

Textile machinery — Safety requirements —

Part 1: Common requirements

The European Standard EN ISO 11111-1:2005 has the status of a British Standard

ICS 59.120.01

National foreword

This British Standard is the official English language version of EN ISO 11111-1:2005. It is identical with ISO 11111-1:2005. BS EN ISO 11111-1, together with BS EN ISO 11111-2, BS EN ISO 11111-3, BS EN ISO 11111-4, BS EN ISO 11111-5, BS EN ISO 11111-6, and BS EN ISO 11111-7 supersedes BS EN ISO 11111:1996 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee TCI/33, Textile machinery, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 21 March 2005

Summary of pages

This document comprises a front cover, an inside front cover, the EN ISO title page, the EN ISO foreword page, the ISO title page, pages ii to vi, pages 1 to 70, the Annex ZA page, the Annex ZB page and a back cover.

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Amendments issued since publication

Amd. No.	Date	Comments

© BSI 21 March 2005

ISBN 0 580 45636 6

English version

Textile machinery - Safety requirements - Part 1: Common requirements (ISO 11111-1:2005)

Matériel pour l'industrie textile - Exigences de sécurité -
Partie 1: Exigences communes (ISO 11111-1:2005)

Textilmaschinen - Sicherheitsanforderungen - Teil 1:
Gemeinsame Anforderungen (ISO 11111-1:2005)

This European Standard was approved by CEN on 21 January 2005.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN ISO 11111-1:2005) has been prepared by Technical Committee ISO/TC 72 "Textile machinery and machinery for dry-cleaning and industrial laundering" in collaboration with Technical Committee CEN/TC 214 "Textile machinery and machinery for dry-cleaning and industrial laundry", the secretariat of which is held by SNV.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2005, and conflicting national standards shall be withdrawn at the latest by August 2005.

This document supersedes EN ISO 11111:1995.

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

For relationship with EU Directive(s), see informative Annex ZB, 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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Endorsement notice

The text of ISO 11111-1:2005 has been approved by CEN as EN ISO 11111-1:2005 without any modifications.

NOTE Normative references to International Standards are listed in annex ZA (normative).

INTERNATIONAL STANDARD

ISO
11111-1

First edition
2005-02-15

Textile machinery — Safety requirements —

Part 1: Common requirements

*Matériel pour l'industrie textile — Exigences de sécurité —
Partie 1: Exigences communes*



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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 11111-1 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 11111-1, together with ISO 11111-2, ISO 11111-3, ISO 11111-4, 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 machines or machine elements not dealt with in the relevant parts 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 contains a summary of safety requirements and/or measures for frequently occurring hazards of textile machinery (see Clause 5) which apply whenever referred to in this, or the other parts, of ISO 11111.

Significant hazards and corresponding safety requirements and/or measures for certain machine elements (e.g. rollers) and their combination of textile machines are also described (see Clause 6).

The various parts of ISO 11111 address significant hazards and corresponding safety requirements and/or measures for specific types of textile machines. As far as possible, these are treated by way of reference to Clauses 5 and 6 of this part of ISO 11111 and other cross-references (see general safety requirements), thus reducing considerably the volume by avoiding many repetitions. The standard for a specific textile machine will normally consist of this part of ISO 11111 and the specific part relevant to that machine. ISO 11111-2 to ISO 11111-7 may also contain exceptions or additions to the requirements given in this part of ISO 11111 (see specific safety requirements).

Textile machinery — Safety requirements —

Part 1: Common requirements

1 Scope

1.1 This part of ISO 11111 specifies safety requirements for frequently occurring hazards common to the types of textile machinery and the hazards of certain machine elements covered by ISO 11111-2 to ISO 11111-7.

1.2 It is applicable to machinery plant and related equipment intended to be used in the textile industry for the following:

- the opening, cleaning, blending, carding, preparation subsequent to carding, spinning and other processing of fibres (staple and filament) and other materials to form yarn or nonwoven material (including felts);
- the winding, doubling, twisting, texturing, etc. of yarns and the processing of yarns preparatory to weaving and knitting;
- the weaving, knitting, lace-making and similar utilization of yarn, etc., to form fabric;
- the formation of braid, cord, strand, rope, twine, net, etc., except take-up reels of stranding and laying machinery;
- processes including the pretreatment, bleaching, dyeing, printing and finishing of fibre, yarn, fabric, braid, cord, etc., and final assembly for despatch;
- the piece dyeing of made-up goods;
- finishing of warp and weft knitting, including hosiery, other than assembly of the finished product (e.g. sewing);
- carpet manufacture, by weaving, tufting and other processes.

