
**Safety requirements for industrial laundry
machinery —**

Part 3:
Washing tunnel lines including component
machines

*Exigences de sécurité pour les machines de blanchisserie industrielle —
Partie 3: Trains de lavage incluant les machines composantes*



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International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet central@iso.ch
X.400 c=ch; a=400net; p=iso; o=isocs; s=central

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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.

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.

International Standard ISO 10472-3 was prepared by Technical Committee ISO/TC 72, *Textile machinery and machinery for dry-cleaning and industrial laundering*, Subcommittee SC 5, *Industrial laundry and dry-cleaning machinery*.

ISO 10472 consists of the following parts, under the general title *Safety requirements for industrial laundry machinery*:

- *Part 1: Common requirements*
- *Part 2: Washing machines and washer-extractors*
- *Part 3: Washing tunnel lines including component machines*
- *Part 4: Air dryers*
- *Part 5: Flatwork ironers, feeders and folders*
- *Part 6: Ironing and fusing presses*

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Introduction

This part of ISO 10472 is intended to instruct the designer of industrial laundry machinery in a systematic manner, focusing on his particular type of machine, regarding the relevant essential safety requirements, and to suggest possible state-of-the-art safety solutions.

The extent to which hazards are covered is indicated in the scope of this part of ISO 10472. In addition, machinery should comply as appropriate with ISO/TR 12100-1 and ISO/TR 12100-2 for hazards which are not specifically referred to in this part of ISO 10472.

All examples given in this part of ISO 10472 represent the state of the art. Equivalent solutions are acceptable, provided they attain at least the same safety level.

The designer is presumed to have taken into account all the provisions of ISO 10472-1 before considering this part of ISO 10472.

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Safety requirements for industrial laundry machinery —

Part 3:

Washing tunnel lines including component machines

1 Scope

This part of ISO 10472 covers, together with ISO 10472-1, most significant hazards associated with washing tunnel lines including component machines such as:

- continuous tunnel washing machines;
- squeeze presses or centrifugal extraction machines;
- transfer conveyor systems;
- automatic transfer tumblers;
- loading or unloading system interfaces;
- access platform and ladders.

This part of ISO 10472 does not cover particular hazards for continuous stand-alone washing lines for endless towels.

This part of ISO 10472 does not cover the hazards caused by processing work which may create an explosive or flammable atmosphere inside the machine.

This part of ISO 10472 complements the basic requirements laid down in ISO/TR 12100-1 and ISO/TR 12100-2. It also gives guidance to the designer on assessing the risks associated with the hazards (see EN 1050) and on selecting measures for attaining the required safety level.

This part of ISO 10472 does not apply to ancillary equipment, e. g. chemical store and supply pumps, steam valves and supply pipework, vent systems, work feed systems and discharge systems and ducting to the atmosphere.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 10472. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreement based on this part of ISO 10472 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6182-1:1993, *Fire protection — Automatic sprinkler systems — Part 1: Requirements and test methods for sprinklers.*

ISO 10472-1:1997, *Safety requirements for industrial laundry machinery — Part 1: Common requirements.*

ISO/TR 12100-1:1992, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology.*

ISO/TR 12100-2:1992, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles and specifications.*

ISO 13849-1:—¹⁾, *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 14119:—¹⁾, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection.*

EN 616:—¹⁾, *Continuous handling equipment and systems — Common safety requirements for design, manufacturing, erection and commissioning stages.*

EN 620:—¹⁾, *Continuous handling equipment and systems — Equipment for mechanical handling both unit loads and bulk materials — Special safety requirements for design, manufacturing, erection and commissioning stages.*

EN 746-2:1997, *Industrial thermoprocessing equipment — Part 2: Safety requirements for combustion and fuel handling systems.*

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

EN 1037:1995, *Safety of machinery — Prevention of unexpected start-up.*

EN 1050:1996, *Safety of machinery — Risk assessment.*

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

EN 1760-2:—¹⁾, *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 50100-1:—¹⁾, *Safety of machinery — Electro-sensitive protective devices — Part 1: General requirements and tests.*

EN 60204-1:1992, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements.* [IEC 204-1:1992, modified]

3 Definitions

For the purposes of this part of ISO 10472, the following definitions apply:

3.1

washing tunnel line

Complete integrated system of linked machines for the washing, moisture extraction and drying or disentangling of discrete batches of textile fabric, including all necessary equipment for supply of water, steam, gas, electricity and chemicals.

