INTERNATIONAL STANDARD

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Safety requirements for industrial laundry machinery —

Part 4:
Air dryers

Exigences de sécurité pour les machines de blanchisserie industrielle —

Partie 4: Séchoirs à air

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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 10472-4 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*

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.

Safety requirements for industrial laundry machinery —

Part 4:
Air dryers

1 Scope

This part of ISO 10472 covers, together with ISO 10472-1, most significant hazards associated with air dryers, and in particular with tumble dryers having a net usable cage volume > 160 l and tunnel finishers including associated conveyors and cabinet dryers.

This part of ISO 10472 complements the basic requirements as 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.

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 13853:—[1)], *Safety of machinery — Safety distances to prevent danger zones being reached by the lower limbs.*

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

IEC 335-1:1991, *Safety of household and similar electrical appliances — Part 1: General requirements.*

1) To be published.

IEC 335-2-11:1993, *Safety of household and similar electrical appliances — Part 2: Particular requirements for tumbler dryers.*

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

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

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
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 produced by the tumble dryer.

NOTE — It may also be used to agitate the loads mechanically without hot air.

3.1.1
front-loaded tumble dryer
Tumble dryer in which the plane of the loading door is at a right angle to the axis of rotation of the cage.

3.1.2
pass-through tumble dryer
Tumble dryer having the loading and unloading doors on opposite sides.

3.1.3
tilting tumble dryer
Tumble dryer which tilts for loading and/or unloading.

3.1.4
automatic tilting tumble dryer
Tilting tumble dryer with the tilting motion to load and unload, and opening and closing doors, under automatic (not manual) control.

1) To be published.

3.2
tunnel finisher
Machine for the drying and finishing of shaped garments within which damp garments arranged on hangers are loaded onto an overhead conveyor for transport through the machine in an atmosphere of high humidity followed by an atmosphere of hot dry air produced by tunnel finisher.

3.3
cabinet dryer
Heated cabinet within which shaped garments are suspended on hangers for the purpose of drying, without being conveyed during the drying cycle.

4 Hazards

4.1 General

The hazards common to most industrial laundry machinery are listed in ISO 10472-1. Significant particular hazards found in air dryers are listed in 4.2 to 4.7.

4.2 Mechanical hazards

4.2.1 Tumble dryers

4.2.1.1 Rotating cage: entanglement within the rotating cage or between moving and fixed elements.

4.2.1.2 Power-operated doors: crushing and shearing between the tumble dryer doors and frame.

4.2.1.3 Tilting tumble dryers (in addition to the hazards described in 4.2.1.1 and 4.2.1.2):

— crushing and shearing between the dryer and fixed parts, including the structure of the building, and descent by gravity during maintenance;

— ejection of pressurized fluids;

— overturning of tilting machines.

4.2.2 Tunnel finishers: drawing-in or trapping between the screw conveyor and fixed elements.

4.3 Electrical hazards

See ISO 10472-1:1997, 4.2.

4.4 Thermal hazards

4.4.1 Hot surfaces around the loading door: burns.

4.4.2 Loading and unloading areas of the tunnel finisher: burns.

4.4.3 Steam spray in tunnel finisher: scalding.

4.5 Hazards generated by noise

Noise emitted by fan ducting of tumble dryers and tunnel finishers 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

4.6.1.1 Tumble dryers: fire hazards caused by tumble dryer load, explosion hazards caused by gas-fired equipment and explosion hazards caused by processing of textiles containing flammable vapour.

4.6.1.2 Tunnel finishers and cabinet dryers: fire hazards due to the exothermic effect of incomplete drying of some textiles, leading to spontaneous combustion.

4.6.2 Chemical hazards: aggressive chemicals (e.g. hypochlorite) may cause damage to the machine. Decomposition of chemicals (e. g. of certain dry-cleaning solvents) in direct gas-fired machines may create toxic fumes.

