International Standard

ISO 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 document 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.

This document also covers construction characteristics relevant for thermal and energy performance.

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

This document is not applicable to refrigerated vending machines.

It is also not applicable to:

— commercial beverage coolers covered by ISO 22044;

— ice cream freezers covered by ISO 22043;

— refrigerated display cabinets covered by ISO 23953-1 and ISO 23953-2;

— cabinets intended for storage or cabinets intended for use, e.g. in catering or non-retail refrigerated applications.

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

The document 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, *Refrigerated display cabinets — Part 1: Vocabulary*

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

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 23953-1 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/

3.1.1
refrigerated food locker
locker
commercial appliance with frozen, chilled or high temperature storage temperature zones, intended for the temporary cold storage of pre-ordered or pre-selected foodstuff until the final collection by the consumer

Note 1 to entry: Refrigerated food lockers are foreseen for constant 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 frozen, chilled, high temperature or switchable storage temperature zones, see Table 1.

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.

3.1.2
installation
assembly of compartments, lockers, refrigerating system and all the apparatus necessary for their operation, which can be connected on-site to make a complete system

3.1.3
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

Note 1 to entry: Typically, a protected installation is sheltered by an incomplete enclosure which includes one or more walls and a roof. The roof typically projects 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.

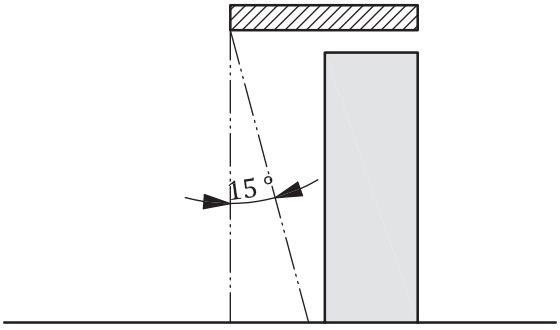

Figure 1 — Protected installation

3.1.4
indoor location
enclosed room or space inside a building, with controlled or uncontrolled environmental conditions

3.1.5
outdoor location
location outside of any building or structure, exposed to the external ambient, with no protection

3.1.6
net volume
storage volume inside the appliance which can be used for storage of products

Note 1 to entry: Net volume shall be calculated in accordance with Annex A.

3.2 Symbols

3.2.1 General

t_{run} running time, expressed in h

t_{stop} stopping time, expressed in h

t_{deft} defrost time, expressed in h

q_m mass flow rate of liquid refrigerant or secondary refrigerant, expressed in kg/s

Δt time between two consecutive measuring samples, expressed in h

N_{max} number of measuring samples, expressed in 24 h

Φ_{24} heat extraction rate during a whole day, expressed in kW

$\Phi_{24\text{-deft}}$ heat extraction rate during a whole day excepting defrost time, expressed in kW

$E_{CPEC,24\ h}$ pumping electrical energy consumption, expressed in kWh

$E_{DEC,24\ h}$ direct daily electrical energy consumption, expressed in kWh

E_{HREC} heat removal energy consumption, expressed in kWh

E_{LEC} lighting energy consumption, expressed in kWh

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

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

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

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

E_{TEC} total energy consumption, expressed in kWh

t_{rr} relative or percentage running time:

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

where

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

Φ_n instant heat extraction rate, expressed in kW

V_N net volume

3.2.2 Compression-type refrigeration systems

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

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

T_{mrun} = θ_{mrun} + 273,15, expressed in K

3.2.3 Indirect refrigeration-type systems

θ_i secondary fluid temperature at locker inlet, expressed in °C

θ_o secondary fluid temperature at locker outlet, expressed in °C

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

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

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

c_i specific heat of secondary fluid, expressed in kJ/(kg · K), at locker inlet

c_o specific heat of the secondary fluid, expressed in kJ/(kg · K), at locker outlet

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

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

4 Requirements

4.1 General

The installation can be indoor or outdoor. In case of outdoor installation, a protected installation shall have the following characteristics:

— avoid direct sun radiation 1 m of shadow;

— protect from rain;

— protect from dust;

— protect from wind;

— protect from snow loading (for the food locker itself) shall be taken into account 20 kg/m^2 for outdoor installation.

4.2 Construction

The locker and its parts shall be constructed for normal conditions of handling, transport and use. The following requirements apply:

a) Interior fittings, including shelves, baskets, rails, etc. and their supports, shall withstand the loads for the intended use.

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.

4.3 Operating characteristics

4.3.1 Classification according to temperature storage

The performance of lockers shall be in conformity 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	—

Key

L1 Frozen temperature class

M1 Chilled temperature class

HT High temperature class

AF antifreeze class

4.3.2 Classification according to environmental condition

Outdoor installation requires that the manufacturer state the maximum as well as 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 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	5.2.2	Outside or inside test room (see 5.2)
Physical dimensions	4.2	5.2.3	
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

5.2.1 General

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

5.2.2 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.

The strip of paper shall not slide freely when the door is closed normally.

NOTE 1 Some lockers that have doors 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 locker 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.

5.2.3 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 that have detachable ends, overall dimensions are given with and without ends. If the locker includes jacks or other components for adjusting 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 (only for lockers with remote unit).

These measurements should be made simultaneously.

5.3.2 Test room conditions

5.3.2.1 General

Subclauses 5.3.2.2, 5.3.2.3 and 5.3.2.4 define general testing conditions which are common for all tests specified in 5.3.4 to 5.3.7 carried out inside the test room. These conditions concern the test room, the test and M-packages and the measuring instruments.

A test room that conforms to ISO 23953-2:2023, 5.3.2.2 shall be used except when testing in winter condition as identified in Table 3.

5.3.2.2 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:

— The size of the room shall be no less than 20 m^2 and with the appliance placed in the middle with a minimum of 1 m of free space surrounding the appliance.

— The 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 (λ = 0,03 W/m °C) should be used for the building of a new test room.

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

Lighting shall be installed to maintain 600 ± 100 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 (e.g. NCS 2706-G90Y or RAL 7032) so that the emissivity is between 0,9 and 1 at 25 °C.

5.3.2.3 Test room (empty): Thermal and air flow characteristics

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

— 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;

— 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.

Obstacles or irregularities projected into the room of more than 1 m^2 surface area facing the discharge technical side wall can exist along the walls. In this case, a three-dimensional grid inside the test room shall be investigated.

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

Air temperature measured at each of the measuring points 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.

The surface temperature of the walls, ceiling and floor shall be measured in proximity to the points which constitute the peripheral line of the grid. 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.

5.3.2.4 Test room climate definition

5.3.2.4.1 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 5.3.2.4.2). The exception to this is test room climate class 3, for which the tolerance of the relative humidity is ±3 units.

When testing at climate classes −3, −2 and −1, the test room shall be capable of maintaining the temperature within ±2 °C at the climate measuring point(s). When testing at climate classes −3, −2 and −1, 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

NOTE 1 The water vapour mass in dry air is one of the main points that influences the performance and energy consumption of the lockers. Therefore, the order of the climate class in the table is based on the water vapour mass column.

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