This part of ISO 11111 applies to all machinery, plant and equipment used during the processes listed above, including equipment to enable automated operation of the machines and processes in either free-standing or complex installations, such as pneumatic fibre transportation, but excluding other transportation between the interfaces of the machines.

NOTE 1 The standard for a specific textile machine will normally consist of two parts: this part of ISO 11111 and the specific part of ISO 11111 relevant to that machine. However, in the case of nonwoven lines, which is covered by ISO 11111-3, ISO 11111-2, ISO 11111-6, and ISO 11111-7 are also to be taken into account.

This ISO 11111 does not deal with specific requirements for pressure containment.

NOTE 2 In the EU and EFTA specific Directives for pressure vessels and electromagnetic compatibility among others exist.

1.3 This and the other parts of ISO 11111 address hazards arising from the assembly and commissioning of the machinery, its adjustment, use, maintenance, decommissioning, dismantling, and disposal. Manual loading/unloading is considered to be part of the normal operation of the machinery.

1.4 This and the other parts of ISO 11111 are not applicable to machinery, plant and related equipment used for

- the manufacture of continuous filaments and man-made fibres up to and including the formation of the first textile package (e.g. continuous filament cheese, staple fibre bale),
- hackling and carding of flax and similar,
- the manufacture of spunbonded and melt blown nonwovens,
- the formation and making up of garments, household and industrial textile goods, and the pressing and die cutting of nonwoven fabric,
- the laundering and drycleaning of made-up textile goods,
- servicing of textile machines (e.g. machines for cardwire mounting, cleaning machines for components of printing machines), and
- certain cutting devices, e.g. log-slitting device, laser cutting, high pressure water jets, ultrasonic device.

NOTE 3 The machines and equipment listed in Annex E are used in the textile industry but are not within the scope of this document.

1.5 This and the other parts of ISO 11111 are not applicable to machinery intended for use in potentially explosive atmospheres.

1.6 This and the other parts of ISO 11111 are not applicable to machines which are manufactured before the dates of publication of the standards.

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 5232, *Graphical symbols for textile machinery*

ISO 9902 (all parts), *Textile machinery — Noise test code*

ISO 10218:1992, *Manipulating industrial robots — Safety*

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

ISO 11111-3:2005, *Textile machinery — Safety requirements — Part 3: Nonwoven machinery*

ISO 11111-4:2005, *Textile machinery — Safety requirements — Part 4: Yarn processing, cordage and rope manufacturing machinery*

ISO 11111-5:2005, *Textile machinery — Safety requirements — Part 5: Preparatory machinery to weaving and knitting*

ISO 11111-6:2005, *Textile machinery — Safety requirements — Part 6: Fabric manufacturing machinery*

ISO 11111-7:2005, *Textile machinery — Safety requirements — Part 7: Dyeing and finishing machinery*

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

ISO 11691, *Acoustics — Measurement of insertion loss of ducted silencers without flow — Laboratory survey method*

ISO 11821, *Acoustics — Measurements of the in situ sound attenuation of a removable screen*

ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology*

ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles and specification*

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

ISO 13849-2:2003, *Safety of machinery — Safety-related parts of control systems — Part 2: Validation*

ISO 13850:1996, *Safety of machinery — Emergency stop — Principles for design*

ISO 13851:2002, *Safety of machinery — Two-hand control devices — Functional aspects and design principles*

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

ISO 13853:1998, *Safety of machinery — Safety distances to prevent danger zones being reached by the lower limbs*

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

ISO 14118:2000, *Safety of machinery — Prevention of unexpected start-up*

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

ISO 14121:1999, *Safety of machinery — Principles of risk assessment*

ISO 14122-1, *Safety of machinery — Permanent means of access to machinery — Part 1: Choice of fixed means of access between two level*

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

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

ISO 14122-4, *Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders*

ISO 14123-1:1998, *Safety of machinery — Reduction of risks to health from hazardous substances emitted by machinery — Part 1: Principles and specifications for machinery manufacturers*

ISO 14123-2:1998, *Safety of machinery — Reduction of risks to health from hazardous substances emitted by machinery — Part 2: Methodology leading to verification procedures*

ISO 14163, *Acoustics — Guidelines for noise control by silencers*

ISO 15667, *Acoustics — Guidelines for noise control by enclosures and cabins*

IEC 60204-1:2000, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60447:1993, *Man-machine interface (MMI) — Actuating principles*

IEC 60947-5-1:2000, *Low voltage switchgear and controlgear — Part 5-1: Control circuit devices and switching elements — Electromechanical control device*

IEC 61310-1:1995, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, auditory and tactile signals*

IEC 61496-1:1997, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests*

IEC 61496-2:1997, *Safety of machinery — Electrosensitive protective equipment — Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)*