3.2

continuous tunnel washing machine

Machine designed to wash items in successive loads as a continuous process.

NOTE — This machine may consist of one cage rotating around a longitudinal axis and subdivided into separate compartments, or several cages or several machines linked by means of a transfer system.

¹⁾ To be published.

3.3

squeeze press

Machine for the mechanical extraction of moisture from textile fabrics by the application of pressure.

NOTE — It is designed to receive loads of textile material automatically from a tunnel washing machine and to remove moisture by applying pressure (e. g. by a flexible membrane). Such a machine may be arranged with one or two pressure stations where the pressure may be applied hydraulically, mechanically or pneumatically.

3.4

centrifugal extraction machine

Machine containing a perforated cage to and from which successive loads are transferred and within which the loads are subjected to a centrifugal force due to the rotation of the cage for the purpose of extracting moisture.

3.5

transfer conveyor system

Handling equipment for conveying loads from moisture extraction machines to tumble dryers to provide automatically controlled storage and handling between washing and drying processes.

3.6

automatic transfer tumble dryer

Machine for moisture extraction from a load of damp textile material by tumbling in a rotating cage in an atmosphere of hot air.

NOTE — It may be designed on the pass-through principle with automatic load and discharge doors at opposite ends, or the tilting principle with load and discharge at the same end.

3.7

loading or unloading system

Handling equipment employed to automatically feed loads to the tunnel washing machine, and transport loads from the tumble dryers to subsequent processes.

3.8

interface

Area where a load is transferred from the loading system into the tunnel washing machine or from the tumble dryer to the unloading system.

3.9

soiled hospital work

Work from hospital wards, nursing homes and operating theatres which may be fouled or contaminated but not infected.

4 Hazards

4.1 General

The hazards common to most industrial laundry machinery are listed in ISO 10472-1. Significant particular hazards found in washing tunnel lines including component machines are listed in 4.2 to 4.8.

4.2 Mechanical hazards

4.2.1 Interface between loading system and continuous tunnel washing machine:

— crushing, shearing, impact, drawing-in between loading system or load and entrance of washing machine;

— falling into the loading chute.

4.2.2 Continuous tunnel washing machine:

- drawing-in or trapping between the rotating cage or drive mechanism and the machine structure, in particular between rotating cage and support rollers;
- shearing between protruding items of the cage and the structure and trapping by the protruding items;
- trapping within the machine due to entry for the purpose of clearing tangled work.

4.2.3 Conveyors between washing machine and squeeze press or centrifugal extraction machine: drawing-in or trapping between conveyor belt and rollers or fixed elements of the conveyors.

4.2.4 Squeeze press: crushing and shearing between the ram, including membrane, and fixed elements of the squeeze press.

4.2.5 Centrifugal extraction machine:

- drawing-in by the rotating cage;
- crushing and shearing by tilting;
- impact by ejected parts of the load or cage caused by out-of-balance loading or overspeed.

4.2.6 Transfer conveyor system: crushing and shearing between the moving elements of the transfer conveyor system and fixed parts, including squeeze press, tumbler frame.

4.2.7 Automatic transfer tumbler: crushing and shearing between the tumble dryer doors and frame.

4.2.8 Interface between tumble dryer and unloading system: crushing and trapping between tumble dryer and unloading system.

4.3 Electrical hazards

See 10472-1:1997, 4.2

4.4 Thermal hazards

See ISO 10472-1:1997, 4.3

4.5 Hazards generated by noise

Noise emitted by tumble dryer fan and associated ducting, ducting within machine or a heat recovery and/or filtration system may cause a hazard.

