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Ice-cream freezers — Classification, requirements and test conditions

Congélateurs pour crèmes glacées — Classification, exigences et conditions d'essai

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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*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 44, *Commercial and professional refrigerating appliances and systems, performance and energy consumption*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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.

Ice-cream freezers — Classification, requirements and test conditions

1 Scope

This document specifies the classification for horizontal closed ice-cream freezer with access of the product from the top via transparent or solid lid(s) and specifies their requirements and test methods.

The ice-cream freezers defined in this document are different from supermarket segment freezers, as they work with static air cooling, with a skin evaporator (no evaporator fan) and are used specifically for the storage and display of pre-packed ice-cream.

This document is only applicable to integral type refrigeration systems. It is not applicable to remote and secondary system type cabinets. Ice-cream freezers defined in this document are intended to have a net volume ≤600 l. For transparent lid ice-cream freezers only, they are intended to have a net volume/TDA ≥ 0,35 m.

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 817, *Refrigerants — Designation and safety classification*

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

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

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

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:

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

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

3.1 General

3.1.1
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) from the top

Note 1 to entry: See Annex A for the designation of the ice-cream freezer family.

3.2 Parts of ice-cream freezers

3.2.1
condensing unit
combination of one or more compressors, condensers and liquid receivers (when required) and the regularly furnished accessories

3.2.2
night cover
top cover permanently integrated into the *ice-cream freezer* (3.1.1) used to reduce the heat ingress (e.g. by infrared radiation or convection) during the period when there are no sales

3.3 Physical aspects and dimensions

3.3.1
depth
horizontal distance between the front and the rear of the *ice-cream freezer* (3.1.1)

3.3.2
width
horizontal distance between the two external sides of the *ice-cream freezer* (3.1.1)

3.3.3
height
vertical distance from the bottom to the top of the *ice-cream freezer* (3.1.1)

3.3.4
load limit
boundary surface consisting of a plane or several planes within which all *M-packages* (3.5.1) can be maintained within the limits for the declared M-package temperature class

3.3.5
load limit line
permanently marked boundary line denoting the edge of the *load limit* (3.3.4) surface

3.3.6
net volume
V_N
storage volume inside the appliance which can be used for storage of products

Note 1 to entry: The calculation method in 6.2.5 shall be applied.

3.3.7
gross volume
volume within the inside walls of the *ice-cream freezer* (3.1.1) or compartment, including internal fittings and the lid when closed

3.3.8
equivalent volume
V_{eq}
reference volume corrected for compartment temperature classification

Note 1 to entry: The calculation method in Annex B shall be applied.

3.3.9
total display area
TDA
total visible foodstuffs area, including visible area through the glazing, defined by the sum of horizontal and vertical projected surface areas of the *net volume* (3.3.6)

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

3.3.10
footprint
surface occupied by the *ice-cream freezer* (3.1.1)

3.4 Performance characteristics

3.4.1
normal conditions of use
operating conditions which exist when the *ice-cream freezer* (3.1.1), including all permanently located accessories, has been set up and situated in accordance with the recommendations of the manufacturer and is in service

Note 1 to entry: The effects of actions by non-technical personnel for the purposes of, e.g. loading, unloading, cleaning, defrosting, the manipulation of accessible controls and of any removable accessories, according to the manufacturer's instructions are applicable within this definition. The effects of actions resulting from interventions by technical personnel for the purposes of maintenance or repair are outside this definition.

3.4.2
defrost
removal of frost, snow and ice from an *ice-cream freezer* (3.1.1)

3.4.3
total energy consumption
TEC
total amount of energy used by an *ice-cream freezer* (3.1.1)

3.4.4
specific energy consumption for ice-cream freezers
SEC
index of the efficiency of the *ice-cream freezer* (3.1.1), expressed as the ratio of TEC divided by *equivalent volume* (3.3.8) (TEC/Equivalent volume)

3.4.5
product temperature
one of the classifications document establishing the performance level of the *ice-cream freezer* (3.1.1)

Note 1 to entry: Defined in Table 1.

