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ISO/DIS 19424

Refrigerated food lockers — Thermal and energy performance, ratings, environmental test conditions and associated testing methods

*Casiers réfrigérés pour aliments — Performance thermique et
énergétique, évaluation, conditions d'essai environnementales et
méthodes d'essai associées*

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Foreword

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Refrigerated food lockers — Thermal and energy performance, ratings, environmental test conditions and associated testing methods

1 Scope

This standard specifies requirements for the thermal and energy performance of refrigerated food lockers, in given environmental conditions and intended for the temporary cold storage of chilled or frozen pre-ordered or pre-selected foodstuff until the final collection by the consumer.

The standard also covers construction characteristics relevant for the thermal and energy performance.

This standard specifies tests conditions and methods for checking the requirements to be satisfied, as well as classification of refrigerated lockers, their marking and the list of characteristics to be declared by the manufacturer.

This standard is not applicable to refrigerated vending machines,

It is also not applicable for commercial beverage coolers covered by ISO 22044, ice cream freezers covered by ISO 22043 and refrigerated display cabinets covered by ISO 23953 as well as 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.

The standard does not cover safe storage temperatures for any specific perishable foodstuff.

The refrigeration system, providing the cooling function, is either fully or partially integrated or completely remote from the refrigerated food locker and connected by interconnecting pipe-work.

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

ISO 23953-2:2023, *Refrigerated display cabinets — Part 2: Classification, requirements and test conditions*

3 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/>

3.1

refrigerated food locker/locker

commercial appliance with chilled, frozen storage temperature zones, intended for the temporary cold storage of chilled or frozen pre-ordered or pre-selected foodstuff until the final collection by the consumer

Note 1 to entry: Refrigerated food lockers are foreseen for 24/7 h operation and are located inside or outside a building or under a specific weather protection which is not part of the refrigerated food locker.

Note 2 to entry: The refrigeration system, providing the cooling function, is either fully or partially integrated or completely remote from the refrigerated food locker and connected by interconnecting pipe-work.

Note 3 to entry: A refrigerated food locker consists of a single or multiple separated cold storage compartments with chilled, frozen or switchable storage temperature zones.

Note 4 to entry: Compartments are thermally insulated and access to the foodstuff is via a locked door or locked opening(s).

Note 5 to entry: The loading of the refrigerated food locker with the foodstuff is executed by professional personnel from the operator either from the front or back and self served by the consumer from the front.

3.2

installation

assembly of compartments, lockers, refrigerating system and all the apparatus necessary for their operation, which might be connected together on-site to make a complete system

3.3

protected installation

installation specifically designed for outdoor locations and capable of operating under specific range of outdoor conditions, in accordance with the information provided in the manufacturer's instructions; it is sheltered by an incomplete enclosure which includes one or more walls and include a roof, projecting on the front side of the installation for a length which guarantees protection from dripping water with a maximum tilt angle of 15°, see [Figure 1](#)

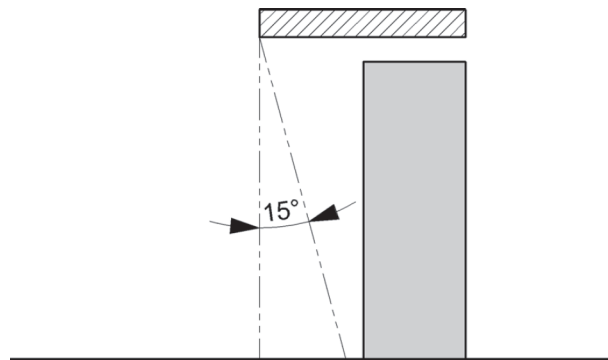


Figure 1 — Protected installation

3.4

indoor location

enclosed room or space inside a building, with controlled or uncontrolled environmental conditions

3.5

outdoor location

location outside of any building or structure, exposed to the external atmosphere, with no protection

3.6

harm

injury or damage to the health of people or damage to property of the environment

3.7

hazard

potential source of harm

3.8

residual risk

risk remaining after risk reduction measures have been implemented

3.9

risk

combination of the probability of occurrence of harm and severity of that harm

3.10

risk reduction measure

actions or means to eliminate hazards or reduce risks

3.11

net volume

V_N

storage volume inside the appliance which can be used for storage of products

Note 1 to entry: For the calculation method see Annex B.

4 Requirements

4.1 General

Installation environment can be indoor, outdoor and protected characteristics of a protected installation

- avoiding direct sun radiation 1 meter of shadow;
- rain;
- dust;
- wind (probably it exists an ISO standard for wind strength);
- snow loading (for the food locker itself) shall be taken into account 20 kg/sqm for outdoor installation.

4.2 Construction

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.

4.3 Operating characteristics

4.3.1 Classification according to temperature storage

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 [Clause 5](#).

