

BS EN ISO 23953-2:2015



BSI Standards Publication

Refrigerated display cabinets

Part 2: Classification, requirements and test conditions

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National foreword

This British Standard is the UK implementation of EN ISO 23953-2:2015. It supersedes BS EN ISO 23953-2:2005+A1:2012 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RHE/19, Commercial refrigerated food cabinets (cold room and display cases).

A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

Refrigerated display cabinets - Part 2: Classification,
requirements and test conditions (ISO 23953-2:2015)

Meubles frigorifiques de vente - Partie 2: Classification,
exigences et méthodes d'essai (ISO 23953-2:2015)

Verkaufskühlmöbel - Teil 2: Klassifizierung,
Anforderungen und Prüfbedingungen (ISO 23953-
2:2015)

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN ISO 23953-2:2015) has been prepared by Technical Committee CEN/TC 44 "Commercial refrigerated cabinets, catering refrigerating appliances and industrial refrigeration", the secretariat of which is held by UNI, in collaboration with Technical Committee ISO/TC 86 "Refrigeration and air-conditioning"

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2016, and conflicting national standards shall be withdrawn at the latest by May 2016.

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Endorsement notice

The text of ISO 23953-2:2015 has been approved by CEN as EN ISO 23953-2:2015 without any modification.

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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).

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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*

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_{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_{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_{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
Δt	time between two consecutive measuring samples, in hours

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

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

where

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

Φ_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
θ_7	refrigerant temperature at evaporator outlet, in degrees Celsius
θ_8	refrigerant temperature at cabinet outlet, in degrees Celsius
θ_4	refrigerant temperature at cabinet inlet, in degrees Celsius

θ_5	refrigerant temperature at evaporator inlet, in degrees Celsius
p_8	refrigerant pressure at cabinet outlet, in Pascals
θ_{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
θ_{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

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 $(\theta_i + \theta_o)/2$
θ_{mrun}	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_{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:

- 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.

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

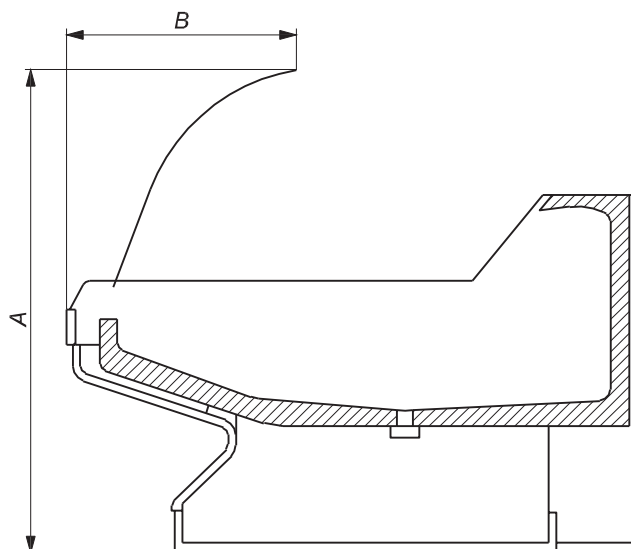
All construction joints and seams within the net volume shall prevent the accumulation of potentially contaminating substances.

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

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 $-25\text{ }^{\circ}\text{C}$ to $+15\text{ }^{\circ}\text{C}$;
- the scale division or smallest numerical increment shall be less than or equal to $1\text{ }^{\circ}\text{C}$;
- 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 $20\text{ }^{\circ}\text{C}$ 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 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 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, θ_{ah} , of warmest M-package colder than or equal to ^{ab}	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 29a		
b	See Figure 29b		
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			

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	4.1	5.2.1	Outside test room (see 5.2)
Physical dimensions of sneeze guard	4.1.1.6	5.2.2	
Absence of odour and taste (not compulsory)	—	Annex C	
Temperature	4.2.2	5.3.3	Inside test room (see 5.3)
Defrosting	4.2.3	5.3.3	
Water vapour condensation	4.2.4	5.3.4	
Energy consumption	4.2.5	5.3.5 and 5.3.6	

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.

For cabinets having detachable ends, overall dimensions are given with and without ends. If the cabinet includes jacks or other components for adjustment of height, the height defined shall be the minimum height necessary at installation of the cabinet.

The total display area (TDA) shall be calculated according to [Annex A](#).

5.3 Tests inside test room

The tests which are carried out inside the test room deal with the measurement of the following characteristics:

- temperature and defrosting;
- water vapour condensation;
- electrical energy consumption;
- heat extraction rate.

These measurements should be made simultaneously.

5.3.1 General conditions

In the following, general testing conditions which are common for all tests specified in [5.3.3](#) to [5.3.6](#) carried out inside the test room are defined. These conditions concern the test room, the test and M-packages, and the measuring instruments.

