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Textile machinery — Safety requirements —

Part 4: Yarn processing, cordage and rope manufacturing machinery

Matériel pour l'industrie textile — Exigences de sécurité —

Partie 4: Machines de transformation du fil et machines de production de cordages et d'articles de corderie

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 11111-4 was prepared by Technical Committee ISO/TC 72, *Textile machinery and machinery for dry-cleaning and industrial laundering*, Subcommittee SC 8, *Safety requirements for textile machinery*.

This first edition of ISO 11111-4, together with ISO 11111-1, ISO 11111-2, ISO 11111-3, ISO 11111-5, ISO 11111-6 and ISO 11111-7, cancels and replaces ISO 11111:1995, which has been technically revised.

ISO 11111 consists of the following parts, under the general title *Textile machinery — Safety requirements*:

— *Part 1: Common requirements*

— *Part 2: Spinning preparatory and spinning machines*

— *Part 3: Nonwoven machinery*

— *Part 4: Yarn processing, cordage and rope manufacturing machinery*

— *Part 5: Preparatory machinery to weaving and knitting*

— *Part 6: Fabric manufacturing machinery*

— *Part 7: Dyeing and finishing machinery*

Introduction

ISO 11111-1 to ISO 11111-7 were prepared simultaneously by ISO/TC 72 and CEN/TC 214 and adopted under the Vienna Agreement in order to obtain identical standards on technical safety requirements for the design and construction of textile machinery.

ISO 11111 as a whole is intended for use by any person concerned with the safety of textile machinery, for example, textile machinery designers, manufacturers, and systems integrators. It is also of interest to users of textile machines and safety experts.

This document is a type C standard as stated in ISO 12100-1. The various parts of ISO 11111 deal with significant hazards generated by machines used in the textile industry. The machinery concerned and the extent to which hazards are covered are indicated in the scope of this standard.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence.

For hazards of machines or machine elements under consideration not dealt with in the relevant part of ISO 11111, the designer is to perform a risk assessment according to ISO 14121 and evolve means for reducing the risk from significant hazards.

This part of ISO 11111 is intended to be used in conjunction with ISO 11111-1. As far as possible, the requirements of this part of ISO 11111 are treated by way of reference to Clauses 5 and 6 of ISO 11111-1. Clause 5 of ISO 11111-1 contains safety requirements and/or measures for frequently occurring hazards of textile machinery which apply whenever referred to in this part of ISO 11111, while Clause 6 describes significant hazards and corresponding safety requirements and/or measures for certain machine elements and their combinations (e.g. rollers), which also apply wherever referred to in this part of ISO 11111.

Textile machinery — Safety requirements —

Part 4:
Yarn processing, cordage and rope manufacturing machinery

1 Scope

This part of ISO 11111 is intended to be used in conjunction with ISO 11111-1. It specifies significant hazards and corresponding safety requirements and/or measures for yarn processing, cordage and rope manufacturing machinery. By taking into account the scope of ISO 11111-1 as far as is relevant, this part of ISO 11111 is applicable to all machinery, plant and related equipment intended to be used for doubling, twisting, texturing, reeling, winding, ball winding, cordage, rope manufacturing and braiding, as specified in Clause 5.

2 Normative references

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

ISO 9902-1, *Textile machinery — Noise test code — Part 1: Common requirements*

ISO 9902-4, *Textile machinery — Noise test code — Part 4: Yarn processing, cordage and rope manufacturing machinery*

ISO 11111-1:2005, *Textile machinery — Safety requirements — Part 1: Common requirements*

ISO 11111-2:2005, *Textile machinery — Safety requirements — Part 2: Spinning preparatory and spinning machinery*

ISO 13849-1:1999, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 13852:1996, *Safety of machinery — Safety distances to prevent danger zones being reached by the upper limbs*

ISO 13854:1996, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

ISO 14119:1998, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

EN 1760-2, *Safety of machinery — Pressure sensitive protective devices — Part 2: General principles for the design and testing of pressure sensitive edges and pressure sensitive bars*

EN 1760-3:2004, *Safety of machinery — Pressure sensitive protective devices — Part 3: General principles for the design and testing of pressure sensitive bumpers, plates, wires and similar devices*

3 Terms and definitions

For the purposes of this part of ISO 11111, the terms and definitions given in ISO 11111-1 apply.

