INTERNATIONAL STANDARD

ISO 8230

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Safety requirements for dry-cleaning machines using perchloroethylene

Exigences de sécurité pour les machines de nettoyage à sec utilisant du perchloroéthylène

Contents

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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 8230 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.*

Annex A of this International Standard is for information only.

Introduction

This International Standard is intended to instruct the designer of dry-cleaning machinery in a systematic manner regarding the relevant essential safety requirements and to suggest possible solutions representing the state of the art with respect to safety.

The extent to which hazards are covered is indicated in the scope of this International Standard. The manufacturer's attention is drawn to the fact that machinery should comply as appropriate with ISO/TR 12100-1 and ISO/TR 12100-2 for hazards which are not covered by this International Standard.

Safety requirements for dry-cleaning machines using perchloroethylene

1 Scope

This International Standard is applicable to closed-circuit dry-cleaning machines of all sizes intended for industrial use (including retail shop operation) for the cleaning of articles made of textile, leather, furs and skins, using perchloroethylene[1)] (commonly shortened to perc) only as liquid solvent.

This International Standard is not applicable to:

— machines placed at the disposal of the general public (e.g. self-service);
— open-circuit dry-cleaning machines using perc and working below atmospheric pressure;
— barrier machines;
— ironing presses (see ISO 10472-1 and ISO 10472-6);
— machines with automatic doors;
— ancillary equipment, e.g. room evacuation equipment, waste recuperation systems of the still, external water cooling systems or complementary systems for perc recovery from the oil in the still.

This International Standard identifies all significant hazards arising from the use of the machine with special emphasis on solvent hazards, where "use of the machine" comprises both intended use and foreseeable abnormal situations. No specific technical advice is given for hazards (apart from the use of the machines) arising during construction, transport and commissioning, decommissioning, dismantling and disposal of the machines.

This International Standard applies primarily to machines manufactured after the date of issue of this standard.

It does not give specific technical advice about:

— pneumatic systems;
— noise;
— hazards caused by processing work which may create an explosive atmosphere (e.g. printers' wipers containing a low-flash solvent);
— machines processing loads which may contain "foreign solvents" which could lead to a change in a property (characteristic) of the cleaning solvent perc, e.g. cause foaming or make it carcinogenic;
— hazards caused by neglect of ergonomic principles;
— measures dealing with the containment of pressure in the machine.

The guidance contained in this International Standard is based on the presumption that the designer has completed a risk analysis of the machine under consideration, see EN 1050. This will enable him to identify and fulfill the significant requirements for his machine as stipulated by this International Standard.

Where for clarity an example of a safety measure is given in the text, this should not be considered as the only possible solution. Any other solution leading to the same risk reduction is permissible if an equivalent level of safety is achieved, evidence of which should be given in the manufacturer's documentation.

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1) IUPAC name tetrachloroethene, chemical formula $Cl_2C = CCl_2$

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard 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 5232:—[2], *Graphical symbols for textile machinery.*

ISO 6178:1983, *Centrifuges — Construction and safety rules — Method for the calculation of the tangential stress in the shell of a cylindrical centrifuge rotor.*

ISO 8232:1988, *Closed-circuit dry-cleaning machines — Defining and checking of machine characteristics.*

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

ISO 10472-6:1997, *Safety requirements for industrial laundry machinery — Part 6: Ironing and fusing presses.*

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

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:—[3], *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design.*

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

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

ISO 13853:—[3], *Safety of machinery — Safety distances to prevent danger zones being reached by the lower limbs.*

ISO 14119:—[3], *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection.*

EN 614-1:1995, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles.*

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

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

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

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

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

2) To be published. (Revision of ISO 5232:1988)
3) To be published.

3 Definitions

For the purposes of this International Standard, the following definitions apply :

3.1
dry-cleaning machine
Machine in which articles made of textile, leather, fur and skins are cleaned using perc only as solvent.

3.1.1
open-circuit dry-cleaning machine
Dry-cleaning machine in which deodorisation takes place by an intake of fresh air and evacuation of any perc/air mixture out of the machine, prior to the opening of the loading/unloading door.

3.1.2
closed-circuit dry-cleaning machine
Dry-cleaning machine which complies with ISO 8232, in which deodorization is carried out without any contact between the air in the drum and the air in the workroom.

3.1.3
barrier dry-cleaning machine
Dry-cleaning machine designed in such a way that, for reasons of hygiene, direct or indirect contact between clean articles and dirty articles is avoided by a partition.

NOTE — This is the case in particular with machines with two doors (one front door and one side door) in which loading and unloading are carried out on opposite sides of this partition.

3.2
drum
Enclosure or container in which the cage rotates.

3.3
***G*-factor**
Dimensionless quotient of the centrifugal acceleration at the outer cage diameter and the gravitational acceleration, obtained by the formula:

$$G = 5{,}6 \cdot \left[\frac{n}{1\,000}\right]^2 \cdot d$$

where

n is the rotational frequency, in reciprocal minutes;
d is the cage diameter, in centimetres.