IEC 61496-3:2001, *Safety of machinery — Electro-sensitive protective equipment — Part 3: Particular requirements for active opto-electronic protective devices responsive to diffuse reflection (AOPDDR)*

EN 563:1994, *Safety of machinery — Temperatures of touchable surfaces — Ergonomics data to establish temperature limit values for hot surfaces; AC:1994; A1:1999*

EN 614-1, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*

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

EN 982:1996, *Safety of machinery — Safety requirements for fluid power systems and their components — Hydraulics*

EN 983:1996, *Safety of machinery — Safety requirements for fluid power systems and their components — Pneumatics*

EN 999:1998, *Safety of machinery — The positioning of protective equipment in respect of approach speeds of parts of the human body*

EN 1005-1, *Safety of machinery — Human physical performance — Part 1: Terms and definitions*

prEN 1005-2:2003, *Safety of machinery — Human physical performance — Part 2: Manual handling of machinery and component parts of machinery*

EN 1005-3, *Safety of machinery — Human physical performance — Part 3: Recommended force limits for machinery operation*

prEN 1005-4:2002, *Safety of machinery — Human physical performance — Part 4: Evaluation of working postures and movements in relation to machinery*

EN 1127-1:1997, *Explosive atmospheres — Explosion prevention and protection — Part 1: Basic concepts and methodology*

EN 1760-1:1997, *Safety of machinery — Pressure-sensitive protective devices — Part 1: General principles for the design and testing of pressure sensitive mats and pressure sensitive floors*

EN 1760-2:2001, *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 12198-1, *Safety of machinery — Assessment and reduction of risks arising from radiation emitted by machinery — Part 1: General principles*

EN 12198-3, *Safety of machinery — Assessment and reduction of risks arising from radiation emitted by machinery — Part 3: Reduction of radiation by attenuation or screening*

EN 12464-1, *Light and lighting — Lighting of work places — Part 1: Indoor work places*

EN 60825-1:1994/A2:2001, *Safety of laser products — Part 1: Equipment classification, requirements and user's guide; Amendment A2*

3 Terms and definitions

For the purposes of this part of ISO 11111, the terms and definitions given in ISO 12100-1 and EN 953, and the following apply.

NOTE Where values are applicable to terms defined in this clause, these values are indicated in Annex A.

3.1

stopping time

time taken by a machine or machine part to reach a stand-still after the signal to stop has been given

3.2

access time

time required to reach a dangerous part from first exposure to that part

3.3

crawl speed

linear or tangential speed of machine elements which is substantially below its normal speed and has a maximum speed and a maximum stopping distance

3.4

reduced running speed

linear or tangential speed of machine elements which is substantially below its normal speed and has a maximum stopping distance

3.5

fence guard

fixed guard to provide a barrier at a distance which prevents access to a danger zone

NOTE It can be either fixed directly to the machine or free-standing and fixed to the floor or constructional elements of the building. Access to the space between the fence guard and the machine is controlled by interlocked doors (see Annex A).

3.6

lap

wrap

undesired wrapping of the process material around a rotating part of the machine

3.7

normal operation

entire sequence of the production process, including start-up and incidental cleaning and elimination of routine process faults

EXAMPLE Feeding and removal of process material, threading up, process surveillance, quality tests, removal of fibre fly, mending of broken ends.

3.8

special operation

procedure and action not included in normal operation

EXAMPLE Setting, tuning, major cleaning, elimination of substantial process faults, maintenance such as the removal of blockages, laps except on spinning, twisting and texturizing machines, re-sewing broken cloth, elimination of rope loops.

3.9

complex installation

combination of textile machines and service equipment, arranged to work as one integrated production unit, subject to overall control either from a central system or from distributed, communicating systems

3.10

automatic machinery [equipment]

machinery [equipment] for which systems are employed to govern its operation without further intervention from the operator once the start control has been activated

NOTE Such machines may be either free-standing or included in a complex installation. Automatic control can apply to the operational sequence of a machine and its integrated equipment located in a permanent place, and equipment which is mobile, including handling devices (e.g. piecing devices, knotters).

4 List of significant hazards

Significant hazards frequently occurring on textile machinery shall be considered in Clause 5. Additional significant hazards common to certain machine elements are given in Clause 6. Specific significant hazards for individual textile machines shall be considered in ISO 11111-2 to ISO 11111-7.

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 textile machinery are always considered in conjunction with safety requirements.

5 Safety requirements and/or measures for frequently occurring hazards

5.1 General

This clause contains safety requirements and/or measures to be taken in relation to frequently occurring significant hazards related to textile machinery.

Machinery shall comply with the safety requirements and/or protective measures of this clause, Clause 6 and ISO 11111-2 to ISO 11111-7. In addition, the machine shall be designed according to the principles of ISO 12100 for hazards relevant but not significant, which are not dealt with by this part of ISO 11111.

