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Refrigerated storage cabinets and counters for professional use — Performance and energy consumption

Armoires et comptoirs frigorifiques de stockage destinés à un usage professionnel — Performances et consommation d'énergie

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO 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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This document was prepared by Technical Committee ISO/TC 86, *Refrigeration and air-conditioning*, Subcommittee SC 7, *Testing and rating of commercial refrigerated display cabinets*.

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

Refrigerated storage cabinets and counters for professional use — Performance and energy consumption

1 Scope

This document specifies requirements for the verification of performance and energy consumption of refrigerated storage cabinets and counters for professional use in commercial kitchens, hospitals, canteens, preparation areas of bars, bakeries, gelateria, institutional catering and similar professional areas.

The products covered in this document are intended to store foodstuffs. It specifies test conditions and methods for checking that the requirements have been satisfied, as well as classification of the cabinets and counters, their marking and the list of their characteristics to be declared by the manufacturer.

It is not applicable to:

— refrigerated cabinets used in the direct sale of foodstuffs;

— cabinets that carry out food processing and not just storage function (e.g. bakery cabinets that chill, heat and humidify);

— cabinets with water cooled condenser;

— appliances with remote condensing unit;

— appliances with open top tables and saladettes for preparation or storage of foodstuffs;

— cabinets specifically intended for storage of specific foodstuffs (i.e. fresh meat, fresh fish, etc.) operating at a temperature different from those specified in Table 1;

— chest freezers;

— appliances intended for short time /intermittent normal operation during the full day;

— built-in cabinets;

— roll-in cabinets;

— pass-through cabinets;

— ice cream freezers.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

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

3.1
refrigerated storage cabinet
cabinet cooled by an incorporated refrigerating system which enables chilled and frozen foodstuffs placed therein to be maintained within prescribed temperature limits

Note 1 to entry: Refrigerated storage cabinets are supplied with:

— transparent door: door where the transparent part is more than 20 % of the surface of the door;

— solid door: door where the transparent part is less than 20 % of the surface of the door.

3.1.1
vertical cabinet
refrigerated storage cabinet (3.1), having overall height equal or higher than 1 050 mm with one or more front doors or drawers accessing the same compartment

3.1.2
counter cabinet
refrigerated storage cabinet (3.1), having overall height lower than 1 050 mm, with one or more front doors or drawers accessing the same compartment

3.1.3
roll-in cabinet
refrigerated cabinet intended to be loaded with trolleys with shelves and designed to be introduced as such in the compartment

3.1.4
pass-through cabinet
refrigerated cabinet accessible from both sides

3.1.5
semi-professional or light duty cabinet
refrigerated cabinet for which the measurement of energy consumption and the capability of maintaining temperature in the compartment are verified when tested at test room climate class 3

3.1.6
normal duty cabinet
refrigerated cabinet for which the measurement of energy consumption and the capability of maintaining temperature in the compartment are verified when tested at test room climate class 4

3.1.7
heavy duty cabinet
refrigerated cabinet for which the verification of the capability of maintaining the temperature in the compartment is performed when tested at test room climate class 5 and the measurement of energy consumption is verified when tested at test room climate class 4

3.1.8
static air cabinet
cooling system without fan inside the cabinet, or system in which the fan can be switched off by the user

3.1.9
built-in cabinet
refrigerated storage cabinet (3.1) intended to be installed into a prepared recess in a wall or similar location and requiring furniture finishing

3.1.10
refrigerator
appliance where the chilled foodstuff is stored at temperature corresponding to that of class M1

3.1.11
freezer
appliance where the frozen foodstuff is stored at temperature corresponding to that of class L1

3.1.12
combined refrigerated cabinet
refrigerated cabinet with different temperatures for chilled and/or frozen foodstuffs in separate compartments of the same cabinet

3.1.13
multi use refrigerated cabinet
refrigerated cabinet or separate compartment of the same cabinet that may be set at different temperatures for chilled or frozen foodstuffs

3.1.14
ice cream freezer
horizontal closed refrigerated cabinet intended to store and/or display and sell pre-packed ice cream where access by the consumer to the pre-packed ice cream is gained by opening a lid (solid or transparent)

3.2
commercial kitchen
area in commercial premises where foodstuffs are processed and stored

Note 1 to entry: This area also includes counter area in a bar.

3.3
overall external dimensions
dimensions of the right parallelepiped bounded by the length, depth and height of the cabinet, including its projecting accessories

3.4
net volume
volume containing foodstuffs within the load limit

3.5
shelf
surface, excluding the base deck, on which the goods are stored

3.6
shelf sham
device intended to limit the loading of a shelf surface

3.7
shelf area
area defined by the external dimensions of the *shelf* (3.5) or internal dimensions of the base of the drawer

Note 1 to entry: The shelf area used for the calculation of volume is different from the area loaded with packages as given in 5.3.3.3.

