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Household refrigerating appliances — Refrigerators with or without low-temperature compartment — Characteristics and test methods

Appareils de réfrigération ménagers — Réfrigérateurs ménagers avec ou sans compartiment basse température — Caractéristiques et méthodes d'essai

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Contents

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Annexes

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 7371 was prepared by Technical Committee ISO/TC 86, *Refrigeration*, Subcommittee SC 5, *Construction and testing of household refrigerators*.

This second edition cancels and replaces the first edition (ISO 7371:1985), which has been technically revised.

Annexes A and B of this International Standard are for information only.

Household refrigerating appliances — Refrigerators with or without low-temperature compartment — Characteristics and test methods

1 Scope

This International Standard specifies the essential characteristics for household refrigerators, with or without a cellar or low-temperature compartment, which are wholly factory assembled, and lays down the methods of test for the checking of these characteristics.

It does not apply to food freezers, which are covered in ISO 5155, or refrigerator-freezers, which are covered in ISO 8187.

It does not include refrigerating performance characteristics and tests, or particular definitions for refrigerators cooled by internal forced air circulation, which are the subject of ISO 8561.

The tests described in this International Standard are type tests. When it is necessary to verify the performance of a refrigerator of a given type in relation to this International Standard, all the tests described should in principle be applied to one and the same unit.

These tests can also be made individually for the study of a particular characteristic.

Where no test method is specified, the particular requirement concerned is to be considered as a recommendation.

The electrical and mechanical safety requirements applicable to household refrigerators are specified in IEC 335-2-24.

Additional safety requirements applicable to mechanical refrigerating systems of household refrigerators are given in ISO 5149.

The safety requirements applicable to gaseous and liquid fuel heating equipment of absorption-type household refrigerating systems will form the subject of a future International Standard.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 534:1988, *Paper and board — Determination of thickness and apparent bulk density or apparent sheet density.*

ISO 817:—[1], *Refrigerants — Number designation.*

ISO 5149:1993, *Mechanical refrigerating systems used for cooling and heating — Safety requirements.*

IEC 335-2-24:1992, *Safety of household and similar electrical appliances — Part 2: Particular requirements for refrigerators, food freezers and ice-makers.*

1) To be published. (Revision of ISO 817:1974)

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 household refrigerator (hereinafter referred to as "refrigerator"): Insulated cabinet of suitable volume and equipment for household use, cooled by one or more energy-consuming means, and having one or more compartments intended for the preservation of food, one at least of which is suitable for the storage of fresh food.

NOTE 1 From the point of view of installation, there are various types of household refrigerators, for example free-standing, wall-mounted, built-in, etc.

3.2 Compartments and sections

3.2.1 fresh food storage compartment: Compartment intended for the storage of unfrozen food which may be itself divided into sub-compartments, and in which the temperatures can be maintained in accordance with 6.2.1.

3.2.2 cellar compartment: Compartment intended for the storage of particular foods or beverages at a temperature warmer than that of the fresh food storage compartment, and in which the temperatures can be maintained in accordance with 6.2.1.

3.2.3 low-temperature compartment: Compartment which may be either

— an ice-making compartment, or

— a frozen food storage compartment.

NOTE 2 A refrigerator may have one or several low-temperature compartments. Alternatively, it may have no low-temperature compartment.

3.2.4 ice-making compartment: Compartment intended specifically for the freezing and storage of water ice-cubes.

3.2.5 frozen food storage compartments: Compartments intended specifically for the storage of frozen food. They are classified according to their temperature, as follows.

3.2.5.1 "one star" compartment: Compartment in which the storage temperature (see 3.4.3.2), measured as described in clause 13, is not warmer than − 6 °C.

3.2.5.2 "two star" compartment: Compartment in which the storage temperature (see 3.4.3.2), measured as described in clause 13, is not warmer than − 12 °C.

3.2.5.3 "two star" section: Part of a "three star" compartment which is not self-contained (i.e. which does not have its own individual access door or lid), in which the storage temperature (see 3.4.3.2), measured as described in clause 13, is not warmer than − 12 °C (see 7.2.6).

3.2.5.4 "three star" compartment: Compartment in which the storage temperature (see 3.4.3.2), measured as described in clause 13, is not warmer than − 18 °C.[2)]

3.3 General definitions

3.3.1 top-opening type: Refrigerator in which the compartment(s) is (are) accessible from the top.

3.3.2 upright type: Refrigerator in which the compartment(s) is (are) accessible from the front.

