INTERNATIONAL STANDARD

ISO 10472-2

First edition
1997-12-15

Safety requirements for industrial laundry machinery —

Part 2:
Washing machines and washer-extractors

Exigences de sécurité pour les machines de blanchisserie industrielle —
Partie 2: Machines à laver et laveuses-essoreuses

Contents

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Printed in Switzerland

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 10472-2 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 2:
Washing machines and washer-extractors

1 Scope

This part of ISO 10472 covers, together with ISO 10472-1, most significant hazards associated with washing machines and washer-extractors of all configurations having a net usable cage volume > 60 l.

This part of ISO 10472 does not cover particular hazards for drawer-type washer-extractors.

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 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, e.g. chemical supply pumps, steam valves and supply pipe work, 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 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 13853:—[1)], *Safety of machinery — Safety distances to prevent danger zones being reached by the lower limbs.*

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1) To be published.

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.*

IEC 335-2-7:1993, *Safety of household and similar electrical appliances — Part 2: Particular requirements for washing machines.*

EN 349:1993, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body.*

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 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 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 machine
Machine performing only those operations required for washing textiles.

3.2
washer-extractor
Machine which combines the functions of textile washing and moisture extraction by centrifugal action.

3.2.1
fixed washer-extractor
Washer-extractor in which the drum is rigidly mounted in the frame.

3.2.2
suspended washer-extractor
Washer-extractor in which the drum is not rigidly connected to the frame but is secured by means of a vibration-reducing system.

3.2.3
tilting washer-extractor
Fixed or suspended washer-extractor in which the drum tilts during loading and/or unloading.

[1] To be published.

3.2.4
drawer-type washer-extractor
Fixed or suspended washer-extractor in which two halfcages slide horizontally out from the frame, in the low position for loading and the high position for unloading.

3.2.5
top-loading, vertical axis washer-extractor
Washer-extractor in which the plane of the loading door is at a right angle to the vertical axis of the rotation of the cage.

3.3
front-loading machine
Washing machine or washer-extractor in which the plane of the loading door is at a right angle to the horizontal axis of rotation of the cage.

3.4
side-loading machine
Washing machine or washer-extractor in which the plane of the loading door is parallel to the horizontal axis of rotation of the cage.

3.5
barrier machine
Washing machine or washer-extractor without direct contact between the loading and unloading positions (e.g. separated by a wall).

3.6
aseptic machine
Washing machine or washer-extractor used for processing infected work.

3.7
infected work
Work which has been in contact with persons suffering or suspected of suffering from infectious diseases.

3.8
cage (basket)
Rotating container within which the work is held during the washing process.

NOTE — Generally the cage is fabricated from perforated stainless steel and supported on rigidly or flexibly mounted bearings. The cage can be either undivided (open-pocket machines) or divided into two or more compartments (multi-pocket machines).

3.9
drum
Container within which the cage operates, generally having the access door as an integral component.

3.10
***G*-factor**
Dimensionless quotient of the centrifugal acceleration at the outer cage diameter and the gravitational acceleration, obtained by the formula:

$$G = 5{,}6 \cdot \left[\frac{n}{1000}\right]^2 \cdot d$$

where n is the rotational frequency, in reciprocal minutes;

d is the cage diameter, in centimetres.

4 Hazards

4.1 General

The hazards common to most industrial laundry machinery are listed in ISO 10472-1. Significant particular hazards found in washers and washer-extractors are listed in 4.2 to 4.11.

4.2 Mechanical hazards

4.2.1 Rotating cage: crushing, shearing, entanglement, drawing-in and trapping.

4.2.2 Manual drum doors: crushing and trapping by falling door.

4.2.3 Doors (cage and drum): drawing-in, trapping, crushing and shearing caused by intended or unintended rotation of the cage during loading or unloading, e.g. while positioning the cage.

4.2.4 Cage doors: crushing, shearing, impact due to incorrectly secured cage door leading to ejection of machine parts.

4.2.5 Power-operated drum doors: crushing, shearing (closing), impact (opening).

4.2.6 Loss of stability (due to out-of-balance): impact.

4.2.7 Suspended washer-extractors: crushing between the suspended drum or attached components and fixed elements of the machine, such as the frame.

4.2.8 Falling load and loading devices: impact, crushing.

4.3 Electrical hazards

See ISO 10472-1:1997, 4.2

4.4 Thermal hazards

4.4.1 Hot liquor: scalding from spillage and splashing.

4.4.2 Hot surfaces around the loading and unloading door(s): burns.

4.4.3 Heat energy: burns and scalding from unintended supply with open door or insufficient water level.

4.4.4 Viewing panels: scalding from hot liquor due to broken panels.

4.5 Hazards generated by noise

The extraction cycle may create a noise hazard.

4.6 Hazards associated with materials and substances

4.6.1 Aggressive chemical action: harmful malfunction of the machine.

4.6.2 Fire and explosion

4.6.2.1 Explosive vapour contained in the load: burns.

4.6.2.2 Gas- and oil-fired heating: burns.

4.6.3 Biological hazards

4.6.3.1 Contact with infected work.

4.6.3.2 Biological or chemical contamination of the public water supply arising from back-flow from the machine.

4.7 Hazards due to neglect of ergonomic principles in machine design

Unhealthy posture due to inadequate height of the loading door of washing machines and of the hopper for adding chemicals; excessive effort when unloading the washer-extractors.