Note 2 to entry: In case of shelves that are recessed into the cabinet walls the recess part is not considered for the calculation of the surface area.

3.8
load limit
each part of the cabinet boundary surface consisting of a plane or several planes within which foodstuffs can be loaded

3.9
load limit line
permanently marked boundary line denoting the limit of the loading surface

3.10
operating conditions
conditions which exist when the cabinet, including all permanently located accessories, has been set up with the recommendations of the manufacturer and is in service

Note 1 to entry: Specific operating conditions are defined in Clause 5.

3.11
defrosting
removal of frost, snow and ice from a refrigerated cabinet

3.11.1
automatic defrosting
defrosting (3.11) where no action is necessary by the user to initiate the removal of frost accumulation and to restore normal operation

Note 1 to entry: It includes automatic removal of defrost water.

3.11.2
semi-automatic defrosting
defrosting (3.11) where an action is necessary by the user to initiate the removal of frost accumulation and operating condition is restored automatically

Note 1 to entry: It either includes automatic removal of defrost water or entails manual removal of defrost water.

3.11.3
manual defrosting
defrosting (3.11) where an action is necessary by the user to initiate the removal of frost accumulation and restoration to normal operation requires a further action by the user

Note 1 to entry: It either includes automatic removal of defrost water or entails manual removal of defrost water.

3.12
defrost water removal
process through which defrost water is removed from a refrigerated cabinet

3.12.1
automatic removal of defrost water
removal and/or evaporation of defrost water that does not require any action by the user

3.12.2
manual removal of defrost water
removal of defrost water that requires an action by the user

3.13
condensing unit
combination of one or more compressors, condensers and liquid receivers (when required) and common accessories

3.14
compression-type refrigerating system
system in which refrigeration is effected by the vaporization at low pressure in a heat exchanger(evaporator) of a liquid refrigerant, the vapour thus formed being restored to the liquid state by mechanical compression to a higher pressure and subsequent cooling in another heat exchanger (condenser)

3.15
indirect-type refrigerating system
system in which a secondary refrigerant circulating system is installed between a central refrigerating system and a refrigerated cabinet

3.16
frame heating
system to avoid condensation on the frame surface and freezing of the gasket of the refrigerated cabinet

3.17
energy consumption
E24h
energy consumption of the refrigerated cabinet in kWh

3.18
M-package
test package fitted with a temperature measuring sensor at its geometric centre

3.19
M-package temperature class
classification of *M-package* (3.18) temperature according to temperatures of M-packages during the temperature test

3.20
climate class
classification of the test room climate according to the dry bulb temperature and relative humidity

3.21
drawer
retractable device for food storage, not located behind a door and accessible directly from the front of the cabinet

3.22
cabinet section
vertical part of a cabinet compartment containing one or more doors or *drawers* (3.21) placed above each other

4 Requirements

4.1 Condensate drainage

Where drains, drip trays or evaporation receptacles are fitted, they shall have a capacity such to avoid overflow immediately during the testing period of 5.3.3.6.1 and whenever relevant (e.g. in case of manual cleaning), specific instructions shall be given on how to access and clean them.

4.2 Operating characteristics

4.2.1 Classification according to temperature

The temperatures measured in the compartment(s) shall comply with the values specified in Table 1 and the tests shall be carried out as specified in 5.3.4.

Table 1 — M-package temperature classes

Class	Highest temperature, θ_{ah}, of warmest M-package less than or equal to (see Figure 11)	Lowest temperature, θ_b, of coldest M-package greater than or equal to (see Figure 11)	Lowest temperature, θ_{al}, of warmest M-package less than or equal to (see Figure 11)
	°C		
L1	–15	—	–18
M1	+5	–1	—

4.2.2 Defrosting

The proposed defrosting procedures (automatic or manual) shall not affect the temperature requirements (see 5.3.4).

4.2.3 Electrical energy consumption

The electrical energy consumption (E24h) shall be measured over a 24 h period according to the conditions and the test methods specified in 5.3.5.

The energy consumption shall be expressed in kWh/24 h rounded to two decimal places.

5 Test conditions

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.

Compartment(s) of a combined refrigerated cabinet that are not foreseen for storage of foodstuffs are not subjected to tests and verifications of this document.

Table 2 lists the tests and verifications.

Table 2 — Test summary

Tests and inspections	Test method	Test room
Temperature	5.3.4	Inside test room (see 5.3)
Defrosting	4.2.2	
Electrical energy consumption	5.3.5	
Calculation of net volume	6.1	Outside test room (see 5.2)

5.2 Tests outside test room

The tests which may be carried out outside the test room deal with the verification of physical dimensions, linear dimensions, areas and volumes.

