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**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

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.

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 documents 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](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 86, *Refrigeration and air-conditioning*, Subcommittee SC 7, and by Technical Committee CEN/TC 44, *Commercial refrigerated cabinets, catering refrigerating appliances and industrial refrigeration* in collaboration.

This second edition cancels and replaces the first edition (ISO 23953-2:2005 and ISO 23953-2:2005/Amd 1:2012), which has been technically revised as follows:

- editorial and technical improvements, corrections and/or clarifications throughout the text to better apply the standard
- addition of a new [Annex D](#) "Performance and energy rating of commercial refrigerated display cabinets"

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

- *Part 1: Vocabulary*
- *Part 2: Classification, requirements and test conditions*

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# 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. It is also not applicable to cabinets intended for storage or cabinets intended for use, for instance, in catering or non-retail refrigerated applications nor does it cover the choice of the types of foodstuffs chosen to be displayed in the cabinets.

### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 and safety classification*

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

ISO 23953-1:2015, *Refrigerated display cabinets — Part 1: Vocabulary*

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

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

### 3 Terms, definitions, symbols and abbreviated terms

#### 3.1 General

$t_{\text{run}}$	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, expressed in hours
$t_{\text{stop}}$	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, expressed in hours
$t_{\text{defst}}$	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, expressed in hours
$q_m$	mass flow rate of liquid refrigerant or secondary refrigerant in kilograms per second
$\Delta t$	time between two consecutive measuring samples, in hours

$N_{\max}$	number of measuring samples in 24 hours
$n_{\text{def}}t$	number of defrosts during 24 h
$\Phi_{24}$	heat extraction rate during a whole day excepting defrost time, in kilowatts
$\Phi_{24\text{-def}t}$	heat extraction rate during a whole day excepting defrost time, in kilowatts
DEC	direct daily electrical energy consumption, in kilowatt hours per 24 h period
DECR	revised direct daily electrical energy consumption, in kilowatt hours per 24 h period
REC <sub>RC</sub>	refrigeration daily electrical energy consumption, in kilowatt hours per 24 h period, for remote cabinet for compression-type refrigerating system
REC <sub>RI</sub>	refrigeration daily electrical energy consumption, in kilowatt hours per 24 h period, for remote cabinet for indirect refrigerating system
RECR <sub>RC</sub>	revised refrigeration daily electrical energy consumption, in kilowatt hours per 24 h period, for remote cabinet for compression-type refrigerating system
RECAR <sub>RC</sub>	additional refrigeration daily electrical energy consumption, in kilowatt hours per 24 h period, for remote cabinet for compression-type refrigerating system
RECR <sub>RI</sub>	revised refrigeration daily electrical energy consumption, in kilowatt hours per 24 h period, for remote cabinet for indirect refrigerating system
RECA <sub>RI</sub>	additional refrigeration daily electrical energy consumption, in kilowatt hours per 24 h period, for remote cabinet for indirect refrigerating system
TEC	total daily electrical energy consumption in kilowatt hours per 24 h period
TECR	total revised daily electrical energy consumption in kilowatt hours per 24 h period
TDA	total display area, in square meters (see <a href="#">Annex A</a> )
SEC	TEC/TDA Specific Daily Electrical Energy Consumption (SEC) for Refrigerated Display Cabinet expressed in kilowatt hours per 24h per square meters
$t_{\text{rr}}$	relative or percentage running time:

$$t_{\text{rr}} = \frac{t_{\text{run}}}{t_{\text{run}} + t_{\text{stop}}} = \frac{t_{\text{run}}}{24 - t_{\text{def}t}}$$

where

$$t_{\text{run}} + t_{\text{stop}} + t_{\text{def}t} = 24\text{h}$$

$\Phi_n$  instant heat extraction rate in kilowatts

### 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
$\theta_7$	refrigerant temperature at evaporator outlet, in degrees Celsius
$\theta_8$	refrigerant temperature at cabinet outlet, in degrees Celsius
$\theta_4$	refrigerant temperature at cabinet inlet, in degrees Celsius