4.7 Failure of control systems

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/or 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 Tumble dryers

5.2.1.1 Rotating cage

In the case of machines having a net usable cage volume < 1 000 l and a cage stopping time under rated wet load condition < 6 s, interlocking the manually openable door is sufficient (see ISO 14119:—, 5.2.1). For all other machines interlocking with guardlocking is required, e.g. in combination with a time delay (see ISO 14119:—, 5.3).

To prevent spontaneous combustion of the load, in the case of failure of energy supply, the door shall be openable under all circumstances. For dryers with interlocked doors with guard locking, this shall also be possible, e.g. by means of a special tool.

NOTE — National regulations may require that the door be openable from the inside.

For loading or unloading the cage at standstill, no specific measures are required.

For loading or unloading if 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 loading or unloading if the cage rotation is initiated automatically, incidental 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.

The manufacturer shall state in the instruction handbook the correct procedure for cleaning blockages of work and the safe procedure for entry into the machine as follows:

— shut off the energy supply and lock the shut-off device;

— shut off other energy sources (steam, presssurized air, etc.) and lock the shut-off devices;

— install, if necessary, the means foreseen to prevent a movement by gravity;

— follow the instructions for specific procedures given by the manufacturer (method for clearing blockages and method for entry into the machine).

A warning sign shall be displayed drawing attention to the information given in the instruction handbook.

5.2.1.2 Power-operated doors

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

— limitation of closing force to 150 N and the kinetic energy of the moving door to 10 J and of pressure to 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, e.g. for a tumbler with a high entry and discharge position or discharging through a hole in the floor; or

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

5.2.1.3 Tilting tumble dryers

Tilting tumble dryers controlled by the operator shall be actuated by a hold-to-run control device located in a position where the operator can clearly see but cannot reach the danger zone. Alternatively a trip device (e.g. a pressure-sensitive protective device) shall be provided to cease the tilting function if an operator enters the danger zone (see ISO 10472-1:1997, 5.1.2 for the hold-to-run control and trip device).

For automatic tilting tumble dryers, the hazards of crushing, shearing and trapping between fixed and moving elements of the machine or building structure shall be prevented by fixed guards provided by the manufacturer (see ISO 10472-1:1997, 5.1.2). The danger zone created by door opening and cage rotation shall be rendered inaccessible during the period of machine movement and discharge.

This guarding may be a combination of fence guard and electrosensitive protective devices that will permit the placement of trolleys but monitors the danger zone during the danger period.

The design developed for each separate installation may be provided by the user; in this instance, however, the manufacturer shall include detailed design guidance in the instruction handbook.

The machine shall be fitted with means to secure any part that may descend by gravity and create a hazard during maintenance and fault clearing. The hydraulic equipment of tilting tumble dryers shall be in accordance with EN 982, and the pneumatic equipment with EN 983.

Tilting tumble dryers shall be so constructed that overturning is prevented, if possible by designing inbuilt stability, i.e. the basepoint of the centre of gravity shall lie within the polygon of support for all tilting positions.

The manufacturer shall take into account the mass of the maximum load in wet condition, the kinetic energy of tilting parts and the overturning moment created by the opened door. When foundation bolting is one of the measures taken to prevent overturning, the manufacturer shall specify in the instruction handbook the bolts and foundation requirements.

5.2.2 Tunnel finishers

Drawing-in or trapping of the operator's fingers between the screw conveyor and fixed elements shall be prevented by fixed guards (see ISO 10472-1:1997, 5.1.2).

5.3 Electrical hazards

For machines having a net usable cage volume of ≥ 350 l, the electrical design shall be in accordance with EN 60204-1 as defined in ISO 10472-1:1997, 5.2.

For machines having a net usable cage volume between 160 l and 350 l, the manufacturer shall decide if IEC 335-1 and IEC 335-2-11 apply, or if EN 60204-1 applies, see ISO 10472-1:1997, 5.2.

The manufacturer shall explain his decision in the instruction handbook.

5.4 Thermal hazards

5.4.1 Hot surfaces

For hot surfaces in general and particularly surfaces surrounding the loading or unloading doors, ISO 10472-1:1997, 5.3 applies.