3.4.6
relative compressor running time
ratio of compressor running time to overall duration of a measurement cycle excluding defrost time

3.5 Test environment

3.5.1
M-package
test package fitted with a temperature measuring device

3.5.2
climate class
classification of the test room climate according to the dry bulb temperature and relative humidity

3.5.3
M-package temperature class
classification of *M-package* (3.5.1) temperature according to the temperatures of the warmest M-packages during the temperature test

3.5.4
ice-cream freezer classification
designation given by the combination of *climate class* (3.5.2) and *M-package temperature class* (3.5.3)

4 Symbols and abbreviated terms

t_{run} running time — time during which the compressor is running within the 24 h test period

t_{stop} stopping time — time during which the compressor is not running within the 24 h test period and excluding defrost time

Δt time between two consecutive measurement samples

N_{max} number of measuring samples in the 24 h test period

RH Relative humidity

SEC specific energy consumption for ice-cream freezers expressed in kilowatt hours per 24 h per m^3 (TEC/V_{eq});

TEC total energy consumption in kilowatt hours per 24 h period

T_{rr} relative or percentage running time:

$$t_{rr} = \frac{t_{run}}{t_{run} + t_{stop}} \quad (1)$$

where $t_{run} + t_{stop} = 24$ h

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

V_{eq} equivalent volume

V_N net volume

5 Classification and requirements

5.1 Classification

The classification of the ice-cream freezers is done according to temperature. The performance of ice-cream freezers 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 Annex E.

Table 1 — Classification according to temperature

Class	Warmest M-package temperature colder or equal to in all tests except lid opening test °C	Warmest M-package maximum temperature rise allowed K
C1	−18,0	2,0
C2	−7,0	2,0
S	Special classification	2,0

5.2 Requirements

5.2.1 Construction

5.2.1.1 Strength and rigidity

The ice-cream freezer 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 shall be sufficiently strong for the duty required;

b) where sliding shelves, baskets or trays 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.

5.2.1.2 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 have sufficient free length and/or vibration eliminators to prevent failure due to fatigue. Where necessary, pipes and valves shall be adequately thermally insulated.

5.2.1.3 Lids

Lids shall be condensate-free at the climate class specified by the manufacturer.

When any 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 (see 6.2.1). The 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.

5.2.1.4 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.

5.2.2 Materials

5.2.2.1 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.

5.2.2.2 Corrosion resistance

Metal parts, used in the construction of cabinets, shall have resistance to corrosion appropriate to their location and function.

5.2.2.3 Thermal insulation

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.

Suitable means shall be used to prevent deterioration of the thermal insulation by the ingress of moisture.

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.

5.2.3 Refrigerating system

5.2.3.1 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 ice cream freezer is in operation or at rest. The maximum ambient temperature during transit shall be taken into account. All refrigerant containing components shall be in accordance with ISO 5149-2.

5.2.3.2 Condensation

There shall be suitable means to prevent water condensing on cold surfaces of the ice cream freezer and its parts and from harmfully affecting the operation of the refrigerating system or its controls.

5.2.3.3 System protection

For ice-cream freezers, the refrigerating system shall suffer no damage if any lid in the cooler is left open while the ice cream freezer is operating in an ambient temperature corresponding to the climate class (see Table 1) for which the cooler is intended. When the 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.

5.2.3.4 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 due to their toxicity, flammability, etc. Guidance on this point is available in ISO 5149-2.

5.2.4 Electrical components

5.2.4.1 General

Electrical components shall be in accordance with EN 60335-1 and EN 60335-2-89.

5.2.4.2 Temperature display

The ice-cream freezer shall incorporate a temperature display instrument showing the air temperature in the refrigerated display ice-cream freezer, at the load line, to provide an indication of the operation and functioning of the refrigerating equipment and information on its operating state.

NOTE As a rule, measured air temperature is not identical with pre-packed ice-cream temperature in an ice-cream freezer.