$\theta_5$	refrigerant temperature at evaporator inlet, in degrees Celsius
$p_8$	refrigerant pressure at cabinet outlet, in Pascals
$\theta_{mrun}$	arithmetic average of evaporator-saturated temperature obtained from pressure $p_8$ by referring to table of saturation properties for refrigerant in use, during $t_{run}$ , in degrees Celsius
$\theta_{min}$	arithmetic average of evaporator-saturated temperature obtained from pressure $p_8$ by referring to table of saturation properties for refrigerant in use, during the last 10 % of all running periods, in degrees Celsius
$T_{mrun}$	$= \theta_{mrun} + 273,15$ in Kelvin

### 3.3 Indirect refrigeration-type systems

$\theta_i$	secondary refrigerant temperature at cabinet inlet, in degrees Celsius
$\theta_o$	secondary refrigerant temperature at cabinet outlet, in degrees Celsius
$\theta$	secondary refrigerant median temperature, in degrees Celsius $(\theta_i + \theta_o)/2$
$\theta_{mrun}$	arithmetic average of the secondary refrigerant median temperature ( $\theta$ ) during $t_{run}$ , in degrees Celsius
$\theta_{min}$	arithmetic average of the secondary refrigerant median temperature ( $\theta$ ) during last 10 % of all running periods, in degrees Celsius
$q_{mrun}$	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
$p_{irun} - p_{orun}$	pressure drop between inlet and outlet of cabinet during $t_{run}$ , in kilo Pascals
CPEC	pumping electrical energy consumption expressed in kilowatt hours per 24 h period
$v$	specific volume of secondary refrigerant, in cubic metres per kilogram (simplification: $v = \text{const.} = 0,001 \text{ m}^3/\text{kg}$ )

## 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. Attention shall be given to the following:

- 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.

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.

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

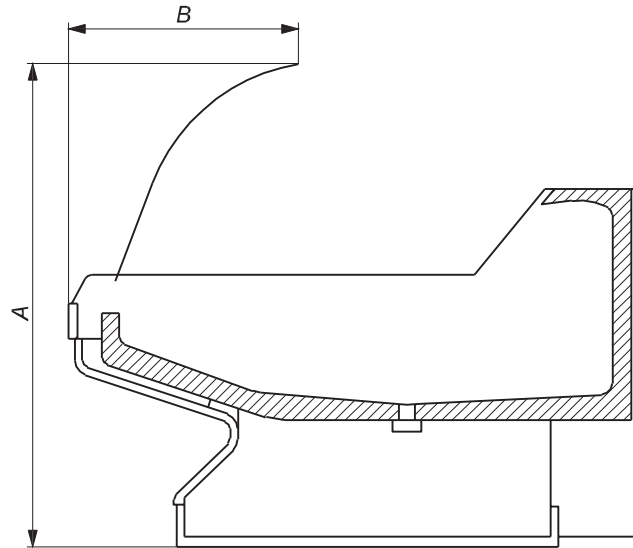
All construction joints and seams within the net volume shall prevent the accumulation of potentially contaminating substances.

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.

**Key**

- A vertical dimension  
B horizontal dimension

**Figure 1 — Dimensions for sneeze guard**

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**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 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.

##### 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 ISO 5149-2.

#### 4.1.5 Electrical components

Electrical components shall be in accordance with IEC 60335-2-89 and IEC 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 or °F) shall be inscribed or displayed on the temperature-measuring instrument;

- the range of measurement shall be at least from  $-25\text{ °C}$  to  $+15\text{ °C}$ ;
- the scale division or smallest numerical increment shall be less than or equal to  $1\text{ °C}$ ;
- the maximum errors shall be  $2\text{ K}$  over the total measuring range;
- the time constant  $t_{90}$  of the sensor shall be equal to or less than  $20\text{ min}$ .

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

#### 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 may 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.

NOTE 4 It is the responsibility of the supplier and end user to ensure that the temperature measurements comply with national regulation on temperature control of foodstuffs.