4.8 Hazards caused by failure of energy supply and control systems

Mechanical hazard occurring if the operator reaches the cage during run down or enters the danger zone during tilting (e.g. for maintenance).

4.8.1 Failure of energy supply.

4.8.2 Failure of control systems.

4.9 Hazards caused by unexpected ejection of machine parts

For instance, overspeed of power transmission.

4.10 Particular hazards associated with barrier machines

Entanglement, drawing-in and trapping by the cage or shearing or crushing by the closing power-operated door due to required interaction of two operators, one on each side of a wall.

Contamination, when used as an aseptic machine (see 4.6.3.1).

4.11 Particular hazards associated with tilting machines

4.11.1 **Tilting controlled manually**: crushing and shearing between the tilting machine and fixed elements.

4.11.2 **Automatic tilting (unexpected start-up)**: crushing and shearing between the tilting machine and fixed elements.

4.11.3 **Loading and unloading:** entanglement.

4.11.4 **Overturning**: crushing.

4.11.5 **Maintenance**: drawing-in or trapping.

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 Rotating cage

The drum doors of horizontal and vertical axis washer-extractors shall prevent access to the rotating cage and shall be interlocked with guard locking (see ISO 10472-1:1997, 5.1.2). This interlock shall be arranged so that door opening is prevented while the cage is rotating. This guard locking device may include, for example, time-delay shut-off to drive-motor, power released spring loaded mechanical brake or motion sensors.

The instruction handbook shall contain details of the testing and maintenance of the braking if used in conjunction with a time-delay.

Hoppers for the manual addition of washing chemicals shall be fitted with means to prevent access to the rotating cage. Such means shall be in accordance with ISO 13852:1996, table 4 (e.g. safety bars at the base of the hopper and a fixed guard in the form of a weir allowing fluid flow but not access).

5.2.2 Manual drum doors

Upward opening doors shall be fitted with a device (e.g. a catch or damping cylinders) to prevent accidental falling back of the door which could generate crushing or trapping hazards. The device shall operate even in case of power failure.

This does not apply to top-loaded vertical axis washer-extractors where the light-weight door (less than 2 kg) opens over the centre.

5.2.3 Doors (cage and drum)

It shall not be possible to position the cage of multi-pocket or of side-loading machines using power when any drum door is open. This requirement does not apply if the machine is automatically loaded or unloaded and access to the danger zone is completely prevented.

For multi-pocket machines where rotation by gravity may create a hazard, measures shall be taken to prevent this rotation while the cage and drum doors are open (e.g. mechanical brake, adequate to support the static out-of-balance load in the maximum load case).

5.2.4 Cage doors

Measures shall be taken to prevent cage doors opening after the drum door has been closed and the machine started.

Such measures may include, for example:

— ensuring adequate machine rigidity to prevent component flexing;

— providing a mechanical trapped-key system that cannot be removed from the cage door until the locking mechanism is correctly engaged.

The instruction handbook shall include detailed advice concerning the inspection and maintenance of the cage door locking means.

5.2.5 Power-operated drum doors

5.2.5.1 Door closing

The hazard due to the automatic closing of doors shall be prevented by one of the following means:

a) where practical, by limitation of force to less than 150 N, and kinetic energy at any door position to less than 10 J and pressure less than 0,5 N/mm², until the gap is less than 8 mm (see EN 953:1997, 6.2.5);

or

b) access prevention by guards (see ISO 10472-1:1997, 5.1.2) such as:

— fences according to ISO 10472-1:1997, annex A;

— casings or covers;

or

c) stopping the door movement by safety devices (see ISO 10472-1:1997, 5.1.2) which are effective only during the closing process of the door, e.g.

— electrosensitive protective devices;

— pressure-sensitive mats or floors (see EN 1760-1);

— trip bars taking into account the stopping time (see EN 1760-2);

or

d) by providing a hold-to-run control (see ISO/TR 12100-1:1992, 3.23.3) for door closing. Such a control shall be located so that the operator has a clear view of the danger zone but cannot reach it.

5.2.5.2 Door opening

If an operator can enter the danger zone and if the maximum velocity of any element of the door on opening is greater than 0,3 m/s, then the instruction handbook shall give information on design and installation of a barrier to prevent impact hazard. The barrier shall not create a new hazard.

As an alternative, the manufacturer may provide a hold-to-run control (see ISO/TR 12100-1:1992, 3.23.3) for door opening. Such a control shall be located so that the operator has a clear view of the danger zone but cannot reach it.

5.2.6 Loss of stability

Fixed washer-extractors with a *G*-factor greater than 150 and all suspended washer-extractors 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 (e.g. to washing speed).

Sensing devices shall be fitted so that they cannot be invalidated by unauthorized persons.

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

EXAMPLE

A rigid bracket fitted to the drum having an elongated hole into which a sensor switch arm protrudes. The sensor switch is rigidly mounted to the machine frame. Any undue movement of the drum will cause the switch contacts to close and reduce the rotational speed to a safe limit (see figure 1).