200 mm as the height of the “protective structure” (*a* in Figure 7).

See also 5.2.2.1.6, 3rd dash.



Key

1 mill rolls

2 stock blender rolls

3 trip bar

4 trapping point between the rubber strip and the blender roll

a corresponds to dimension *b* of EN ISO 13857:2008, Table 1

x corresponds to dimension *c* of EN ISO 13857:2008, Table 1

y corresponds to dimension *a* of EN ISO 13857:2008, Table 1

Figure 7 — Example for the positioning of the stock blender rolls

5.2.2.7 Recovery conveyor belt

For two-roll mills equipped with automatic and/or intentional mill roll reversal, the distance between the mill roll and the recovery conveyor belt shall be at least 120 mm (Figure 8).

Dimension in millimetres

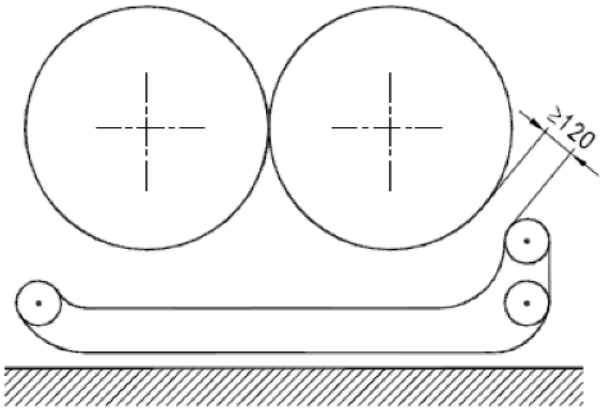


Figure 8 — Recovery conveyor belt

5.2.2.8 Mill tray

If the tray is moveable it shall be equipped with a mechanical self-acting device to lock it in the working position.

The mill tray shall be designed to prevent footholds. Therefore dimension d in Figure 6 shall not be less than 300 mm or a complementary guard shall be installed to prevent footholds (see 5.2.2.1.7).

5.2.2.9 Retractable ploughs

Two-roll mills fitted with retractable ploughs shall be installed within an enclosing guard. Doors in the enclosing guard shall be interlocked with the movement of the ploughs towards the mill rolls according to PL_r = c of EN ISO 13849-1:2008 and shall be equipped with guard locking so as to allow access only when the ploughs have retracted by at least 120 mm as indicated in Figure 9.

Movement of the ploughs due to gravity shall be prevented using pneumatic or hydraulic restraint devices connected directly to the cylinder.

Dimension in millimetres

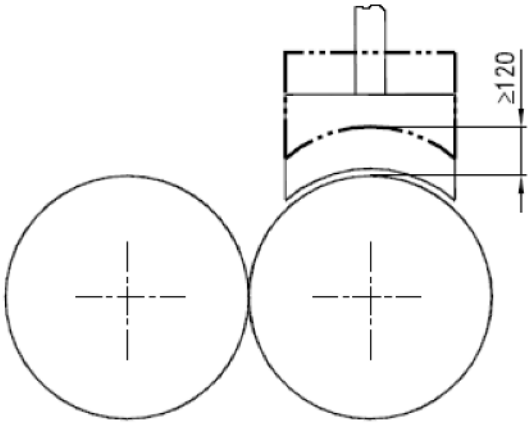


Figure 9 — Retractable ploughs

5.2.3 Specific requirements applicable to small two-roll mills ($D \leq 200$ mm)

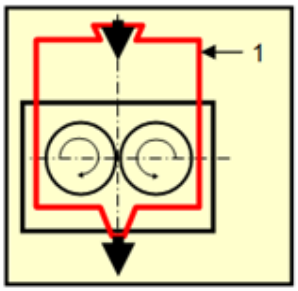
5.2.3.1 Installation of the machine

The top of the mill rolls shall be at a height of not less than 1 100 mm above the normal standing level of the operator.

5.2.3.2 Prevention of access to the principal crushing zone by guards

Access to the principal crushing zone at small two-roll mills shall be prevented by fixed guards or interlocking guards with or without guard locking.