3.3.3 overall dimensions (doors or lids closed): Measurements of the rectangular parallelepiped, whose base is horizontal, within which the refrigerator is inscribed to include the complete appliance except for the handle, the protrusion of which, if any, is to be specified separately.

3.3.4 overall space required in use (doors or lids open): Overall dimensions including the handle, increased by the space necessary for free circulation of the cooling air when the appliance is in service, plus the space necessary to allow opening of the means of access to that minimum angle permitting removal of all removable parts such as containers and shelves, including the drip tray with water if this has to be removed and emptied manually (see figure 1).

2) In certain instances, "two star" sections and/or compartments are permitted within the compartment (see 7.2.6).

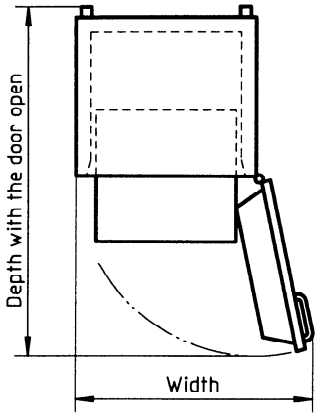

Figure 1 — Overall space required in use (upright type)

3.3.5 Volumes

3.3.5.1 gross volume: The volume within the inside walls of the appliance, or of a compartment with external door, without internal fittings, doors or lids being closed.

3.3.5.2 rated gross volume: Gross volume stated by the manufacturer.

3.3.5.3 total gross volume: Sum of the gross volumes of the fresh food storage compartment(s), low-temperature compartment(s) [including any "two star" section(s) and/or compart- ment(s) contained in a "three star" compartment], and cellar compartment(s), even if their doors or lids are independent.

3.3.5.4 rated total gross volume: Total gross volume stated by the manufacturer.

3.3.5.5 storage volume: That part of the gross volume of any compartment which remains after deduction of the volume of components and spaces recognized as unusable for the storage of food, determined by the method given in 7.2.

3.3.5.6 rated storage volume: Storage volume stated by the manufacturer.

3.3.5.7 total storage volume: Sum of the storage volumes of the appliance, comprising the storage volumes of the fresh food storage compartment(s), low-temperature compartment(s) [including any "two star" section(s) and/or compartment(s) contained in a "three star" compartment] and cellar compartment(s).

3.3.5.8 rated total storage volume: Total storage volume stated by the manufacturer.

3.3.6 Storage surfaces

3.3.6.1 shelf: For the purpose of this International Standard, a shelf is any horizontal surface (shelves, partitions, etc.) on which food can be placed.

It may be formed by one component or by components fitted side by side, which may be fixed or removable.

3.3.6.2 storage shelf area: Sum of the horizontal projections of the storage surfaces within the storage volume, including door shelves and the bottom of each compartment, determined in accordance with 7.3.

3.3.6.3 rated storage shelf area: Storage shelf area stated by the manufacturer.

3.3.7 load limit(s): Surface enveloping the frozen food storage volume(s).

3.3.8 load limit line(s): Permanent mark(s) indicating the limits of "three star" frozen food storage volume(s).

3.4 Definitions relating to some performance characteristics

3.4.1 energy consumption: Consumption of a refrigerator over a period of 24 h, running under stable operating conditions at an ambient temperature of + 25 °C (in the case of class SN, class N and class ST refrigerators) or + 32 °C (in the case of class T refrigerators) (see clause 4) and measured under the conditions specified in clause 15.

3.4.2 rated energy consumption: Energy consumption stated by the manufacturer.

3.4.3 Storage temperatures

3.4.3.1 fresh food storage temperature, t_m: Arithmetical average of the mean temperatures t_1, t_2 and t_3 which are the mean internal temperatures measured in copper or brass cylinders (see 8.4) placed at given points in the fresh food storage compartment as specified in 8.5, i.e. the arithmetical average of the extreme values at these points during a complete control cycle (see 3.4.6).

3.4.3.2 frozen food storage temperature, t^{***}, t^{**}, t^{*} (as appropriate): Maximum temperature of the warmest "M" package of a load placed in storage as specified in 8.6.

3.4.3.3 cellar compartment temperature, t_{cm}: Arithmetical average of the mean temperature t_{c1}, t_{c2} and t_{c3} (as appropriate, see figure 10), which are the mean internal temperatures measured in copper of brass cylinders (see 8.4) placed at given points in the cellar compartment as specified in 8.5, i.e. the arithmetical average of the extreme values at these points during a complete control cycle (see 3.4.6).