3.4
cage
Rotating perforated cylinder, totally enclosed by the drum, in which the load to be cleaned is placed.

NOTE — The capacity of the cage is defined in ISO 8232.

3.5
drying system
All parts of the dry-cleaning machine comprising the circuit through which a current of air flows which is heated and cooled in fixed sequences in order to recover the perc contained in the articles at the end of cleaning.

3.6
deodorization
Reduction of perc concentration in the treated goods and in the air of the cage after the drying phase.

3.7
drying condenser
Component of the drying system which cools a current of air and condenses perc vapour and water vapour contained in that air.

3.8
still condenser
Component of the distillation circuit which condenses and cools perc vapour and water vapour after vaporization.

3.9
water separator
Component of the dry-cleaning machine which separates the mixture from the condenser into a layer of water and a layer of perc.

NOTE - The water layer contains a low concentration of dissolved perc because this is slightly soluble in water.

3.10
still
Component of the dry-cleaning machine which heats and evaporates solvent and water from dirty solvent, leaving the dirt in the still.

3.11
tank
Container of the dry-cleaning machine, to store used perc for the cleaning process, designed to withstand the stress to which it is subjected and the chemical effects of perc.

3.12
lint filter
Mechanical device for removing lint and particles from the air during the drying phase.

3.13
solvent filter
Mechanical device for removing particles from the liquid perc during the washing phase.

3.14
button trap filter
Mechanical device for protecting the solvent pumps from solid objects during the washing phase.

4 Hazards

This International Standard concerns primarily solvent hazards (perc emission to the workroom). Other hazards are mentioned with appropriate references, as an aid to the designer.

4.1 Hazards associated with the use of dry-cleaning machines

4.1.1 Mechanical hazards

4.1.11 Moving drive components: shearing, entanglement or trapping.

4.1.1.2 Rotating cage: shearing, entanglement or trapping.

4.1.1.3 Ejection of machine parts: impact.

4.1.2 Electrical hazards

4.1.3 Hazards caused by failure of services (heating, power, compressed air, coolant)

4.1.4 Thermal hazards

4.1.4.1 Hot surfaces: burns.

4.1.4.2 Steam-heated surfaces: burns.

4.1.4.3 Components using thermal fluid at atmospheric pressure: burns.

4.1.4.4 Components using pressurized fluid: burns.

4.1.5 Hazards generated by noise

4.1.6 Hazards generated by machine vibration: machine breakdown and/or machine movement, impact

4.1.7 Hazards generated by perc

The following hazards can lead to inhalation of unhealthy vapour and perc contact with skin (including feet) and eyes by the machine operator, other personnel and members of the public on the premises, as well as contamination of water and ground.

4.1.7.1 Perc emission when the loading/unloading door is opened.

4.1.7.2 Evaporation of perc outside the machine from work which has not been dried sufficiently.

4.1.7.3 Perc emission to the workroom, seepage into the ground and the sewer during operation and maintenance of the water separator.

4.1.7.4 Perc emission from rotating joints, door hatch seals and flexible tubes.

4.1.7.5 Perc emission resulting from cleaning of the lint filter.

4.1.7.6 Perc emission resulting from cleaning of the button trap.

4.1.7.7 Perc emission resulting from cleaning and maintenance of the solvent filter.

4.1.7.8 Perc emission resulting from operation, cleaning and maintenance of the distilling installation.

4.1.7.9 Perc emission when filling or topping-up tanks.

4.1.7.10 Perc emission resulting from faulty operation.

4.1.7.11 Perc emission resulting from cooling failure in the drying system.

4.1.7.12 Spillage of perc from machine, giving free flow across the floor.

4.1.7.13 Thermal breakdown of perc into toxic products.

4.1.8 Hazards due to neglect of ergonomic principles in machine design

4.2 Hazards associated with phases of "life" of a machine other than use

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

5.1 Hazards associated with the use of dry-cleaning machines

5.1.1 Mechanical hazards

Guards shall comply with table 1.

Table 1 — Safety requirements and /or measures for guards

Application	Reference
Guard selection	ISO/TR 12100-2:1992, 4.1 EN 953:1997, clause 5
Guard design and construction	ISO/TR 12100-2:1992, 4.2 EN 953:1997, clauses 6 and 7
Guard fastening	EN 953:1997, 5.4, 7.2 and 7.3
Guard arrangement	ISO 13852:1996, tables 1 and 4 ISO 13853
Guard interlocking	ISO 14119:—, clause 5

5.1.1. Moving drive components

Access to the drive shall be prevented by the body of the machine and/or guards. Guards shall comply with table 1.

5.1.1.2 Rotating cage

Access to the cage shall only be possible at standstill through the door(s).

The door(s) shall be fitted with an interlocking device with guard locking in accordance with ISO 14119:—, clause 5, e.g. in combination with a motion sensor or time delay, so that it is not possible to open the door until motion has stopped.