5.3.1.1 Test room — General design, walls, floor and radiant heat

The test room shall be a parallelepiped space in which two of the opposite side walls, referred to as the discharge technical side wall and the return technical side wall, are designed to create an even, horizontal air flow within the test room. By convention, the distance separating these two technical side walls is referred to as the “length” of the test room.

The minimum useful dimensions (length, width, height) of the test room shall be dependent on the overall dimensions (length, depth, height) of the cabinet to be tested and on the location of the display opening of the cabinet (see [5.3.2.1](#)).

The ceiling and the two non-technical side walls of the room shall be thermally insulated and shall be equipped with an inner metal skin.

A minimum insulation level equivalent to 60 mm of rigid polyurethane foam ($\lambda = 0,03 \text{ W/m } ^\circ\text{C}$) should be used for the building of a new test room.

The floor shall be made of concrete or of thermally equivalent material and/or shall be sufficiently insulated to ensure that external climatic conditions do not affect the floor temperature.

Fluorescent or led lighting shall be installed to maintain $600 \pm 100 \text{ lx}$ measured at a height of 1 m above the floor level and shall be lit continuously during the test period. The emission spectrum of that lighting device within the infrared field shall not include peaks of a value of more than 500 W/5 nm/lm .

The walls, ceilings and any partitions of rooms intended for the testing of refrigerated display cabinets shall be painted in light grey (for example, NCS 2706-G90Y or RAL 7032) so that the emissivity is between 0,9 and 1 at $25 \text{ }^\circ\text{C}$.

5.3.1.2 Test room (empty) — Thermal and air flow characteristics

An experimental evaluation of the test-room performances shall be carried out minimum once per year

- with test room empty and with lighting switched on,

- in a test-room climate class 3 (see [Table 3](#)),
- measuring the velocity, temperature and relative humidity of the air at different points of two vertical planes parallel to the technical side walls and 600 mm away from the technical side walls, and
- with the climate measuring point located at the geometrical centre of the test room during this evaluation.

These measuring points shall form a two-dimensional grid in which the step is a maximum of 500 mm in the horizontal and vertical directions. The peripheral line of points shall be located at a maximum of 500 mm from the other two side walls, floor and ceiling.

A three-dimensional grid inside the test room shall be investigated when obstacles/irregularities projected into the room of more than 1 m² surface area facing the discharge technical side wall exist along the walls.

The mean horizontal air velocity measured during 1 min with a maximal interval of 5 s at each of the points defined above shall lie between 0,1 m/s and 0,2 m/s.

Air temperature measured at each of the points defined above shall not deviate from the rated temperature of the test-room climate class by more than 2 °C.

The test room shall be capable of maintaining values of humidity within ± 3 units of the relative humidity percentage figures of the rated humidity of the test room temperature class at the specified measuring points.

Surface temperature of walls, ceiling and floor shall be measured in proximity to the points which constitute the peripheral line of the grid defined above. These surface temperatures shall remain within a tolerance of ± 2 °C in relation to the air temperature measured at the nearest point of the grid.

5.3.1.3 Test room climate definition

5.3.1.3.1 Test room climate classes

Tests shall be carried out in one of the climate classes according to [Table 3](#).

During the test, the test room shall be capable of maintaining values of temperature and humidity within ± 1 °C of the temperature and ± 5 units of the relative humidity percentage figures at the specified climate measuring point(s) (see [5.3.1.3.2](#)). The exception to this is test-room climate class 3, for which the tolerance of the relative humidity is instead ± 3 units.

Table 3 — Climate classes

Test room climate class	Dry bulb temperature °C	Relative humidity %	Dew point °C	Water vapour mass in dry air g/kg
0	20	50	9,3	7,3
1	16	80	12,6	9,1
8	24	55	14,4	10,2
2	22	65	15,2	10,8
3	25	60	16,7	12,0
4	30	55	20,0	14,8
6	27	70	21,1	15,8
5	40	40	23,9	18,8

NOTE The water vapour mass in dry air is one of the main points influencing the performance and the energy consumption of the cabinets. Therefore the order of the climate class in the table is based on the water vapour mass column. See also [Annex B](#) to compare lab and store conditions.

Table 3 (continued)

Test room climate class	Dry bulb temperature °C	Relative humidity %	Dew point °C	Water vapour mass in dry air g/kg
7	35	75	30,0	27,3

NOTE The water vapour mass in dry air is one of the main points influencing the performance and the energy consumption of the cabinets. Therefore the order of the climate class in the table is based on the water vapour mass column. See also [Annex B](#) to compare lab and store conditions.

5.3.1.3.2 Climate measuring point

The point for measurement of ambient temperature and relative humidity shall be midway along the length of the cabinet and in accordance with [Figures 2](#) to [5](#).

In the case of typical island cabinets, and island with air discharge in the middle, temperatures shall be taken at both sides [see [Figure 3](#) a), b), c)].