Where the means of reducing the risk is by the arrangement of the installed machine or a safe system of working the machine, the manufacturer shall give a detailed description of this in the instruction handbook.

Where type B standards that are referred to offer a choice of safety requirements and/or measures having different levels of safety and the selection is not specified in this part of ISO 11111 or in ISO 11111-2 to ISO 11111-7, the manufacturer shall carry out a risk assessment to identify the appropriate level.

5.2 Safety requirements for the different phases of “life” of a machine

The safety requirements given in this Clause 5 and in Clause 6, together with the requirements set out in ISO 11111-2 to ISO 11111-7, apply to the use and maintenance of the machine. For the other phases in the life of a machine, mainly see Clause 8.

5.3 Risk reduction by design and safeguarding

5.3.1 General

A design concept for the machine and/or its mechanisms which does not inherently create a hazard shall, as far as possible, be adopted

EXAMPLE Use of pneumatic trunking instead of open lattice conveyors, use of pneumatic uncurling devices instead of mechanical uncurling rollers.

5.3.2 Reduction of risks by design

Hazards arising from the machine shall be reduced by the application of safety requirements selected from ISO 12100-2 in accordance with Table 1.

Table 1 — Risk reduction by design

Application	Reference ISO 12100-2:2003
Making machines safe by virtue of — avoiding sharp edges and corners, protruding parts, etc., — the shape and the relative location of their mechanical component parts (see ISO 13854), — the limitation of the actuating force (see A.4), — the limitation of the mass and/or velocity (see A.1).	4.2

5.3.3 Reduction of risks by safeguarding

Guards and safety devices used to reduce risks from textile machines shall conform to the requirements of the standards given in Tables 2 and 3.

Table 2 — Safety requirements and/or measures for guards

Application	Reference
Guard selection, unless specified in Clause 6 of this part of ISO 11111 and in ISO 11111-2 to ISO 11111-7	ISO 12100-2:2003, 5.2 EN 953:1997, Clause 6
Guard design and construction	ISO 12100-2:2003, 5.3 EN 953:1997, Clauses 6 and 7
Guard fastening	EN 953:1997, 6.4.3 and 7.3
Guard arrangement, unless specified in Clause 6 of this part of ISO 11111 and in ISO 11111-2 to ISO 11111-7 ^a	ISO 13852:1996, Tables 1 and 4 ISO 13853:1998, Table 1 and A.1
Guard interlocking, unless specified in Clause 6 of this part of ISO 11111 and in ISO 11111-2 to ISO 11111-7	ISO 14119:1998, Clauses 5, 6 and 7
Fence guard	A.3
^a The safety distances for guards shall apply to all positions for normal operation as well as setting, adjustment, maintenance work and elimination of process faults.	

Table 3 — Safety requirements and/or measures for safety devices

Application	Reference
Selection of safety devices, unless specified in Clause 6 of this part of ISO 11111 and in ISO 11111-2 to ISO 11111-7	ISO 12100-2:2003, 5.2
Technical characteristics of safety devices	ISO 12100-2:2003, 5.3.3 IEC 61496-1:1997, Clause 4
Positioning of safety devices, unless specified in Clause 6 of this part of ISO 11111 and in ISO 11111-2 to ISO 11111-7 ^a	EN 999:1998, Clauses 5 to 7
Interlocking (with and without guard locking): — selection — design	ISO 14119:1998, Clause 7 ISO 14119:1998, Clauses 5 and 6 IEC 61496-1:1997, A.5, A.6 and A.8

Table 3 (continued)

