INTERNATIONAL STANDARD

ISO 23953-2

Third edition
2023-11

Refrigerated display cabinets —

Part 2: Classification, requirements and test conditions

Meubles frigorifiques de vente —

Partie 2: Classification, exigences et méthodes d'essai

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 86, *Refrigeration and air-conditioning*, Subcommittee SC 7, *Testing and rating of commercial refrigerated display cabinets*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 44, *Commercial and Professional Refrigerating Appliances and Systems, Performance and Energy Consumption*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 23953-2:2015), which has been technically revised.

The main changes are as follows:

— revision of:

  — the scope has been revised as this document not applicable to commercial beverage coolers covered by ISO 22044 and ice cream freezers covered by ISO 22043;

  — mass flow with EEV only, to adapt standard to technological improvement;

  — $E_{\mathrm{CPEC,24h}}$ also for brine / indirect cooling;

  — testing repeatability;

  — requirements for refrigerant with glide;

— addition of:

  — extrapolation methods for liquid cooled condensing units, depth, height, length and plug-in alternative components;

  — liquid cooled condensing unit (semi plug-in) type;

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— S_{TDA} for new types of cabinets;

— standard rating conditions and configurations;

— marking, load limits, multiple loading line for different M-package temperature.

A list of all parts in the ISO 23953 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Refrigerated display cabinets —

Part 2:
Classification, requirements and test conditions

1 Scope

This document specifies requirements for the performance of refrigerated display cabinets used in the sale and display of foodstuffs and construction characteristics impacting performance. 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.

This document is not applicable to refrigerated vending machines, commercial beverage coolers covered by ISO 22044, ice cream freezers covered by ISO 22043. It is also not applicable to cabinets intended for storage or cabinets intended for use, for instance, in catering or non-retail refrigerated applications.

This document does not cover health and safety aspects and ergonomic principles.

This document is not intended to specify storage temperature for foodstuff.

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2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 817:2014, *Refrigerants — Designation and safety classification*

ISO 23953-2:2023

ISO 5149-2:2014, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 2: Design, construction, testing, marking and documentation*

ISO 23953-1:2023, *Refrigerated display cabinets — Part 1: Vocabulary*

IEC 60335-1:2020, *Household and similar electrical appliances — Safety — Part 1: General requirements*

IEC 60335-2-89:2019, *Household and similar electrical appliances — Safety — Part 2-89: Particular requirements for commercial refrigerating appliances and ice-makers with an incorporated or remote refrigerant unit or motor-compressor*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 23953-1:2023 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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3.1.1
running time
t_{run}
time during which compressor is running (or solenoid valve is open) or secondary refrigerant is circulating (or solenoid valve is open), within 24 h

3.1.2
stopping time
t_{stop}
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

3.1.3
defrost time
t_{deft}
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

3.2 Symbols

3.2.1 General

t_{run}	running time, expressed in h
t_{stop}	stopping time, expressed in h
t_{deft}	defrost time, expressed in h
q_m	mass flow rate of liquid refrigerant or secondary refrigerant in kg/s
Δt	time between two consecutive measuring samples, in h
N_{max}	number of measuring samples in 24 h
n_{deft}	number of defrosts during 24 h
Φ_{24}	heat extraction rate during a whole day, in kW
$\Phi_{24\text{-deft}}$	heat extraction rate during a whole day excepting defrost time, in kW
$E_{ACE,24h}$	anti-condensate energy consumption, in kWh
E_{add}	additional refrigeration energy consumption, in kWh
E_{CEC}	compressor energy consumption, in kWh
$E_{CPEC,24h}$	pumping electrical energy consumption, in kWh
E_{CSEC}	cooling system energy consumption, in kWh
$E_{DEC,24h}$	direct daily electrical energy consumption, in kWh
E_{DFEC}	defrost energy consumption, in kWh
E_{FEC}	fan energy consumption, in kWh
$E_{HEC,24h}$	heat extracted condenser, in kWh
$E_{HECR,24h}$	revised heat removal energy consumption, in kWh

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$E_{HLE,24h}$ heat load extracted daily, in kWh

E_{HREC} heat removal energy consumption, in kWh

E_{HRECA} additional heat removal energy consumption, in kWh

E_{LEC} lighting energy consumption, in kWh

E_{PEC} condensate evaporator pan energy consumption, in kWh

$E_{REC,24h}$ refrigeration electrical energy consumption, in kWh

$E_{REC\text{-}RC,24h}$ refrigeration electrical energy consumption compression-type, in kWh

$E_{REC\text{-}RI,24h}$ refrigeration electrical energy consumption indirect, in kWh

$E_{RECA,24h}$ additional refrigeration daily electrical energy consumption, in kWh