4 List of significant hazards

Significant hazards found in yarn processing, cordage and rope manufacturing machines which are common with those frequently occurring with other textile machines or with machine elements of other textile machines shall be considered in accordance with ISO 11111-1:2005, Clauses 5 and 6, whenever referred to under the heading “General safety requirements” in Clause 5 of this part of ISO 11111. Significant hazards which are particular to yarn processing, cordage and rope manufacturing machines are considered as “Specific hazards” in Clause 5 of this part of ISO 11111.

Before using this part of ISO 11111, it is important to carry out a check to ascertain that the specific machine has the significant hazards identified.

NOTE The significant hazards of yarn processing, cordage and rope manufacturing machines are always considered in conjunction with safety requirements.

5 Significant hazards and corresponding safety requirements and/or measures

5.1 General

Machinery shall conform to the safety requirements of ISO 11111-1:2005, Clauses 5 and 6, whenever referred to under the heading “General safety requirements” of this Clause 5 and shall conform to the additional “Specific safety requirements” of this Clause 5.

5.2 Doubling, twisting, texturing machines

Doubling machines, twisting machines (e.g. flyer doubling and twisting frames, ring doubling and twisting machines, two-for-one twisters, uptwisters, novelty twisters, draw twisters, draw winders and similar machines) are used to ply and twist yarns.

Texturing machines (e.g. false-twist texturing machines, air texturing machines and other texturing machines) are used to crimp continuous filament yarns.

General safety requirements

The safety requirements and/or measures shall be in accordance with Table 1.

Table 1 — General safety requirements relating to doubling, twisting and texturing machines

Application	Reference ISO 11111-1:2005
All machines:	
Electrical equipment in general	5.4.2.1 and 5.4.2.2
Electrical control systems	5.4.2.3
Starting and stopping	5.4.2.4
Reduction of risks by design	5.3.2
Reduction of risks by safeguarding	5.3.3
— with guards	Table 2
— with safety devices	Table 3
Noise	5.4.7, 7, 8.2
Fire	5.4.11
Ergonomics	5.4.13
Devices for special operation	5.5
Fitting of parts	5.8
Particular machine elements:	
Drive and transmission enclosures	6.2
Machine elements which normally do not require safeguarding, in particular, feed rollers, spindles, false-twist devices, thread guides	6.4
Rollers	6.5
Rotating shafts	6.6
Automatic machines and equipment	6.21

Specific hazards

Mechanical, from the rotating spindles, flyers, laps of yarn, loops of strong yarn, knives for removal of laps, in particular, cutting, entanglement, impact.

Specific risks

Frequent access during normal operation, particularly at start-up or during mending of broken ends, and special operation, including the removal of laps, leading to high probability of light-to-moderate injury.

Specific safety requirements

a) For flyers used in heavy-duty twisting, particularly bast fibre processing, ISO 11111-2:2005, 5.7.8 shall apply. In addition, the frame shall be provided with fixed guards at both ends and guards below the flyer-guards to prevent access from the sides or beneath the movable guards. For bobbins and bobbin spindles used in heavy-duty twisting, the requirements given in 5.5.2.1 shall apply.

b) If pushbuttons are used as an emergency stopping device, there should be one on each end section, at least.

c) Information relating to safe methods for threading-up and removal of laps shall be provided in the instruction handbook in accordance with ISO 11111-1:2005, 8.2.

5.3 Reeling and winding machines

Reeling and winding machines are used to package thread or yarn in the form of a hank, bobbin or cheese either for further processing or for sale.

General safety requirements

The safety requirements and/or measures shall be in accordance with Table 2.