Application		Reference
Electro-sensitive protective equipment: ^d — requirements ^b — testing — marking for identification and for safe use — accompanying documentation — arrangement		IEC 61496-1:1997, Clause 4 IEC 61496-1:1997, Clause 5 IEC 61496-1:1997, Clause 6 IEC 61496-1:1997, Clause 7 EN 999:1998, Clause 6
Active opto-electronic protective devices (AOPD): ^d — requirements ^b — testing — marking for identification and for safe use — accompanying documentation — arrangement — safety distance (upper and lower limbs)		IEC 61496-2:1997, Clause 4 IEC 61496-2:1997, Clause 5 IEC 61496-2:1997, Clause 6 IEC 61496-2:1997, Clause 7 EN 999:1998, Clause 6 ISO 13852 and ISO 13853
Active opto-electronic protective devices responsive to diffuse reflection(AOPDDR): ^d — requirements — testing — marking for identification and for safe use — accompanying documentation — arrangement — safety distance (upper and lower limbs)		IEC 61496-3:2001, Clause 4 IEC 61496-3:2001, Clause 5 IEC 61496-3:2001, Clause 6 IEC 61496-3:2001, Clause 7 EN 999:1998, Clause 6 ISO 13852 and ISO 13853
Pressure-sensitive mats and floors: ^d — selection — installation — design		EN 1760-1:1997, Clause 4 EN 1760-1:1997, Annex D EN 1760-1:1997, Annex C
Pressure-sensitive edges and bars: ^d — selection — installation — design		EN 1760-2:2001, Clause 4 EN 1760-2:2001, Annex E EN 1760-2:2001, Annex C
Two-hand controls: — selection ^c	ISO 13851:2002, Clause 4 and Annex B ISO 13849-1:1999, Clause 6 and Annex B IEC 60204-1:2000, 9.2.5.7	
Hold-to-run control devices	ISO 12100-1:2003, 3.26.3 IEC 60204-1:2000, 9.2.5.6	
Limited movement control devices	ISO 12100-1:2003, 3.26.9	
^a The safety distances for safety devices shall apply to all positions for normal operation as well as setting, adjustment, maintenance work and elimination of process faults.		
^b The type selected shall be consistent with the category of the safety-related part of the control system as defined in ISO 13849-1:1999, 6.2. for category 2 of ISO 13849-1:1999, type 2 of IEC 61496-1:1997 shall be used.		
^c The type selected shall be consistent with the category of the safety-related part of the control system as defined in ISO 13849-1:1999, 6.2. For category 2 of ISO 13849-1:1999, type II of ISO 13851 : 2002 shall be used.		
^d Trip devices.		

5.4 Safety requirements for various hazards

5.4.1 General

The principles of risk elimination, reduction by design and safeguarding in accordance with 5.3 shall apply.

5.4.2 Electrical hazards

5.4.2.1 General

Hazards

- Electrical, generated by contact of persons with live parts and parts which have become live under fault conditions (e.g. insulation fault or failure), or by approach of persons to live parts, especially in the high voltage range.
- Mechanical, due to failure of electrical equipment e.g. failure of the control system, unexpected restart.

5.4.2.2 General safety requirements for electrical equipment

Hazards arising from electrical equipment shall be reduced by the application of safety requirements selected from the clauses of IEC 60204-1 in accordance with in Table 4.

Table 4 — Safety requirements for electrical equipment of machines

Electrical hazards	Reference IEC 60204-1:2000
Electric shock	Clauses 6 and 8
Overcurrent, overspeed and overload	Clauses 7 and 8
Environmental influences	Clause 4
Restart after voltage drop or supply interruption	7.5
Accessibility, layout and identification of control equipment	Clauses 10, 12 and 17
Ergonomics for manual operation	Clauses 10 and 12
Cabling and wiring	Clauses 13 and 14
Accessories and lighting	Clause 16
Documentation and instruction handbook	Clause 18
Testing	Clause 19

5.4.2.3 Specific safety requirements for control systems and devices

Hazards arising from the control system shall be reduced by the application of safety requirements selected from the Clauses of IEC 60204-1 or from other relevant standards in accordance with Table 5.

Table 5 — Safety requirements for control systems

Application	Reference
Design of control system	ISO 12100-2:2003, 4.11
Control circuits and functions	IEC 60204-1:2000, Clause 9
Control interfaces	IEC 60204-1:2000, Clauses 10 and 11
Programmable electronic equipment	IEC 60204-1:2000, Clause 11
Control gear	IEC 60204-1:2000, Clause 12
Categories of resistance to faults	ISO 13849-1:1999, Clause 6
Fault exclusion/proven components	ISO 13849-2:2003, Clause 7
Control devices	IEC 60204-1:2000, Clause 10
Safety signals, symbols and signs	IEC 61310-1:1995, Clauses 5 to 8
Arrangement of control devices	ISO 2100-2:2003, 4.8.8 and 4.11.8
Actuating principles	IEC 60447:1993

If, in Clause 6 or ISO 11111-2 to ISO 11111-7, no category according to ISO 13849-1 has been selected, at least category 2 shall apply.

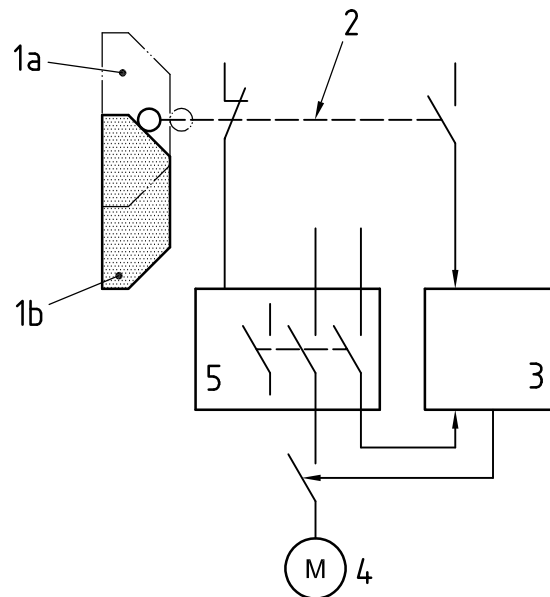
Where it is necessary to make fault exclusions to achieve the required category for the used components, ISO 13849-2:2002 shall apply.