For plug-in cabinets, the warm condenser air flow shall be prevented from influencing the temperature at the measuring point by air deflectors or other suitable means (see [5.3.2.1](#), [Figure 9](#)).

Dimensions in millimetres

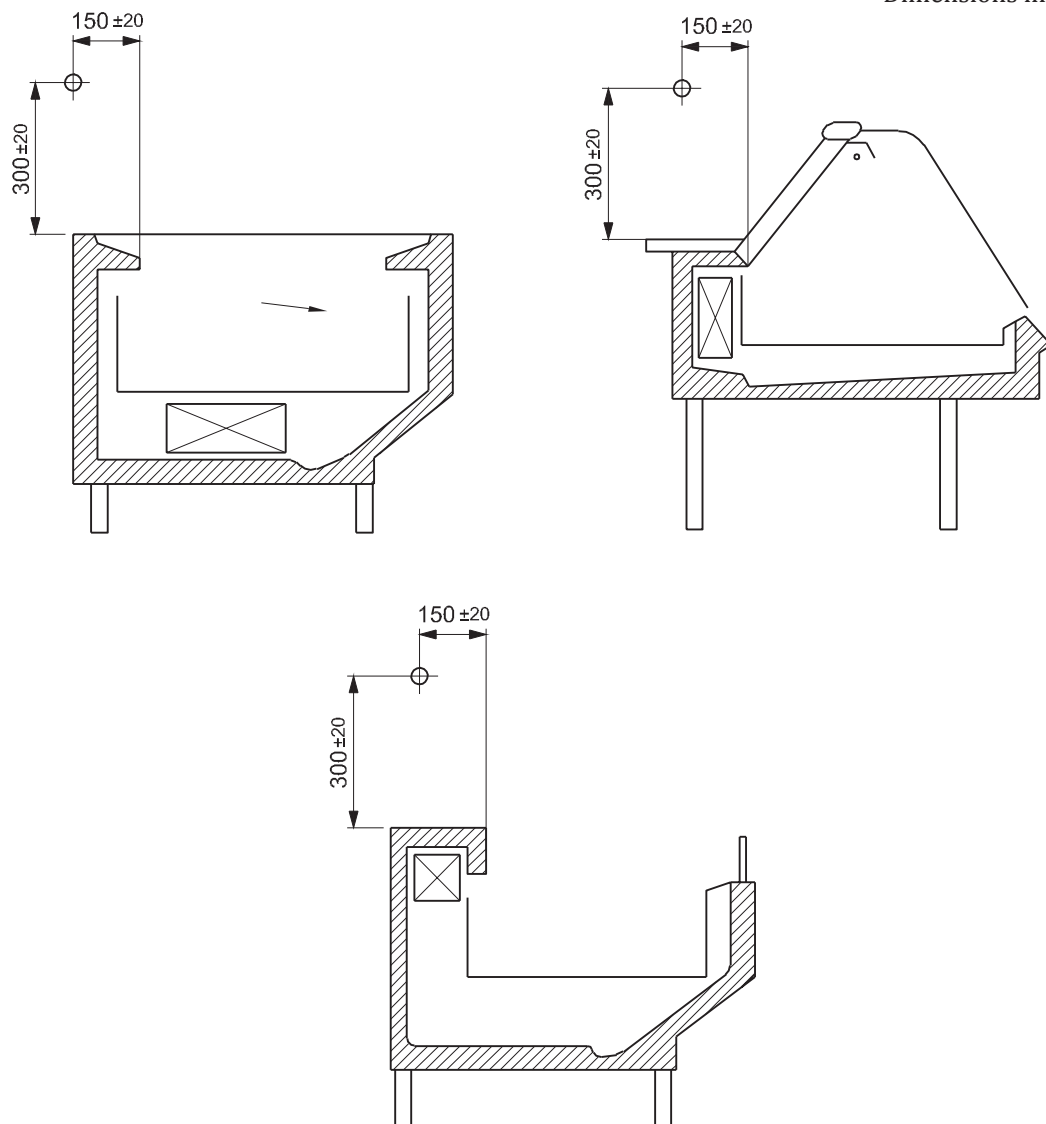


Figure 2 — Climate measuring point for two typical examples of horizontal open, wall site cabinets, and one example of serve-over counter cabinet

