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Plastics and rubber machines — Tyre curing machines — Safety requirements

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National foreword

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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.

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Foreword

This document (EN 16474:2015) 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of an identical text or by endorsement, at the latest by October 2015, and conflicting national standards shall be withdrawn at the latest by October 2015.

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For relationship with EU Directive 2006/42/EC, 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, 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 European Standard is a type C standard as stated in EN ISO 12100.

The machinery concerned and the extent to which hazards, hazardous situations and hazardous events are covered are indicated in the scope of this European 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 in accordance with the provisions of this type C standard.

1 Scope

This European Standard applies to tyre curing machines having the following configuration.

— crossing flow tyre curing machines, with two cavities with:

  — common curing cycle and common safeguarding; or

  — independent curing cycles and common safeguarding; or

  — independent curing cycles and independent safeguarding;

— tyre curing machines with one cavity;

— tyre curing machines with automatic rear feeding and discharge.

The safety requirements and/or protective measures specified in this European Standard apply to tyre curing machines for passenger vehicle tyres and truck tyres.

This European Standard does not deal with:

— feeding system and discharge system;

— tyre curing machines with manual loading of the green tyre into the mould and manual unloading of the cured tyre from the mould;

— ancillary equipment which is not an integral part of the tyre curing machine, e.g. conveying equipment;

— exhaust systems.

This European Standard deals with all significant hazards, hazardous situations and events relevant to tyre curing machines, when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer (see Clause 4).

It does not deal with hazards associated with falling of parts of the container or mould.

Some tyre curing machines include pressure vessels, which fall under Directive 97/23/EC [1]; this European standard is not intended to support the Directive 97/23/EC.

This European Standard is not applicable to tyre curing machines which are manufactured before the date of its publication as an EN.

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 619:2002+A1:2010, *Continuous handling equipment and systems - Safety and EMC requirements for equipment for mechanical handling of unit loads*

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

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

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

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 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 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 13856-3:2013, *Safety of machinery - Pressure-sensitive protective devices - Part 3: General principles for design and testing of pressure-sensitive bumpers, plates, wires and similar devices (ISO 13856-3:2013)*

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

EN ISO 14122-2:2001/A1:2010, *Safety of machinery - Permanent means of access to machinery - Part 2: Working platforms and walkways - Amendment 1 (ISO 14122-2:2001/Amd 1:2010)*

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

EN ISO 14122-3:2001/A1:2010, *Safety of machinery - Permanent means of access to machinery - Part 3: Stairs, stepladders and guard-rails - Amendment 1 (ISO 14122-3:2001/Amd 1:2010)*

EN ISO 14122-4:2004, *Safety of machinery - Permanent means of access to machinery - Part 4: Fixed ladders (ISO 14122-4:2004)*

EN ISO 14122-4:2004/A1:2010, *Safety of machinery - Permanent means of access to machinery - Part 4: Fixed ladders - Amendment 1 (ISO 14122-4:2004/Amd 1:2010)*

CLC/TS 61496-3:2008, *Safety of machinery — Electro-sensitive protective equipment — Part 3: Particular requirements for Active Opto-electronic Protective Devices responsive to Diffuse Reflection (AOPDDR) (IEC 61496-3:2008)*

ISO 7010:2011, *Graphical symbols — Safety colours and safety signs — Registered safety signs*

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
tyre curing machine
machine used for vulcanisation of tyres usually comprising fixed and movable parts that can be locked together, inside which the green tyre assumes its final shape and characteristics by the use of pressure and heating

Note 1 to entry See Figure 1 and Figure 2.

3.2
crossing flow
machine type in which green tyres are fed and loaded from the front and cured tyres are unloaded and discharged from the rear

3.3
cavity
part of the machine in which the container and/or the mould and the bladder are installed

3.4
green tyre
assembly of rubber parts intended to be cured

3.5
cured tyre
tyre in its final form after vulcanisation

3.6
bladder
inflatable rubber component used to push the green tyre into contact with the mould while being inflated by the curing media

Note 1 to entry: The bladder is connected to the machine by means of the top ring and bottom ring.

3.7
bottom ring
assembly of the bottom bladder clamping plate

3.8
top ring
assembly of the top bladder clamping plate

3.9
green tyre stand
supporting element for the green tyre before loading

3.10
chuck
device for holding or gripping the green or cured tyre

3.11
movable upper part
part of the machine that is opened for loading the green tyre and unloading the cured tyre and is closed and locked during curing

3.12
heating platen
equipment used to heat sidewalls of the mould by contact

3.13
steam dome
equipment used to heat the complete mould by direct contact with the steam

3.14
container
exchangeable equipment used to receive and heat the segments of the curing mould

Note 1 to entry: The container is fixed to the tyre curing machine by use of screws or automatic fixation device.

3.15
mould
exchangeable equipment used to give the external shape to the cured tyre

3.16
dummy mould
subassembly representative of the mould used in industrial conditions

3.17
mould segment
movable part of the mould

3.18
semi-closed position
position of the movable upper part where the still open segments of the mould in the container touch the lower part of the container thus preventing the risk of projection

3.19
feeding
manual or automatic operation to feed green tyres to the loading device

3.20
loading device
device used to pick up the green tyre and insert it into the tyre curing machine

3.21
curing cycle
period of time in which the curing process is completed, i.e. from full closing, squeezing and locking until the pressure is dropped down

3.22
unloading device
device used to remove the cured tyre from the tyre curing machine

3.23
discharge
manual or automatic operation to remove cured tyres from the unloading device

3.24
take-away conveyor
conveyor that is an integral part of the machine and on which the unloading device deposits the cured tyres for discharge to the rear of the tyre curing machine

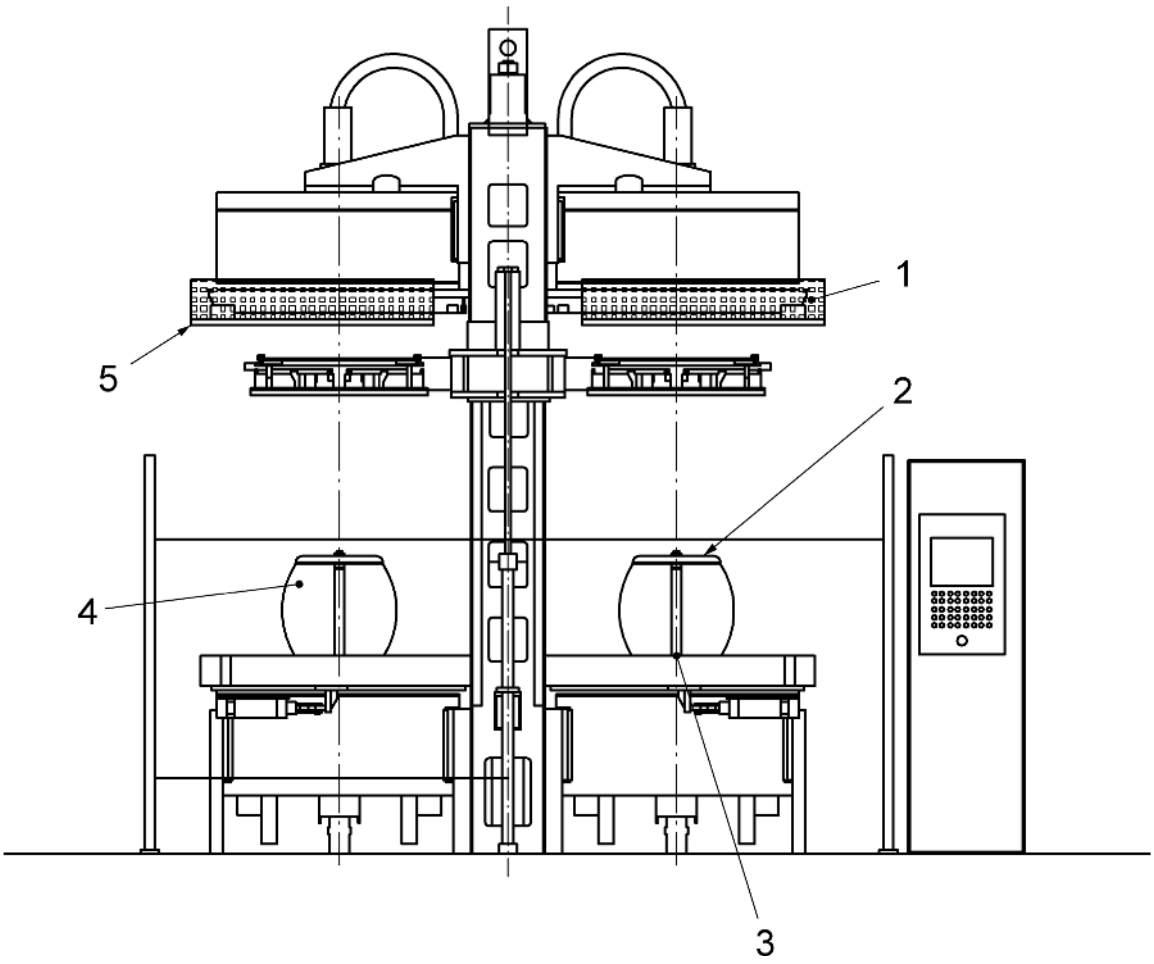
3.25
spraying device
static or dynamic nozzle(s) used to treat the mould and/or the bladder with treatment fluid

3.26
distance guard
guard which does not completely enclose a danger zone, but which prevents or reduces access by virtue of its dimensions and its distance from the danger zone, e.g. perimeter fence or tunnel guard

[SOURCE: EN 953:1997+A1:2009, 3.2.2]

3.27
enclosing guard
guard which prevents access to the danger zone from all sides

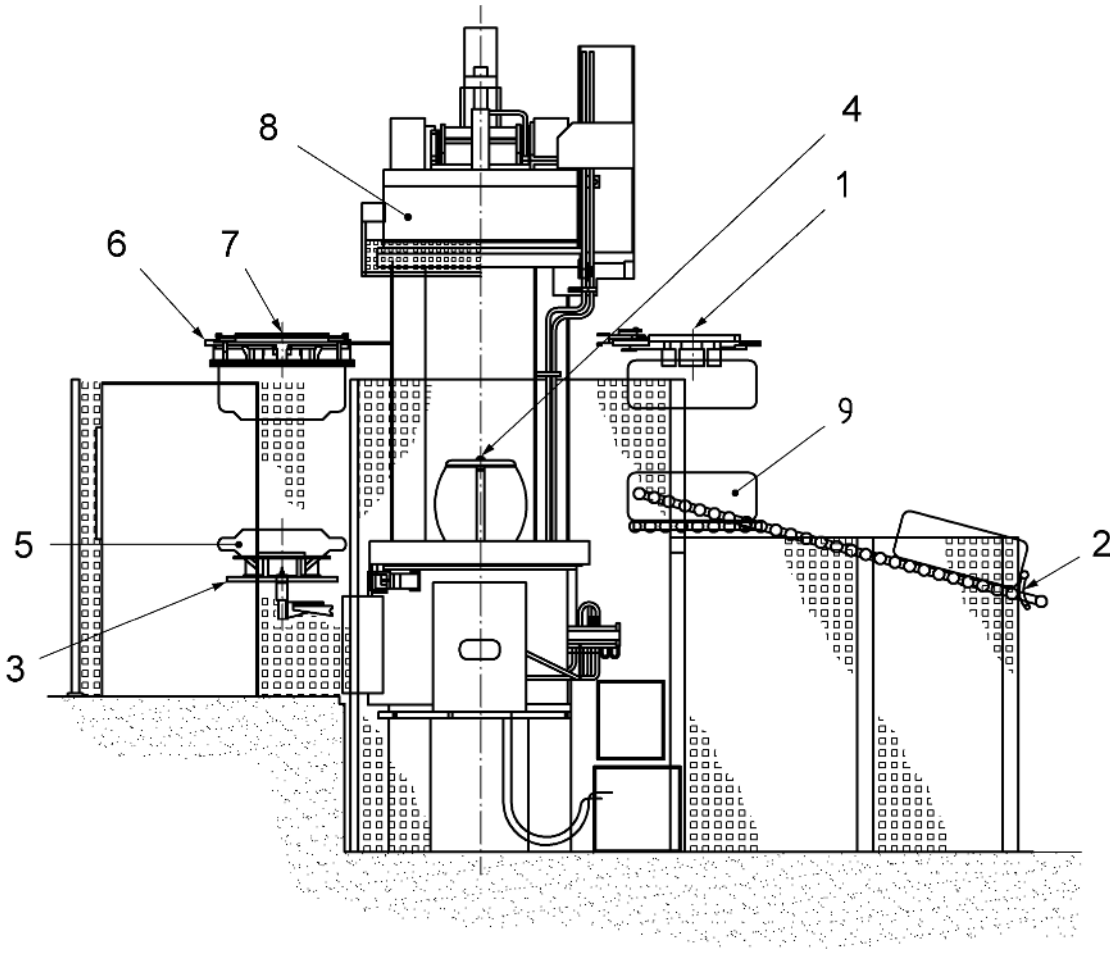
[SOURCE: EN 953:1997+A1:2009, 3.2.1]



Key

1 container
2 top ring
3 bottom ring
4 bladder
5 heating platen

Figure 1 — Main parts of tyre curing machines (front view)



Key

1 unloading device
2 take-away conveyor
3 green tyre stand
4 top ring
5 green tyre
6 loading device
7 chuck
8 movable upper part
9 cured tyre

Figure 2 — Main parts of tyre curing machines (side view)

4 List of significant hazards

4.1 General

This clause contains all the significant hazards, hazardous situations and events identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk.

