INTERNATIONAL STANDARD

ISO 23953-2

First edition
2005-10-15

Refrigerated display cabinets —

Part 2: Classification, requirements and test conditions

Meubles frigorifiques de vente —
Partie 2: Classification, exigences et méthodes d'essai

Reference number
ISO 23953-2:2005(E)

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Published in Switzerland

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 23953-2 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 44, *Household refrigerating appliances and commercial refrigeration equipment*, in collaboration with Technical Committee ISO/TC 86, *Refrigeration and air-conditioning*, Subcommittee SC 7, *Testing and rating of commercial refrigerated display cabinets*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition of ISO 23953-2, together with the first edition of ISO 23953-1, cancels and replaces ISO 1992-1:1974, ISO 1992-4:1974, ISO 1992-5:1974, ISO 1992-6:1974, ISO 5160-1:1979 and ISO 5160-2:1980, of which it constitutes a technical revision.

ISO 23953 consists of the following parts, under the general title *Refrigerated display cabinets*:

— *Part 1: Vocabulary*

— *Part 2: Classification, requirements and test conditions*

Refrigerated display cabinets —

Part 2:
Classification, requirements and test conditions

1 Scope

This part of ISO 23953 specifies requirements for the construction, characteristics and performance of refrigerated display cabinets used in the sale and display of foodstuffs. It specifies test conditions and methods for checking that the requirements have been satisfied, as well as classification of the cabinets, their marking and the list of their characteristics to be declared by the manufacturer. It is not applicable to refrigerated vending machines or cabinets intended for use in catering or similar non-retail applications; nor does it cover the choice of the types of foodstuffs chosen to be displayed in the cabinets.

2 Normative references

The following referenced documents are indispensable for the application 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 817, *Refrigerants — Designation system*

ISO 9050, *Glass in building — Determination of light transmittance, solar direct transmittance, total solar energy transmittance and ultraviolet transmittance, and related glazing factors*

ISO 23953-1:2005, *Refrigerated display cabinets — Part 1: Vocabulary*

IEC 60335-2:89, *Safety of household and similar electrical appliance — Part 2: Particular requirements for commercial refrigerating appliances with an incorporated or remote refrigerant condensing unit*

EN 378-2, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 2: Design, construction, testing, marking and documentation*

EN 60335-1, *Safety of household and similar electrical appliances — Part 1: General requirements*

3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms and definitions given in ISO 23953-1 and the following symbols and abbreviated terms apply.

3.1 General

t_{run} running time — time during which compressor is running (or solenoid valve is open) or secondary refrigerant is circulating (or solenoid valve is open), within 24 h

t_{run75} 75 % of the running time between defrosts, excluding the time just after defrost, 0,75 t_{run}

t_{stop} stopping time — time during which compressor is not running (or solenoid valve is closed) or secondary refrigerant is not circulating (or solenoid valve is closed), within 24 h and excluding defrost time

t_{deft} defrost time — time during defrost during which compressor is not running (or solenoid valve is closed) or secondary refrigerant is generally not circulating, within 24 h, but not considered as stopping time

q_m mass flow rate of liquid refrigerant or secondary refrigerant in kilograms per second

Δt time between two consecutive measuring samples

N_{max} number of measuring samples in 24 hours

N_{75} number of measuring samples during 75 % of the running time period between 2 defrosts, excluding time just after defrost

n_{deft} number of defrosts during 24 h

DEC direct electrical energy consumption, in kilowatt hours per 24 h period

REC_{RC} refrigeration electrical energy consumption, in kilowatt hours per 2 h period, for remote cabinet for compression-type refrigerating system

REC_{RI} refrigeration electrical energy consumption, in kilowatt hours per 2 h period, for remote cabinet for indirect refrigerating system

TEC total energy consumption in kilowatt hours per 24 h period

t_{rr} relative or percentage running time:

$$t_{rr} = \frac{t_{run}}{t_{run} + t_{stop}} = \frac{t_{run}}{24 - t_{deft}}$$

where $t_{run} + t_{stop} + t_{deft} = 24$ h

Φ_n instant heat extraction rate

3.2 Compression-type refrigeration systems

h_8, h_4 specific enthalpy in kilojoules per kilogram, where state at point 8 corresponds to refrigerant outlet, and state at point 4 to refrigerant inlet, of cabinet