Table 2 — General safety requirements relating to reeling and winding machines

Application	Reference ISO 11111-1:2005
All machines:	
Electrical equipment in general	5.4.2.1 and 5.4.2.2
Electrical control systems	5.4.2.3
Starting and stopping	5.4.2.4
Reduction of risks by design	5.3.2
Reduction of risks by safeguarding	5.3.3
— with guards	Table 2
— with safety devices	Table 3
Noise	5.4.7, 7., 8.2
Fire	5.4.11
Ergonomics	5.4.13
Devices for special operation	5.5
Fitting of parts	5.8
Particular machine elements:	
Drive and transmission enclosures	6.2
Machine elements which do not require safeguarding in particular, thread guides	6.4
Rollers	6.5
Rotating shafts	6.6
Conveyors, including the conveyors of the cop preparation system and the doffing system	6.10
Automatic machines and equipment	6.21

Specific hazards

Mechanical from loops of strong yarn, laps, knives for removal of laps; from the automatic knotter or splicer unit and doffer unit; from the automated knitting or splicing mechanism; from the reels.

Specific risks

Access during normal operation, particularly threading-up, and during special operation, particularly removal of laps, leading to high probability of minor to moderate injury.

Specific safety requirements

a) Information relating to safe methods for threading-up, particularly of strong threads and yarns, removal of laps and elimination of process faults shall be provided in the instruction handbook.

b) Crushing and shearing points between the automatic knotter or splicer unit, doffer unit and the fixed parts shall be protected. When the units are mobile, this may be achieved by trip devices (e.g. trip bars according to EN 1760-2 or trip plates according to prEN 1760-3 on both sides extending over the whole height of the carriage).

c) The automated knotting or splicing mechanism shall be guarded (e.g. by means of fixed or interlocked movable guards).

d) On reeling machines, the faces of the reeling devices shall be guarded (e.g. by means of fixed or interlocked movable guards).

5.4 Ball winding machines

Multi-head machines, including automatic machines for the manufacture of balls of twine and yarn.

General safety requirements

The safety requirements and/or measures shall be in accordance with Table 3.

Table 3 — General safety requirements relating to ball-winding machines

Application	Reference ISO 11111-1:2005
All machines:	
Electrical equipment in general	5.4.2.1 and 5.4.2.2
Electrical control systems	5.4.2.3
Starting and stopping	5.4.2.4
Reduction of risks by design	5.3.2
Reduction of risks by safeguarding	5.3.3
— with guards	Table 2
— with safety devices	Table 3
Fluid power systems and components	5.4.5
Noise	5.4.7, 7, 8.2
Ergonomics	5.4.13
Devices for special operation	5.5
Escape and rescue of trapped persons	5.7
Fitting of parts	5.8
Particular machine elements:	
Drive and transmission enclosures	6.2
Rollers	6.5
Rotating shafts	6.6
Automatic machines and equipment	6.21

Specific hazards

Mechanical, caused by the rotating flyers, moving mandrel bars and flyer bars, appliances for the fixing of plug-in devices or bands as well as automatic doffer, transport and forming devices for the balls, especially crushing, shearing, entanglement, impact.

Specific risks

Occasional access during normal and special operation, in particular, elimination of process faults, leading to low probability of severe injury.

Specific safety requirements

a) Guards or safety devices shall be provided to prevent access to the flyers. These can be, for example, in the form of fence guards with interlocked sliding doors, or active opto-electronic protective devices, e.g. light curtains.

b) Ball-winding machines shall be so designed as to prevent crushing and shear points between moving mandrel bars or flyer bars and fixed machine parts, including lateral guiding devices in accordance with ISO 13854. Where such hazards cannot be eliminated, access to the danger zones shall be prevented by guards or safety devices as in a).

c) On automatic ball-winding machines, the automatic devices such as appliances for the fixing of plug-in devices or bands, as well as automatic doffer, transport systems and ball-forming devices, shall be in accordance with ISO 11111-1:2005, 6.21. The safeguarding of the automatic devices may be combined with the measures according to a) and b).

d) Guards or safety devices are required on both the operating and rear sides of the machines.