For the location of hazards on crossing flow tyre curing machines, see Figure 3, Figure 4 and Figure 5.

For the location of hazards on tyre curing machines with automatic rear feeding and discharge, see Figure 6, Figure 7 and Figure 8.

The numbering of hazards on Figure 3 to Figure 8 and in 4.3 corresponds to the numbering of hazards in Table 1.

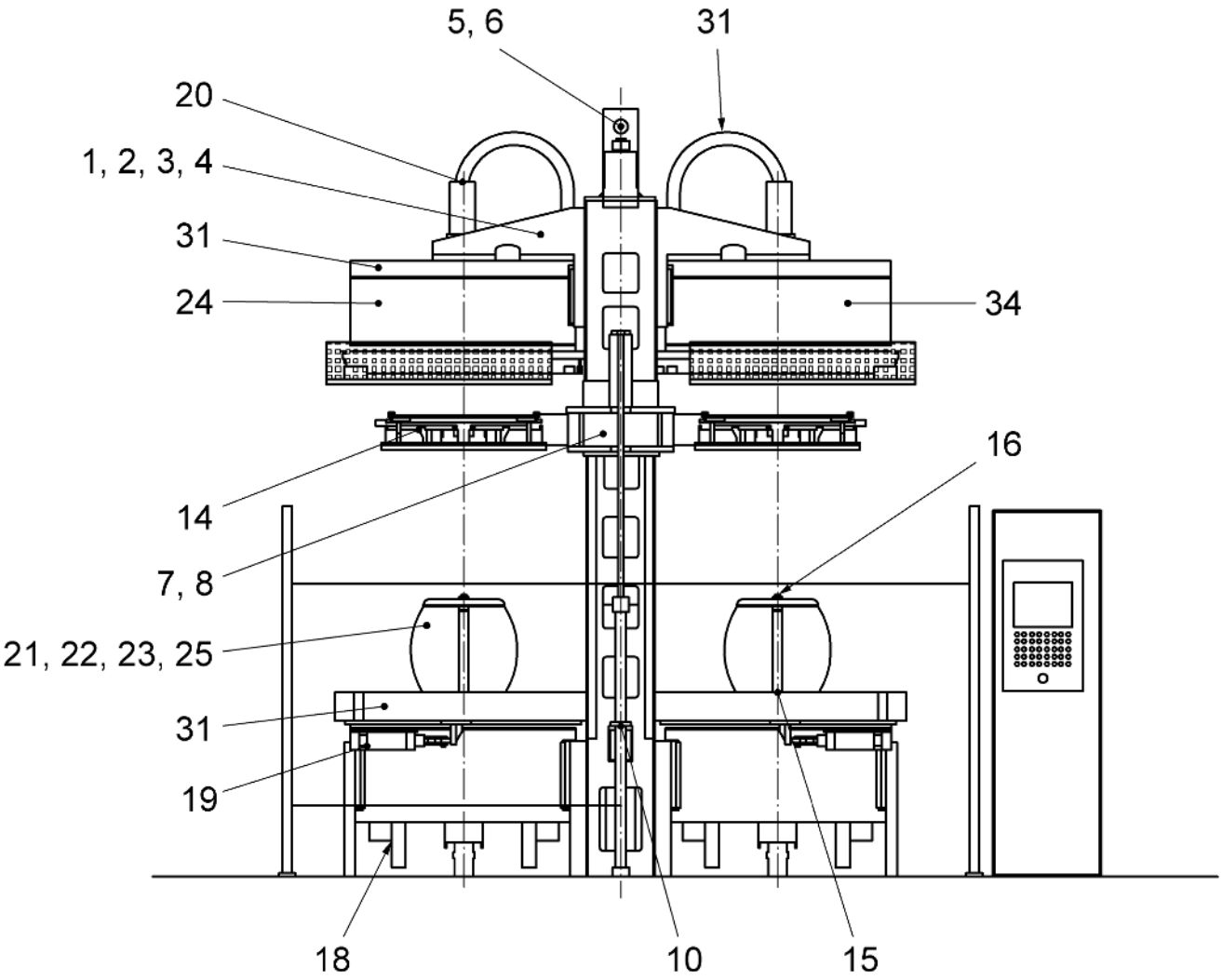


Figure 3 — Location of hazards on crossing flow tyre curing machines (front view)

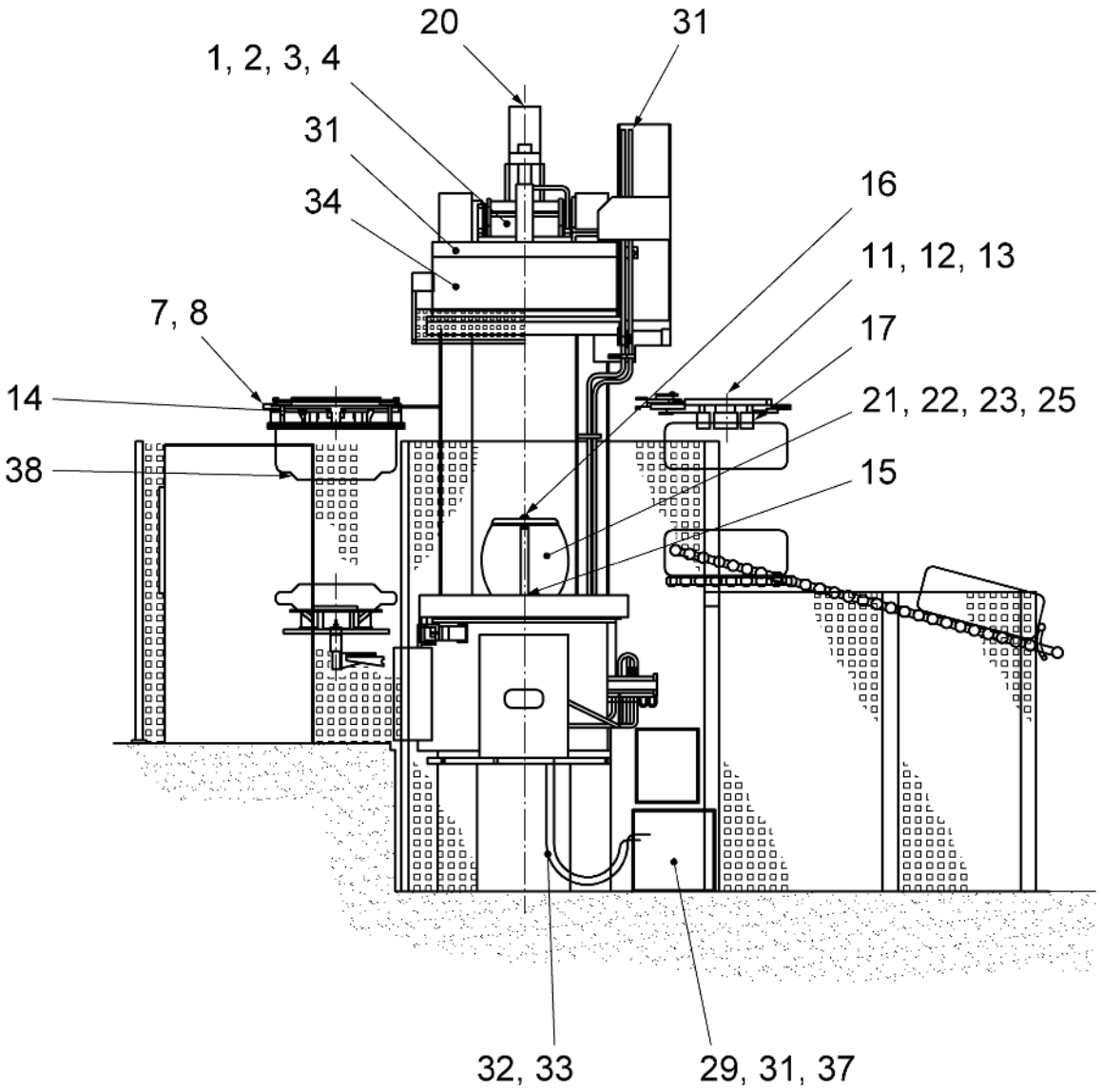


Figure 4 — Location of hazards on crossing flow tyre curing machines (side view)

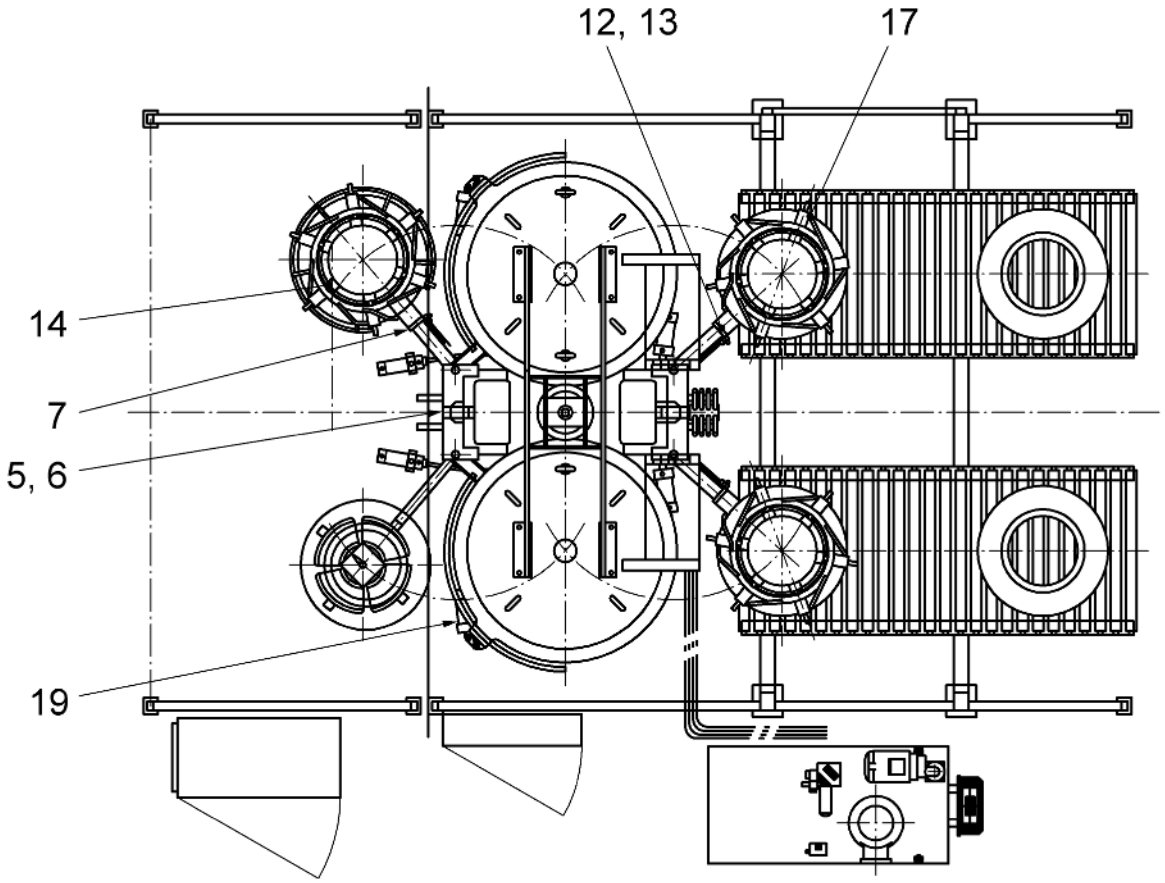


Figure 5 — Location of hazards on crossing flow tyre curing machines (top view)