θ_7 refrigerant mean temperature at evaporator outlet

θ_{mrun} arithmetic average of evaporator-saturated temperature obtained from pressure p_7 by referring to table of saturation properties for refrigerant in use — during t_{run}, in degrees Celsius

θ_{min} arithmetic average of evaporator-saturated temperature obtained from pressure p_7 by referring to table of saturation properties for refrigerant in use — during the last 10 % of all running periods, in degrees Celsius

T_{mrun} $= \theta_{\mathrm{mrun}} + 273{,}18$

3.3 Indirect refrigeration-type systems

θ_{i} secondary refrigerant temperature at cabinet inlet, in degrees Celsius

θ_{o} secondary refrigerant temperature at cabinet outlet, in degrees Celsius

θ secondary refrigerant median temperature, in degrees Celsius $(\theta_{\mathrm{i}} + \theta_{\mathrm{o}})/2$

$\theta_{m\mathrm{run}}$ arithmetic average of the secondary refrigerant median temperature (θ) during t_{run}, in degrees Celsius

θ_{min} arithmetic average of the secondary refrigerant median temperature (θ) during last 10 % of all running periods, in degrees Celsius

$q_{m\mathrm{run}}$ arithmetic average of the secondary refrigerant mass flow during t_{run}, in kilograms per second

c_{i} specific heat of secondary refrigerant, in kilojoules per kilogram per degree Celsius at cabinet inlet

c_{o} specific heat of the secondary refrigerant, in kilojoules per kilogram per degree Celsius, at cabinet outlet

$p_{\mathrm{irun}} - p_{\mathrm{orun}}$ pressure drop between inlet and outlet of cabinet during t_{run}, in newtons per square metre

PEC pumping electrical energy consumption

v specific volume of secondary refrigerant, in cubic metres per kilogram
(simplification: v = const. = 0,001 $\mathrm{m^3/kg}$)

4 Requirements

4.1 Construction

4.1.1 General

4.1.1.1 Strength and rigidity

The cabinet and its parts shall be constructed with adequate strength and rigidity for normal conditions of handling, transport and use and attention shall be given to the following:

a) interior fittings, including shelves, baskets, rails, etc. and their supports, shall be sufficiently strong for the duty required;

b) where sliding shelves, baskets, trays or drawers are fitted they shall retain their shape and ease of movement when fully loaded;

c) any fitments which are provided with stops to prevent accidental removal shall be self-supporting when fully loaded and withdrawn to the limit of the stops.

d) stops.

4.1.1.2 Pipes and connections

Pipes and connections to moving or resiliently mounted parts shall be arranged so as not to foul or transmit harmful vibrations to other parts. All other pipes and connections shall be securely anchored and sufficient free length and/or vibration eliminators shall be provided to prevent failure due to fatigue. Where necessary, pipes and valves shall be adequately thermally insulated.

4.1.1.3 Condensate drainage

Where drains, drip trays or evaporation receptacles are fitted, they shall have ample capacity and shall be easily accessible and cleanable.

Any condensate or defrost water receptacle, or group of receptacles, requiring to be emptied manually shall have a capacity equivalent to at least 48 h of normal operation in the appropriate climate class for which the cabinet is intended.

4.1.1.4 Closed refrigerated cabinets (self-service type)

Closed refrigerated cabinets shall meet certain special requirements as follows.

Self-closing doors shall be opened by different angles up to and including 80° and shall from these different positions automatically assume their original position and close tight in accordance with 5.2.1.

On low-temperature applications, transparent doors and lids shall be condensate-free at the climate class specified by the manufacturer. Glass doors shall incorporate sufficient heating to the internal surface to provide moisture dispersal for clear vision after closing. Horizontal sliding lids are exempt from this requirement.

Door fasteners and hinges under normal conditions of use shall be smooth and positive in action and designed to function properly without undue wear.

When any doors or lids provided to ensure an air seal to the refrigerated space are closed, there shall be no undue leakage of ambient air into the interior.

The doors or lids shall not open of their own accord.

The gasket shall be made from a material whose characteristics are compatible with the operating conditions (especially temperatures). If the fastening device is mechanical, a stop or other means shall be provided to prevent the gasket from being excessively deformed.