5.5 Cordage and rope manufacturing machines

5.5.1 Common requirements of cordage and rope manufacturing machines

Goods machines, drawing machines, flyer twisters, cabling machines, stranding machines, closing machines and combined stranding and closing machines used for the manufacture of cordage and rope from textile fibres are included.

General safety requirements

The safety requirements and/or measures shall be in accordance with Table 4.

Category 3 or 4 according to ISO 13849-1:1999, Clause 6, shall be selected for the safety-related part of the control system for the interlocking system of guards.

Table 4 — General safety requirements relating to cordage and rope manufacturing machines

Application	Reference ISO 11111-1:2005
All machines:	
Electrical equipment in general	5.4.2.1 and 5.4.2.2
Electrical control systems	5.4.2.3
Starting and stopping	5.4.2.4
Reduction of risks by design	5.3.2
Reduction of risks by safeguarding	5.3.3
— with guards	Table 2
— with safety devices	Table 3
Noise	5.4.7, 7, 8.2
Ergonomics	5.4.13
Devices for special operation	5.5
Elevated servicing positions	5.6
Escape and rescue of trapped persons	5.7
Fitting of parts	5.8
Particular machine elements:	
Drive and transmission enclosures	6.2
Rotating shafts	6.6
Handwheels	6.7.2
Work platforms and walkways	6.13

5.5.2 Safety requirements and/or measures for certain machine elements common to several cordage and rope manufacturing machines

5.5.2.1 Bobbin spindles

Bobbins are often connected to fixed drive shafts using removable spindles in order to rotate the bobbin.

General safety requirements

The safety requirements of 5.5.1 shall apply.

Specific hazards

Impact from unexpected ejection of bobbins.

Specific risks

Low probability of moderate-to-severe injury during normal operation.

Specific safety requirements

a) Bobbin supports shall be designed to retain the bobbins while the machine is running.

b) Solid enclosing guards shall be provided which are capable of withstanding the ejection of the bobbin during rotation (caused, for example, by contact with the rotating flyer or by centrifugal force when being located in a rotating cradle).

5.5.2.2 Flyers

Flyers are the rotating parts surrounding the bobbins.

General safety requirements

The safety requirements of 5.5.1 shall apply.

Specific hazards

Mechanical, from the rotating flyer, in particular, crushing, shearing, entanglement and impact.

Specific risks

Occasional access during normal operation, e.g., during changing of bobbins or threading-up, and during special operation, leading to low probability of severe injury.

Specific safety requirements

Enclosing guards shall be provided to prevent access to the flyers and associated parts, e.g. a combination of fixed guards and interlocked movable guards. Where the longest stopping time without braking exceeds the access time, means shall be provided to ensure that movable guards cannot be opened until the flyers and associated moving parts have been brought to a standstill, e.g. a guard locking device in conjunction with a motion sensor. The guard locking device shall keep the guard closed when the control system or power supply fails (see ISO 14119:1998, 5.4).

A brake is a useful aid to reduce stopping time, but should not be used to replace the guard locking system.

5.5.2.3 Capstans

A capstan is an arrangement of pulleys used to draw the rope and deliver it to the coiling equipment.

General safety requirements

The safety requirements of 5.5.1 shall apply.

Specific hazards

Mechanical, from on-running strands or ropes, in particular, drawing-in or trapping.

Specific risks

Low probability of severe injury during normal operation and special operation.

Specific safety requirements

A guard shall be provided to protect the nip point (e.g. an interlocking guard or a fixed nip guard or distance guard shaped to follow the contours of the capstan).

5.5.3 Goods machines or spreaders

Goods machines consist of a conveyor which carries pieces of compressed fibre (usually sisal or jute) through infeed rollers to a slow-moving bed of course pins or hackles. A faster-moving bed draws the fibre from the slow bed and combs it.

General safety requirements

The safety requirements and/or measures shall be in accordance with 5.5.1 and Table 5.