See ISO 10472-1:1997, 4.4.

4.6 Hazards associated with materials and substances

4.6.1 Fire and explosion.

4.6.2 Biological hazards

4.6.2.1 Hazards due to soiled hospital work.

4.6.2.2 Hazards due to biological or chemical contamination of the public water supply arising from backflow from the machine.

4.7 Failure of control systems

Particular hazards: Requirement for an operator to enter the machine for the purpose of clearing a blockage.

4.8 Hazards associated with complex installations

Additional hazards may arise at the interfaces of the units when combined into a complex installation.

5 Safety requirements and/or measures for the hazards identified in clause 4

5.1 General

The designer shall consider the common safety requirements and measures described in ISO 10472-1 in addition to the particular hazards and measures described in this part of ISO 10472.

5.2 Mechanical hazards

5.2.1 Interface between loading system and continuous tunnel washing machine

The danger zone between the conveyor and the entrance of the washing machine, and between the load and this entrance shall be guarded (e. g. by fixed guards, see ISO 10472-1:1997, 5.1.2).

The plant shall be designed such that falling into the loading chute is prevented, for example, by fixed guards.

NOTE — These guards may be an integral component of the machine or provided by the user to comply with a typical design prepared by the machine manufacturer and described in the instruction handbook.

5.2.2 Continuous tunnel washing machine

Fixed guards shall be fitted to prevent access to the rotating cage, both at the sides and both ends (see ISO 10472-1:1997, 5.1.2). The dimensions given in ISO 13852:1996, table 2 shall apply. The guards may be arranged with doors or removable panels. If, by the opening of a door or a panel, a danger point becomes accessible, the door or panel shall be interlocked with the rotation of the machine, see ISO 14119. This shall not be required if nip or shear points behind the doors or panels are encased and protruding parts of the rotating cage are designed so that they cannot catch garments or persons.

The manufacturer shall state in the instruction handbook the correct procedure for clearing blockages and the safe procedure for entry to the machine. A warning sign shall be displayed drawing attention to the information given in the instruction handbook.

5.2.3 Conveyors between washing machine and squeeze press or centrifugal extraction machine

These conveyors shall be designed in accordance with EN 616 and EN 620.

5.2.4 Squeeze press

The squeeze press shall be fitted with fixed guards and access door(s) which shall be interlocked (see ISO 10472-1:1997, 5.1.2) with all moving parts. It shall be fitted with automatic means to secure any part that

may descend by gravity and create a hazard (e. g. during maintenance or fault clearing) in accordance with EN 1037:1995, 7.2. The manufacturer shall provide mechanical supports for these parts and instructions for their use.

The instruction handbook shall draw attention to the potential hazards of entry into the squeeze press (e.g. to clear collapsed loads). A warning sign drawing attention to the hazard shall be fixed on the machine.

5.2.5 Centrifugal extraction machine

The machine shall be fully encased, see ISO 10472-1:1997, 5.1.2, table 1. Any opening door providing access to the rotating cage and other danger points shall be interlocked with guard locking, see 5.7 and ISO 14119:—, clause 5.

The machine shall be fitted with means for detecting an out-of-balance condition of the loaded rotating cage. Such means shall be set to operate at an acceptable limit beyond which the rotational speed shall be reduced.

Sensing devices shall be fitted so that they cannot be invalidated by unauthorized persons. For example, a rigid bracket fitted to the drum having an elongated hole into which a sensor arm protrudes. The sensor switch shall be rigidly mounted to the machine frame. Any undue movement of the drum shall cause the switch contacts to close and reduce the rotational speed below a safe limit (see figure 1).

The manufacturer shall describe in the instruction handbook the method of testing the out-of-balance control system.