5.2.4.3 Temperature-measuring instrument

Suitable temperature-measuring instruments shall be used, i.e. those that fulfill the following requirements:

— the unit symbol (°C) shall be inscribed or displayed on the temperature-measuring instrument;

— the range of measurement shall be at least from −40 °C to + 40 °C;

— the scale division or smallest numerical increment shall be less than or equal to 1 °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.

When temperature-measuring instruments are employed in ice-cream freezers:

— one temperature-measuring instrument shall be employed for each ice-cream freezer with its own refrigerating circuit.

5.2.4.4 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.

The temperature sensor of a thermometer is considered to be “readily accessible” if it is reached directly for examination. It is necessary to remove the access panel(s) to carry out replacement.

NOTE 1 The positioning of the temperature sensor in a guide tube is also considered to be “readily accessible” if the sensor is introduced into and removed from the guide tube without a tool.

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.

NOTE 2 For electronic controllers, it is possible to display a calculated temperature.

NOTE 3 For recording and display of temperatures, one or two temperature sensors are used. The temperature sensor is the same as those used for controlling the refrigeration. An alarm is activated in case of error. This option is not in accordance with the requirements of EN 12830.

5.2.5 Operating characteristics

5.2.5.1 Water vapour condensation

The performance of the ice-cream freezer 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 6.3.6.4.

5.2.5.2 Energy consumption

The energy consumption shall be stated by the manufacturer. The total energy consumption (TEC) shall be measured and calculated according to the conditions and the test methods specified in 6.3.6.6.3.

5.2.5.3 Specific energy consumption

The ice-cream freezer specific energy consumption (SEC) as ratio between TEC and equivalent volume (TEC/V_{eq}) shall be stated by the manufacturer. This value shall be used to compare the energy efficiency between different ice-cream freezers.

6 Tests

6.1 General

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

Table 2 lists the tests and inspections that shall be carried out. Ice-cream freezers shall comply with the requirements specified in this part of the document using the appropriate test method.

Table 2 — Test summary

Tests and inspections	Requirement clause	Test method	Test room
Seal test	5.2.1.3	6.2.1	Outside test room (see 6.2)
Absence of odour and taste (not compulsory)	—	Annex D	
Durability of lid	5.2.1.3	6.2.2	
Temperature	5.1	6.3.6.1	Inside test room (see 6.3)
Water vapour condensation	5.2.3.2	6.3.6.4	
Temperature rise time	—	6.3.6.5	
Energy consumption	5.2.5.2	6.3.6.6	

6.2 Tests outside test room

6.2.1 General

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.

6.2.2 Seal test for lids

The effectiveness of lids provided to ensure a seal shall be tested as follows (with the ice-cream freezer 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 lid closed normally on it the strip of paper shall not slide freely.

NOTE 1 Attention is drawn to the fact that some ice-cream freezers having lids 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 ice-cream freezer 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 ice cream freezer closed and lighted from the inside.