If category 1 is realized instead of category 2, the reason shall be justified by risk assessment.

Proven components shall be used in category 1, such as are defined in ISO 13849-2, e.g. mechanical position switch with forcibly actuated normally closed contact according to IEC 60947-5-1.

The safety function according to category 2 shall be checked prior to starting a production cycle, irrespective of the type of initiation. If the production cycle exceeds 24 h, the control system shall be checked within 24 h intervals. If the test interval should be exceeded, the control system shall automatically stop the machine. Interlocking of guards with mechanical position switches can only be checked by displacing the guard. If this checking is not suitable for the machine operation, category 3 shall be applied.

A single fault in control circuits according to category 3 shall not lead to a failure of the safety function. Faults shall be recognized as far as possible with the functional control. This may be, e.g. a plausibility check within a programmable logic controller; where the existing signal is continuously compared with the expected value (see Figure 1).



Key

- 1a guards in displaced position
- 1b guards in operating position
- 2 limit switch in accordance with IEC 60947-5-1 fault exclusion, because of safe positioning and safe wiring
- 3 programmable logic controller
- 4 drive for dangerous movements (M)
- 5 safety component (e.g. emergency-stop relay)

Figure 1 — Block diagram Category 3 with recognition of faults by programmable logic controller

A single fault of control circuits according to category 4 shall not lead to a failure of the safety function. If faults are not recognized during or before the next run, an accumulation of up to 3 faults shall not lead to a failure of the safety function.

If other technologies for the control system are considered, the choice of the category shall be checked in order to achieve an equivalent level of safety.

Control devices shall be arranged according to ISO 12100-2:2003, 4.8.8 and 4.11.8

To afford unobscured visibility of the danger zones from the main control position, mirrors, TV monitors and similar viewing aids may be used, or the position may be elevated.

In order to allow sufficient time for exposed persons to move to a safe place, the interval between activation of any warning signal and actual start-up shall be not less than 3 s and not more than 6 s unless otherwise stated in ISO 11111-2 to ISO 11111-7, and an emergency stop control shall be provided at the danger points.

5.4.2.4 Specific safety requirements for starting and stopping

Hazards arising from starting and stopping shall be reduced by the application of safety requirements selected from the clauses of IEC 60204-1 or from other relevant standards in accordance with Table 6.

Table 6 — Safety requirements for starting and stopping

Application	Reference
Starting	ISO 12100-2:2003, 4.11.2 and 4.11.3
Unexpected start-up	ISO 14118:2000, Clauses 5 and 6
Isolation from energy sources	ISO 12100-2:2003, 5.5.4 IEC 60204-1:2000, 5.3 and 5.4
Start-up by inadvertent actuation	5.4.2.4 a) IEC 60204-1:2000, 10.6
Observation of danger zones from main control position	5.4.2.4 b)
Start-up by unauthorized persons	5.4.2.4 b)
Automatic restart after process interruption	5.4.2.4 c)
Start-up after interruption of power supply	IEC 60204-1:2000, 7.5
Emergency stopping	5.4.2.4 d) ISO 12100-2:2003, 5.5.2 ISO 13850 IEC 60204-1:2000, 10.7 and 10.8

a) Requirements concerning start-up by inadvertent actuation shall be satisfied by any of the following:

- 1) control switch button slightly recessed in relation to the surrounding surface;
- 2) covered control switch;
- 3) control switch requiring more than one operation (e.g. pressing and turning);
- 4) control switch located beneath a hinged flap;
- 5) control switch with lock in the off position;
- 6) two-button start control.

b) Textile machinery plant or systems which cannot be totally observed from the main control position (e.g. automated blow room machinery, continuous carpet dyeing and finishing lines, nonwoven production lines), or in the proximity of which communication is difficult (owing, in particular, to loud noise, e.g. speed frames, weaving machines, braiding machines) shall, in addition to the measures specified in ISO 12100-2:2003, 4.8.8, be provided with individual key-operated control switches or similar devices (e.g. lockable isolator switches) to prevent the equipment being started up by unauthorized persons.

NOTE "Start-up by unauthorized persons" means switching on a machine by a person neither deputed nor directed so to do.