Technical measures shall be applied to the door handle but need not be applied to the drum door, nor the viewing panel, nor the area of the machine face adjacent to the door.

5.4.2 Loading and unloading areas of the tunnel finisher

The machine shall be fitted with controls that reduce the emission of heat, when there are no garments being processed. The controls shall detect the absence of any garments within the machine, e.g. by a photoelectric protective device, and shut down the heat energy being supplied to the machine.

5.4.3 Steam spray in tunnel finishers

Fixed guards (see ISO 10472-1:1997, 5.1.2) with a slot of width ⩽ 180 mm (see ISO 13853:—, 4.2) shall be provided to prevent access to the interior of the machine; or pressure-sensitive mats or floors (see EN 1760-1) interlocked with the steam spray, conveyor drive and hot air fans shall be provided in front of the entrance and the exit to prevent the risk of burning when entering the tunnel. Restart shall be possible only by means of a reset control.

In addition, warning notices and/or graphical symbols shall be clearly displayed. The instruction handbook shall contain clear instructions that the operating machine shall not be entered.

5.5 Hazards generated by noise

See ISO 10472-1:1997, 5.4.

NOTE — The instruction handbook should contain details and examples of methods by which the user may reduce the noise of the fan ducting.

5.6 Hazards associated with materials and substances

5.6.1 Fire and explosion

5.6.1.1 Tumble dryers

The instruction handbook shall include details concerning the procedures to prevent spontaneous combustion of loads left in the machine, e. g. instructions for removal of load at the end of cycle as follows:

— to draw the user's attention to the potential risks of self-combustion of a load of work;

— to remove the load quickly after the completion of the cycle;

— to remove the load quickly in case of failure of power supply (see 5.2.1.1, second paragraph).

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

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

Combustion systems for gas- and oil-fired tumble dryers shall be in accordance with EN 746-2 (see ISO 10472-1:1997, 5.5.2). For machines with net usable cage volumes < 350 l, see the note in ISO 10472-1:1997, 5.5.2.

For large gas- and oil-fired tumble dryers with net usable cage volumes > 3 500 l, sprinklers shall be fitted within the machine (see ISO 6182-1).

To prevent very fast heat build-up in direct-heated machines, i.e. machines heated by gas or electricity without heat exchange, the heating shall be interlocked with the cage drive and air handling system such that the heat control is turned off when the cage rotation control or the air circulation control is turned off.

5.6.1.2 Tunnel finishers and cabinet dryers

The instruction handbook shall include a warning that work containing exothermic materials can cause fires in these machines.

The machines shall be fitted with heat detection devices linked to an audible signal to detect a potential fire. Gas-fired machines with an internal capacity greater than 200 garments shall be fitted with an integrated sprinkler system (see ISO 6182-1).

5.6.2 Chemicals

For tumble dryers, particularly those of the directly gas heated type, the instruction handbook shall include a warning regarding the possible presence of residual quantities of aggressive or decomposed chemicals in the load that may produce damage to the machine and harmful fumes (see EN 626-1).

5.7 Failure of control systems

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 system controlling the entrance and exit of the tunnel finisher, which shall not be lower than category 2.

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
5.2.1.1	Rotating cage		
	Interlocked door	ISO 14119	Demonstration
	Stopping time		Measurement
	Interlocked door with guard-locking	ISO 14119	Demonstration
	Opening the door in the event of power failure		Demonstration
	Unloading with doors open and cage rotating	ISO 10472-1:1997, 5.1.2	Demonstration
	Clearing blockages, entry into machine	Instruction handbook	Confirm accuracy and content
5.2.1.2	Power-operated doors		
	Force, pressure, kinetic energy		Measurement
	Electrosensitive protective device	EN 50100-1	Demonstration
	Fixed guard	EN 953	Visual inspection
	Pressure sensitive protective device	EN 1760-1 EN 1760-2	Visual inspection, test function Visual inspection, test function
5.2.1.3	Tilting tumble dryers		
	Manually controlled tilting:		
	- hold-to-run control, trip device	ISO 10472-1:1997, 5.1.2	Test function
	Automatic tilting:		
	- fixed guards, fence guard	ISO 10472-1:1997, 5.1.2	
	Descent by gravity		Test function
	Electrosensitive protective device	EN 50100-1	Demonstration
	Hydraulic system	EN 982	
	Pneumatic system	EN 983	
	Overturning		Demonstration
	Bolting	Instruction handbook	Confirm accuracy and content