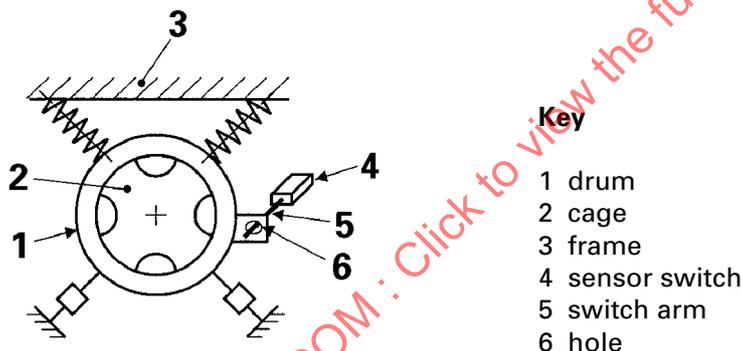


Figure 1 — Sensing device for out-of-balance condition

5.2.6 Transfer conveyor system

The conveyors within the system shall be guarded in accordance with EN 616 and EN 620. The complete system from moisture extraction to tumble dryers shall be enclosed by a fence provided with a door in accordance with ISO 10472-1:1997, annex A.

5.2.7 Automatic transfer tumble dryers

The crushing hazard associated with the doors shall be prevented by at least one of the following safety measures (see ISO 10472-1:1997, 5.1.2):

- limitation of closing force to less than 150 N and of the kinetic energy of the moving door to less than 10 J, and of pressure to less than 0,5 N/mm² until the closing gap is less than 8 mm (see EN 953:1997, 6.2.5); or
- an electrosensitive protective device in accordance with EN 50100-1 to monitor the closing gap; or
- a fixed guard system in accordance with EN 953:1997, 3.2; or

- a pressure-sensitive edge to the face of the machine (see EN 1760-2); or
- a pressure-sensitive mat or floor (see EN 1760-1).

5.2.8 Interface between tumble dryers and unloading system

For unloading where the cage rotation is initiated manually, reaching into the cage shall be prevented, e.g. by a hold-to-run control at a safe distance or a two-hand-control. See ISO 10472-1:1997, 5.1.2.

For unloading where cage rotation is initiated automatically, unintentional access to the danger zone shall be prevented, e. g. by a fixed guard or fence. See ISO 10472-1:1997, 5.1.2 and annex A.

5.3 Electrical hazards

The requirements of EN 60204-1 shall apply for all machines covered by this part of ISO 10472, see ISO 10472-1:1997, 5.2.

5.4 Thermal hazards

See ISO 10472-1:1997, 5.3 for hot surfaces.

5.5 Hazards generated by noise

See ISO 10472-1:1997, 5.4.

5.6 Hazards associated with materials and substances

5.6.1 Fire and explosion

The manufacturer shall state in the instruction handbook that continuous tunnel washing machines not specifically designed for work which may create an explosive atmosphere (inside the machine) shall not be used for this purpose.

For dryers, the instruction handbook shall include details concerning the operating procedure to prevent internal combustion of loads left in the machine, e. g. removal of load at end of cycle.

For large gas-fired tumble dryers with a net usable cage volume > 3 500 l, automatic sprinklers shall be fitted within the machine (see ISO 6182-1). Combustion systems for gas-fired tumble dryers shall be in accordance with EN 746-2 (see ISO 10472-1:1997, 5.5.2).

NOTE — This part of ISO 10472 does not give technical advice about protection against explosions.

5.6.2 Biological hazards

5.6.2.1 Soiled hospital work

Machines intended for soiled hospital work shall be designed in such a manner that:

- the relevant parts of the machine and work can be disinfected, e. g. by means of thermal, chemical or a combination of thermal and chemical methods; and
- the disinfected work and the rinsing water cannot be contaminated by work or water from contaminated compartments; and

- it is possible to disinfect the rinsing area separately from the rest of the machine; and
- the work cannot be transferred through the machine until disinfection of the work has been achieved.

The manufacturer shall state in the instruction handbook at least one verifiable method of disinfection which is adequate for use in the machine.

NOTE — National regulations may exist for disinfection cycles.

