
Safety requirements for wetlaid- nonwoven machinery

*Exigences de sécurité pour les machines de production de non tissé
par voie humide*

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 72, *Textile machinery and accessories*, Subcommittee SC 8, *Safety requirements for textile machinery*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 214, *Textile machinery and accessories*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document was 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 wetlaid-nonwoven machinery.

This document is a type-C standard as stated in ISO 12100.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

- machine manufacturers (small, medium and large enterprises);
- machine designers;
- systems integrators;
- health and safety bodies (regulators, accident prevention organisations, market surveillance, etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

- machine users/employers (small, medium and large enterprises);
- machine users/employees (e.g. trade unions, organizations for people with special needs);
- service providers, e.g. for maintenance (small, medium and large enterprises);
- consumers (in case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

The machinery concerned and the extent to which hazards, hazardous situations or hazardous events are covered are indicated in the Scope of this document. When requirements of this type-C standard are different from those which are stated in type-A or type-B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

For machines or machine equipment not dealt with in this document, the designer performs a risk assessment according to ISO 12100 and provides means for reducing the risk from significant hazards. These risk reduction measures that need to be identified by the designer/manufacturer of the machinery by risk assessment are outside the scope of this document.

This document contains a summary of general safety requirements and/or protective/risk reduction measures for frequently occurring hazards of wetlaid-nonwoven machinery (see [Clause 5](#)) which apply whenever referred to in this document.

Specific hazards and corresponding specific safety requirements and/or protective/risk reduction measures for certain machine elements (e.g. winders) and their combination of wetlaid-nonwoven machines are also described (see [Clause 6](#)).

Safety requirements for wetlaid-nonwoven machinery

1 Scope

This document specifies safety requirements and means of verification for wetlaid-nonwoven machinery.

This document applies to wetlaid-nonwoven machines, including approach flow system, headbox, wire section and jet head, hydroentangling unit, dryer, finishing, quality control system (QCS), winder, drives and control system. [Annex C](#) illustrates general wetlaid-nonwoven machinery and their components.

It deals with all significant hazards, hazardous situations and hazard events relevant to wetlaid-nonwoven machines, when used as intended and under the conditions foreseeable by the manufacturer.

This document does not deal with pressure hazards in steam-heated drying cylinders and does not apply to equipment under pressure.

This document does not apply to machines which are intended for use in explosive atmospheres.

This document does not apply to wetlaid-nonwoven machines which have been manufactured before the date of publication of this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components*

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

ISO 9902-1:2001, *Textile machinery — Noise test code — Part 1: Common requirements*

ISO 9902-3:2001, *Textile machinery — Noise test code — Part 3: Nonwoven machinery*

ISO 10218-1:2011, *Robots and robotic devices — Safety requirements for industrial robots — Part 1: Robots*

ISO 11111-3:2005/Amd.2:2016, *Textile machinery — Safety requirements — Part 3: Nonwoven machinery — Amendment 2*

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

ISO 11161:2007, *Safety of machinery — Integrated manufacturing systems — Basic requirements*

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

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

ISO 13732-1:2006, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces*

ISO 13849-1:2015, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 13849-2:2012, *Safety of machinery — Safety-related parts of control systems — Part 2: Validation*

ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design*

ISO 13851:2019, *Safety of machinery — Two-hand control devices — Principles for design and selection*

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

ISO 13856-1:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 1: General principles for design and testing of pressure-sensitive mats and pressure-sensitive floors*

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 13856-3:2013, *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 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14118:2017, *Safety of machinery — Prevention of unexpected start-up*

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

ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

ISO 14122-3:2016, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails*

ISO 14122-4:2016, *Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders*

ISO 14123-1:2015, *Safety of machinery — Reduction of risks to health resulting from hazardous substances emitted by machinery — Part 1: Principles and specifications for machinery manufacturers*

ISO 19353:2019, *Safety of machinery — Fire prevention and fire protection*

IEC 60204-1:2016, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60204-11:2018, *Safety of machinery — Electrical equipment of machines — Part 11: Requirements for HV equipment for voltages above 1 000 V a.c. or 1 500 V d.c. and not exceeding 36 kV*

IEC 60447:2004, *Basic and safety principles for man-machine interface, marking and identification — Actuating principles*

IEC 60825-1:2014, *Safety of laser products — Part 1: Equipment classification and requirements*

IEC 61000-6-2:2016, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity standard for industrial environments*

IEC 61310-1:2007, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals*

IEC 61496-1:2020, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests*

IEC 61496-2:2020, *Safety of machinery — Electro-sensitive protective equipment — Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)*

IEC 61496-3:2018, *Safety of machinery — Electro-sensitive protective equipment — Part 3: Particular requirements for Active Opto-electronic Protective Devices responsive to Diffuse Reflection (AOPDDR)*