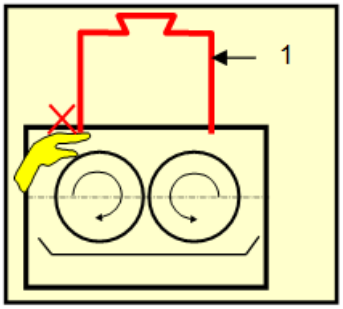
These guards shall be fully enclosing guards (see example Figure 10) or positioned over the full width of the mill rolls at a maximum distance of 4 mm above the surface of the mill rolls (see example Figure 11).



Key

1 fixed guards

Figure 10 — Example of an enclosing guard



Key

1 fixed guards

Figure 11 — Example of a guard above the mill rolls

Interlocking guards shall be positioned in accordance with EN ISO 13855:2010, taking into account the braking performance achieved by either a spring operated brake or a braking system, excluding electronic braking, with an equivalent braking performance when operating without a power supply. The overall system stopping performance (see EN ISO 13855:2010, 3.1.2) shall be calculated taking power failure into account. The safety function shall be in accordance with PL_r = d, category 3 of EN ISO 13849-1:2008. If EN ISO 13855:2010 cannot be respected, interlocking guards with guard locking shall be adopted. The unlocking signal for the guard locking shall be in accordance with PL_r = c of EN ISO 13849-1:2008. The safety function shall be in accordance with PL_r = d of EN ISO 13849-1:2008.

Opening interlocking guards shall stop the mill rolls according to category 0 or 1 of EN 60204-1:2006, 9.2.2, whichever provides the best stopping performance.

A separate manual reset shall be installed in a position giving full view of the danger zone. Actuating the reset shall not restart the machine.

5.2.3.3 Prevention of access to the principal crushing zone by a combination of fixed and/or interlocking guards with or without guard locking and other protective devices

5.2.3.3.1 General

Where the requirements of 5.2.3.2 cannot be met due to process constraints, access to the principal crushing zone shall be prevented as specified in 5.2.3.3.2 or 5.2.3.3.3.

5.2.3.3.2 Combination of fixed and/or interlocking guards with or without guard locking and mechanically actuated trip devices such as pressure sensitive bars or rigid flaps e.g. hinged guards

Access to the principal crushing zone from the top shall be prevented using fixed guards or interlocking guards with or without guard locking according to 5.2.1.1.

Access from the front and rear of the two-roll mill shall be prevented using mechanically actuated trip devices that shall be positioned in accordance with normative Annex A.

Gaps between the trip devices and the guards, if any, shall be in accordance to EN ISO 13857:2008, Table 4.

The trip devices shall extend over the full width of the mill rolls and the actuation force shall be less than 25 N.

It shall not be possible to increase the gap between the trip devices and the mill roll without activating the trip device.

A device for the automatic measuring of the stopping angles as specified in 5.2.2.1.2 c) shall be installed. See also 7.2.2.

Actuation of the trip devices:

— shall stop the mill rolls according to category 0 or 1 of EN 60204-1:2006, 9.2.2, whichever provides the best stopping performance. The safety function shall be in accordance with PL_r = d, category 3 of EN ISO 13849-1:2008; and

— shall cause the mill rolls to stop in an angle not greater than 60° even with the machine unloaded and running at maximum rated speed. The braking system shall be a spring operated brake or a braking system, excluding electronic braking, with an equivalent braking performance when operating without a power supply: and

— shall not create new hazards.

Following the mill rolls coming to rest, automatic separation of the mill rolls achieving a gap of at least 50 mm within 5 s shall occur. The separation shall be achieved, even in case of energy failure, using permanently stored energy e.g. springs, potential energy, etc. If this energy cannot be stored permanently e.g. in an accumulator a permanent monitoring function shall detect the energy level and stop the machine if a fault is detected. See also 5.2.1.5.

The return of the trip device to its rest position shall not cause restarting.

A separate manual reset shall be installed in a position giving full view of the danger zone. Actuating the reset shall not restart the machine.

In addition, knee plates shall be provided in accordance with 5.2.3.4.

5.2.3.3.3 Combination of fixed and/or interlocking guards with or without guard locking and active opto-electronic protective devices in the form of light curtains

Access to the principal crushing zone from the top shall be prevented using fixed guards or interlocking guards with or without guard locking in accordance with 5.2.1.1.

Access from the front and rear of the two-roll mill shall be prevented using active opto-electronic protective devices in the form of light curtains as defined in EN 61496-2:2013, 3.205.