Table 1 — M-package temperature classes

Class	Highest temperature, θ_{ah} , of warmest M-package less than or equal to (see Figure 9)	Lowest temperature, θ_b , of coldest M-package greater than or equal to (see Figure 9)	Lowest temperature, θ_{al} , of warmest M-package less than or equal to (see Figure 9)
	°C		
L1	-15	—	-18
M1	+5	-1	—
HT	+20	+10	—
AF	—	+ 5	—
NOTE 1 HT: High Temperature compartment.			
NOTE 2: AF antifreeze.			

4.3.2 Classification according to environmental condition

Outdoor installation requires that manufacturer state, additionally to the maximum, also the minimum environmental classes that the appliance is capable of sustaining with no changes.

Test for a winter condition shall be verified in a cold room, in one of the conditions listed in [Table 3](#) according to the relevant test of [Clause 5](#).

Classes intended to simulate outdoor winter conditions are specified in [Table 3](#) with a negative value for test room climate class.

5 Tests

5.1 General

When the characteristics of a locker are to be verified, all the tests shall be applied to one and the same refrigerated food locker.

All compartments within the locker shall be tested according to the declared temperature classification.

If the locker is capable of operating at different temperature classification., tests shall be carried out at each classification. Tests shall be carried out for each declared performance within the classes defined in [Table 1](#).

If a locker compartment is specified for multiple product temperature classification, the lowest temperature is used for testing of temperature performances ([5.3.4](#)) and energy consumption ([5.3.6](#)).

Lockers shall comply with the requirements specified in [clause 4](#) using the appropriate test method as described in [Table 2](#).

Table 2 — Test summary

Tests	Requirement clause	Test method	Test location
Seal test	4.1	5.2.1	Outside or inside test room (see 5.2)
Physical dimensions	4.2	5.2.2	
Temperature	4.3	5.3.4	Inside test room (see 5.3)
Defrosting	4.3	5.3.4	
Water vapour condensation	4.3	5.3.5	
Energy consumption	4.3	5.3.6	
heat extraction rate	4.3	5.3.7	

5.2 Tests outside or inside test room

The tests that deal with the inspection of construction characteristics, physical dimensions may be carried out outside the test room.

5.2.1 Seal test for doors

The effectiveness of doors provided to ensure a seal shall be tested as follows (with the locker 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 closed normally on it the strip of paper shall not slide freely.

NOTE 1 Attention is drawn to the fact that some lockers 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 is 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 locker closed and lit from the inside.

5.2.2 Linear dimensions, areas

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

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

5.3 Tests inside test room

5.3.1 General

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

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

These measurements should be made simultaneously.

5.3.2 Test room conditions

In the following, general testing conditions which are common for all tests specified in [5.3.4](#) to [5.3.7](#) carried out inside the test room are defined. These conditions concern the test room, the test and M-packages, and the measuring instruments.

A test room compliant with the requirements set out in ISO 23953-2:2023, 5.3.2.2 shall be used except when testing in winter condition as identified in [Table 3](#).

5.3.2.1 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 refrigerated food locker to be tested and on the location of the opening of the locker (see [5.3.3.1](#)).

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.

For winter conditions identified in [Table 3](#) the following apply:

- size of the room shall be no less than 20 m² and with the appliance placed in the middle with a minimum of 1 m of free space surrounding the appliance;
- room height shall be at least 1 m higher than the maximum height of the appliance.

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.

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 lockers 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 °C.

5.3.2.2 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.

5.3.2.3 Test room climate definition

5.3.2.3.1 Test room climate classes

Tests shall be carried out in at least one of the climate classes defined in [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 [5.3.2.3.2](#)). The exception to this is test-room climate class 3, for which the tolerance of the relative humidity is instead ± 3 units.

Only for test-room climate classes -3; -2 and -1 test room shall be capable of maintaining values of temperature on climate measuring point(s) within ± 2 °C, while the relative humidity is not relevant.

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
-3	-22	Not relevant	Not relevant	-
-2	-7	Not relevant	Not relevant	-
-1	+5	Not relevant	Not relevant	-
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
7	35	75	30,0	27,3

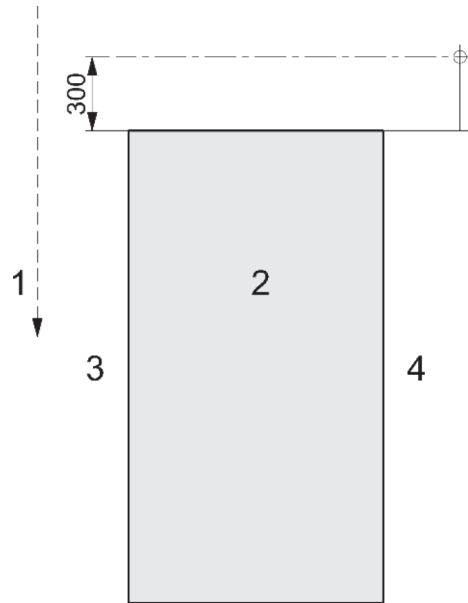
NOTE 1 The water vapour mass in dry air is one of the main points influencing the performance and the energy consumption of the lockers. Therefore the order of the climate class in the table is based on the water vapour mass column. See also Annex B to compare lab and store conditions.