4.1.1.5 Joints and seams

All construction joints and seams within the net volume shall prevent the accumulation of potentially contaminating substances.

All construction joints and seams within the net volume shall permit the easy removal of any deposits of potentially contaminating substances.

4.1.1.6 Sneeze guard

The front façade constitutes a guard against risks of contamination emanating from consumers through handling, coughing, etc. in case of display and sale of unpacked foodstuffs.

For this, the sum of vertical dimension A and horizontal dimension B as shown in Figure 1 shall be not less than 1 500 mm.

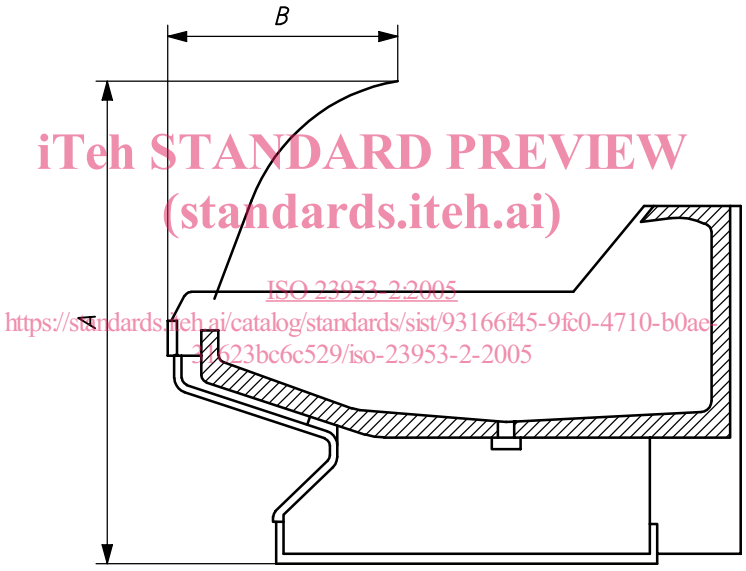


Figure 1 — Dimensions for sneeze guard

4.1.2 Materials

4.1.2.1 General

The materials shall be durable and shall not favour the development of mould or emit odours.

Under normal conditions of use, materials in contact with foodstuffs shall be resistant to moisture and shall neither be toxic nor contaminate them.

4.1.2.2 Wear resistance

Internal and external finishes shall be resistant to wear and capable of being cleaned effectively and hygienically. Finishes shall not crack, chip, flake, rub off or soften under normal conditions of use or during cleaning.

4.1.2.3 Corrosion resistance

Metal parts, used in the construction of cabinets, shall have resistance to corrosion appropriate to their location and function.

4.1.3 Thermal insulation

4.1.3.1 Efficiency

The thermal insulation shall be efficient and permanently fixed. In particular, the insulating material shall not be subject to shrinkage and shall not allow under normal working conditions an accumulation of moisture (see 4.2.4).

4.1.3.2 Vapour barrier

Suitable means shall be used to prevent deterioration of the thermal insulation by the ingress of moisture.

4.1.3.3 Containment of insulation material

Where the insulation space is vented to the inside, it shall be ensured that particles of the insulation material cannot escape into the foodstuff display compartment.

For fibrous insulation materials, it shall not be possible to insert a rigid probe of 1 mm diameter through any aperture which allows access to the insulating material, the probe being applied with negligible force.

4.1.4 Refrigerating system

4.1.4.1 Design and construction

The design and construction of all parts of the refrigerating system subject to internal pressure shall take into account the maximum working pressure to which they will be subjected when the cabinet is in operation or at rest.

For refrigerated display cabinets with integral condensing unit or components thereof which are charged with refrigerant prior to transportation, the maximum ambient temperature during transit shall be taken into account. All refrigerant containing components shall be in accordance with EN 378-2.

4.1.4.2 Condensation

There shall be suitable means to prevent water condensed on cold surfaces of the cabinet and its parts from harmfully affecting the operation of the refrigerating system or its controls.

4.1.4.3 System protection

For cabinets fitted with doors or lids, the refrigerating system shall suffer no damage if any door or lid in the cabinet is left open while the cabinet is operating in an ambient temperature corresponding to the climate class (see Table 3) for which the cabinet is intended.