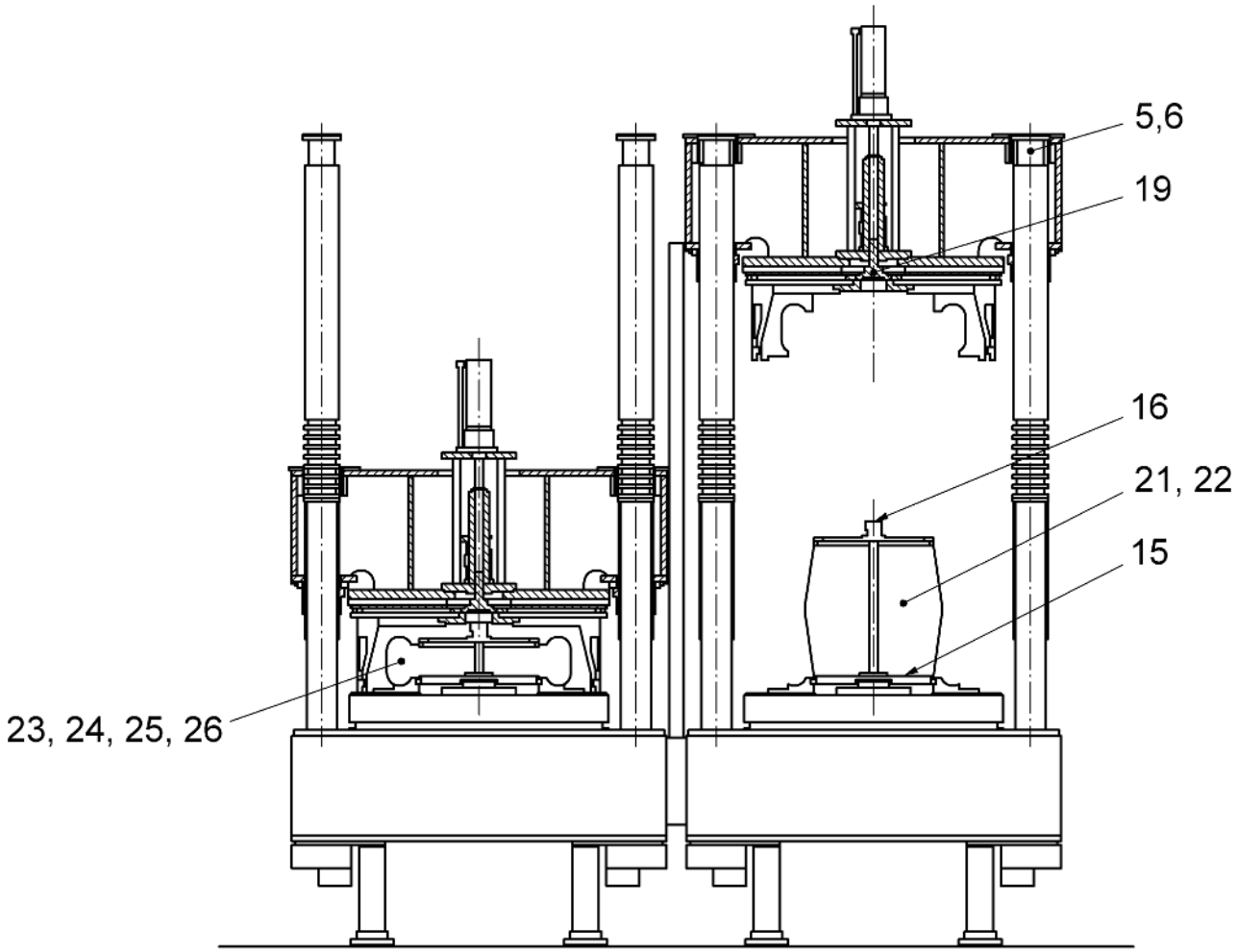


Figure 6 — Location of hazards on tyre curing machines with automatic rear feeding and discharge (front view)

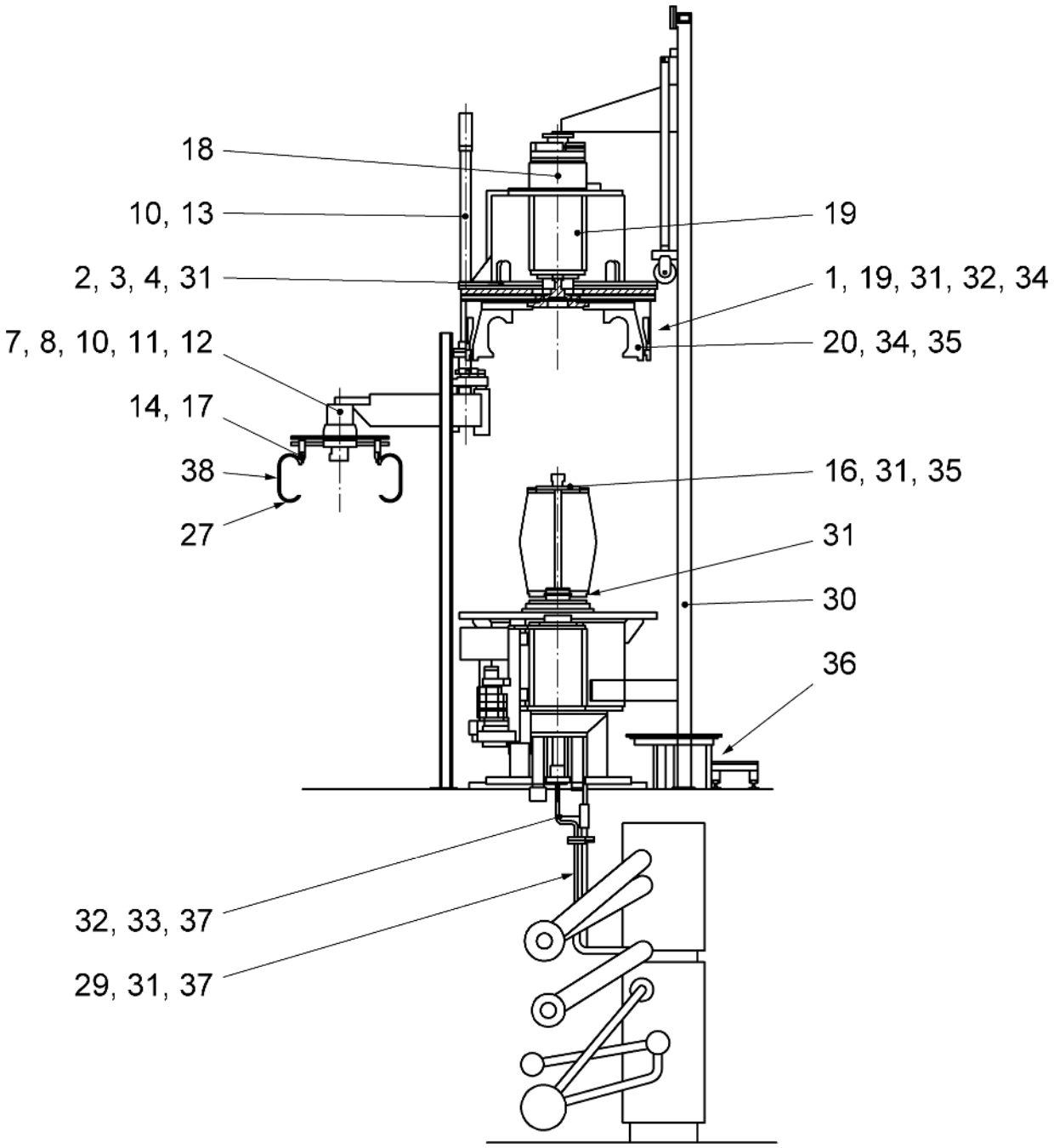


Figure 7 — Location of hazards on tyre curing machines with automatic rear feeding and discharge (side view)

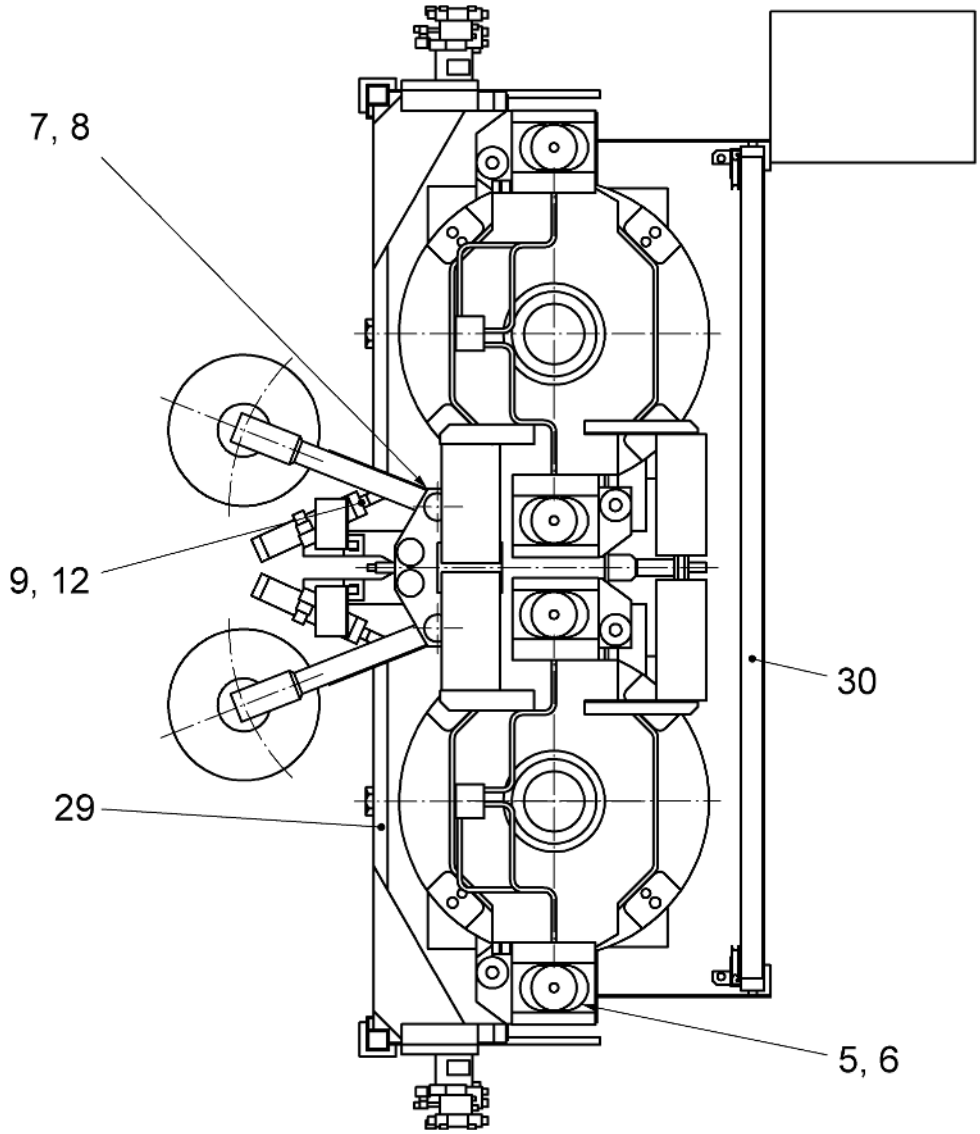


Figure 8 — Location of hazards on tyre curing machines with automatic rear feeding and discharge (top view)

4.2 General hazards

Electric shock or burns due to direct or indirect contact with live conductive parts (see 5.1).

Hazards due to malfunction of the hydraulic or pneumatic systems (see 5.1).

Hazards from high noise levels resulting for example in hearing impairment, tiredness, stress, loss of balance or awareness, interference with speech communications or with the perception of acoustic signals (see 5.4).

Hazards due to neglecting ergonomic principles, e.g. musculoskeletal disorders due to posture, efforts and/or repetitive activity related to manual feeding of green tyres (see 5.1).