5.6.2.2 Contamination of the water supply

The manufacturer shall provide means to prevent back-syphonage of contaminated water to the main water supply and shall draw the user's attention to relevant local or national regulations for water supply.

5.7 Failure of control systems

See ISO 10472-1:1997, 5.7.2.

To prevent unexpected transfer through the washing machine, means shall be provided to prevent multiple loads entering the machine (e. g. fail-safe process control), and other potentially hazardous circumstances (e. g. failure of the water level control), as a result of failure of the control system.

For hazards caused by failure of the control system the category of the safety-related part of the control system (see ISO 13849-1:—, clause 6) shall not be lower than category 1 except for the interlocking fence guard (see 5.2.6) and the interlocking guard on the squeeze press or centrifuge (see 5.2.4 and 5.2.5) which shall not be lower than category 2. This shall provide for automatic test on start-up.

5.8 Hazards associated with complex installations

See ISO 10472-1:1997, 5.1.4.

6 Verification of safety requirements and/or measures

Verification shall follow the general requirements of ISO 10472-1 and the particular requirements of clause 5 of this part of ISO 10472. Table 1 gives a list of verifications.

Table 1 — List of verifications

Sub-clause	Subject	Reference	Test method
5.2.1	<u>Interface between loading system and continuous tunnel washing machine</u> Fixed guards	ISO 10472-1:1997, 5.1.2 Instruction handbook	Visual inspection, measurement Confirm accuracy and content
5.2.2	<u>Continuous tunnel washing machine</u> Fixed guards, doors or removable panels Interlocking system for doors or removable panels Enclosing guards behind doors or removable panels Protruding parts Clearing blockages and entry into machine	ISO 10472-1:1997, 5.1.2 ISO 13852:1996, table 2 ISO 14119 Instruction handbook Warning sign	Visual inspection Measurement Demonstration Visual inspection, measurement Visual inspection Confirm accuracy and content Visual inspection
5.2.3	Conveyors	EN 616, EN 620	
5.2.4	<u>Squeeze press</u> Fixed guards, interlocked access doors Falling parts (e. g. ram) Mechanical supports Entry into the squeeze press	ISO 10472-1:1997, 5.1.2 EN 1037 Instruction handbook Instruction handbook Warning sign	Visual inspection, measurement, demonstration Inspection Confirm accuracy and content Confirm accuracy and content Visual inspection
5.2.5	<u>Centrifugal extraction machine</u> Enclosing guards Interlocked doors with guard locking Device for detecting out-of-balance Test method	ISO 10472-1:1997, 5.1.2 ISO 14119 Instruction handbook	Visual inspection, measurement Demonstration with cage rotating Inspection and test Confirm accuracy and content

Table 1 (continued)

Sub-clause	Subject	Reference	Test method
5.2.6	<u>Transfer conveyor system</u> Guards for conveyor belts Fence	ISO 10472-1:1997, 5.2.3 ISO 10472-1:1997, annex A	
5.2.7	<u>Automatic transfer tumble dryers</u> Force, kinetic energy, closing pressure Electrosensitive protective device Fixed guard system Pressure-sensitive protective device	EN 50100-1 ISO 10472-1:1997, 5.1.2 EN 1760-1 EN 1760-2	Measurement Demonstration Demonstration
5.2.8	<u>Interface between tumbler and unloading system</u> Hold-to-run control, two-hand control Fixed guard, fence	ISO 10472-1:1997, 5.1.2 ISO 10472-1:1997, 5.1.2	
5.3	Electrical hazards	ISO 10472-1:1997, 5.2	
5.4	Hot surfaces	ISO 10472-1:1997, 5.3	
5.6.1	<u>Fire and explosion</u> Explosive atmosphere inside the machine Internal combustion of load Gas-fired tumble dryers Automatic sprinklers Combustion system for gas-fired tumbler	Instruction handbook Instruction handbook ISO 10472-1:1997, 5.5.2 ISO 6182-1 EN 746-2	Confirm accuracy and content Confirm accuracy and content Visual inspection