Table 5 — Additional safety requirements relating to goods machines or spreaders, breakers

Application	Reference ISO 11111-1:2005
All machines:	
dust emission	5.4.10
Particular machine elements:	
Rollers	6.5
Work platforms and walkways	6.13

Specific hazards

Mechanical, from the feed rollers, drafting rollers, the slow bed, the fast bed, and the delivery rollers, in particular, drawing-in.

Specific risks

Low probability of moderate to severe injury during normal and special operation.

Specific safety requirements

a) Tunnel guards for infeed rollers shall conform with ISO 13852.

b) The drafting rollers and beds shall be protected by fixed enclosing guards or movable interlocked guards.

c) Delivery rollers shall be protected by fixed enclosing guards and feed openings and slots shall conform with ISO 13852.

The guards may be part of the dust collection system.

5.5.4 Draw frames and finishers

Draw frames and finishers for bast fibre use a drawing sheet consisting of a series of pinned faller bars to produce a finely combed sliver.

General safety requirements

The safety requirements shall be in accordance with 5.5.1 and ISO 11111-1:2005, 5.4.10.

Specific hazards

Mechanical, from the input rollers, infeed rollers, drawing sheet and delivery rollers, in particular, drawing-in and puncture.

Specific risks

Low probability of moderate-to-severe injury, during normal and special operation.

Specific safety requirements

a) The input rollers shall be guarded, e.g. nip guards or trip devices.

b) The infeed rollers, drawing sheet, side delivery rollers and central delivery rollers shall be guarded, e.g. by fixed guards; any openings shall conform to ISO 13852.

5.5.5 Stranding machines

Stranding machines are used to form strands from rope yarn. The rope yarns pass through a register plate and compression tube and a cropping attachment (if fitted). They are collected on the rotating bobbin around which the flyer revolves.

General safety requirements

The safety requirements and/or measures shall be in accordance with 5.5.1 and Table 6.

Table 6 — Additional safety requirements relating to stranding machines

Application	Reference ISO 11111-1:2005
Particular machine elements:	
Particularly dangerous machine elements	6.3
	This part of ISO 11111
Other items:	
Bobbin spindles	5.5.2.1
Flyers	5.5.2.2

Specific hazards

Entanglement from loops in yarns coming from the creel in the vicinity of the register plate.

Specific risks

Access during normal operation, leading to high probability of moderate-to-severe injury, and during special operation, leading to high probability of severe injury.

Specific safety requirements

Information shall be given in the instruction handbook regarding the risk of entanglement from loops of yarn and the necessity of bringing the machine to a standstill to repair broken ends.

5.5.6 Laying (closing) machines

Laying machines are used to form ropes from rope strands. The bobbins are accommodated on spindles held in cradles. The rope strands pass over guide pulleys fitted on rotating flyer arms to the die. The resulting rope passes round twin haul-off capstans to the coiling drums.

General safety requirements

The safety requirements and/or measures shall be in accordance with 5.5.1 and Table 7.

Table 7 — Additional safety requirements relating to laying (closing) machines

Application	Reference to this part of ISO 11111
Other items:	
Bobbin spindles	5.5.2.1
Flyers	5.5.2.2
Capstans	5.5.2.3
Stranding machines	5.5.5

Specific hazards

Entanglement from the rope strands in the vicinity of the die.

Specific risks

Low probability of moderate-to-severe injury during normal and special operation.

Specific safety requirements

A fixed or interlocked enclosing guard shall be provided to enclose the forming die.

5.5.7 Combined stranding and closing machines

These machines are used to form first strands and then ropes as a continuous operation.

Bobbins or spools containing yarn are located on spindles fitted to cradles. The yarn is fed from the bobbins through a plate and die to form a strand, which is then twisted by flyer arms which rotate around the cradle. A number of separate strands pass into the compression tube where they are formed into a rope. This rope is twisted by a second rotating flyer arm and then passed around haul-off capstans onto the coiling drum.