4.3 Hazards associated with specific machine parts or areas

The significant hazards associated with specific parts or areas of tyre curing machines are the following:

1) Crushing, shearing and/or entanglement due to closing of the movable upper part;

2) Crushing, shearing, entanglement and/or impact due to opening of the movable upper part;

3) Crushing due to unexpected falling of the movable upper part when it is in the fully open position;

4) Crushing due unexpected gravity fall of the movable upper part when it is in any raised position;

5) Crushing and/or shearing due to locking of the movable upper part;

6) Crushing and/or shearing due to unlocking of the movable upper part;

7) Crushing, shearing and/or impact due to downward movement of the loading device and/or green tyre stand;

8) Crushing, shearing and/or impact due to upward movement of the loading device and/or green tyre stand;

9) Crushing, shearing and/or impact due to rotation of the loading device (chuck type);

10) Crushing, shearing and/or impact due to unexpected gravity fall of the loading device when it is in raised position;

11) Crushing, shearing and/or impact due to downward movement of the unloading device;

12) Crushing, shearing and/or impact due to upward movement of the unloading device, rotation of the chuck type unloading device or swivelling of the fork type unloading device;

13) Crushing, shearing and/or impact due to unexpected gravity fall of the unloading device when it is in raised position;

14) Cutting, crushing and/or impact due to expansion/collapse of the chuck elements of the loading device;

15) Crushing and/or shearing due to downward and upward movement of the bottom ring;

16) Crushing and/or shearing due to downward and upward movement of the top ring;

17) Cutting, crushing and/or impact due to expansion/collapse of the chuck elements of the unloading device;

18) Crushing and/or cutting due to movement to create/release the squeeze force;

19) Crushing and/or shearing due to movement of the automatic container locking and unlocking system;

20) Crushing, shearing and/or trapping due to closing movement of the mould segments;

21) Bursting and/or ejection of materials or steam due to pressure to the bladder when the tyre curing machine is above the semi-closed position;

22) Bursting and/or ejection of materials due to pressure to the bladder when the tyre curing machine is below the semi-closed position;

23) Bursting and/or ejection of materials due to pressure to the bladder when the tyre curing machine is closed and locked;

24) Bursting ejection of materials, impact, injection and/or burns due to high pressure inside the dome before unlocking;

25) Bursting, ejection of materials, impact, injection and/or burns due to high pressure inside the bladder before unlocking;

26) Bursting, ejection of materials, impact, injection and/or scalds, due to accumulation of hot water under pressure between the bladder and tyre in case of a leakage of the bladder (only for machines using hot water as curing media);

27) Scalds due to accumulation of hot water between the bladder and the tyre or mould;

28) Inhalation of substances hazardous to health due to release of fumes;

29) Asphyxia due to leakage of nitrogen from pipes;

30) Impact, crushing and/or cutting due to movement of power operated guards on tyre curing machines with automatic rear feeding and discharge;

31) Burns due to hot parts (pipes, mould, heating platens, hoses, valves, etc.);

32) Scalds, burns and/or impact due to rupture of flexible hoses or failure of rigid pipes feeding curing media to the tyre curing machine;

33) Scalds due to leakage from flexible hoses or rigid pipes feeding curing media to the tyre curing machine;

34) Crushing and/or impact due to falling of the upper part of the container;

35) Projection of fluid and/or impact due to movement of the spraying jib, if any and/or inhalation of toxic substances released from the spraying device;

36) Fall from working positions at height;

37) Projection of fluid and/or burns due to residual pressure of curing media inside pipework;

38) Impact and/or crushing due to falling of the green tyre from the loading device or cured tyre from the unloading device.

5 Safety requirements and/or protective measures

5.1 General safety requirements and/or protective measures

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

Safety distances for fixed distance guards and machine parts acting as fixed guards shall comply with EN ISO 13857:2008. For the hazard “reaching over protective structures”, if not otherwise specified in the relevant subclauses, Table 2 shall be applied for crushing and shearing hazards, otherwise Table 1 may be used. For reaching through openings, Table 3 and Table 4 shall be used.

Guards shall be designed and manufactured in accordance with EN 953:1997+A1:2009. Interlocking devices shall comply with EN ISO 14119:2013. The choice between interlocking guards and interlocking guards with guard locking shall comply with EN ISO 14119:2013, Clause 7 and EN ISO 13855:2010, Clause 9. Interlocking guards may be power operated on tyre curing machines with automatic rear feeding and discharge.

Light curtains shall be in accordance with EN 61496-1:2013 and EN 61496-2:2013.

Scanners shall comply with CLC/TS 61496-3:2008.

Light curtains and interlocking guards without guard locking shall be positioned in accordance with EN ISO 13855:2010.

Opening an interlocking guard or actuating a protective device shall stop any dangerous movement for which the safeguard is installed before the dangerous moving part can be reached but shall not interrupt the curing process when the tyre curing machine is closed and locked.

The safety related parts of the control system 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 taking into account the risk assessment.

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

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.

Power operated take-away conveyors shall be in accordance with EN 619:2002+A1:2010.

Ergonomic principles (see EN 1005-3:2002+A1:2008 and EN 1005-4:2005+A1:2008) shall be taken into consideration for the design of green tyre stands in case of manual feeding.

For tyre curing machines which include pressure equipment, the manufacturer shall consider the forces resulting from the pressurization for the calculation of the mechanical strength of machine parts subjected to these forces. See also Table 1, hazards 21 to 25.

5.2 Specific safety requirements and/or protective measures

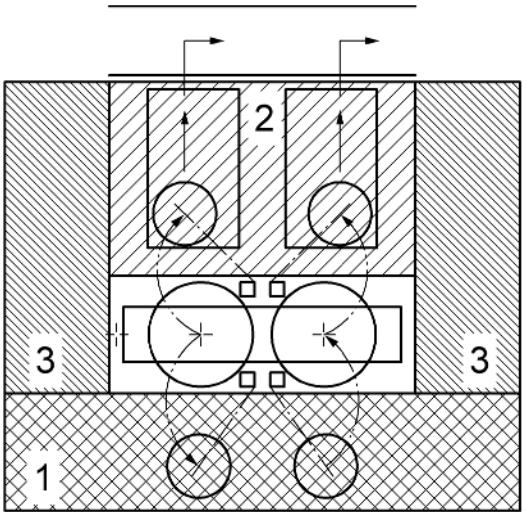
5.2.1 Specific requirements for operation in production mode

5.2.1.1 Protection against hazards associated with specific machine parts or areas

Safety requirements and/or protective measures for operation in production mode are given in Table 1 for crossing flow tyre curing machines and for tyre curing machines with automatic rear feeding and discharge.

The lines of Table 1 are related to the respective significant hazards listed in 4.3.

In Table 1, the safety requirements and/or protective measures are specified for the front, rear and side positions on the tyre curing machine. Figure 9 and Figure 10 show these positions.



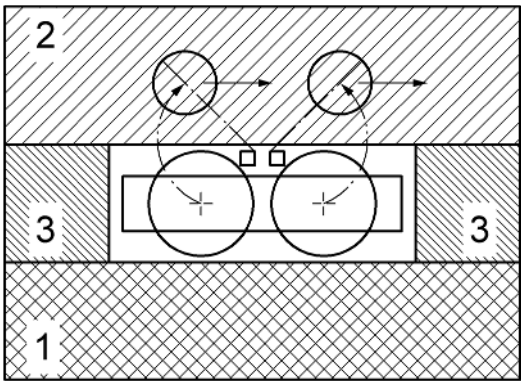
Key

1 front position

2 rear position

3 side position

Figure 9 — Positions on crossing flow tyre curing machines



Key

1 front position

2 rear position

3 side position

Figure 10 — Position on tyre curing machine with automatic rear feeding and discharge

.

Table 1 — Safety requirements and/or protective measures for tyre curing machines in production mode (1 of 30)

Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
1	Closing of the movable upper part	Crushing Shearing Entanglement	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access. Where these safeguards cannot be practically implemented, e.g. due to lack of space, pressure sensitive bumpers in accordance with EN ISO 13856-3:2013 may be installed under the following conditions: — the pressure sensitive bumper shall be dimensioned and positioned so that the dangerous moving part has stopped before any injury can occur and that nobody can stand between the pressure sensitive bumper and crushing/shearing points; — if the pressure sensitive bumper is adjustable, its safe position with respect to the size of the container and mould shall be detected by the safety related parts of the control system of the machine before the movement can be started.	d	Interlocking guard with or without guard locking.	d for the safeguar-ding function c only for the stopping function of the downward movement in case of use of the interlocking guard with guard locking
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard.		Interlocking guard with guard locking for the feeding/discharge system and/or Interlocking guard without guard locking associated with light curtains.	
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.		Fixed distance guard.	

Table 1 (2 of 30)

Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
2	Opening of the movable upper part	Crushing Shearing Entanglement Impact	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.	b if no access to the crushing/ shearing hazard d if access to crushing/ shearing hazard	Interlocking guard with or without guard locking.	b if no access to the crushing /shearing hazard d if access to crushing/ shearing hazard
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard.		Interlocking guard with guard locking for the feeding/discharge system and/or Interlocking guard without guard locking associated with light curtains.	
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.		Fixed distance guard.	

Table 1 (3 of 30)

Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
3	Unexpected falling of the movable upper part when it is in the fully open position.	Crushing	Position 1: front	Combination of fixed distance guards and machine parts acting as fixed guards preventing access or Mechanical restraint device that is automatically engaged; the engagement of this device shall be visually indicated.	d	Upper part mechanical restraint device that is automatically engaged. The engagement of this device shall be visually indicated.	d
			Position 2: rear	Fixed distance guard and/or Take-away conveyor acting as fixed distance guard or Mechanical restraint device that is automatically engaged; the engagement of this device shall be visually indicated.		Upper part mechanical restraint device that is automatically engaged. The engagement of this device shall be visually indicated.	
			Position 3: side	Combination of fixed distance guards and machine parts acting as fixed guards preventing access or Mechanical restraint device that is automatically engaged; the engagement of this device shall be visually indicated.		Fixed distance guard and Upper part mechanical restraint device that is automatically engaged. The engagement of this device shall be visually indicated.	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
4	Unexpected gravity fall of the movable upper part when it is in any raised position	Crushing	Position 1: front	Combination of fixed distance guards and machine parts acting as fixed guards preventing access or Restraint system activated by opening an interlocking guard or actuating a protective device that achieves a stopping distance of the moveable upper part of less than 20 mm, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.	d	Combination of fixed distance guards and machine parts acting as fixed guards preventing access or Restraint system activated by opening an interlocking guard or actuating a protective device that achieves a stopping distance of the moveable upper part of less than 20 mm, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.	d Not applicable if interlocking guard with guard locking
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard or Restraint system activated by opening an interlocking guard or actuating a protective device that achieves a stopping distance of the moveable upper part of less than 20 mm, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.		Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard or Restraint system activated by opening an interlocking guard or actuating a protective device that achieves a stopping distance of the moveable upper part of less than 20 mm, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.	
			Position 3: side	Combination of fixed distance guards and machine parts acting as fixed guard preventing access or Restraint system activated by opening an interlocking guard or actuating a protective device that achieves a stopping distance of the moveable upper part of less than 20 mm, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.		Combination of fixed distance guards and machine parts acting as fixed guards preventing access or Restraint system activated by opening an interlocking guard or actuating a protective device that achieves a stopping distance of the moveable upper part of less than 20 mm, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
5	Locking of the movable upper part	Crushing Shearing	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access and/or Fixed enclosing guard compliant with EN ISO 13857:2008, Table 4.	d	Interlocking guard with or without guard locking or Fixed distance guard.	d
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard or Fixed enclosing guard compliant with EN ISO 13857:2008, Table 4.		Interlocking guard with guard locking for the feeding/discharge system and/or Interlocking guard without guard locking associated with light curtains or Fixed distance guard.	
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed guards preventing access or Fixed enclosing guard compliant with EN ISO 13857:2008, Table 4.		Fixed distance guard.	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
6	Unlocking of the movable upper part	Crushing Shearing	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access and/or Fixed enclosing guard compliant with EN ISO 13857:2008, Table 4.	d	Interlocking guard with or without guard locking or Fixed distance guard.	d
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard or Fixed enclosing guard compliant with EN ISO 13857:2008, Table 4.		Interlocking guard with guard locking for the feeding/discharge system and/or Interlocking guard without guard locking associated with light curtains or Fixed distance guard.	
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed distance guards preventing access or Fixed enclosing guard compliant with EN ISO 13857:2008, Table 4.		Fixed distance guard	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
7	Downward movement of the loading device and /or green tyre stand	Crushing Shearing Impact	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access. Where these safeguards cannot be practically implemented, e.g. due to lack of space, pressure sensitive bumpers in accordance with EN ISO 13856-3:2013 may be installed under the following conditions : — the pressure sensitive bumper shall be dimensioned and positioned so that the dangerous moving part has stopped before any injury can occur and that nobody can stand between the pressure sensitive bumper and crushing/shearing points; — if the pressure sensitive bumper is adjustable, its safe position with respect to the size of the loading device and/or green tyre stand shall be detected by the safety related parts of the control system of the machine before the movement can be started.	d	Interlocking guard with or without guard locking.	d
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard.		Interlocking guard with guard locking for the feeding/discharge system.	
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.		Fixed distance guard.	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
8	Upward movement of the loading device and /or green tyre stand	Crushing Shearing Impact	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.	a if access to impact hazard only c if access to crushing/ shearing hazard	Interlocking guard with or without guard locking.	a if access to impact hazard only c if access to crushing/ shearing hazard
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard.		Interlocking guard with guard locking for the feeding/discharge system and/or Interlocking guard without guard locking associated with light curtains.	
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.		Fixed distance guard.	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
9	Rotation of the loading device (chuck type)	Crushing Shearing Impact	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access. Where these safeguards cannot be practically implemented, e.g. due to lack of space, pressure sensitive bumpers in accordance with EN ISO 13856-3:2013 may be installed under the following conditions : — the pressure sensitive bumper shall be dimensioned and positioned so that all the dangerous moving parts are protected and have stopped before any injury can occur and that nobody can stand between the pressure sensitive bumper and crushing/shearing points; — if the pressure sensitive bumper is adjustable, its safe position with respect to the size of the loading device and/or green tyre stand shall be detected by the safety related parts of the control system of the machine before the movement can be started.	c	Interlocking guard with or without guard locking.	c
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard.		Interlocking guard with guard locking for the feeding/discharge system.	
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.		Fixed distance guard.	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
10	Unexpected gravity fall of the loading device when it is in raised position	Crushing Shearing Impact	Position 1: front	Combination of fixed distance guards and machine parts acting as fixed guards preventing access or Restraint system, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.	d	Combination of fixed distance guards and machine parts acting as fixed guards preventing access or Restraint system, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.	d Not applicable if interlocking guard with guard locking
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as fixed distance guard or Restraint system, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.		Fixed distance guard and/or Take-away conveyor, acting as fixed distance guard or Restraint system, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.	
			Position 3: side	Combination of fixed distance guards and machine parts acting as fixed guards preventing access or Restraint system, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.		Combination of fixed distance guards and machine parts acting as fixed guards preventing access or Restraint system, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
11	Downward movement of the unloading device	Crushing Shearing Impact	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access. Where these safeguards cannot be practically implemented, e.g. due to lack of space, pressure sensitive bumpers in accordance with EN ISO 13856-3:2013 may be installed under the following conditions: — the pressure sensitive bumper shall be dimensioned and positioned so that the dangerous moving part has stopped before any injury can occur and that nobody can stand between the pressure sensitive bumper and crushing/shearing points; — if the pressure sensitive bumper is adjustable, its safe position with respect to the size of the unloading device and/or cured tyre shall be detected by the safety related parts of the control system of the machine before the movement can be started.	c	Interlocking guard with or without guard locking.	d
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard.		Interlocking guard with guard locking for the feeding/discharge system.	
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.		Fixed distance guard.	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
12	Upward movement of the unloading device, rotation of the chuck type unloading device or swivelling of the fork type unloading device	Crushing Shearing Impact	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access. Where these safeguards cannot be practically implemented, e.g. due to lack of space, pressure sensitive bumpers in accordance with EN ISO 13856-3:2013 may be installed under the following conditions: — the pressure sensitive bumper shall be dimensioned and positioned so that all the dangerous moving parts are protected and have stopped before any injury can occur and that nobody can stand between the pressure sensitive bumper and crushing/shearing points; — if the pressure sensitive bumper is adjustable, its safe position with respect to the size of the unloading device and/or cured tyre shall be detected by the safety related parts of the control system of the machine before the movement can be started.	a if access to impact hazard only c if access to crushing/ shearing hazard	Interlocking guard with or without guard locking.	a if access to impact hazard only c if access to crushing/ shearing hazard
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard.		Interlocking guard with guard locking for the feeding/discharge system.	
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.		Fixed distance guard.	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
13	Unexpected gravity fall of the unloading device when it is in raised position	Crushing Shearing Impact	Position 1: front	Combination of fixed distance guards and machine parts acting as fixed guards preventing access or Restraint system, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.	c	Combination of fixed distance guards and machine parts acting as fixed guards preventing access or Restraint system, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.	d Not applicable if interlocking guard with guard locking
			Position 2: rear	Fixed distance guard and/or Take-away conveyor acting as fixed distance guard or Restraint system, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.		Fixed distance guard and/or Take-away conveyor, acting as fixed distance guard or Restraint system, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.	
			Position 3: side	Combination of fixed distance guards and machine parts acting as fixed guards preventing access or Restraint system, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.		Combination of fixed distance guards and machine parts acting as fixed guards preventing access or Restraint system, e.g. restraint valves fitted directly on the cylinder, a brake system, etc.	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
14	Expansion/collapse of the chuck elements of the loading device	Cutting Crushing Impact	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access. Where these safeguards cannot be practically implemented, one of the following measures shall be applied: — maximum contact pressure of 50 N/cm² and maximum contact force of 75 N at each point of the mechanism where part of the upper limb can be trapped; — movement with a maximum speed of 33 mm/s. In both cases the maximum values shall be ensured by design or by the safety related parts of the control system.	c	Interlocking guard with or without guard locking or Fixed distance guard.	c
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard.		Interlocking guard with guard locking for the feeding/discharge system and/or Interlocking guard without guard locking associated with light curtains or Fixed distance guard.	
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.		Fixed distance guard.	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
15	Downward and upward movement of the bottom ring	Crushing Shearing	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.	d for downward movement c for upward movement	Interlocking guard with or without guard locking.	d for downward movement c for upward movement
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard.		Interlocking guard with guard locking for the feeding/discharge system and/or Interlocking guard without guard locking associated with light curtains or Light curtains.	
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.		Fixed distance guard	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
16	Downward and upward movement of the top ring	Crushing Shearing	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.	c	Interlocking guard with or without guard locking.	c
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard.		Interlocking guard with guard locking for the feeding/discharge system and/or Interlocking guard without guard locking associated with light curtains or Light curtains.	
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.		Fixed distance guard.	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
17	Expansion/collapse of the chuck elements of the unloading device	Cutting Crushing Impact	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access. Where these safeguards cannot be practically implemented, one of the following measures shall be applied: — maximum contact pressure of 50 N/cm² and maximum contact force of 75 N at each point of the mechanism where part of the upper limb can be trapped; — movement with a maximum speed of 33 mm/s. In both cases the maximum values shall be ensured by design or by the safety related parts of the control system.	c	Interlocking guard with or without guard locking or Fixed distance guard.	c
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard.		Interlocking guard with guard locking for the feeding/discharge system and/or Interlocking guard without guard locking associated with light curtains or Fixed distance guard.	
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.		Fixed distance guard.	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
18	Movement to create/release the squeeze force	Crushing Cutting	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.	d	Interlocking guard with or without guard locking or Fixed distance guard.	d
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard.		Interlocking guard with guard locking for the feeding / discharge system and/or Interlocking guard without guard locking associated with light curtains or Fixed distance guard.	
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.		Fixed distance guard.	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
19	Movement of the automatic container locking and unlocking system	Crushing Shearing	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.	c for the locking system d for the unlocking system	Interlocking guard with or without guard locking or Fixed distance guard.	c for the locking system d for the unlocking system
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard.		Interlocking guard with guard locking for the feeding/discharge system and/or Interlocking guard without guard locking associated with light curtains or Fixed distance guard.	
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.		Fixed distance guard.	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
20	Closing movement of the mould segments	Crushing Shearing Trapping	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.	d	Interlocking guard with or without guard locking.	d
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard.		Interlocking guard with guard locking for the feeding/discharge system and/or Interlocking guard without guard locking associated with light curtains or Light curtains.	
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.		Fixed distance guard.	

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
21	Pressure to the bladder when the tyre curing machine is above the semi-closed position	Bursting Ejection of materials or steam	Position 1: front	The control circuit shall monitor that the pressure is less than or equal to a maximum value that shall be indicated by the bladder manufacturer. In any case this value shall not exceed 0,7 bar. The supply of curing media shall be closed and the drain shall be opened if one of the following situations occurs: a) for machine safeguarded by light curtain or scanner or combination of fixed distance guards: — the pressure goes over the maximum value defined above for 5 s — the pressure reaches 1,5 bar — in any case when the scanner or light curtain is actuated b) for machine safeguarded by pressure sensitive bumper: — the pressure reaches 0,7 bar — in any case when a pressure sensitive bumper is actuated. NOTE Supplementary requirements may be necessary for machines which fall under Directive 97/23/EC [1], see also 5.1.	d	The control circuit shall monitor that the pressure is less than or equal to a maximum value that shall be indicated by the bladder manufacturer. In any case this value shall not exceed 0,7 bar. The supply of curing media shall be closed and the drain shall be opened if one of the following situations occurs: — the pressure goes over the maximum value defined above for 5 s — the pressure reaches 1,5 bar — in any case when a guard is opened The interlocking guard with guard locking shall be so designed that a possible ejection of materials or steam is contained. NOTE Supplementary requirements may be necessary for machines which fall under Directive 97/23/EC [1], see 5.1.	d

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
21 (continued)	Pressure to the bladder when the tyre curing machine is above the semi-closed position (continued)	Bursting Ejection of materials or steam (continued)	Position 2: rear	The control circuit shall monitor that the pressure is less than or equal to a maximum value that shall be indicated by the bladder manufacturer. In any case this value shall not exceed 0,7 bar. The supply of curing media shall be closed and the drain shall be opened if one of the following situations occurs: — the pressure goes over the maximum value defined above for 5 s — the pressure reaches 1,5 bar — in any case when a safeguard is opened/interrupted. NOTE Supplementary requirements may be necessary for machines which fall under Directive 97/23/EC [1], see also 5.1.	d	The control circuit shall monitor that the pressure is less than or equal to a maximum value that shall be indicated by the bladder manufacturer. In any case this value shall not exceed 0,7 bar. The supply of curing media shall be closed and the drain shall be opened if one of the following situations occurs: — the pressure goes over the maximum value defined above for 5 s — the pressure reaches 1,5 bar — in any case when a guard is opened. The interlocking guard with guard locking shall be so designed that a possible ejection of materials or steam is contained. NOTE Supplementary requirements may be necessary for machines which fall under Directive 97/23/EC [1], see also 5.1.	d
			Position 3: side	The control circuit shall monitor that the pressure is less than or equal to a maximum value that shall be indicated by the bladder manufacturer. In any case this value shall not exceed 0,7 bar. The supply of curing media shall be closed and the drain shall be opened if one of the following situations occurs: — the pressure goes over the maximum value defined above for 5 s — the pressure reaches 1,5 bar — in any case when a safeguard is opened/interrupted. The fixed distance guard shall be so designed that a possible ejection of materials or steam is contained. NOTE Supplementary requirements may be necessary for machines which fall under Directive 97/23/EC [1], see also 5.1.	d	The control circuit shall monitor that the pressure is less than or equal to a maximum value that shall be indicated by the bladder manufacturer. In any case this value shall not exceed 0,7 bar. The supply of curing media shall be closed and the drain shall be opened if one of the following situations occurs: — the pressure goes over the maximum value defined above for 5 s — the pressure reaches 1,5 bar. The fixed distance guard shall be so designed that a possible ejection of materials or steam is contained. NOTE Supplementary requirements may be necessary for machines which fall under Directive 97/23/EC [1], see also 5.1.	d

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
22	Pressure to the bladder when the tyre curing machine is below the semi-closed position	Bursting Ejection of materials	Position 1: front	The control circuit shall monitor that the pressure is less than or equal to 1,5 bar. The supply of curing media shall be closed and the drain shall be opened if one of the following situations occurs: — the pressure goes over 1,5 bar — in any case when a safeguard is opened/interrupted/actuated. NOTE Supplementary requirements may be necessary for machines which fall under Directive 97/23/EC [1], see also 5.1.	d	The control circuit shall monitor that the pressure is less than or equal to 1,5 bar. The supply of curing media shall be closed and the drain shall be opened if one of the following situations occurs: — the pressure goes over 1,5 bar — in any case when a guard is opened. The interlocking guard with guard locking shall be so designed that a possible ejection of materials is contained. NOTE Supplementary requirements may be necessary for machines which fall under Directive 97/23/EC [1], see also 5.1.	d
			Position 2: rear	The control circuit shall monitor that the pressure is less than or equal to 1,5 bar. The supply of curing media shall be closed and the drain shall be opened if one of the following situations occurs: — the pressure goes over 1,5 bar — in any case when a safeguard is opened/interrupted. NOTE Supplementary requirements may be necessary for machines which fall under Directive 97/23/EC [1], see also 5.1.	d	The control circuit shall monitor that the pressure is less than or equal to 1,5 bar. The supply of curing media shall be closed and the drain shall be opened if one of the following situations occurs: — the pressure goes over 1,5 bar — in any case when a guard is opened. The interlocking guard with guard locking shall be so designed that a possible ejection of materials is contained. NOTE Supplementary requirements may be necessary for machines which fall under Directive 97/23/EC [1], see also 5.1.	d