The light curtains shall be of type 4 in accordance with EN 61496-1:2013 and EN 61496-2:2013, positioned in accordance with EN ISO 13855:2010.

Gaps between the light curtains and the guards, if any, shall be in accordance to EN ISO 13857:2008, Table 4.

The light curtains shall become effective as soon as the two-roll mill is switched on.

It shall not be possible to reach the danger area around, above or beneath the light curtain.

Interrupting the light curtains shall stop the mill rolls according to category 0 or 1 of EN 60204-1:2006, 9.2.2, whichever provides the best stopping performance. The safety function shall be in accordance with PLr = d of EN ISO 13849-1:2008.

The end of an interruption of the light curtain shall not automatically initiate any further movement. A new start command shall be required.

A separate manual reset shall be installed in a position giving full view of the danger zone. The manual reset function shall enable the control system for accepting a separate start command. The reset function shall be in accordance with EN ISO 13849-1:2008, 5.2.2.

See also 7.2.3.

5.2.3.4 Requirements for knee plates

The knee plate shall be designed as pressure sensitive protective device which shall extend over the working width of the mill roll at the operator's side and, when actuated, performs the safety function in accordance with 5.2.3.3.2.

The actuation force of the knee plate shall be ≤ 100 N.

Where it is possible to operate the two-roll mill from both sides, knee plates shall be provided on both sides.

The SRP/CS shall be in accordance with PL_r = c of EN ISO 13849-1:2008.

Release of the knee plate shall not cause restarting.

A separate manual reset shall be installed in a position giving full view of the danger zone. Actuating the reset shall not restart the machine.

5.2.4 Specific requirements applicable to intermediate two-roll mills (200 mm < D < 400 mm)

For intermediate two-roll mills, if fixed and interlocking guards cannot be used for operational reasons, the trip bar as specified in 5.2.2.1 shall be the primary protective measure to be adopted. However, distance 'b' shall not be less than 850 mm (see 5.2.2.1.3 and Figure 6)

If it is not possible to position the trip bar so that the safety limits as defined in 3.4 are out of reach and a good ergonomic working position achieved, then the safeguarding used for small two-roll mills (see 5.2.3) shall be adopted. See also Annex A.

5.3 Electrical hazards and hazards due to electromagnetic interference

Electrical equipment shall be in accordance with EN 60204-1:2006.

Electronic control systems shall be designed and installed so as to be protected from electromagnetic interference in accordance with EN 61000-6-2:2005.

The electromagnetic emissions of electrical/electronic circuits shall be limited in accordance with EN 61000-6-4:2007.

The conductive masses shall be grounded to prevent the accumulation of electrostatic charges.

5.4 Thermal hazards

Where unintentional contact with hot machine parts other than the mill rolls is not precluded, these parts shall be insulated so that the burn thresholds as specified in EN ISO 13732-1:2008 are not exceeded.

Injury caused by escaping fluids from uncovered heat conditioning hoses and fittings shall be prevented by guards.

For the mill rolls and hot materials, see 7.2.1.

5.5 Hazards caused by gases, dusts or vapours hazardous to health

The machine shall be designed such that a local exhaust ventilation system for the extraction of harmful substances when emitted can be fitted or positioned without modification to the machine. See 7.2.1.

5.6 Hazards generated by neglecting ergonomic principles

These hazards are reduced by meeting the requirements given in the following subclauses:

— for large two-roll mills, 5.2.2.1.2 for the installation height of the machine and 5.2.2.1.3 for the positioning of the trip bar;

— for small two-roll mills, 5.2.3.1 for the installation height of the machine.

The required positioning of the trip bar may cause unfavourable working conditions for small operators. However, positioning the trip bar nearer to the mill rolls or making it adjustable towards the mill rolls is not acceptable because it would be prejudicial to the safety for all other operators.

5.7 Hazards generated by noise

5.7.1 Main noise sources

The main sources of noise on two-roll mills are the drive and transmission unit(s), the air cooling systems, the motors, the control cabinets.

In addition noise can be generated by ancillaries and by the process itself, e.g. the bursting of air bubbles in the materials being processed.

5.7.2 Noise reduction at source by design

Two-roll mills shall be designed and constructed so that risks resulting from the emission of airborne noise are reduced to the lowest level, taking account of technical progress and the availability of means of reducing noise, in particular at source. (See also EN ISO 11688-1:2009.)