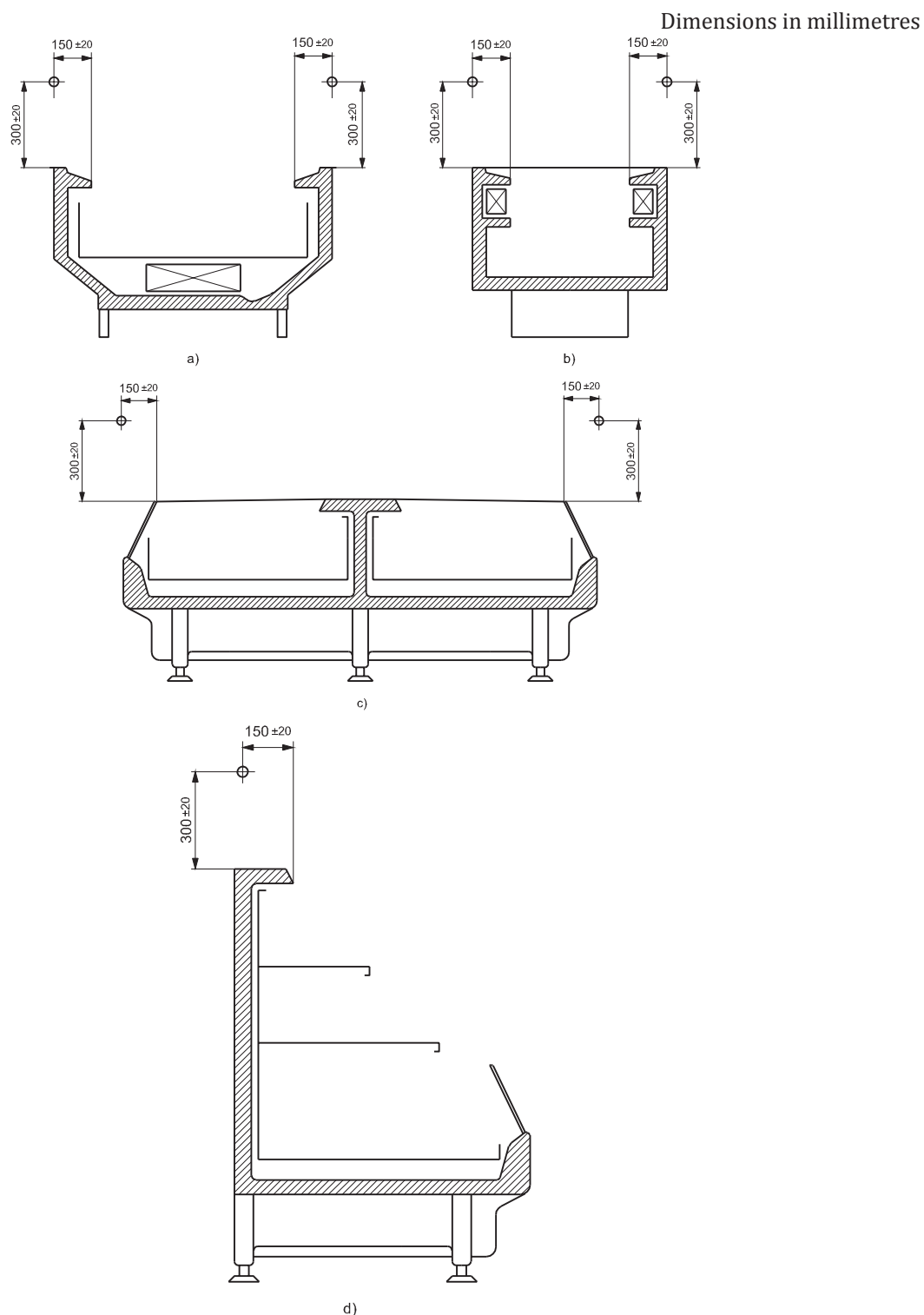


Figure 3 — Climate measuring point for two typical examples of horizontal, open, island site cabinets [a), b)] for island with air discharge in the middle [c)] and for semi-vertical cabinet [d)]

Dimensions in millimetres

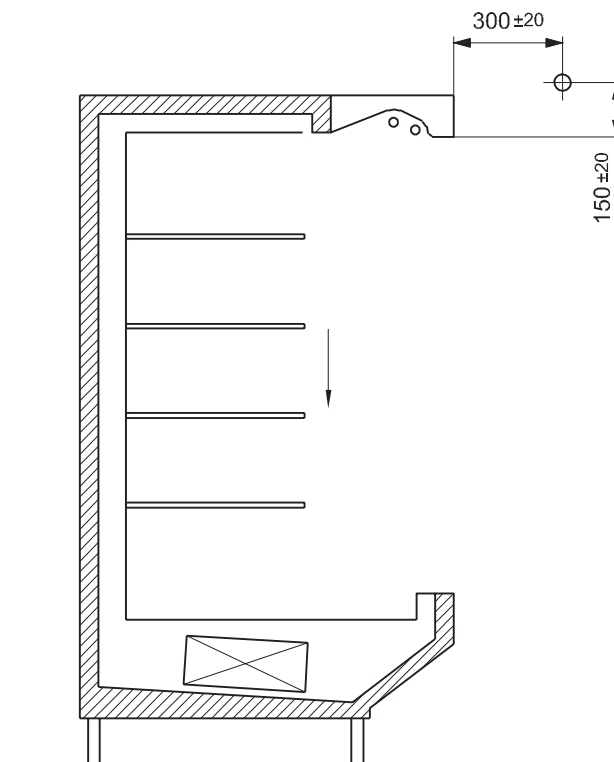


Figure 4 — Climate measuring points for one typical example of vertical multi-deck cabinet