- IEC 61800-1:2021, *Adjustable speed electrical power drive systems — Part 1: General requirements — Rating specifications for low voltage adjustable speed DC power drive systems*
- IEC 61800-2:2021, *Adjustable speed electrical power drive systems — Part 2: General requirements — Rating specifications for low voltage adjustable speed AC power drive systems*
- IEC 61800-3:2017, *Adjustable speed electrical power drive systems — Part 3: EMC requirements and specific test methods*
- IEC 61800-5-1:2016, *Adjustable speed electrical power drive systems — Part 5-1: Safety requirements — Electrical, thermal and energy*
- IEC 61800-5-2:2016, *Adjustable speed electrical power drive systems — Part 5-2: Safety requirements — Functional*
- IEC 62061:2021, *Safety of machinery — Functional safety of safety-related electrical, electronic and programmable electronic control systems*
- EN 349:1993+A1:2008, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*
- EN 614-1:2006+A1:2009, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*
- EN 614-2:2000+A1:2008, *Safety of machinery — Ergonomic design principles — Part 2: Interactions between the design of machinery and work tasks*
- EN 746-1:1997+A1:2009, *Industrial thermoprocessing equipment — Part 1: Common safety requirements for industrial thermoprocessing equipment*
- EN 746-2:2010, *Industrial thermoprocessing equipment — Part 2: Safety requirements for combustion and fuel handling systems*
- EN 894-1:1997+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 1: General principles for human interactions with displays and control actuators*
- EN 894-2:1997+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 2: Displays*
- EN 894-3:2000+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 3: Control actuators*
- EN 894-4:2010, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 4: Location and arrangement of displays and control actuators*
- EN 1005-1:2001+A1:2008, *Safety of machinery — Human physical performance — Part 1: Terms and definitions*
- EN 1005-2:2003+A1:2008, *Safety of machinery — Human physical performance — Part 2: Manual handling of machinery and component parts of machinery*
- EN 1005-3:2002+A1:2008, *Safety of machinery — Human physical performance — Part 3: Recommended force limits for machinery operation*
- EN 1005-4:2005+A1:2008, *Safety of machinery — Human physical performance — Part 4: Evaluation of working postures and movements in relation to machinery*
- EN 1837:2020, *Safety of machinery — Integral lighting of machines*
- EN 12198-1:2000+A1:2008, *Safety of machinery — Assessment and reduction of risks arising from radiation emitted by machinery — Part 1: General principles*
- EN 12198-3:2002+A1:2008, *Safety of machinery — Assessment and reduction of risks arising from radiation emitted by machinery — Part 3: Reduction of radiation by attenuation or screening*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 approach flow system

assembly group consisting of pumps, vats and pipelines, constantly feeding the fibre suspension to the headbox (3.2)

3.2 headbox

unit that keeps the fibres dispersed and delivers the stock uniformly onto the wire

Note 1 to entry: There are many types of headboxes, including an open flow box or hydraulic flow boxes.

3.3 former

unit where the fibre suspension is dewatered and in which the web is formed

3.4 hydroentangling unit

unit where the material is bonded with high-pressure water jets

3.5 through-air dryer

unit where the material is dried with hot air

3.6 finishing

unit for applying binders, pigments, colours or fillers onto web

3.7 quality control system QCS

set of measuring devices consisting of an ionizing and/or non-ionizing radiation source to gauge weight moisture content and other characteristics of the web

3.8 winder

reel-up section where the web is wound onto a reel spool

3.9 jet head

unit that creates high-pressure water jets

3.10 performance level PL

discrete level used to specify the ability of safety-related parts of control systems to perform a safety function under foreseeable conditions

Note 1 to entry: See ISO 13849-1:2015, 4.5.1.

[SOURCE: ISO 13849-1:2015, 3.1.23]

3.11**safety integrity level****SIL**

discrete level (one out of a possible four), corresponding to a range of safety integrity values, where safety integrity level 4 has the highest level of safety integrity and safety integrity level 1 has the lowest

[SOURCE: IEC 61508-4:2010, 3.5.8]

3.12**sensitive protective equipment****SPE**

equipment for detecting persons or parts of persons which generates an appropriate signal to the control system to reduce risk to the persons detected

Note 1 to entry: The signal can be generated when a person or part of a person goes beyond a predetermined limit — for example, enters a hazard zone — (tripping) or when a person is detected in a predetermined zone (presence sensing), or in both cases.

[SOURCE: ISO 12100:2010, 3.28.5]

3.13**active opto-electronic protective device****AOPD**

device whose sensing function is performed by optoelectronic emitting and receiving elements detecting the interruption of optical radiation, generated within the device, by an opaque object present in the specified detection zone

Note 1 to entry: IEC 61496 gives detailed provisions.

[SOURCE: ISO 12100:2010, 3.28.6]

4 List of significant hazards

[Table 1](#) contains all significant hazards, hazardous situations and hazard events, as far as they are dealt with in this document, which are identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk.