The category of the control system for this function shall be 3 or 4 in accordance with ISO 13849-1:—, clause 6.

5.1.1.3 Ejection of machine parts

Means of preventing hazards resulting from the rupture of components and/or projection of fragments under the effect of rapid rotation shall be integrated in the machine design as follows:

— the assembly, particularly shafts and bearings, shall be capable of withstanding the maximum force to which it can be subjected in use under the conditions stated by the manufacturer in the instruction handbook and take into account the foreseeable effects of fatigue, corrosion and ageing;

— for dry-cleaning machines with a *G*-factor greater than 100, the tangential stress on the shell of the cage shall be calculated in accordance with ISO 6178.

5.1.2 Electrical hazards

The safety requirements of EN 60204-1:1992, option 1, shall apply as described in table 2.

Table 2 — Safety requirements and/or measures for electrical equipment of machines

Safety requirements and/or measures concerning:	See EN 60204-1:1992, clause:
Electric shock	4, 6, 7, 8, 15, 16 and 18
Overcurrent, overspeed and overload	7 and 8
Environmental influences	4, 13 and 16
Electromagnetic compatibility	4, 8 and 9
Restart after voltage drop or supply interruption	7.5
Accessibility, layout and identification of control equipment	10, 13 and 18
Ergonomics for manual operation	10 and 13
Cabling and wiring	14 and 15
Accessories and lighting	17
Documentation and instruction handbook	19
Machine testing	20
Degree of protection	13.3

Safety-related parts of the control system shall conform to category 1, see ISO 13849-1:—, clause 6, unless otherwise specified for specific safety functions.

An emergency stop device shall be provided which complies with the specific requirements of ISO 13850. The emergency stop device shall cause all machine functions to cease except the provision of cooling.

The general shut-down of the machine shall be lockable in accordance with EN 1037.

5.1.3 Failure of services

In the event of failure of one or more services (heating, power, compressed air or coolant), the machine shall go automatically to a safe condition, i.e.:

— the door shall remain locked in the closed position; it shall be openable by means of a tool;

— all valves presenting a risk of perc leakage outside the machine shall automatically return to a safe position;

— in case of intentional or unintentional stop during the cycle, the choice of operating sequence for restarting shall be the result of manual intervention on the part of the operator;

— the cooling water flow shall be monitored so that if cooling water flow or pressure is not maintained then the machine will automatically shut down, see 5.1.7.8 h) and 5.1.7.11.

The pneumatic system shall conform to EN 983:1996, clause 5.

5.1.4 Thermal hazards

5.1.4.1 Hot surfaces

The risk of burns from contact with hot surfaces shall be eliminated by keeping surface temperatures below the following values:

— uncoated metal	70 °C
— coated metal (e.g. paint thickness 60 μm)	80 °C
— glass	85 °C

Where this is not possible, the surfaces shall be guarded, shielded or insulated.

Where, for technical reasons, total protection cannot be provided by design (e.g. still sight-glass), a warning shall be given on the machine and information shall be given in the instruction handbook concerning instruction and training of operators and the use of personal protective equipment.

5.1.4.2 Steam-heated surfaces

The manufacturer shall give technical information in the instruction handbook about an isolating valve to shut off the steam supply. Steam pipes shall be insulated.

5.1.4.3 Systems using thermal fluid at atmospheric pressure

In order to avoid an excessive fluid temperature, this shall be controlled by a thermostatic heating regulator acting directly on the power control of the heater.

The maximum temperature given by the adjustment range of the thermostat shall be below the maximum operating temperature of the thermal fluid recommended by the thermal fluid manufacturer. The temperature of the thermal fluid shall be measured independently to control the correct running of the thermostat, and alarm shall be given below the limit of the operating temperature due to thermostat fault. The instruction handbook shall contain information on appropriate actions.

An expansion vessel or an expansion volume shall be fitted on the heating chamber or the heating chamber shall be large enough to accommodate, without overflow, the increase in the volume of thermal fluid associated with the maximum temperature setting of the thermostat. The vessel shall permit the level of thermal fluid at the regulator temperature to be checked, e.g. by direct reading.

Valves for controlling the thermal fluid shall be closed while the machine is at standstill, e.g. by using automatic valves of the normally closed type.

Advice shall be given in the instruction handbook for periodic cleaning of the venting pipe, e.g. once per year to avoid an eventual blockage.

5.1.4.4 Systems using pressurized fluids

Flexible components or components made of fragile material (e.g. glass) and containing hot pressurized fluids (steam, water or oil) shall be designed to prevent direct spraying in the event of leakage or rupture or shall be shielded.

5.1.5 Hazards generated by noise

This International Standard does not contain specific measures concerning noise reduction. At an early stage of design, consideration should be given to the possible noise hazard likely to arise. The selection of appropriate measures should be based on the latest state of technology (ISO/TR 11688-1).