Dimensions in millimetres

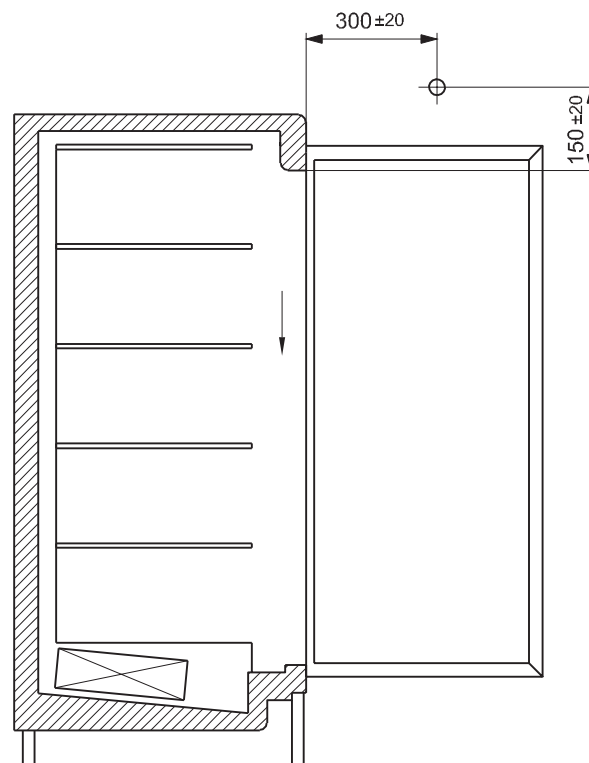


Figure 5 — Climate measuring point for one typical example of vertical glass door cabinet

5.3.1.4 Test packages and life-time

When tests are carried out, test packages in the form of right parallelepipeds shall be used; the size and mass of the test packages, including their packaging, shall be as specified in [Table 4](#).

The tolerances for new test packages shall be

- ±2 mm for linear dimensions 25 mm to 50 mm,
- ±4 mm for linear dimensions 100 mm to 200 mm, and
- ±2 % for mass.

Table 4 — Dimensions and mass of test packages

Dimensions mm	Mass g
50 × 100 × 100	500
50 × 100 × 200	1 000
The following packages may be used as fillers to complete the cabinet loading:	
25 × 100 × 200	500

Due to the frequency of use and to the loading pressure, the package could change in dimensions and weight. Test packages shall be checked at least annually for conformity with the following life-time tolerances. When a test package is found to exceed one of the tolerances, it shall be replaced.

- a) Loss of mass: −5 %
- b) On the wrapper: no visible hole
- c) Change in linear dimensions:
 - 1) ±4 mm for dimensions 25 mm and 50 mm;
 - 2) ±8 mm for dimensions 100 mm and 200 mm.

Each test package shall consist of filling material and a wrapper.

Filling material containing, per 1 000 g:

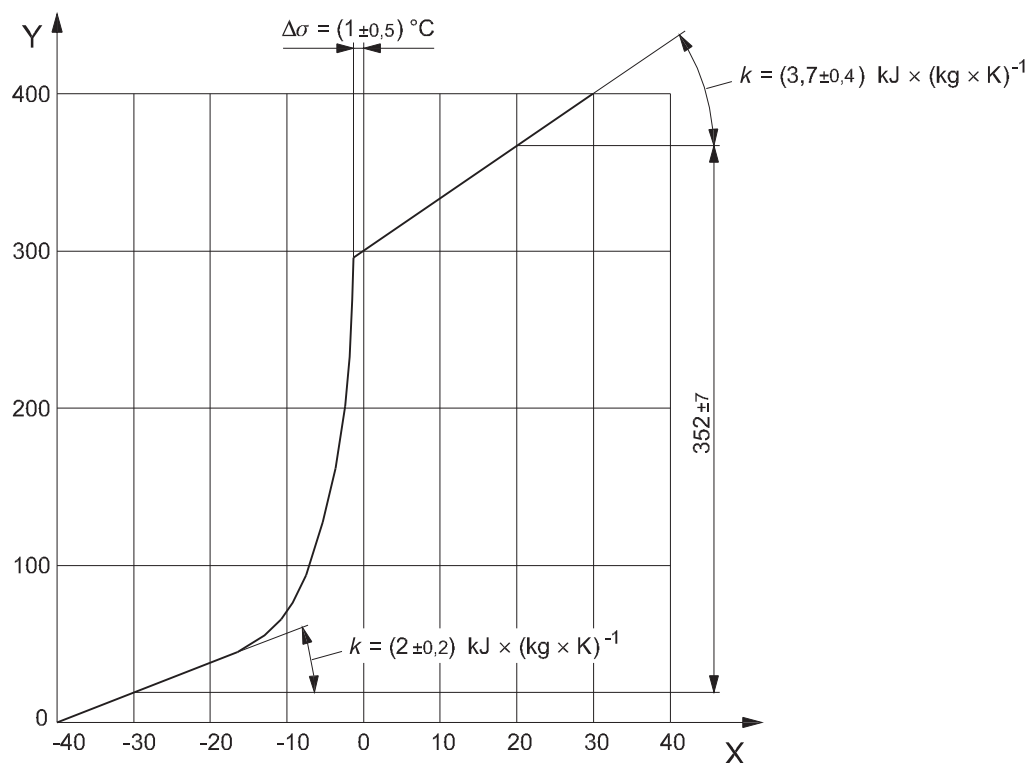
- 230,0 g of oxyethylmethylcellulose,
- 764,2 g of water,
- 5,0 g of sodium chloride, and
- 0,8 g of para-chlorometa-cresol.