NOTE Noise generation mechanisms are described in EN ISO 11688-2:2000.

For the drive and transmission unit(s) noise reduction shall be achieved by selecting low noise components.

Low noise cooling systems should be used to reduce the noise levels.

5.7.3 Noise reduction by devices

The pneumatic cabinets shall be fitted with noise reduction devices (e.g. silencers on the air inlets/outlets, vent silencers on the pneumatic systems in particular on the exhaust).

If the processed materials tend to include air bubbles, the noise emission can rise considerably when the air bubbles are compressed and burst in the nip. This noise emission cannot be avoided or reduced by machinery design, so partial or complete enclosure shall be considered. See 7.2.4.

5.7.4 Information connected with noise hazards

See 7.2.4 and Annex B.

6 Verification of the safety requirements and/or protective measures

Verification of the safety requirements and/or protective measures shall be undertaken as shown in Table 2 below.

Table 2 — Verification methods

Subclause	Verification methods			
	Visual inspection	Functional test	Measurement	Calculation
5.1.1	X	X		X
5.1.2	X	X	X	
5.2.1.1	X	X	X	X
5.2.1.2		X		
5.2.1.3	X	X	X	X
5.2.1.4	X	X	X	X
5.2.1.5	X			
5.2.2.1.1	X	X		
5.2.2.1.2	X	X	X	X
5.2.2.1.3	X		X	X
5.2.2.1.4	X	X	X	X
5.2.2.1.5	X	X	X	
5.2.2.1.6	X	X		X
5.2.2.1.7	X	X	X	X
5.2.2.2.1	X	X	X	X
5.2.2.2.2	X	X	X	X
5.2.2.3	X	X	X	X
5.2.2.4.1	X			
5.2.2.4.2	X	X	X	X
5.2.2.5	X	X	X	X
5.2.2.6	X		X	X
5.2.2.7			X	
5.2.2.8	X	X	X	
5.2.2.9	X	X	X	X
5.2.3.1			X	
5.2.3.2	X	X	X	X
5.2.3.3.2 and Annex A	X	X	X	X
5.2.3.3.3	X	X	X	X

Subclause	Verification methods			
	Visual inspection	Functional test	Measurement	Calculation
5.2.3.4	X	X	X	X
5.2.4	X	X	X	X
5.3	X	X	X	X
5.4	X		X	
5.5	X			
5.6			X	
5.7 and Annex B	X		X	X

Functional testing includes the verification of the function and efficiency of the guards and protective devices on the basis of:

— descriptions given in the information for use;

— safety related design documents;

— the requirements given in Clause 5 of this standard and the other quoted standards.

Functional testing of the guards and protective devices according to PL_r = c, d or e of EN ISO 13849-1:2008 shall also include the simulation of failures which are likely to occur.

7 Information for use

7.1 General

Information for use shall be provided in accordance with EN ISO 12100:2010, 6.4.

7.2 Instruction handbook

7.2.1 General

Each two-roll mill shall be accompanied by an instruction handbook giving general instructions for its use (see EN ISO 12100:2010, 6.4.5) and the following information:

— personal protective equipment to be used in case of high temperature of the mill rolls or material processed (see EN ISO 13732-1:2008);

— the fitting and positioning of a local exhaust ventilation system. It shall be indicated that the local exhaust ventilation system shall be fitted or positioned under the responsibility of the user if harmful emissions can be expected due to certain materials being processed;

— the manufacturer shall indicate the effects of the emergency stop;

— the manufacturer shall define the procedure to release persons who have been accidentally drawn in between the mill rolls when no energy is supplied to the machine, and indicate that the manually operated mechanism and associated tools shall always be available on the machine;

— the manufacturer shall draw the attention of the user to the residual risk associated with partly covered cutting edges of the strip cutting devices and shall give instructions to adjust the protective devices with reference to the material processed;

— the manufacturer of small or intermediate two-roll mills shall give information about suitable tools to be used to introduce materials into the nip.