Table 1 *(continued)*

Sub-clause	Subject	Reference	Test method
5.2.2	Tunnel finisher		
	Fixed guards	ISO 10472-1:1997, 5.1.2	Visual inspection, Measurement
5.3	Electrical hazards		
	Machine of capacity ≥350 l	ISO 10472-1:1997, 5.2 EN 60204-1:1992, clause 20	
	Machine of capacity 160 l to 350 l	IEC 335-1 IEC 335-2	
	Decision	Instruction handbook	Confirm accuracy and content
5.4.1	Hot surfaces		
	Surface temperature	ISO 10472-1:1997, 5.3	Measurement after not less than 1 h
5.4.2	Loading and unloading areas of the tunnel finisher		
	Control to reduce heat emission		Demonstration
5.4.3	Steam spray in tunnel finishers		
	Fixed guards	ISO 10472-1:1997, 5.1.2	
	Slot width < 180 mm		Measurement
	Pressure-sensitive mat or floor:	EN 1760-1	Demonstration
	- interlock with steam spray, conveyor drive and hot air fan		Demonstration
	- restart control		Demonstration
	Entering the machine:		
	- warning sign		Visual inspection
	- instructions not to enter	Instruction handbook	Confirm accuracy and content
5.5	Noise reduction measures	Instruction handbook	Confirm accuracy and content

Table 1 *(concluded)*

Sub-clause	Subject	Reference	Test method
5.6.1.1	Tumble dryers		
	Internal combustion	Instruction handbook	Confirm accuracy and content
	Explosion caused by potentially explosive load	Instruction handbook	Confirm accuracy and content
	Gas- and oil-fired tumble dryers	EN 746-2	
	Sprinklers	ISO 6182-1	Visual inspection
	Interlocking device for direct-heated tumble dryers	ISO 14119	Demonstration
5.6.1.2	Tunnel finishers and cabinet dryers		
	Warning against fire	Instruction handbook	Confirm accuracy and content
	Detection device linked to audible signal		Demonstration
	Integrated sprinklers	ISO 6182-1	Visual inspection
5.6.2	Chemicals, residues in the work	Instruction handbook	Confirm accuracy and content
5.7	Failure of control system, category	ISO 13849-1:—, clause 6	Check manufacturer's technical files
7.1	Instruction handbook	ISO 10472-1:1997, 7.1	Check completeness
7.2	Warning signs	ISO 10472-1:1997, 7.2	Visual inspection

7 Information concerning machine use

7.1 Instruction handbook

All information called for in ISO 10472-1:1997, 7.1 shall be provided. Furthermore, the manufacturer shall provide in the instruction handbook detailed information as required in clause 5 of this part of ISO 10472 on:

5.2.1.1, clearing blockages, entry into machine;
5.2.1.3, tilting tumble dryers - installation of foundation bolts;
5.3, decision if IEC 335 or EN 60204-1 applies;
5.4.3, instruction about entry;
5.5, noise reduction;
5.6.1.1, combustion of loads - potentially explosive loads;
5.6.1.2, exothermic loads;
5.6.2, aggressive chemicals.

7.2 Warning signs

The manufacturer shall provide machine marking in accordance with ISO 10472-1:1997, 7.2 and, in addition marking required in clause 5 of this part of ISO 10472 on:

5.4.3, warning against entry.

ICS 97.060

Descriptors: laundries, industrial facilities, textile machinery, laundering machines, dryers, hazards, accident prevention, safety of machines, specifications, safety requirements, safety measures, verification, marking, instructions, instructions for use.

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