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
22 (conti-nued)	Pressure to the bladder when the tyre curing machine is below the semi-closed position (continued)	Bursting Ejection of materials (continued)	Position 3: side	The control circuit shall monitor that the pressure is less than or equal to 1,5 bar. The supply of curing media shall be closed and the drain shall be opened if one of the following situations occurs: — the pressure goes over 1,5 bar — in any case when a safeguard is opened/interrupted. The fixed distance guard shall be so designed that a possible ejection of materials is contained. NOTE Supplementary requirements may be necessary for machines which fall under Directive 97/23/EC [1], see also 5.1.	d	The control circuit shall monitor that the pressure is less than or equal to 1,5 bar. The supply of curing media shall be closed and the drain shall be opened if the pressure goes over 1,5 bar. The fixed distance guard shall be so designed that a possible ejection of materials is contained. NOTE Supplementary requirements may be necessary for machines which fall under Directive 97/23/EC [1], see also 5.1.	d
23	Pressure to the bladder when the tyre curing machine is closed and locked	Bursting Ejection of materials	Position 1: front Position 2: rear Position 3: side	High pressure shall be enabled only when the machine is closed and locked. The locking system shall be dimensioned to sustain the maximum squeeze force specified by the manufacturer. Information shall be given in the instruction handbook, see 7.2.9. When the machine is closed and locked, it is not required to stop the vulcanization process inside the closed mould if the safeguards are opened/interrupted/actuated. NOTE Supplementary requirements may be necessary for machines which fall under Directive 97/23/EC [1], see also 5.1.	e	High pressure shall be enabled only when the machine is closed and locked. The locking system shall be dimensioned to sustain the maximum squeeze force specified by the manufacturer. Information shall be given in the instruction handbook, see 7.2.9. When the machine is closed and locked, it is not required to stop the vulcanization process inside the closed mould if the safeguards are opened/interrupted. NOTE Supplementary requirements may be necessary for machines which fall under Directive 97/23/EC [1], see also 5.1.	e

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Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
24	High pressure inside the steam dome before unlocking	Bursting Ejection of materials Impact Injection Burns	Position 1: front Position 2: rear Position 3: side	The unlocking system shall be interlocked with a pressure detecting system in order to allow the unlocking only when the pressure in the steam dome is less than 0,2 bar. In case of excessive pressure inside the steam dome, the locking system shall not be able to open.	e	The unlocking system shall be interlocked with a pressure detecting system in order to allow the unlocking only when the pressure in the steam dome is less than 0,2 bar. In case of excessive pressure inside the steam dome, the locking system shall not be able to open.	e
25	High pressure inside the bladder before unlocking	Bursting Ejection of materials Impact Injection Burns	Position 1: front Position 2: rear Position 3: side	The unlocking system shall be interlocked with a pressure detecting system in order to allow the unlocking only when the pressure in the bladder is less than 1,5 bar. In case of excessive pressure inside the bladder, the locking system shall not be able to open. When opening the machine, the same safety requirements shall apply as those for the closing phase defined for hazards 21 and 22.	e	The unlocking system shall be interlocked with a pressure detecting system in order to allow the unlocking only when the pressure in the bladder is less than 1,5 bar. In case of excessive pressure inside the bladder, the locking system shall not be able to open. When opening the machine, the same safety requirements shall apply as those for the closing phase defined for hazards 21 and 22.	e
26	Accumulation of hot water under pressure between the bladder and tyre in case of a leakage of the bladder	Bursting Ejection of materials Impact Injection Scalds	Position 1: front Position 2: rear Position 3: side	Fixed distance guard covering the full opening stroke of the segments and dimensioned to resist an impact resulting from a leakage of at least 20 % of the tyre volume. and/or Downward movement of the top ring before the machine unlocking, at each cycle.	d	Fixed distance guard covering the full opening stroke of the segments and dimensioned to resist an impact resulting from a leakage of at least 20 % of the tyre volume. and/or Downward movement of the top ring before the machine unlocking, at each cycle.	d

Table 1 (26 of 30)

Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
27	Accumulation of hot water between the bladder and the tyre or mould	Scalds	Position 1: front Position 2: rear Position 3: side	A warning sign shall be affixed at the operator's position, see 7.4.	Not applicable	A warning sign shall be affixed at the operator's position, see 7.4.	Not applicable
28	Release of fumes	Inhalation of substances hazardous to health	Position 1: front Position 2: rear Position 3: side	Information shall be given in the instruction handbook, see 7.2.2.	Not applicable	Information shall be given in the instruction handbook see 7.2.2.	Not applicable
29	Leakage of nitrogen from pipes	Asphyxia	Position 1: front Position 2: rear Position 3: side	Information shall be given in the instruction handbook, see 7.2.3.	Not applicable	Information shall be given in the instruction handbook, see 7.2.3.	Not applicable
30	Movement of power operated guards	Impact Crushing Cutting	Position 1: front	Not applicable	Not applicable	Maximum closing speed limited to 250 mm/s and at least one of the following protective measures: — maximum closing force limited to 75 N; — leading edge of the guard equipped with pressure sensitive edge in accordance with EN ISO 13856-2:2013 that stops or reverses the movement of guard when actuated. The operating force shall not exceed 150 N; — for upstroking power operated guards, a fixed plate preventing access to the crushing area between the reversing guard and the structure of the machine.	c
			Position 2: rear	Not applicable	Not applicable		
			Position 3: side	Not applicable	Not applicable	Not applicable	Not applicable

Table 1 (27 of 30)

Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
31	Hot parts (pipes, mould, heating platens, hoses, valves, etc.)	Burns	Position 1: front Position 2: rear Position 3: side	Hot machine parts, except for those which cannot be covered for operational or process reasons (e.g. the mould because it is in direct contact with the tyre), shall be protected against accidental contact by using insulating material or impeding devices as defined in EN ISO 12100:2010, 3.29; for temperature limit values see EN ISO 13732-1:2008. Warning signs shall be provided on or close to uncovered hot parts; see 7.3. Information and recommendation about the wearing of personal protective equipment and safe working practices shall be given in the instruction handbook; see 7.2.4.	Not applicable	Hot machine parts, except for those which cannot be covered for operational or process reasons (e.g. the mould because it is in direct contact with the tyre), shall be protected against accidental contact by using insulating material or impeding devices as defined in EN ISO 12100:2010, 3.29; for temperature limit values see EN ISO 13732-1:2008. Warning signs shall be provided on or close to uncovered hot parts; see 7.3. Information and recommendation about the wearing of personal protective equipment and safe working practices shall be given in the instruction handbook; see 7.2.4.	Not applicable
32	Rupture of flexible hoses or failure of rigid pipes feeding curing media to the tyre curing machine	Scalds Burns Impact	Position 1: front Position 2: rear Position 3: side	To prevent whiplash of hoses and release of pressurized curing media from hose and pipe systems, these shall be enclosed in the machine frame or fixed enclosing guards without opening shall be installed. Alternative protective measures: — to prevent unintentional detachment from connection points of rigid pipes, cutting ring type connectors shall not be used; — to prevent whiplash of flexible hoses additional attachment e.g. by a chain or bracket shall be used These protective measures are not necessary on hoses and pipes of the control circuit. See also 7.2.9.	Not applicable	To prevent whiplash of hoses and release of pressurized curing media from hose and pipe systems, these shall be enclosed in the machine frame or fixed enclosing guards without opening shall be installed. Alternative protective measures: — to prevent unintentional detachment from connection points of rigid pipes, cutting ring type connectors shall not be used; — to prevent whiplash of flexible hoses additional attachment e.g. by a chain or bracket shall be used These protective measures are not necessary on hoses and pipes of the control circuit. See also 7.2.9.	Not applicable
33	Leakage from flexible hoses or rigid pipes feeding curing media to the tyre curing machine	Scalds	Position 1: front Position 2: rear Position 3: side	Information shall be given in the instruction handbook, see 7.2.5.	Not applicable	Information shall be given in the instruction handbook, see 7.2.5.	Not applicable

Table 1 (28 of 30)

Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
34	Falling of the upper part of the container	Crushing Impact	Position 1: front Position 2: rear Position 3: side	Information shall be given in the instruction handbook, see 7.2.8.	Not applicable	Information shall be given in the instruction handbook, see 7.2.8.	Not applicable
35	Hazards due to the spraying device	Projection of fluid Impact due to movement of the spraying jib, if any Inhalation of toxic substances	Position 1: front	Scanner or Light curtain or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.	b	Interlocking guard with or without guard locking.	b
			Position 2: rear	Fixed distance guard and/or Take-away conveyor, acting as a fixed distance guard.	Not applicable	Interlocking guard with guard locking for the feeding/discharge system and/or Interlocking guard without guard locking.	b
			Position 3: side	Fixed distance guard and interlocking guard with or without guard locking or Combination of fixed distance guards and machine parts acting as fixed guards preventing access.	b	Fixed distance guard.	Not applicable

Table 1 (29 of 30)

Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
36	Working positions at height	Fall from height	Position 1: front Position 2: rear Position 3: side	Designated working positions on the machine located at height shall be provided with permanent safe means of access in accordance with EN ISO 14122, Parts 2, 3 and 4. Where permanent safe means of access cannot be installed due to the machine layout, the machine shall be designed so that it is possible to use a non-permanent safe means of access, see 7.2.6.	Not applicable	Designated working positions on the machine located at height shall be provided with permanent safe means of access in accordance with EN ISO 14122, Parts 2, 3 and 4. Where permanent safe means of access cannot be installed due to the machine layout, the machine shall be designed so that it is possible to use a non-permanent safe means of access, see 7.2.6.	Not applicable
37	Residual pressure of curing media inside pipe work	Projection of fluid Burns	Position 1: front Position 2: rear Position 3: side	Manually operated valves shall be installed on the supply and drain lines of the curing media. These valves shall be lockable in the closed position in order to prevent unauthorized opening. All the pressurized pipes on the machine side shall be fitted with manually operated valves that can be locked in the open position and lead the curing media to a defined location.	Not applicable	Manually operated valves shall be installed on the supply and drain lines of the curing media. These valves shall be lockable in the closed position in order to prevent unauthorized opening. All the pressurized pipes on the machine side shall be fitted with manually operated valves that can be locked in the open position and lead the curing media to a defined location.	Not applicable

Table 1 (30 of 30)

Hazard N°	Dangerous situation	Significant hazard(s)	Position/ location	Crossing flow tyre curing machines		Tyre curing machines with automatic rear feeding and discharge	
				Safeguards and/or protective measures	PL_r	Safeguards and/or protective measures	PL_r
38	Falling of the green tyre from the loading device or cured tyre from the unloading device	Impact Crushing	Position 1: front	Design of the green tyre stand preventing access under the loading device or Safeguards interlocked with the loading device in order to prevent the loading device from releasing the tyre when the safeguards are opened/interrupted/actuated. In addition a warning sign shall be affixed to the machine, see 7.4. Failure of the energy supply shall not cause the falling of the tyre.	d for tyre weight more 20 kg c for tyre weight less than 20 kg	Design of the green tyre stand preventing access under the loading device or Guards interlocked with the loading device in order to prevent the loading device from releasing the tyre when the guards are opened. In addition a warning sign shall be fixed to the machine, see 7.4. Failure of the energy supply shall not cause the falling of the tyre.	d
			Position 2: rear	Design of the take-away conveyor preventing access under the unloading device and/or Fixed distance guards. Failure of the energy supply shall not cause the falling of the tyre.	Not applicable	Fixed distance guard and interlocking guard with guard locking for tyre feeding/discharge system. In addition a warning sign shall be affixed to the machine, see 7.4. Failure of the energy supply shall not cause the falling of the tyre.	
			Position 3: side	Design of the take-away conveyor preventing access under the unloading device or Safeguards interlocked with the unloading device in order to prevent the unloading device from releasing the tyre when the safeguards are opened/interrupted/actuated. In addition a warning sign shall be affixed to the machine, see 7.4. Failure of the energy supply shall not cause the falling of the tyre.	d	Fixed distance guard.	Not applicable

5.2.1.2 Normal stopping

A normal stop device shall be provided to bring the machine to a complete stop.

Actuating the normal stop device during the curing process shall allow the movements to fulfil the following sequence:

— completing the curing cycle;

— unloading the cured tyre;

— locking the movable upper part in the upper position;

and stop all the other movements.

Actuating the normal stop device before or after the curing cycle shall stop all movements.

The safeguards shall remain active until the stopping process is completed.

After the stopping process is completed, the energy supply to the actuators involved shall be cut off.