- c) Where automated process fault elimination devices are fitted to a machine, automatic restart after process interruption shall only be possible when guards and safety devices are in position and activated. Where there is a residual risk, the operator shall be warned by a warning signal in accordance with IEC 61310-1 before restart. The warning device shall be positioned close to the danger zone.
- d) Each textile machine shall be equipped with at least one emergency stop control. Where an emergency stop control is used to safeguard against a residual risk, it shall be positioned close to the respective danger zone.

5.4.3 Mechanical hazards

Hazards

Table 7 lists, illustrates and describes hazards associated with textile machinery, from, for example, machine elements or transmission parts.

Safety requirements

Mechanical hazards arising from the machine shall be reduced by the application of safety requirements in accordance with 5.3.

Table 7 — Mechanical hazards

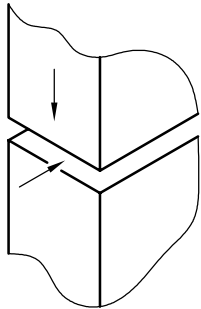
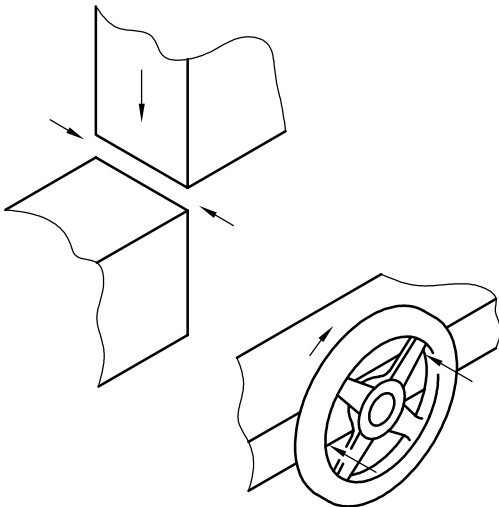
Hazard	Illustration examples ^a	Description
Crushing		Generated when — two movable parts are moving towards each other, or — one movable part is moving towards a fixed part. (For minimum gaps, see ISO 13854:1996.)
Shearing		Generated when — two movable parts move closely past each other, or — one movable part moves closely past a fixed part.

Table 7 (continued)

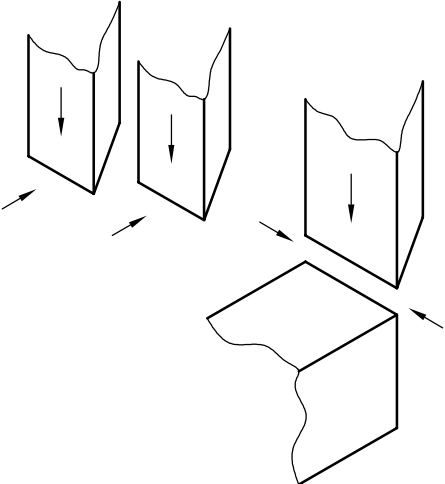
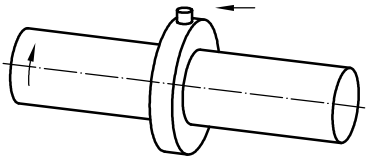
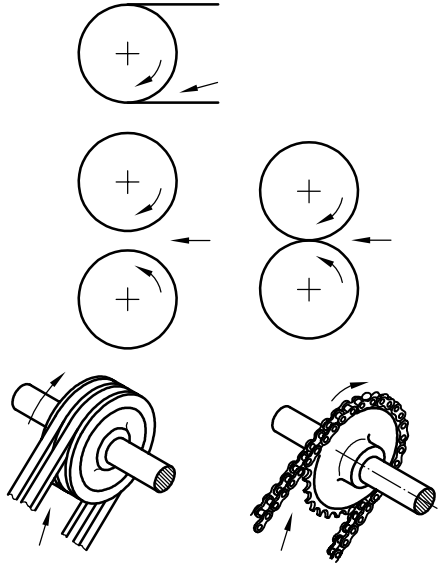
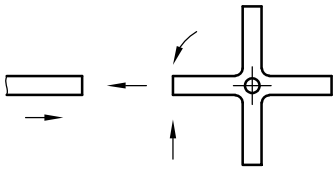
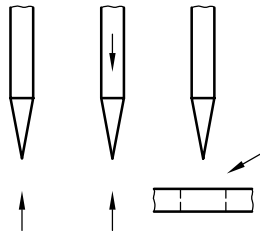
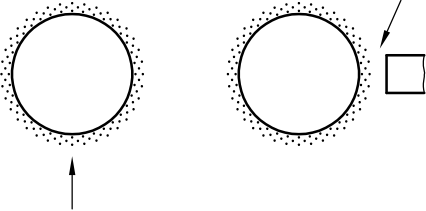
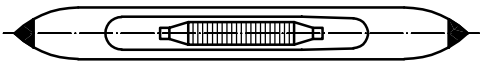
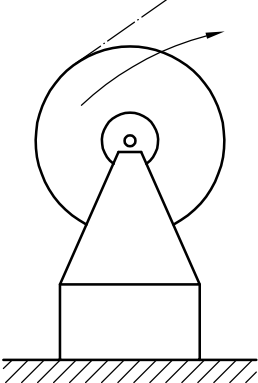
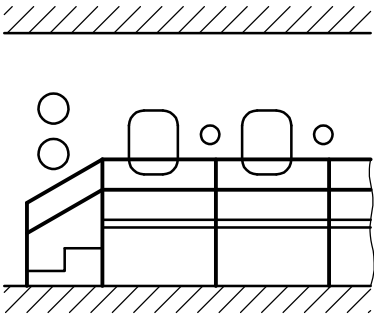
Hazard	Illustration examples ^a	Description
Cutting or severing		Generated when stationary or movable parts have sharp edges (e.g. blades, knives).
Entanglement		Generated when shafts or shaft ends, rotating or traversing parts with projecting edges, teeth, cotters, screws, bolts, oiler cups etc.; can entangle clothing, hair and/or body parts.
Drawing-in and trapping		Generated when — two-counter-rotating parts are in either direct or close contact with each other, or — rotating parts are in contact with tangential parts or process materials (e.g. rollers and process materials, conveyor belts and pulleys, chains and sprockets), or — rotating parts are close to a fixed surface.
Impact		Generated when a moving part can strike an exposed person (e.g. traversing parts, beaters, flyers, winches).