Table 1 — List of significant hazards

No.	Hazard		Relevant subclause in this document
	Origin (source)	Potential consequences	
Mechanical hazards			
1	Inadequate design of workplaces, means of access, walkways, passageways	Slipping, tripping and falling	5.5 ; 5.5.9 ; 5.16 ; 5.19 ; 5.37
2	Obstacles in the area of workplaces, means of access, walkways, passageways	Impact hazards for the head	5.5.9 ; 5.13 ; 5.18 ; 6.6
3	In-running nips on rotating rolls, reels, cylinders; Wrapping points of fabrics, wires, ropes, power transmissions elements	Drawing-in or trapping, amputation, death	5.7 ; 5.8 ; 5.10 ; 5.19 ; 5.29 ; 5.30.1 ; 5.30.2 ; 5.36.1 ; 5.37 ; 6.1 ; 8.2
4	Linear and swivelling movements of machinery parts	Crushing injuries Shearing injuries	5.8 ; 5.16 ; 5.17 ; 5.19 ; 5.21 ; 5.31 ; 5.33 ; 5.37 ; 6.1 ; 6.2 ; 6.5
5	Knives, edges of wires, sharp edges of machinery frame	Cutting injuries	5.1 ; 5.33 ; 5.37
6	Movement of crane, reels	Impact, crushing injuries	5.7 ; 5.16 ; 5.18 ; 5.30.1
7	Rotating bolts on rolls and cylinders	Impact injuries, winding	5.30.1
8	Hydraulic and pneumatic equipment	Injuries by ejection of high-pressure fluids	5.14 ; 5.15 ; 5.19 ; 5.33
9	Ejection and falling of machinery parts	Crushing, impact of persons	5.10 ; 5.31 ; 5.37 ; 6.1
Electrical hazards			
10	Electrical equipment	Electric shock	5.10 ; 5.12 ; 5.13 ; 5.22
11	Electrical equipment	Outside effects on electrical equipment	5.10 ; 5.13
Thermal hazards			
12	Hot surfaces of machinery parts	Burning and scalds by contact of persons	5.21 ; 5.28
Noise hazards			
13	Machine and machine components	Hearing loss and physiological disorders (as occupational diseases) and interference with oral communication and acoustic warning signals (as source of accidents)	5.20 ; 6.3
Radiation hazards			
14	Measuring unit with radioactive source	Ionising radiation, cancer causing	5.27 ; 6.5
15	Infrared dryer	Irritating or burning to the skin by infrared radiation	5.21
16	Laser	Burning, radiation	5.26 ; 5.27
Hazards generated by material and substances			
17	Chemical substances	Loss of health, injuries of the skin or eyes	5.25
18	Nonwoven, dryer, hydraulic oil	Fire	5.13 ; 5.21 ; 5.22 ; 5.28
Hazards generated by neglecting ergonomic principles			
19	Neglect of ergonomic principles, inadequate lighting of the workplace	Discomfort, fatigue, stress, overload, blinding, falling	5.5.6 ; 5.13 ; 5.19 ; 5.24 ; 5.28 ; 5.37

Table 1 (continued)

No.	Hazard		Relevant subclause in this document
	Origin (source)	Potential consequences	
Hazards caused by failure of energy supply, control system and other functional disorders			
20	Unexpected start-up	Crushing, shearing, impact, drawing-in or trapping	5.7 ; 5.9 ; 5.11 ; 5.13 ; 5.14 ; 5.15 ; 5.35
21	Malfunction in the control system	Crushing, shearing, impact, drawing-in or trapping, overturn, falling or ejection of objects	5.8 ; 5.9 ; 5.10 ; 5.12 ; 5.13 ; 5.16 ; 5.19 ; 5.29 ; 5.30.1 ; 5.33 ; 5.36.1 ; 6.1 ; 6.5
Combination of hazards			
22	Work in confined spaces	Asphyxiate, inhalation of chemical substances, crushing, shearing, impact, electric shock, stress	5.32 ; 5.35

5 General safety requirements and/or protective/risk reduction measures

5.1 General

This subclause contains safety requirements and/or protective/risk reduction measures to be taken in relation to significant hazards related to wetlaid-nonwoven machinery. Machinery shall comply with the general and specific safety requirements and/or protective/risk reduction measures of this document.

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 instructions handbook.

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

5.2 Safety requirements for the different “phases of life” of wetlaid-nonwoven machines

The safety requirements given in [Clauses 5](#) and [6](#) apply to the use and maintenance of the machine/machine sections. For other phases in the life of a machine, see [Clause 8](#).

5.3 Safety requirements for design/risk minimization

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

The technical guidelines on inherently safe design in accordance with ISO 12100:2010, 6.2, shall apply.

For risk minimization on wetlaid-nonwoven machines, the “strategy for risk assessment and risk reduction” cited in ISO 12100:2010, Clause 4, shall apply.

The target of risk reduction can be achieved by an elimination of hazards or by separate or simultaneous reduction of each of the two elements determining the risk involved:

- probability of occurrence of harm;
- the severity of that harm.

The “three-step procedure” described in ISO 12100:2010, 6.1, shall always be observed:

- Step 1: Inherently safe design measures;