5.2.1.3 Reset device

The end of an interruption of a scanner or a light curtain, or the closing of an interlocking guard, or the end of the actuation of a pressure sensitive bumper shall not automatically initiate any further movement. A new start command shall be required.

Before a new start is executed a separate manual reset is required to restore the normal intended operation in the following cases:

— when a light curtain or a scanner is interrupted, or an interlocking guard is opened, or a pressure sensitive bumper is actuated during any dangerous movement in the cycle;

— in case whole body access is possible because the smallest horizontal gap between a light curtain and the machine frame is ≥ 150 mm or between an interlocking guard and the machine frame is ≥ 100 mm.

The reset function shall be in accordance with EN ISO 13849-1:2008, 5.2.2.

5.2.1.4 Actuation of protective devices during the curing cycle

When the machine is in the curing cycle (machine closed and locked), actuation of a protective device shall stop any dangerous movement but shall not interrupt the curing process.

5.2.1.5 Failure of power supply

In case of interruption or failure of the power supply the machine shall remain in, or go to, a safe state. Restoration of the energy supply shall not result in unexpected start-up (see EN ISO 12100:2010, 3.31).

5.2.2 Specific requirements for operations other than the production mode

The machine shall preferably be designed so that bladder change, mould change, mould cleaning, set-up operations and thermocouple cure can be performed with all safeguards active.

If movements of certain machine parts are necessary while the safeguards are deactivated, these movements shall only be possible if following requirements are met:

— a specific mode shall be activated by a lockable or coded mode selector switch in accordance with EN ISO 12100:2010, 6.2.11.9 and 6.2.11.10; and

— in the specific mode, the circuit disabling the safeguards shall fulfil the same PL as the safeguards that are disabled; and

— these movements shall be permitted by the use of a hold-to-run control device in accordance with EN ISO 13849-1:2008, PL_r = c associated with a reduced speed equal or less than 33 mm/s; the speed control shall be in accordance with EN ISO 13849-1:2008, PL_r = c. If the actuator of the hold-to-run control device is positioned on a portable control unit, it shall have the following positions: 1 for stop, 2 for run, 3 for stop again. After the actuator has passed the pressure point to position 3, a restart shall only be possible after returning the actuator to position 1.

The machine shall be equipped with a mechanical restraint device that is automatically engaged in the fully open position of the movable upper part. The engagement of this device shall be detected by the safety related part of the control system and shall be visually indicated.

For maintenance see 7.2.7.

5.2.3 Specific requirements for tyre curing machines with two cavities and independent curing cycles and independent safeguarding

On such machines, the two cavities shall be separated by a solid fixed distance guard. Each cavity of the machine shall be considered as a tyre curing machine in itself.

5.3 Emergency stop function

An emergency stop actuator shall be positioned within reach of any workplace which may be occupied by an operator.

The emergency stop shall function as a stop category 0 or 1 of EN 60204-1:2006, 9.2.2, whichever provides the best stopping performance.

Emergency stop devices shall be in accordance with EN ISO 13850:2008 and EN 60204-1:2006, 10.7. When the machine is not in the curing cycle, actuation of emergency stop actuators shall stop any movement, de-energize all the valves and discharge curing media.

When the machine is in the curing cycle (machine closed and locked), actuation of emergency stop actuators shall stop any movement and de-energize all the valves. The emergency stop shall interrupt the vulcanization process by closing the supply of curing media. If the curing media are not discharged as an effect of the emergency stop, an additional command device (e.g. a switch) shall be provided to discharge all curing media (steam, nitrogen, hot water, etc.).

See also 7.2.10.

5.4 Requirements for noise reduction

5.4.1 Main noise sources

The main sources of noise on tyre curing machines are:

— hydraulic system, especially the hydraulic unit;

— exhaust of pneumatic valves.

NOTE The hydraulic unit might not be an integral part of a tyre curing machine.

5.4.2 Noise reduction at source by design

Tyre curing machines 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 for example EN ISO 11688-1:2009).

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

For the hydraulic system noise reduction shall be achieved by selecting low noise emission components or implementing additional or alternative measures giving identical or higher noise reduction efficiency, e.g. uncoupling of the machine structure by vibration absorbers.

5.4.3 Noise reduction by protective measures

For the hydraulic system additional noise reduction may be achieved e.g. by installing acoustic panels.

For the exhaust of pneumatic valves, noise reduction shall be achieved by vent silencers.

5.4.4 Information connected with noise hazards

See 7.2.11 and Annex A.

6 Verification of the safety requirements and/or protective measures

Tests shall be used to verify the safety requirements and/or protective measures in accordance with Table 2.

The numbering of the hazards given in Table 3 and Table 4 corresponds to the numbering of the hazards in Table 1.

Table 2 — Verification methods for common safety requirements

Subclause	Visual inspection	Measurement / Calculation	Functional test	Design validation
5.1		x	x	x
5.2.1.1	(see Table 3 and Table 4)			
5.2.1.2	x		x	
5.2.1.3	x	x	x	x
5.2.1.4			x	
5.2.1.5			x	x
5.2.2	x	x	x	x
5.2.3	x			
5.3	x		x	x
5.4	x			
Annex A		x	x	x

Table 3 — Verification methods for crossing flow tyre curing machines (1 of 3)

Hazard N°	Item	Visual inspection	Measurement/ Calculation	Functional test	Design validation
1, 2, 5, 6, 7, 8, 9, 11, 12, 14, 15, 16 17, 18, 19, 20, 35	Scanner	x	x	x	x
	Light curtain	x	x	x	x
	Combination of front fixed distance guards and machine parts acting as fixed guards preventing access	x	x		x
	Rear fixed distance guard	x	x		x
	Take-away conveyor acting as a fixed distance guard	x	x		x
	Side fixed distance guard and interlocking guard with or without guard locking	x	x	x	x
	Combination of side fixed distance guards and side machine parts acting as fixed guards preventing access	x	x		x
1, 7, 9, 11, 12	Pressure sensitive bumper	x	x	x	x
3, 4	Combination of front fixed distance guards and machine parts acting as fixed guards preventing access	x	x		x
	Mechanical restraint device/restraint system	x	x	x	x
	Rear fixed distance guard	x	x		x
	Take-away conveyor acting as fixed distance guard	x	x		x
	Combination of side fixed distance guards and machine parts acting as fixed guards preventing access	x	x		x
5, 6	Front fixed enclosing guard	x	x		x
	Rear fixed enclosing guard	x	x		x
	Side fixed enclosing guard	x	x		x
10, 13	Combination of front fixed distance guards and machine parts acting as fixed guards preventing access	x	x		x
	Restraint system	x	x	x	x
	Combination of side fixed distance guards and machine parts acting as fixed guards preventing access	x	x		x
	Rear fixed distance guards	x	x		x
	Take-away conveyor acting as fixed distance guard	x	x		x

Table 3 (2 of 3)

Hazard N°	Item	Visual inspection	Measurement/ Calculation	Functional test	Design validation
14, 17	Maximum contact pressure and maximum contact force		x	x	x
	Movement with maximum speed		x	x	x
21, 22, 25	Maximum pressure value monitoring		x	x	x
	Closing of curing media supply	x	x	x	x
	Opening of the drain	x	x	x	x
	Side fixed distance guard able to contain projection of materials or steam	x	x		x
23	High pressure enabled only when the machine is closed and locked			x	
	Dimensioning of the locking system		x		x
	Information in the instruction handbook	x			
24	Interlocking of the unlocking system with the pressure detecting system (pressure in the steam dome)		x	x	x
25	Interlocking of the unlocking system with the pressure detecting system (pressure in the bladder)		x	x	x
26	Fixed distance guard	x	x	x	x
	Downward movement of the top ring before the machine unlocking		x	x	x
27	Presence of warning sign	x			
28, 29, 33, 34	Information in the instruction handbook	x			
31	Insulating material	x	x		
	Impeding devices	x			
	Presence of warning signs	x			
	Information on personal protective equipment and safe working practices in the instruction handbook	x			
32	Hose and pipe system enclosed in the machine frame	x			
	Fixed enclosing guards without opening	x	x		x
	Absence of cutting ring type connectors	x			
	Additional attachment of flexible hoses	x			

Table 3 (3 of 3)

Hazard N°	Item	Visual inspection	Measurement/ Calculation	Functional test	Design validation
36	Permanent safe means of access	x	x		x
	Possibility to use a non-permanent safe means of access and information in the instruction handbook	x			
37	Manually operated valves lockable in the closed position	x		x	
	Manually operated valves lockable in the open position	x		x	
38	Design of green tyre stand	x			
	Safeguards interlocked with the loading device at the front side	x	x	x	x
	Presence of warning sign	x			
	Impossibility of tyre falling in case of failure of energy supply		x	x	x
	Design of take-away conveyor	x			x
	Rear fixed distance guard	x	x		x
	Safeguards interlocked with the unloading device on the side	x	x	x	x

Table 4 — Verification methods for tyre curing machines with automatic rear feeding and discharge (1 of 3)

Hazard N°	Item	Visual inspection	Measurement/ Calculation	Functional test	Design validation
1, 2, 5, 6, 7, 8, 9, 11, 12, 14, 15, 16, 17, 18, 19, 20, 35	Front interlocking guard with or without guard locking	x	x	x	x
	Rear interlocking guard with guard locking for the feeding / discharge system	x	x	x	x
	Side fixed distance guard	x	x		x
1, 2, 5, 6, 8, 14, 15, 16, 17, 18, 19, 20	Rear interlocking guard without guard locking associated with light curtain	x	x	x	x
3	Upper part mechanical restraint device	x	x	x	x
	Side fixed distance guards	x	x		x
4	Combination of front fixed distance guards and machine parts acting as fixed guards preventing access	x	x		x
	Restraint system	x	x	x	x
	Rear fixed distance guard	x	x		x
	Take-away conveyor acting as fixed distance guard	x	x		x
	Combination of side fixed distance guards and machine parts acting as fixed guards preventing access	x	x		x
5, 6, 14, 17, 18, 19	Front fixed distance guard	x	x		x
	Rear fixed distance guard	x	x		x
10, 13	Combination of front fixed distance guards and machine parts acting as fixed guards preventing access	x	x		x
	Restraint system	x	x	x	x
	Combination of side fixed distance guards and machine parts acting as fixed guards preventing access	x	x		x
	Rear fixed distance guards	x	x		x
	Take-away conveyor acting as fixed distance guard	x	x		x

Table 4 (2 of 3)

Hazard N°	Item	Visual inspection	Measurement/ Calculation	Functional test	Design validation
15, 16, 20	Light curtain at the rear side	x	x	x	x
21, 22, 25	Maximum pressure value monitoring		x	x	x
	Closing of curing media supply	x	x	x	x
	Opening of the drain	x	x	x	x
	Front interlocking guard with guard locking able to contain projection of materials or steam	x	x	x	x
	Rear interlocking guard with guard locking able to contain projection of materials or steam	x	x	x	x
	Side fixed distance guards able to contain projection of materials or steam	x	x		x
23	High pressure enabled only when the machine is closed and locked			x	x
	Dimensioning of the locking system		x		x
	Information in the instruction handbook	x			
24	Interlocking of the unlocking system with the pressure detecting system (pressure in the steam dome)		x	x	x
25	Interlocking of the unlocking system with the pressure detecting system (pressure in the bladder)		x	x	x
26	Fixed distance guard	x	x	x	x
	Downward movement of the top ring before the machine unlocking		x	x	x
27	Presence of warning sign	x			
28, 29, 33, 34	Information in the instruction handbook	x			

Table 4 (3 of 3)

Hazard N°	Item	Visual inspection	Measurement/ Calculation	Functional test	Design validation
30	Maximum closing speed		x	x	x
	Maximum closing force		x	x	x
	Pressure sensitive edge	x	x	x	x
	Fixed plate	x	x		
31	Insulating material	x	x		
	Impeding devices	x			
	Presence of warning signs	x			
	Information and recommendation about the wearing of personal protective equipment and safe working practices in the instruction handbook	x			
32	Hose and pipe system enclosed in the machine frame	x			
	Fixed enclosing guards without opening	x	x		x
	Absence of cutting ring type connectors	x			
	Additional attachment of flexible hoses	x			
36	Permanent safe means of access	x	x		x
	Possibility to use a non-permanent safe means of access and information in the instruction handbook	x			
37	Manually operated valves lockable in closed position	x		x	
	Manually operated valves lockable in open position	x		x	
38	Design of green tyre stand	x			
	Guards interlocked with the loading device at the front side	x	x	x	x
	Presence of the warning sign	x			
	Impossibility of tyre falling in case of failure of energy supply		x	x	x
	Rear fixed distance guards	x	x		x
	Rear interlocking guard with guard locking for tyre feeding/discharge system	x	x	x	x
	Side fixed distance guard	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;

— requirements given in Clause 5 of this European Standard.