The freezing point of this material is −1 °C (its thermal characteristics corresponding to those of lean beef). The enthalpy value of 285 kJ/kg shall correspond to the temperature (−1 ± 0,5) °C (see [Figure 6](#), [Tables 5](#) and [6](#)).

About 4 % of water should be added in order to compensate for evaporation during the preparation of the filling material.

Wrapper: a sheet of transparent colourless plastic or any other suitable material of such nature that exchange of moisture with the ambient medium is negligible being the surface emissivity coefficient equal to or greater than 0,9 at 25 °C. The maximum total thickness shall be 1,0 mm. After filling this sheet shall be sealed.

The correspondence of the packages' material composition with the above mentioned characteristics should be verified by the supplier or by an independent laboratory.



Key

X temperature, °C

Y specific enthalpy, kJ/kg

Figure 6 — Thermal characteristics of test packages

Table 5 — Temperature and specific enthalpy of test packages

Temperature °C	Specific enthalpy kJ/kg
-40	0
-30	19
-25	28
-20	39
-18	43
-16	49
-14	55
-12	63
-10	73
-9	79
-8	85
-7	93
-6	102
-5	114

Table 5 (continued)

Temperature °C	Specific enthalpy kJ/kg
-4	129
-3	152
-2	194
-1	285
0	297
+10	334
+20	371

Table 6 — Temperature and increase in specific enthalpy of test packages

Temperature range °C	Increase in specific enthalpy kJ/kg
-30 to -20	20 ± 2
+10 to +20	37 ± 4
-30 to +20	352 ± 7

5.3.1.5 M-packages and life-time

Some of the 500 g packages (50 mm × 100 mm × 100 mm) specified in 5.3.1.4 shall be equipped for temperature measurement, being fitted with temperature sensors inserted in the geometrical centre of the packages in direct contact with the filling material. All precautions shall be taken to minimize extraneous conduction of heat and to avoid any possibility of entrance of the air from the hole in the wrapper for the passage of the temperature sensor that could create oxidation and loss of weight in the filling material. These packages are called M-packages (see Figure 7).

Due to frequency of use and loading pressure the package could change in dimensions and weight. All M-packages shall be checked at least annually for conformity with the life time tolerances specified in 5.3.1.4. The checking results shall be recorded for each lot of M-packages. When an M-package is found to exceed one of the tolerances, it shall be replaced.

Dimensions in millimetres

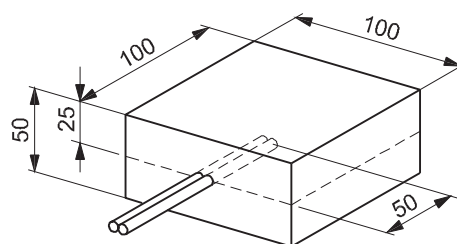


Figure 7 — M-Package

5.3.1.6 Alternative for filling test packages

Alternative filling test packages having the dimensions shown in Table 4 and density of $(480 \pm 80) \text{ kg/m}^3$ can be used, except for rows and columns on transverse section containing M-packages.

This test package may be a box made of plastic material of any density, and of 1 mm nominal thickness. Cellular or foam material shall not be used. The case shall not incorporate any protrusions that would cause the vertical separation of packages in a stack. Opposite faces shall be substantially parallel.

and moulding draft shall be the minimum practicable. Seams or joints shall not result in protrusions sufficient to cause significant air gaps between adjacent packages.

Colour can be important if dark enough to be affected by ambient heat radiation; however, a pastel colour, e.g. light pink, pale blue or green, shall have no significant effect in normal surroundings.

The contents shall be water containing 0,08 % of para-chlorometa-cresol and 0,5 % of sodium chloride, soaked into a porous material such as a natural, plastics or cellulose sponge.