Safety requirements

The safety requirements and/or measures of 5.5.5 and 5.5.6 shall apply. Where protection is achieved by common means for the whole machine, this shall include the take-up reel.

5.5.8 Strand-plaited rope-making machines

These machines produce a double plait from strands.

Safety requirements

The safety requirements and/or measures of 5.6 and, in particular, 5.6 c) shall apply.

5.6 Braiding machines

Tracked or horn gear machines, rotary-type braiding and solid or spiral braid machines are included.

General safety requirements:

The safety requirements and/or measures shall be in accordance with Table 8.

Table 8 — General safety requirements relating to braiding machines

Application	Reference ISO 11111-1:2005
All machines:	
Electrical equipment in general	5.4.2.1 and 5.4.2.2
Electrical control systems	5.4.2.3
Starting and stopping	5.4.2.4
Reduction of risks by design	5.3.2
Reduction of risks by safeguarding	5.3.3
— with guards	Table 2
— with safety devices	Table 3
Noise	5.4.7, 7, 8.2
Dust emission	5.4.10
Ergonomics	5.4.13
Devices for special operation	5.5
Fitting of parts	5.8
Particular machine elements:	
Drive and transmission enclosures	6.2
Rotating shafts	6.6

Specific hazards

Mechanical, from moving carrier (lace bobbins), in particular, crushing, entanglement, impact, and from the carrier feet and horn gear, in particular, crushing and shearing.

Specific risks

Access during normal operation, particularly on start-up, and during special operation (e.g. cleaning, threading-up), leading to low probability of light-to-moderate injury.

Specific safety requirements

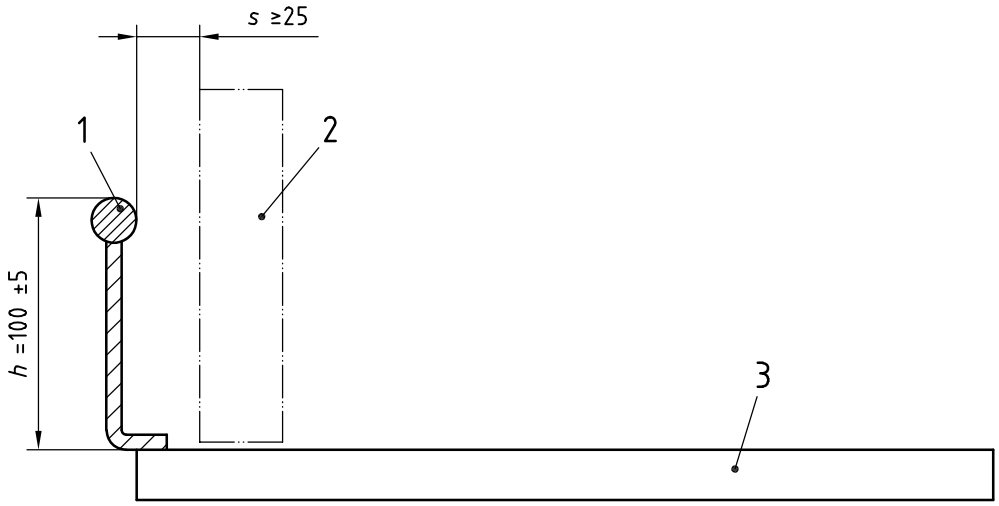
a) Machines with a horn gear diameter $d \leqslant 120$ mm, and Soutache and President machines, independent of their size and whether single- or multi-head machines, shall be provided with a bar around their outer contours with a clearance $s \geqslant 25$ mm from the carrier in its outer position and a height $h = 100 \text{ mm} \pm 5 \text{ mm}$ above the table (see Figures 1 and 2).

   A suitable overload device (e.g. ball coupling, safety pin, electronic motor overload) shall be incorporated between the motor drive and the carrier gear in order to disengage the drive from the motor if an excessive load occurs.