7.2.2 Two-roll mills equipped with a trip bar as in 5.2.2.1

For these machines the following instructions and information shall also be included:

— the two-roll mill shall be installed so that the top of the mill rolls is at a height of not less than 1 300 mm above the normal standing level of the operator;

— an explanation about the safety limits and the warning notice mentioned in 7.3.2 with the remark that the use of the machine shall be possible only if the operator cannot reach the dangerous area; the test shall be carried out under the supervision of a person responsible for the safety of the operators; it shall be stressed that after installation nothing shall be allowed to raise the normal standing level of the operator;

— the functional testing shall include the measurement of the stopping angle as defined in 3.3. The instructions shall specify the actions to be taken for the adjustment of the braking system if the measured braking angle is greater than 60°. If the braking system includes a mechanical friction brake, the measured braking angle is the highest value measured in a series of three consecutive measurements within 10 min;

— the use of the device for the automatic measuring of the stopping angle.

7.2.3 Two-roll mills equipped with light curtains as in 5.2.3.3.3

For these machines the manufacturer shall:

— give adequate instructions on the monitoring of the stopping time;

— state that the user shall ensure that the stopping time relating to the light curtains is verified at least once a year.

7.2.4 Noise emission

The instruction handbook, the technical documentation and the sales literature describing the two-roll mill shall:

— give the declared noise emission values of the two-roll mill in accordance with B.6 of this standard;

— refer to the noise test code specified in Annex B to this standard upon which the determination of the noise emission values of the two-roll mill is based and state which basic noise measurement standards have been used;

— contain information on possible methods of installation to minimize noise emission, in particular the installation of acoustic screens;

— recommend the wearing of personal hearing protection in case of high noise emission caused by the processing of rubber materials which tend to include air bubbles.

7.3 Marking

7.3.1 General

The minimum markings for all machines shall include:

— business name and full address of the manufacturer and where applicable his authorized representative;

— designation of the machinery;

— mandatory marking;

— designation of series or type;

— serial number if any, or machine number;

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

7.3.2 Two-roll mills equipped with a trip bar as in 5.2.2.1

Two-roll mills equipped with a trip bar shall be marked with safety limits which meet the following requirements:

— the safety limits shall be clearly and permanently marked on the stock guides or on the machine frame at both ends of the mill rolls by means of vertical lines not less than 10 mm wide and extending above the stock guides;

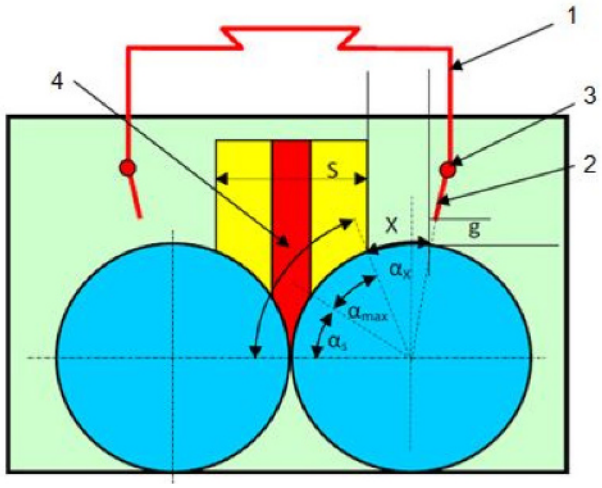
— the machine shall bear the following notice close to the trip bar: “This mill is not safe for persons who can reach beyond the marked safety limits without actuating the trip bar.”;

— these limits and notice shall be clearly visible in all operating situations.

Annex A
(normative)

Positioning of the trip devices specified in 5.2.3.3.2 and 5.2.4

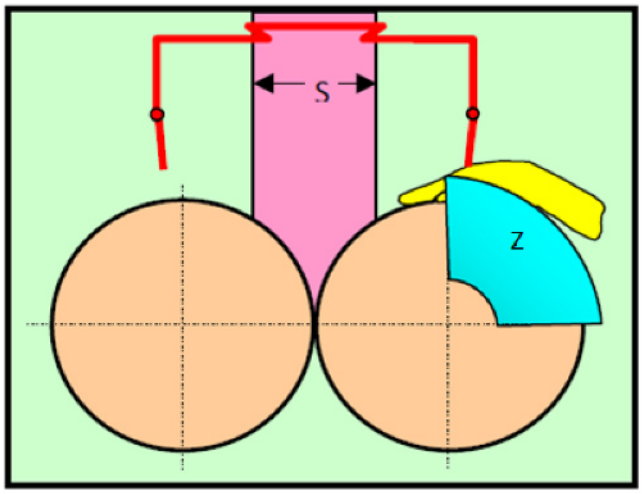
The positioning of the trip devices shall be determined as follows:



Key

1	fixed guard
2	pressure sensitive rigid flap
3	pivoting axis of the rigid flap
4	crushing zone
α_s	angle related to the trapping area
α_{max}	maximum stopping angle
α_X	angle related to distance *X*
S	distance between the safety limits of the dangerous area
X	distance from the trip device to the dangerous area along the circumference of the mill roll
g	maximum gap between the trip device and the mill roll surface

Figure A.1 — Positioning of a pressure sensitive rigid flap when combined with a fixed guard (example)



Key

S distance between the safety limits of the dangerous area

Z area where gap g (see Figure A.1) shall be measured

Figure A.2 — Schematic drawing showing the area where gap g shall be measured

Parameters:

D mill roll diameter

X = $\alpha_X \bullet D / 2$

C = 8 (g – 14)

S = $D \bullet \left(1 - \cos \alpha_{tot}\right)$

α_{tot} = $\alpha_s + \alpha_{max}$

α_s = arccos $\left[\left(D - 12\right)/D\right]$

α_{max} ≤ 60°

Requirements for the positioning of the trip devices:

— the distance *X* shall be more than the intrusion distance *C*, but not less than 0; and

— the edge of the gap "g" shall be in the upright quarter circle as shown in Figure A.2.

Calculation:

The maximum gap g in mm shall be:

$$g < \alpha_X \bullet D / 16 + 14 \quad \text{(A.1)}$$

at a distance X from the dangerous area:

$$X = \alpha_X \bullet D / 2 \quad \text{(A.2)}$$

where:

$$\alpha_X \leq \pi - \alpha_{tot}$$

The angle values shall be expressed in radians in the formulas.

Results of the calculation:

Table A.1 below is obtained considering the maximum stopping angle α_{max} = 30° for diameters less than 250 mm and α_{max} = 40° for diameters more than or equal to 250 mm, and the gap "g" positioned at 60° from the top of the mill roll.

Table A.1 — Dimensions g and X for various mill roll diameters D

D (mm)	110	150	200	250	300
α_s (°)	27,01	23,07	19,95	17,82	16,26
α_{max} (°)	30,00	30,00	30,00	40,00	40,00
α_{tot} (°)	57,01	53,07	49,95	57,82	56,26
S (mm)	50,11	59,88	71,30	116,87	133,37
α_X (°)	92,99	96,93	100,05	92,18	93,74
X (mm)	**89,26**	**126,88**	**174,63**	**201,10**	**245,41**
g (mm)	**25,16**	**29,86**	**35,83**	**39,14**	**44,68**