When the door or lid is kept open under normal operating conditions (for example, during product loading) or is left open accidentally, any automatic motor overload protective device may come into operation.

4.1.4.4 Refrigerant

When deciding on the refrigerant for the system, attention shall be given to the possible hazards associated with the use of certain refrigerants and heat-transfer media or secondary refrigerant, due to their toxicity, flammability etc. Guidance on this point is available in EN 378-1.

4.1.5 Electrical components

Electrical components shall be in accordance with IEC 60335-2-89 and EN 60335-1.

4.1.6 Temperature display

The cabinets shall incorporate a temperature display instrument showing the air temperature in the refrigerated display cabinets to provide an indication of the operation and functioning of refrigerating equipment and information on its operating state.

NOTE As a rule, measured air temperature is not identical with foodstuff temperature in refrigerated display cabinets.

4.1.6.1 Temperature-measuring instrument

Suitable temperature-measuring instruments shall be used, i.e. those that fulfil the following requirements:

— the unit symbol (°C) shall be inscribed or displayed on the temperature-measuring instrument;

— the range of measurement shall be at least from −25 °C to +15 °C;

— the scale division or smallest numerical increment shall be less than or equal to 1 °C;

— the maximum errors shall be 2 K over the total measuring range;

— the time constant t_{90} of the sensor shall be equal to or less than 20 min.

NOTE The t_{90} time is the time in which 90 % of a sudden temperature change of 20 °C is indicated, the measurement medium being moderately agitated air (velocity 1 m/s).

4.1.6.2 Temperature sensor location

The temperature sensor location shall be readily accessible to enable on-site testing for the correct indication of temperature and replacement of the temperature-measuring instrument on site in service.

NOTE 1 The temperature sensor of a thermometer is considered to be “readily accessible” if it can be reached directly for examination. It could be necessary to remove access panel(s) to carry out replacement.

NOTE 2 For cabinets with natural convection cooling, the positioning of the temperature sensor in a guide tube is also considered to be “readily accessible” if the sensor can be introduced into and removed from the guide tube without a tool.

Wherever possible, the mounting method shall not supply heat to, or withdraw heat from, the temperature sensor.

The temperature sensor shall be protected against heat radiation from the external ambient.

The temperature sensor's location is defined as part of the temperature test of the refrigerated display cabinet. During the temperature test, air temperatures at the declared sensor location shall be measured and these values noted in the test report.

The air return temperature shall be displayed. The temperature sensor shall be mounted to indicate the temperature at the air-return side at the level of the clearly marked load limit line, except for vertical cabinets for chilled foodstuffs, vertical closed cabinets for chilled and frozen foodstuffs and cabinets with natural convection cooling.

For vertical cabinets (semi-vertical, multi-deck, roll-in) for chilled foodstuffs and vertical closed cabinets for chilled and frozen foodstuffs, the temperature sensor shall be mounted to indicate the temperature at one of the following locations.

a) At the air return, at a free place between physical air return and front area of the heat exchanger.

b) At the location on the back wall panel or on the ceiling panel of the cabinet to the right or to the left of the cabinet horizontally (500 ± 200) mm away from the end of the cabinet (see Figure 2). It shall be fixed (13 ± 5) mm away from the panel (not blocking a hole) and positioned at (125 ± 75) mm away from the reference point which is