NOTE 2 Classes with a negative test room climate class are intended to simulate outdoor winter conditions.

5.3.2.3.2 Climate measuring point

The point for measurement of ambient temperature and relative humidity shall be placed 300 mm upstream towards the test room air supply wall in accordance with plan view in [Figure 2](#) and section view in [Figure 3](#).

The warm condenser air flow shall be prevented from influencing the temperature at the measuring point by air deflectors or other suitable means (see [5.3.3.1](#), [Figures 4](#) and [5](#)).



Key

- 1 room air flow
- 2 locker
- 3 back
- 4 front

Figure 2 — Plan of climate measuring point

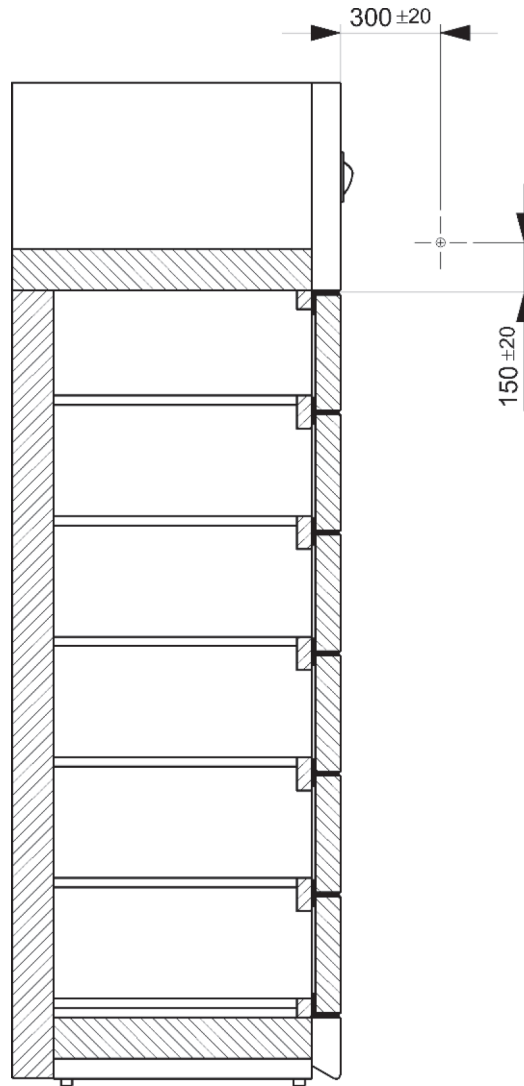


Figure 3 — Climate measuring point for one typical example

5.3.2.3.3 Test packages and life-time

Measurement test packages, where foreseen, shall be compliant with specifications of ISO 23953-2:2023, 5.3.2.5, 5.2.3.6 and 5.3.2.7.

5.3.2.3.4 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 locker 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 [5.3.7.2.2](#)).

- Illumination flux per square metre shall be measured to an accuracy of ± 10 %.
- Pressures shall be measured to an accuracy of ± 1 % during the t_{run} period of operation of the locker.
- 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 5.3.6).
- 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 less than or equal to 20 s (see 5.3.7.2).

In the case of electronic expansion valves (EEV), measurements shall be sampled at a rate to avoid undersampling due to the periodic openings of the valve.

NOTE According to the Nyquist - Shannon sampling theorem, undersampling means sampling a periodic signal with a frequency below 2 times the frequency of the signal itself.

- 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 % during the t_{run} period of operation of the locker (see 5.3.7).

5.3.3 Preparation of test locker and general test procedures

5.3.3.1 Locker selection, installation and positioning within the test room

Each locker 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 locker, 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 locker shall be located as follows (see Figure 4).

- $X = 2$ m and $B \geq 1$ m for all other lockers;
- $Y \geq 0,8$ m for horizontal lockers, vertical lockers;
- $A \geq 0,8$ m;

$A = Y$ should be used when $A \geq 1,5$ m;

- $C \geq$ height of locker +0,5 m (for vertical lockers).

The locker 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 locker is equal with a tolerance of ± 4 mm for each meter of length of the locker.

For lockers intended to be placed against a wall, and in order to check the running of lockers 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 locker or at a distance d_p from the rear as specified by the manufacturer (see Figure 4).

The distance, d_p , between the back of the locker and the vertical panel shall be specified by the manufacturer (see Figure 4). Where this is not specified the locker shall be tested with the partition placed against the rear of the locker. i.e. distance $d_p = 0$.