   NOTE The diameter d of the horn gear is, in the present context, equal to twice the maximum radius of the horn gear.

b) Machines with a horn gear diameter 120 mm < $d \leqslant 180$ mm shall be provided with a guard around the outer contours of a single machine or group of machines with a clearance $s \geqslant 25$ mm from the carrier in its outer position and extending 25 mm above the upper edge of the carrier. In deviation from ISO 13852, reaching over the guard need not be prevented.

Dimensions in millimetres

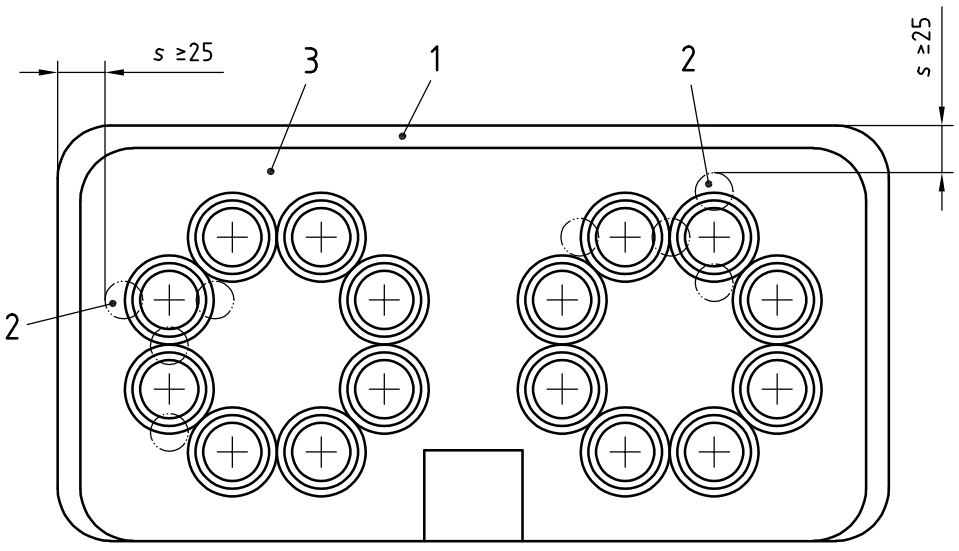


Key

1 bar
2 carrier in its outer position
3 table

Figure 1 — Safeguarding of small single head braiding machines

Dimensions in millimetres



Key

1 bar
2 carrier in its outer position
3 table

Figure 2 — Safeguarding of small multi-head braiding machines

c) Large machines with a horn gear diameter d > 180 mm — in particular, strand-plaited rope making machines — shall be provided with fence guards or guards around the machine which, in accordance with ISO 13852, cannot be reached over, or else enclosing guards shall be provided.

   Any access doors shall be interlocked.

   Where the longest stopping time without braking exceeds the access time, means shall be provided to ensure that doors cannot be opened until the carriers have been brought to a standstill, e.g. by a guard-locking device in conjunction with a motion sensor. These means shall keep the door closed when the control system or power supply fails.

   A brake is a useful aid to reduce stopping time, but should not be used to replace the guard locking system.

d) Rotary-type machines shall be provided with movable enclosing guards. These shall be interlocked. Requirements for interlocking shall be the same as for c).

6 Verification of safety requirements and/or measures

Final verification shall be carried out when the machine is in a fully commissioned condition, in accordance with ISO 11111-1:2005, Clause 7 and Annex C.

Noise emission values shall be determined for all machines covered by this part of ISO 11111 in accordance with ISO 9902-1 and ISO 9902-4, whether or not noise is a significant hazard.

7 Information concerning machine use

Information for use of the machine shall be provided in accordance with ISO 11111-1:2005, Clause 8. It shall include all elements in Clause 5.

Noise emission values shall be declared for all machines covered by this part of ISO 11111 in accordance with ISO 9902-1 and ISO 9902-4, whether or not noise is a significant hazard.

Bibliography

[1] ISO 14121, *Safety machinery — Principles of risk assessment*

[2] ISO 12100-1, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology*

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