5.3.1.7 Instruments, measuring equipment and measuring accuracy

All measurements shall be carried out with instruments that have been calibrated.

- Temperature measurements shall be made to an accuracy of $\pm 0,8$ °C. Climate temperatures shall be measured by sensors, inserted in the centre of tinned solid copper or copper-zinc alloy cylinders having a mass of 25 g and of minimum external area (diameter = height = approximately 12,5 mm).

Specially for the test of a cabinet intended for connection to an indirect type refrigerating system, secondary refrigerant temperature difference measurements shall be made to an accuracy of $\pm 0,1$ °C (see [5.3.6.2.2](#)).

- Illumination flux per square metre shall be measured to an accuracy of ± 10 %.
- Pressures shall be measured to an accuracy of ± 1 %.
- Relative humidity shall be measured to an accuracy of ± 3 units of the percentage figure.
- Electrical energy consumption shall be measured to an accuracy of ± 2 % (see [5.3.5](#)).
- Time interval measurements shall be made to an accuracy of ± 1 % or better. All the temperatures are checked every 60 s.

The time interval for the measurements of refrigerant mass flow rate, inlet/outlet temperature and inlet and suction pressure shall be 20 s (see [5.3.6.2](#)).

- Air velocity shall be measured using a laboratory-type instrument with an accuracy of 10 % or $\pm 0,03$ m/s whichever is the greater and with a minimum sensitivity of 0,03 m/s in the range of 0 m/s to 1,5 m/s in horizontal flow at the temperature of the selected ambient class.
- Mass flow rate shall be measured to an accuracy of ± 1 % (see [5.3.6](#)).

5.3.2 Preparation of test cabinet and general test procedures

5.3.2.1 Cabinet selection, installation and positioning within the test room

Each refrigerated display cabinet intended to be tested, unless a prototype, shall be selected from stock or routine production and shall be representative as to construction and adjustment.

The cabinet, including all components required for normal operation, shall be assembled, set up and sited as it would be installed in service as far as practicable and in accordance with the manufacturer's instructions. All permanently located accessories required for normal use shall be in their respective places.

The cabinet shall be located as follows (see [Figure 8](#)).

$X \geq 1,5$ m and $B \geq 0,5$ m for vertical glass door cabinets of length less than 1,6 m and horizontal closed cabinets;

- $X = 2$ m and $B \geq 1$ m for all other cabinets;
- $Y \geq 1,5$ m for open vertical cabinets and combined cabinets with open top, defined as cabinet families VC1, VC2, VC3, VF1, VF2, YC1, YC2, YF1, YF2, YM5, YM6 (see ISO 23953-1:2015, Annex A).

- $Y \geq 0,8$ m for horizontal cabinets, vertical cabinets with glass doors and combined cabinets with glass door top, defined as cabinet families HC1, HC2, HC3, HC4, HC5, HC6, HF1, HF3, HF4, HF5, HF6, VC4, VF4, YC3, YC4, YF3, YF4, YM7, YM8 (see ISO 23953-2:2015, Annex A);
- $A \geq 0,8$ m
 $A = Y$ should be used when $A \geq 1,5$ m;
- $C \geq$ height of cabinet +0,5 m (for vertical cabinets).

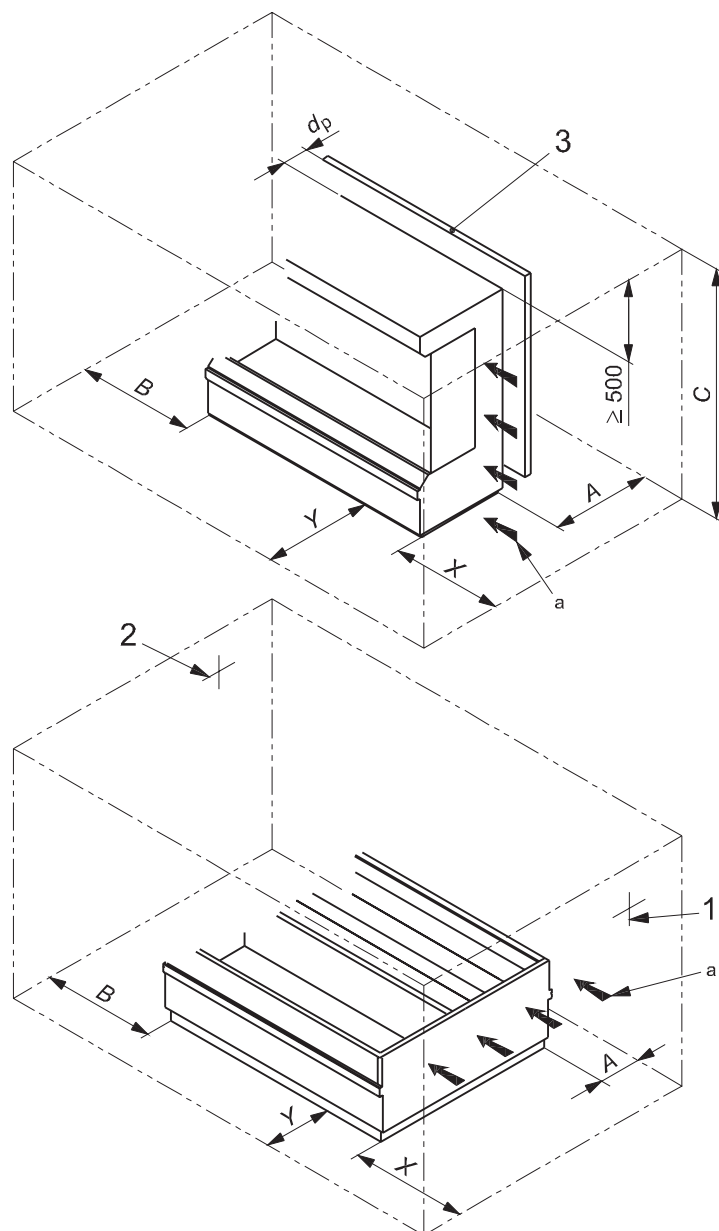
The cabinet shall be located within the test room perpendicularly to the two technical side walls in such a way that the distances A (and respectively Y) measured at the two ends of the cabinet is equal with a tolerance of ± 4 mm for each meter of length of the cabinet.