Table 7 (continued)

Hazard	Illustration examples ^a	Description
Stabbing or puncture		Generated when stationary or moving parts have pointed edges or tips.
Friction or abrasion		Generated when contact is made with the surface of a rapidly moving part or with a moving part having an abrasive surface (e.g. card clothing).
Ejection of parts (including process material falling)		Generated when a moving part of machinery or process material leaves its defined path or is thrown out of the machine (e.g. tubes, bobbins, shuttles or beams).
Overturning, unexpected loss of stability		Generated when a part of a machine or the machine itself can overturn or become unfastened from its mountings due to inherent lack of stability or rapid start-up of certain processes (e.g. running off process material from A-frames).
Slip, trip and fall		Generated when — surfaces of walkways, work platforms, staircases, ladders, etc. are slippery, or — floor surfaces are uneven or parts are projecting, or — process material, its carrier (e.g. tubes, bobbins, beams, etc.) have fallen onto or are left lying on the floor, or — no rail is present.

^a In the figures, the smaller arrow indicates the moving direction, while the larger one indicates the danger area.

5.4.4 Static electricity

Hazards

Static electricity can be unintentionally generated in the course of the production process (e.g. carding fibre) and result in the discharge of sparks, which can cause fire or explosion, or shocks to persons contacting parts charged by process materials.

Safety requirements

Appropriate safety requirements and/or measures to prevent the build up of static electricity or to discharge shall be provided.

To prevent the generation of static electricity, suitable materials from which the machine is constructed shall be used.

To discharge static electricity, one of the following measures or any combination thereof shall be taken:

- a) providing a low resistance earthed protective conductor of suitable capacity from the conductive parts of the machinery or plant;
- b) fitting static eliminators in appropriate positions on machinery;
- c) providing information in the instruction handbook on minimum humidity to be provided by the air-conditioning system.

NOTE Detailed information for the avoidance of static electricity is given in CENELEC Report R 044-001:1999.

5.4.5 Fluid power systems and components

Hazards

Generated when fluid under pressure is ejected from or leaks out of tubes, fittings, nozzles, vessels, hoses, etc. (e.g. compressed air, hydraulic oil).

Safety requirements

The safety requirements and/or measures given in ISO 12100-2:2003, 4.10, in EN 982:1996, Clause 5 (hydraulic) and in EN 983:1996, Clause 5 (pneumatic) shall apply.

5.4.6 Extreme temperatures

5.4.6.1 Hot surfaces and flames

Hazards

Generated by contact of persons with hot surfaces of machines or vessels used or with flames (e.g. singeing machines) or by proximity radiation heaters (e.g. infrared heaters). The hot surfaces result from the incorporation of purposely heated parts to directly assist and further the production process (i.e., heated rollers, tubes, burners or plates), or are generated in the course of the production process, even extending to the entire vessels themselves, due to the hot liquors or steam they contain.

Safety requirements

Textile machines shall be designed so as to reduce the risk of burn injury caused by intended or non-intended contact with or proximity to machine parts, process material at high temperatures or to flames.