   — the air curtain outlet for ceiling mounting, or

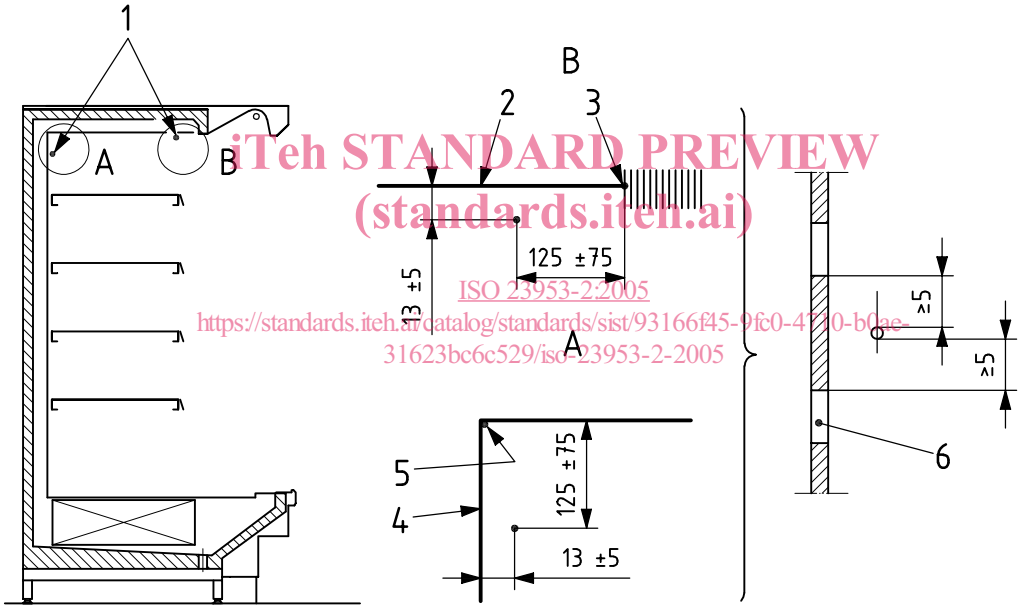
   — for back-wall mounting, the ceiling back wall corner or the lower edge of the mirror (if present).

For cabinets with natural convection cooling, the manufacturer defines the temperature sensor location.

NOTE 3 For an electronic controller, it is possible to display a calculated temperature.

NOTE 4 For recording and display of temperatures, one or two temperature sensors can be used. The temperature sensor can be the same as those used for controlling the refrigeration. An alarm can be activated in case of error. However, this option is not in accordance with the requirements of EN 12830.

Dimensions in millimetres



Key

1 temperature sensor
2 ceiling
3 reference point for ceiling mounting: inner side of air curtain outlet
4 back wall
5 reference point for back wall mounting: ceiling back wall corner or lower edge of mirror
6 ceiling or back wall with holes

Figure 2 — Location of temperature sensor of vertical chilled cabinet when not located at air return

4.1.6.3 Number of temperature-measuring instruments

When temperature-measuring instruments are employed in refrigerated display cabinets:

— one temperature-measuring instrument shall be employed for each refrigerated display cabinet with its own refrigerating circuit;

— in the case of several refrigerated display cabinets with a common refrigerating circuit operating in one temperature class, a minimum of one temperature-measuring instrument shall be employed for maximum two refrigerated display cabinets with a total length of maximum 3,75 m;

— in the case of several refrigerated display cabinets with a common refrigerating circuit working in different temperature classes, the above requirement shall be observed, but with separate temperature-measuring instruments employed for each temperature class.

4.2 Operating characteristics

4.2.1 Absence of odour and taste

The absence of odour and taste is not compulsory. An optional test method of is given in Annex D.

4.2.2 Classification according to temperature

The performance of cabinets shall comply with one of the classifications defined in Table 1. The performance shall be verified in accordance with the conditions and test methods specified in 5.3.3.

NOTE Annex C compares laboratory and store condition.

Table 1 — M-package temperature classes

Class	Highest temperature, θ_{ah}, of warmest M-package less than or equal to (see Figure 25)	Lowest temperature, θ_b, of coldest M-package greater than or equal to (see Figure 25)	Lowest temperature, θ_{al}, of warmest M-package less than or equal to (see Figure 25)
	°C		
L1	– 15	—	– 18
L2	– 12	—	– 18
L3	– 12	—	– 15
M1	+ 5	– 1	—
M2	+ 7	– 1	—
H1	+ 10	+ 1	—
H2	+ 10	– 1	—
S	Special classification		

4.2.3 Defrosting

The accumulation of ice, frost or snow on surfaces within the refrigerated space (excluding the surfaces of the test packages), as well as the accumulation of drained defrost water, shall not occur, as it would impair the performance of cabinets other than those which are intended to be defrosted manually. This shall be verified according to the conditions and test methods specified in 5.3.3.3.

The proposed defrosting procedures (automatic or manual) shall not affect the temperature requirements.

For cabinets or parts of cabinets with manual defrosting, the manufacturer shall supply all necessary instructions for the correct operation of the defrosting system.