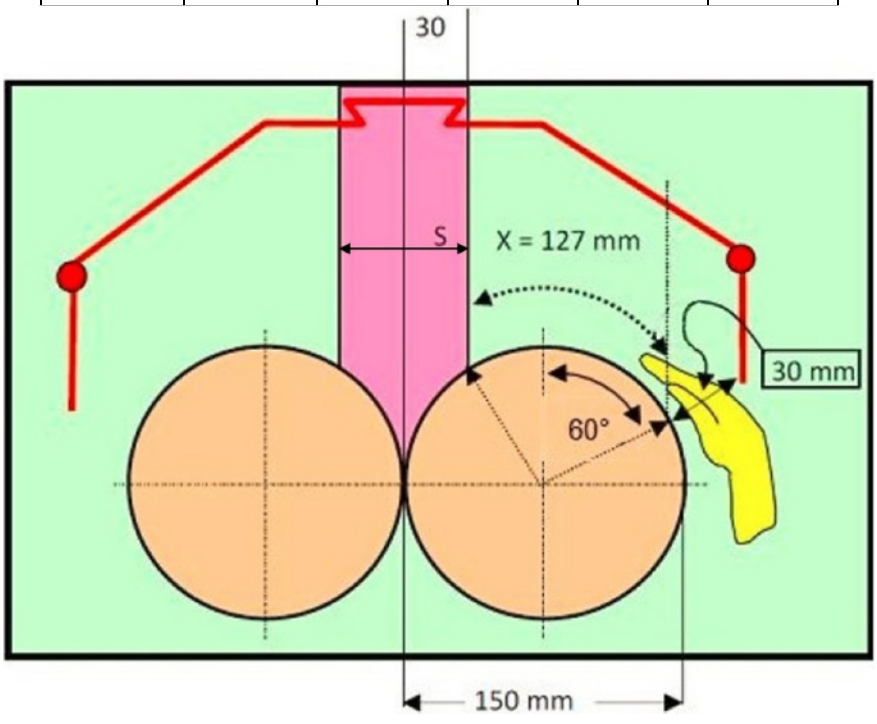


Figure A.3 — Example for Table A.1 with D = 150 mm

For parameters other than the ones used for Table A.1, calculations shall be carried out using Formulae (A.1) and (A.2).

Annex B
(normative)

Noise test code

B.1 Introduction

This noise test code specifies all the information necessary to carry out efficiently and under standardized conditions the determination, declaration and verification of the airborne noise emission values of two-roll mills.

The determination of these quantities is necessary for:

— manufacturers to declare the noise emitted,

— comparing the noise emitted by machines in the family concerned,

— purposes of noise control at source at the design stage.

It specifies the noise measurement methods and operating and mounting conditions for the test.

The use of this noise test code ensures the reproducibility of the measurements and the comparability of the airborne noise emission values within specified limits determined by the grade of accuracy of the basic measurement method used. Noise measurement methods allowed by this noise test code are engineering (grade 2 of accuracy) methods. If this is technically not possible survey (grade 3 of accuracy) methods may be used stating the justification for the use of such a method.

B.2 Determination of the A-weighted emission sound pressure level at the workstation

B.2.1 Basic standards and measurement procedure

The determination of the A-weighted emission sound pressure level shall be carried out using one of the standards EN ISO 11201:2010 with grade 2 of accuracy, EN ISO 11202:2010 with grade 2 of accuracy or EN ISO 11204:2010 with grade 2 of accuracy.

For two-roll mills where there are no defined workstations, microphone positions shall be located at 1m from the contour of the machine and at a height of 1,6 m. The highest value measured and the location where it is observed shall be recorded, reported and declared.

For two-roll mills which are manually loaded and unloaded by an operator the determination of the A-weighted emission sound pressure level shall be carried out at all designated operators' positions defined by the manufacturer in the instruction handbook using one of the standards EN ISO 11201:2010 with grade 2 of accuracy or EN ISO 11204:2010 with grade 2 of accuracy.

The measurement duration shall be as follows:

— if the noise emission is steady, the measurement duration shall be at least 10s;

— if the two-roll mill runs in a continuous mode but with impulsive sound emissions (e.g. with a periodicity of 30 s), the duration shall be at least 2 min.

If it is not possible to use an engineering method (grade 2 of accuracy), a survey method (e.g. EN ISO 11202:2010 with grade 3 of accuracy) may be used stating the justification for the use of such a method.

B.2.2 Measurement uncertainty

If a grade 2 (engineering) method is used, the standard-deviation of reproducibility for A-weighted levels is:

$$\sigma_{RA} = 1{,}5 \text{ dB},$$

resulting in a measurement uncertainty of 3 dB, if the operating conditions of the machine are stable, which is normally the case for two-roll mills.

The measurement uncertainty may be much higher if a grade 3 (survey) method is used and/or the operating conditions of the machine are not stable.

NOTE Detailed information about uncertainty is given in EN ISO 11201:2010, Clause 11, EN ISO 11202:2010, Clause 12 and EN ISO 11204:2010, Clause 11. See also EN ISO 4871:2009.

B.3 Determination of the A-weighted sound power level

B.3.1 Basic standards and measurement procedure

For two-roll mills that emit an A-weighted sound pressure level higher than 80 dB, the sound power level shall also be measured.

The determination of the A-weighted sound power level shall be carried out using one of the standards EN ISO 3744:2010 or EN ISO 9614-2:1996 with grade 2 of accuracy.

If it is not possible to use an engineering method (grade 2 of accuracy), a survey method (e.g. EN ISO 3746:2010 with grade 3 of accuracy) may be used stating the justification for the use of such a method.