#### 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  $3,75\text{ m}$ ;
- 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 B](#) compares laboratory and store condition.

**Table 1 — M-package temperature classes**

Class	Highest temperature, $\theta_{ah}$ , of warmest M-package colder than or equal to <sup>ab</sup>	Lowest temperature, $\theta_b$ , of coldest M-package warmer than or equal to <sup>b</sup>	Highest minimum temperature, $\theta_{al}$ , of all M-package colder than or equal to <sup>a</sup>
	°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		

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<sup>a</sup> See [Figure 29a](#)

<sup>b</sup> See [Figure 29b](#)

For Class M, the highest temperature of warmest package  $\theta_{ah}$  colder than or equal to 6,1 °C but the average of the warmest M package colder than or equal to 5 °C

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**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.

**4.2.4 Water vapour condensation**

The performance of cabinets shall not be impaired by water vapour condensation. The amount of water vapour condensation shall be verified according to the conditions and test methods specified in [5.3.4](#).

**4.2.5 Energy consumption**

The heat extraction rate and the energy consumption shall be stated by the manufacturer.

The direct daily electrical energy consumption (DEC) and, when the condensing unit is remote from the cabinet, the refrigeration daily electrical energy consumption (REC) and total daily energy consumption (TEC) shall be measured and calculated according to the conditions and the test methods specified in [5.3.5](#) and [5.3.6](#).

#### 4.2.6 Specific Energy Consumption

The Cabinet Specific Daily Electrical Energy consumptions SEC as ratio between TEC and TDA shall be stated by the manufacturer; this value, representing the best index for performance evaluation of a commercial refrigerated display cabinet.

## 5 Tests

### 5.1 General

When the characteristics of a cabinet are to be verified, all the tests and inspections shall be applied to one and the same cabinet. These tests and inspections may also be made individually for the study of a particular characteristic.

[Table 2](#) lists the tests and inspections. Cabinets shall comply with the requirements specified in this part of ISO 23953 using the appropriate test method.

**Table 2 — Test summary**

Tests and inspections	Requirement clause in this part of ISO 23953	Test method	
Seal test	<a href="#">4.1</a>	<a href="#">5.2.1</a>	<b>Outside test room</b> (see <a href="#">5.2</a> )
Physical dimensions of sneeze guard	<a href="#">4.1.1.6</a>	<a href="#">5.2.2</a>	
Absence of odour and taste (not compulsory)	—	<a href="#">Annex C</a>	
Temperature	<a href="#">4.2.2</a>	<a href="#">5.3.3</a>	<b>Inside test room</b> (see <a href="#">5.3</a> )
Defrosting	<a href="#">ISO 23953-4.2.3</a>	<a href="#">5.3.3</a>	
Water vapour condensation	<a href="#">4.2.4</a>	<a href="#">5.3.4</a>	
Energy consumption	<a href="#">4.2.5</a>	<a href="#">5.3.5</a> and <a href="#">5.3.6</a>	

### 5.2 Tests outside test room

The tests which may be carried out outside the test room deal with the inspection of construction characteristics, physical dimensions and the absence of odour and taste.

#### 5.2.1 Seal test for doors and lids on low temperature applications

The effectiveness of doors or lids provided to ensure a seal shall be tested as follows (with the cabinet not running).

Insert a strip of paper 50 mm wide, 0,08 mm thick and of a suitable length at any point of the seal. With the door or lid closed normally on it the strip of paper shall not slide freely.

NOTE 1 Attention is drawn to the fact that some cabinets having doors provided to ensure an air seal are fitted with decompression valves which allow air to penetrate for a short period of time so that any drop in pressure created inside the cabinet may be compensated. No test is required for such valves.

NOTE 2 The most unfavourable points can be found by inspecting the contact of the seal with the cabinet closed and lit from the inside.

#### 5.2.2 Linear dimensions, areas

Measurements shall be made with the cabinet not in operation but situated in a place where the temperature is maintained between 16 °C and 30 °C.