Functional testing of guards and protective devices in accordance with PL_r c, d or e shall also include the simulation of non-destructive faults 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

The manufacturer shall provide an instruction handbook giving general information for use in accordance with EN ISO 12100:2010, 6.4.5. In addition the instruction handbook shall contain the information given in 7.2.2 to 7.2.11.

7.2.2 Exhaust system

The manufacturer shall indicate that some materials likely to be processed can emit harmful gases, vapours or smokes and that an exhaust system may be needed. The manufacturer shall indicate that in that case an exhaust system corresponding to the expected emissions should be positioned or fitted under the responsibility of the user. The manufacturer shall give information concerning the installation of the exhaust system and the tyre curing machine shall not be started in production mode before the exhaust system is operating.

7.2.3 Leakage of nitrogen

The manufacturer shall inform the user that where nitrogen is used in the process, the oxygen rate should be verified prior to any intervention in pits.

7.2.4 Hazards due to hot surfaces

The manufacturer shall inform the user about personal protective equipment to be worn and safe working practices against accidental contact with hot machine parts or hot materials if the surface temperature exceeds the limit values specified in EN ISO 13732-1:2008.

7.2.5 Leakage of curing media from hoses and pipes

The manufacturer shall give recommendations for periodical checking of hoses and pipes and shall indicate that retention devices and/or flow exhaust pipes should be positioned or fitted under the responsibility of the user.

7.2.6 Non-permanent safe means of access

The manufacturer shall indicate the normal working positions of the machines. If those positions are not equipped with safe means of access by the manufacturer the following shall be indicated:

— the appropriate characteristics of the non-permanent safe means of access to the designated working positions on the machines;

— the space to be reserved in order to install and use the non-permanent means of access;

— the necessary precautions when installing and using the non-permanent means of access.

The manufacturer shall indicate that the user is responsible for providing non-permanent means of access that are safe against slipping, tripping and falling.

The manufacturer shall inform the user about the correct positioning of the non-permanent safe means of access so that danger areas of the machine cannot be reached from those means of access.

7.2.7 Maintenance operations

The manufacturer shall inform the user in which situations the machine shall be locked-out/tagged-out.

The manufacturer shall describe correct maintenance operating modes, especially if the machine has stopped in a dangerous position.

The manufacturer shall inform the user about residual risks and propose possible measures to prevent or reduce those risks.

7.2.8 Fixation of the upper part of the container or mould

The manufacturer shall state in the instruction handbook and/or on the tyre curing machine the maximum force that can be applied to the mechanical bolts and that the upper part of the container and mould needs to be fixed properly.

7.2.9 Machine parameters

The manufacturer shall state in the instruction handbook the maximum squeeze force and the maximum operating pressure of curing media.

7.2.10 Emergency stop and discharge of curing media

The manufacturer shall indicate the effects of the emergency stop.

The manufacturer shall describe how to discharge the curing media after an actuation of an emergency stop.

7.2.11 Noise emission

The instruction handbook and the technical sales literature describing tyre curing machines shall:

— give the declared noise emission values of the tyre curing machine in accordance with A.5 of this standard and EN ISO 4871:2009, A.2.2, as dual-number noise emission values;

— refer to the noise test code specified in Annex A to this standard upon which the determination of the noise emission values of the tyre curing machine is based and state which basic noise measurement standard has been used;

— contain information on possible methods of installation to minimise noise emission, e.g. the installation of hydraulic units far from the work stations;

— recommend proper maintenance in order to keep the noise level low;

— if necessary, recommend the wearing of personal hearing protection.

7.3 Marking

The tyre curing machines shall be marked visibly, legibly and indelibly with the following minimum particulars:

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

— designation of the machinery;

— mandatory marking;

— designation of series or type;

— serial number, if any;

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

In addition, the following shall also be marked:

— electrical connection values;

— net mass of the machine, if the machine is foreseen to be moved as a whole;

— maximum lifting capacity of the tyre curing machine for moulds and container for each cavity;

— position of lifting points.

7.4 Warning signs

A pictogram for thermal hazard (ISO 7010-W017) shall be affixed in the vicinity of hot machine parts, the surface temperature of which exceeds the limit values specified in EN ISO 13732-1:2008 and which are not protected against inadvertent contact by means of insulating material or additional guards.

A pictogram for the hazard of impact or crushing due to falling of green or cured tyres (ISO 7010-W015) shall be affixed in the vicinity of the loading and unloading devices.

The pictogram for the hazard of scald due to accumulation of hot water between the bladder and the tyre or mould, shown in Figure 11, shall be affixed at the relevant operator's position.

Figure 11 — Pictogram for hot water

Annex A
(normative)

Noise test code

A.1 Introduction

This noise test code specifies all the information necessary to carry out efficiently and under standardised conditions the determination, declaration and verification of the airborne noise emission values of tyre curing machines.

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.

This noise test code 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 emission measurement methods allowed by this standard are engineering methods (grade 2). If this is technically not possible survey methods (grade 3) may be used stating the justification for the use of such methods.

A.2 Measurement of the A-weighted emission sound pressure level at the operator's or other specified positions

A.2.1 Basic standards

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.

NOTE Grade 2 of accuracy can be reached only with class 1 measuring instruments. Class 2 instruments are allowed when using EN ISO 11202:2010 but grade 3 of accuracy results are obtained with, consequently, a higher uncertainty.

A.2.2 Measurement procedure

Measurements shall be carried out at each microphone position during one complete test cycle of the machine (see A.3).

The microphone shall be located at all operator positions designated by the manufacturer in the instruction handbook. The A-weighted emission sound pressure level at each of these operator positions shall be recorded, reported and declared.

If no workstations are designated by the manufacturer, measurements shall be carried out at 4 positions located 1 m from the surface of the machine and at a height of 1,60 m from the floor, one on each side of the machine. The highest A-weighted emission sound pressure level determined and its location relative to the machine shall be recorded, reported and declared.

If the A-weighted emission sound pressure level at any of the measurement positions defined above exceeds 80 dB, the determination of the A-weighted sound power level should normally be carried out. However, tyre curing machines are considered as very large machines and therefore, instead of the A-weighted sound power level, the A-weighted emission sound pressure levels at positions located 1 m from the surface of the machine and at a height of 1,60 m from the floor, one on each side of the machine shall be measured, recorded, reported and declared. These specified positions are identical to those used for machines with no workstation designated by the manufacturer.

A.2.3 Measurement uncertainty

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

σ_{RA} = 1,5 dB, resulting in a measurement uncertainty of 3 dB if the operating conditions of the machine are stable, which is normally the case for tyre curing machines.

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.

A.3 Installation, mounting and operating conditions for noise emission measurement

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

The installation, mounting and operating conditions shall be identical for all measurements.

For the noise test, the machine shall be operated under no load at the manufacturer’s premises with the following test cycle: a complete automatic cycle of the machine with dummy mould and nominal pressure to close the dummy mould but without curing media and tyre.

A.4 Information to be recorded and reported

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

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

At least the data specified below shall be recorded and reported:

— type, serial number if any, year of manufacture of the tyre curing machine;

— technical data of the tyre curing machine;

— mounting and operating conditions and precise description of the automatic cycle (duration of the different parts of the cycle and pressures for movements of the movable upper part);

— ambient temperature;

— date of test, location, person in charge;

— measurement standard(s) that have been used;

— location of measurement positions;

— noise emission values obtained, especially the highest value of the A-weighted emission sound pressure level and the position where it is obtained;

— determined noise emission values and associated uncertainty.

Any deviation from this noise test code shall be recorded and reported.

A.5 Declaration and verification of noise emission values

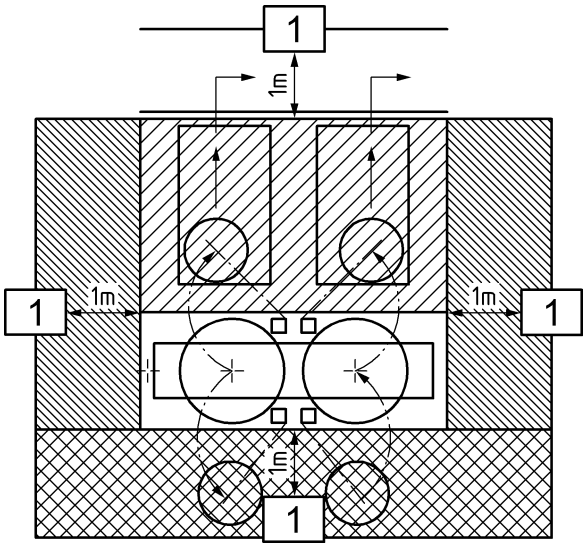
The noise declaration shall be a dual-number declaration as defined in EN ISO 4871:2009 i.e. the measured values and the measurement uncertainty associated to each value shall be indicated separately. Noise emission data shall be declared as follows:

— For machines with workstations designated by the manufacturer and where no measured A-weighted emission sound pressure level exceeds 80 dB, declare the value measured at the designated workstations. Where a value is less than 70 dB, instead of the measured value, insert the statement “LpA less than 70 dB”.

— For machines with workstations designated by the manufacturer where at least one measured A-weighted emission sound pressure level exceeds 80 dB, declare the values measured at the designated workstations and the values measured at the 4 positions around the machine (see A.2.2). Where a value is less than 70 dB, instead of the measured value, insert the statement “LpA less than 70 dB”.

— For machines without workstations designated by the manufacturer, declare the values of the A-weighted emission sound pressure level measured at the 4 positions around the machine (see A.2.2). Highlight the position where the highest value has been measured. Where a value is less than 70 dB, instead of the measured value, insert the statement “LpA less than 70 dB”.

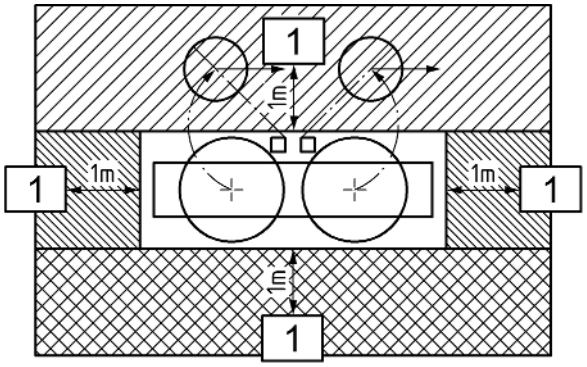
Values measured on the path around the machine shall be indicated on drawings, examples of which are given in Figure A.1 and Figure A.2.



Key

1 microphone position

Figure A.1 — Example of microphone positions on crossing flow tyre curing machines



Key

1 microphone position

Figure A.2 — Example of microphone positions on tyre curing machines with automatic rear feeding and discharge

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 standard has been used and give details of the mounting and operating conditions of the machine during the determination of its noise emission, especially a precise description of the automatic cycle (duration of the different parts of the cycle and pressures for movements of the movable upper part). The noise declaration shall clearly indicate deviation(s) from this noise test code and/or from the basic standard used if any.

If the declared values tend to significantly underestimate the noise emission values encountered when the machine operates in real conditions with curing media and tyre, this fact shall be highlighted in the noise emission declaration.

NOTE EN ISO 4871:2009 gives a methodology for declaring and verifying noise emission values. No technical data on noise emission are presently available to estimate the standard deviation of reproducibility for tyre curing machines. Therefore the values of the standard deviation of reproducibility stated in the basic noise emission standards are used in this noise test code (see A.2.3) as interim upper boundaries for the determination of the uncertainty when preparing the noise declaration. Joint investigations by manufacturers could lead to the determination of a possible lower value of the standard deviation of reproducibility which will result in a lower value of the uncertainty. Results of such investigations will be reflected in a future version of this standard.

If undertaken, the verification of declared values shall be conducted according to EN ISO 4871:2009, 6.2, 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.

Once this European 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 European Standard confers, within the limits of the scope of this European 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 European Standard.

Bibliography

[1] *Directive 97/23/EC of the European Parliament and of the Council of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment*, OJ L 181, 9.7.1997, p. 1–55

[2] EN 1005-3:2002+A1:2008, *Safety of machinery - Human physical performance - Part 3: Recommended force limits for machinery operation*

[3] EN 1005-4:2005+A1:2008, *Safety of machinery - Human physical performance - Part 4: Evaluation of working postures and movements in relation to machinery*

[4] EN ISO 11688-1:2009, *Acoustics - Recommended practice for the design of low-noise machinery and equipment - Part 1: Planning (ISO/TR 11688-1:1998)*

[5] 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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