For cabinets intended to be placed against a wall, and in order to check the running of cabinets with incorporated condensing unit correctly according to 5.3.2 or the water vapour condensation according to 5.3.4, a vertical partition shall be placed either against the rear of the cabinet or at a distance d_p from the rear as specified by the manufacturer [see Figure 8 and 9].

For all vertical and semi-vertical cabinets, with incorporated condensing unit, when the warm condenser air flow direction is across the testing room air flow direction, from the front to the back of the cabinet, then an air deflector positioned as shown in Figure 9 shall be used in such a way to create a duct between the back of the cabinet and the vertical panel. This duct shall be closed in the front end side towards the testing room airflow discharge direction and open in the opposite side. On the top this duct shall be closed at the same height of the cabinet.

The distance, d_p , between the back of the cabinet and the vertical panel shall be specified by the manufacturer (see Figure 9).

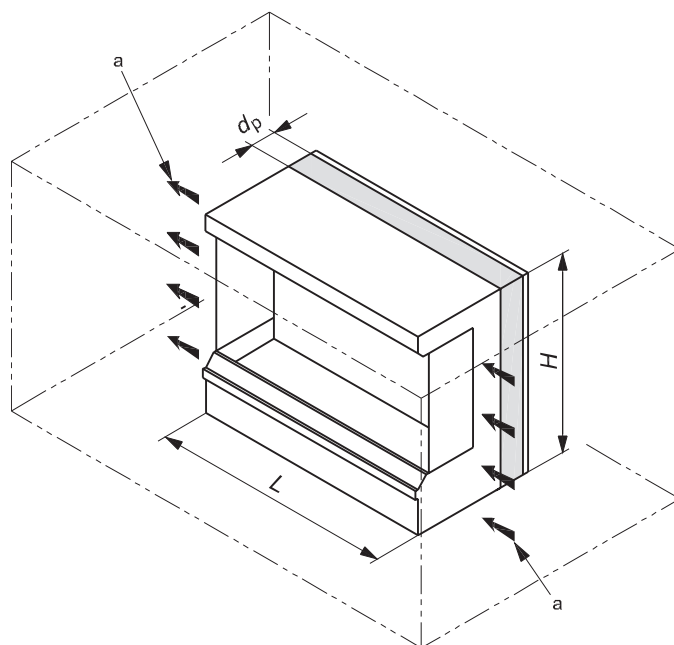
Dimensions in millimetres



Key

- d_p partition distance specified by the manufacturer
- 1 technical side wall — test room air discharge
- 2 technical side wall — test room air return
- 3 vertical partition for wall site cabinet with same length and height as cabinet
- a air currents parallel to the plane of the opening (in longitudinal direction)

Figure 8 — Cabinet location within test room



Key

L length of the air back duct = length of the cabinet

H height of the air back duct = height of the cabinet

d_p depth of the air back duct

a air currents parallel to the plane of the opening (in longitudinal direction)

Figure 9 — Size and position of the air back duct

For horizontal plug-in cabinets a back duct is not required.

NOTE In general the power of horizontal cabinets is much lower than that of vertical cases.

The warm condenser air can be removed by the test room airflow.

The air movement of the test room shall be parallel to the longitudinal axis according to [5.3.2.2](#).

The direction of the warm condenser airflow should be the same as the test room air flow direction and not opposed to it.

If this is not possible because of the cabinet's design the condenser airflow should be across the test room airflow direction (see [Figure 10](#)).