When EN ISO 3744:2010 or EN ISO 3746:2010 is used the measurement surface shall be a parallelepiped and the measurement distance shall be 1 m.

The measurement duration shall be as follows:

— if the noise emission is steady, the measurement duration shall be at least 10 s;

— if the two-roll mill runs in a continuous mode but with impulsive sound emissions (e.g. with a periodicity of 30 s), the duration shall be at least 2 min.

B.3.2 Measurement uncertainty

If a grade 2 (engineering) method is used, the standard-deviation of reproducibility for A-weighted levels is

$$\sigma_{RA} = 1{,}5 \text{ dB},$$

resulting in a measurement uncertainty of 3 dB, if the operating conditions of the machine are stable, which is normally the case for two-roll mills.

The measurement uncertainty may be much higher if a grade 3 (survey) method is used and/or the operating conditions of the machine are not stable.

NOTE EN ISO 4871:2009 provides a method for deriving the total measurement uncertainty from the value of the standard deviation of reproducibility.

B.4 Mounting and operating conditions

During the noise test the machine shall be mounted and operated as specified/recommended by the manufacturer in the instruction handbook.

For the noise test the machine shall be operated unloaded but in a working condition (e.g. ready to process material) and at nominal rotation speed. Under different operating conditions the noise level can differ and may be higher.

Noise emission measurement shall be made by the manufacturer in collaboration with the user.

In general, two-roll mills can only be run under operational conditions, i.e. with the intended material, at the user's premises. Noise emission of two-roll mills without material may not be representative. It is therefore recommended that manufacturers start gathering noise emission data on two-roll mills operated with material. This data can be obtained from measurements carried out by manufacturers at users' premises on new two-roll mills after installation or during commissioning. From this data, manufacturers will progressively become able:

— to assess the effectiveness of the noise control measures they implement at the design stage;

— to inform users about noise emission values that can be expected.

B.5 Information to be recorded and reported

B.5.1 General

The information to be recorded and reported shall include all the data required by the basic measurement standards used i.e. precise identification of the machine under test, acoustic environment, instrumentation, presence and position(s) of the operator(s) if any. If there is any deviation to this test code this shall be recorded, reported and declared.

The operating conditions of the machine during measurement and the methods that have been used for the measurement shall be indicated.

At least the data specified in B.5.2 to B.5.5 shall be recorded and reported.

B.5.2 General data

— Type, serial number if any, year of manufacture of the machine;

— date of test, location, person in charge;

— ambient temperature.

B.5.3 Mounting and operating conditions

Mounting and operating conditions during noise measurement:

— parameters of the drive system;

— rotation speed of the mill rolls;

— list of ancillary equipment in operation during measurement (local exhaust ventilation system, hydraulic power unit, etc.).

B.5.4 Standards

The measurement standard(s) that have been used.

B.5.5 Noise data

— Location of measurement positions;

— determined noise emission values and associated uncertainty.

B.6 Declaration and verification of noise emission values

The noise declaration shall be a dual-number declaration as defined in EN ISO 4871:2009, A.2.2, i.e. the measured value and the measurement uncertainty shall be indicated separately. It shall include the following:

— the A-weighted emission sound pressure level at workstations, where this exceeds 70 dB(A); where this level does not exceed 70 dB(A), this fact shall be indicated; and

— the A-weighted sound power level emitted by the machinery, where the A-weighted emission sound pressure level at at least one workstation exceeds 80 dB(A).

The declaration shall indicate not only the highest emission sound pressure level measured on a path around the machine but also the location where it is observed.

The actual operating conditions shall be described as quantitatively as possible, e.g. the value of the nominal rotation speed during the noise test shall be declared.

The noise declaration shall mention explicitly that noise emission values have been obtained according to this noise test code. It shall indicate which basic measurement standards have been used and give details of the mounting and operating conditions of the machine during the determination of its noise emission. The noise declaration shall clearly indicate deviation(s) from this noise test code and/or from the basic measurement standards used if any.

If undertaken the verification of declared values shall be conducted according to EN ISO 4871:2009 by using the same mounting and operating conditions as those used for the initial determination of noise emission values.

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 a 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.

Bibliography

[1] EN ISO 11688-1:2009, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1:1995)*

[2] EN ISO 11688-2:2000, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 2: Introduction to the physics of low-noise design (ISO/TR 11688-2:1998)*

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