6.2.3 Test on durability of lid

6.2.3.1 General

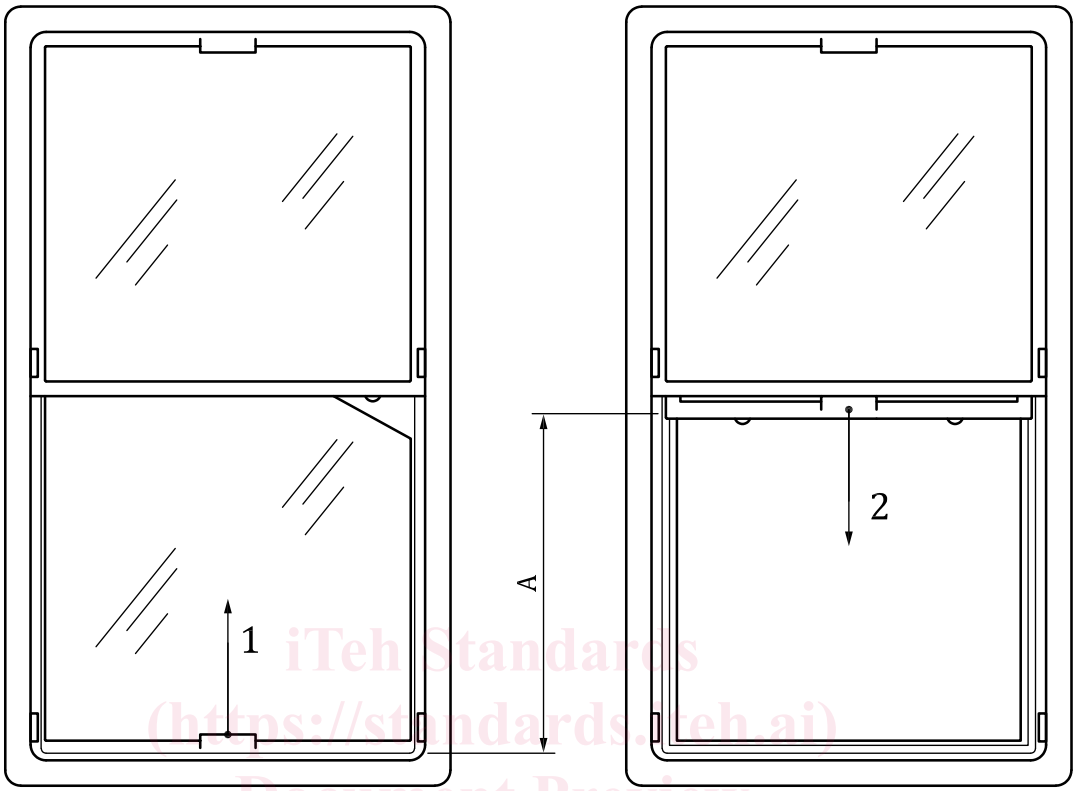
The purpose of these tests, carried out using the following procedures, is to check the durability of the lids. The ambient temperature shall be between +16 °C and +32 °C. The refrigerating appliance shall be switched off.

6.2.3.2 Opening sequence

The lids shall be pulled out to within 15 mm to 20 mm of their fully open position (Figure 1).

6.2.3.3 Closing sequence

The lids shall be closed as in normal use from within 15 mm to 20 mm of their fully closed position (Figure 1).



Key

A opening course
1 pull out
2 push

Figure 1 — Durability of lid

The number of cycles per minute shall be between 5 and 10. Each lid shall withstand 30 000 opening and closing operations without deterioration which could be prejudicial to the air-tightness of the lid sealing. All the lids shall be present on the cabinet when tested.

6.2.4 Linear dimensions, areas and volumes

Measurements shall be made with the ice-cream freezer not in operation but situated in a place where the temperature is maintained between 16 °C and 30 °C. If the ice cream freezer includes jacks or other components for adjustment of height (i.e. castor or wheel), the height defined shall be the minimum height necessary at installation of the ice cream freezer.

When measuring the net volume, parts necessary for the proper functioning of the ice-cream freezer shall be fitted as intended and the volume representing the space occupied by these parts deducted (see 6.2.5).

6.2.5 Net volume calculation

The net volume (VN) shall be calculated as the sum of the individual volumes obtained within the load limit lines, excluding any basket(s).

Each of the individual volumes shall be expressed in litres, to two decimal places. The net volume shall be rounded to the nearest decimal place.

6.3 Tests inside test room

6.3.1 General

The tests which are carried out inside the test room measure the following characteristics:

— temperature;

— water vapour condensation;

— electrical energy consumption.

General test conditions are defined, which are common for all tests carried out inside the test room. These conditions concern the test room, the test and M-packages, and the measuring instruments.

6.3.2 Test room conditions

6.3.2.1 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 ice-cream freezer to be tested.

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 (λ = 0,03 W/m °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 ± 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 the ice-cream freezer shall be painted in light grey (for example, NCS 2706-G90Y or RAL 7032) with an emissivity between 0,9 and 1 at 25 °C.

6.3.2.2 Thermal and air flow characteristics

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

— with test room empty and with lighting switched on,

— in a test room at ambient temperature of 25 °C and 60 % RH,

— measuring the velocity, temperature and relative humidity of the air at different points within 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 the evaluation.