$E_{RECR,24h}$ revised refrigeration energy consumption, in kWh

E_{SEC} specific daily electrical energy consumption, in kWh/m^2

E_{TEC} total energy consumption, in kWh

E_{TECR} total revised daily electrical energy consumption, in kWh

$E_{TECR,24h}$ total revised daily electrical energy consumption, in kWh

t_{rr} relative or percentage running time:

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

where

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

Φ_n instant heat extraction rate in kW

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3.2.2 Compression-type refrigeration systems

h_8, h_4 specific enthalpy in kJ/kg, where state at point 8 corresponds to refrigerant outlet, and state at point 4 to refrigerant inlet, of cabinet

θ_7 refrigerant temperature at evaporator outlet, in °C

θ_8 refrigerant temperature at cabinet outlet, in °C

θ_4 refrigerant temperature at cabinet inlet, in °C

θ_5 refrigerant temperature at evaporator inlet, in °C

θ_{mrun} evaporating temperature, calculated as the average of θ_{dew} and θ_{bub} obtained from pressure p8 and averaged over the t_{run} period, in °C

θ_{cond} condensing temperature, calculated as the average of θ_{bub} and θ_{dew} obtained from pressure p4 and averaged over the t_{run} period, in °C

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θ_{min} evaporating temperature, calculated as the average of θ_{dew} and θ_{bub} obtained from pressure p8 by referring to table of saturation temperature in use and averaged over the last 10 % of all t_{run} periods in °C

T_{mrun} = θ_{mrun} + 273,15 in Kelvin

3.2.3 Indirect refrigeration-type systems

θ_i secondary refrigerant temperature at cabinet inlet, in °C

θ_o secondary refrigerant temperature at cabinet outlet, in °C

θ secondary refrigerant median temperature, in °C (θ_i + θ_o)/2

θ_{mrun} arithmetic average of the secondary refrigerant median temperature (θ) during t_{run}, in °C

q_L instant value of the secondary refrigerant mass flow during t_{run}, in kg/s

c_i specific heat of secondary refrigerant, in kJ/(kg · K), at cabinet inlet

c_o specific heat of the secondary refrigerant, in kJ/(kg · K), at cabinet outlet

$p_{irun} - p_{orun}$ pressure drop between inlet and outlet of cabinet during t_{run}, in kPa

v specific volume of secondary refrigerant, in m^3/kg
(simplification: v = constant = 0,001 m^3/kg)

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4 Requirements

4.1 Construction

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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. 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.

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4.1.1.3 Condensate drainage

Where drains, drip trays or evaporation receptacles are fitted, they shall have sufficient capacity at the rated climate class conditions.

NOTE Drains, drip trays or evaporation receptacles are to 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.

Hinged lids and doors shall be opened by different angles of at least 60°.

Transparent doors and lids shall be condensate-free at the climate class specified by the manufacturer.

NOTE Intermittent misting only is allowed, see 5.3.5.2.

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.

4.1.2 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.

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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

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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 are 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 ISO 5149-2:2014.

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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.

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 ISO 5149-2:2014.

4.1.5 Electrical components

Electrical components shall be in accordance with IEC 60335-2-89:2019 and IEC 60335-1:2020.

Cabinets should incorporate a means of controlling all or part of the lighting using a manual switch, sensor, timeclock or provision for an external control with a similar automatic device.

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4.1.6 Temperature display

4.1.6.1 General

The cabinets shall incorporate a temperature display instrument and can additionally have a means of temperature monitoring, 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.

4.1.6.2 Temperature-measuring instrument

Temperature-measuring instruments shall be used, i.e. fulfil the following requirements:

— the unit symbol (°C or °F) 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).

4.1.6.3 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 can 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.

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

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 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.

4.1.6.4 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;

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— 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 C.

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 5.3.4.

NOTE Annex B compares laboratory and store condition.

Table 1 — M-package temperature classes

Class	Highest temperature, θ_{ah}, of warmest M-package colder than or equal to [a,b]	Lowest temperature, θ_b, of coldest M-package warmer than or equal to [b]	Highest minimum temperature, θ_{al}, of all M-package colder than or equal to [a]
	°C		
L1	−15	—	−18
L2	−12	—	−18
L3	−12	—	−15
M0	+4	−1	—
M*	6	−1	—
M1	+5	−1	—
M2	+7	−1	—
H1	+10	+1	—
H2	+10	−1	—
S	Special classification		

[a] See Figure 31a).

[b] See Figure 31b).

For class M, the highest temperature of warmest package θ_{ah} colder than or equal to 6,1 °C but the average of the warmest M package colder than or equal to 5 °C. The measured temperatures are rounded to zero decimal places for temperature classification (see 5.3.4.6).

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.

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.

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