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.

If the cabinet includes permanent jacks, rollers, feet or other components for adjustment of height, they are considered in the measurement of the height of the cabinet. The height for the counter shall not include the work top.

5.3 Tests inside test room

5.3.1 General

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

— temperature and defrosting;

— electrical energy consumption.

5.3.2 Test conditions

5.3.2.1 General

In the following, general testing conditions which are common for all tests specified in Clause 6 carried out inside the test room are defined. These conditions concern the test room, the test and M-packages, and the measuring instruments.

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

The test room shall be a parallelepiped space. The walls of the room shall be thermally insulated.

The minimum dimensions of the test room shall be such as to allow at least 0,5 m above the top of the cabinet, 1 m on the side of the climate measuring point, 0,5 m on the opposite side and 1,5 m on the front of the cabinet with doors in closed position (see Figure 4).

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 the 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 ± 100) lx measured at a height of 1 m above the floor level and shall be lit continuously during the test period.

The walls, ceilings and any partitions of rooms intended for the testing of refrigerated cabinets shall have an emissivity between 0,9 and 1 at 25 °C.

5.3.2.3 Test room climate definition

5.3.2.3.1 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).

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	25	60	16,7	12,0
4	30	55	20,0	14,8
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.				

5.3.2.3.2 Climate measuring point

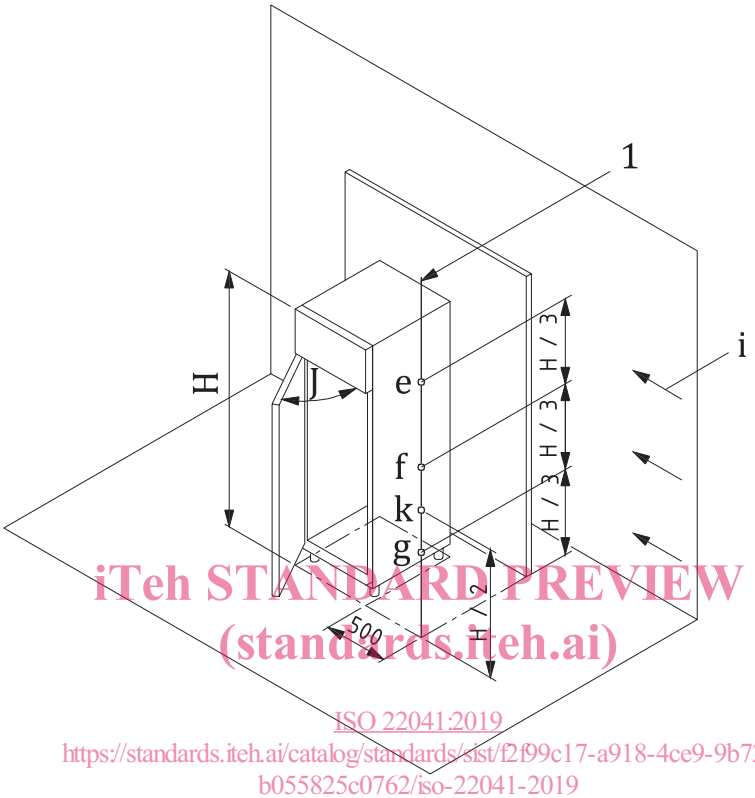
The climate measuring point shall be located in the test room air flow, 500 mm upstream of the cabinet (i.e. on the air supply side of the cabinet), in line with the front of the cabinet at a vertical height that is half the cabinet height (including cabinet feet and fixings).

To avoid undue influence from the movement of doors or of doors operating means, for the value of the relative humidity, the mean of the relative humidity values measured during 1 min shall be considered.

The warm condenser air flow shall be prevented from influencing the temperature at the measuring point by air deflectors or other suitable means.

Positioning and type of air deflectors if any shall be indicated. This information is included in the information foreseen in Annex A.

Dimensions in millimetres



Key

1	climate measuring line
H	overall height of cabinet including feet or castor
J	opening angle of cabinet door during test (≥60°)
e, f, g	climate measuring points detecting air flow
i	air currents parallel to the plane of the door opening
k	climate measuring point detecting temperature and humidity

Figure 1 — Environmental measuring points within the climate chamber

5.3.2.3.3 Temperature gradient

The temperature gradient shall be measured with the cabinet operating in the test room and with the doors and drawers closed. Temperatures shall be measured in a vertical line through the climate measuring point. The temperature gradient shall not exceed 2 °C/m and there shall not be a difference of more than 6 °C in the measurements made between the points 150 mm above the floor and 150 mm below the ceiling.

5.3.2.4 Test packages characteristics

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