3.4.4 Defrosting

3.4.4.1 automatically defrosted: A compartment is automatically defrosted where no action is necessary by the user to initiate the removal of frost accumulation nor to restore normal operation, and where the disposal of the defrost water is automatic.

3.4.4.2 semi-automatically defrosted: A compartment is semi-automatically defrosted where an action is necessary by the user to initiate the removal of frost accumulation and normal operation is restored automatically, the defrost water being removed manually or removed and disposed of automatically.

A compartment is also semi-automatically defrosted where no action is necessary by the user to initiate the removal of frost accumulation nor to restore normal operation, but where the removal of the defrost water is manual.

3.4.4.3 manually defrosted: A compartment is manually defrosted where an action is necessary by the user to initiate the removal of frost acccumulation and restoration to normal operation requires a further action by the user, the defrost water being removed manually or removed and disposed of automatically.

The method of defrosting shall be specified separately for the fresh food storage compartment(s) and low-temperature compartment(s).

The means of disposal of defrost water may be any of the following types.

3.4.4.4 automatic disposal of defrost water: Disposal of defrost water is automatic where the removal and the evaporation of the defrost water does not require any action by the user.

3.4.4.5 manual removal of defrost water: Removal of defrost water is manual where an action is necessary by the user to remove the defrost water.

3.4.5 "M" package: A test package in accordance with 8.2, of dimensions 50 mm × 100 mm × 100 mm, fitted with a temperature sensor at its geometric centre.

3.4.6 control cycle: Period between two successive starts, or two successive stops, of a refrigerating system, or of a part of a system, under stable operating conditions.

3.4.7 stable operating conditions: In the case of cyclic operation of a refrigerating system, or of a part of a system, including any automatic defrost periods, stable operating conditions are deemed to be reached when, for each of the "M" packages and copper or brass cylinders, the temperatures at all corresponding points during successive operating cycles agree within ± 0,5 K and there is no marked trend away from the mean temperature during a period of 24 h.

In the case of continuous operation of a refrigerating system, or of a part of a system, stable operating conditions are deemed to be reached when, although there may be a certain variation in temperature, the increase or decrease in the temperature of all the "M" packages and copper or brass cylinders does not exceed 0,5 K during a period of 18 h.

3.4.8 percentage running time, R (apparatus with on/off control for the refrigerating source)**:** Under given conditions of ambient temperature and of internal storage temperature, the ratio

$$R = \frac{d}{D} \times 100$$

where

d is the duration of the refrigerating system operation during a whole number of cycles;

D is the total duration of the cycles.

In the case of a refrigerator having two independent refrigerating systems, there will be two values for percentage running time, one for the fresh food storage compartment and one for the low-temperature compartment.

3.4.9 ice-making capacity: Quantity of ice the refrigerator is capable of producing within 24 h, or the time necessary for the freezing of the water in the ice tray(s) supplied with the appliance.

3.4.10 ambient temperature: Temperature in the space surrounding the appliance under test. It is the arithmetical average of the mean value of temperatures t_{a1} and t_{a2}, measured (see 8.1.1) at two points located 350 mm from the vertical centreline of the side walls of the appliance at 1 m above the floor line.

3.4.11 temperature rise time: Period between the moment when, under specified test conditions, the

temperature of the warmest "M" package in the "three star" compartment reaches – 18 °C to the moment when any of the "M" packages (excluding any "two star" sections) first reaches a temperature of – 9 °C when the operation of the refrigerating system is interrupted.

3.5 Definitions relating to the refrigerating system

3.5.1 refrigerant: Fluid used for heat transfer in a refrigerating system, which absorbs heat at a low temperature and a low pressure of the fluid and rejects heat at a higher temperature and a higher pressure of the fluid, usually involving changes of state of the fluid.

3.5.2 cooling device: Device containing the evaporator or in thermal contact with the evaporator; it may be a device with fins or may be suitably shaped for the storage of frozen food or water ice-cubes.

3.6 Definitions relating to compression-type refrigerators

3.6.1 compression-type refrigerator: Refrigerator 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).

3.6.2 hermetically sealed motor-driven refrigerating compressor: Motor-compressor in which the compressor and the electric motor (or its moving parts at least) are enclosed in a shell rendered gastight by welding, brazing or other means such that dismantling is not normally possible after assembly. It does not include moving parts outside the shell.

3.6.3 hermetically sealed compressor refrigerating system: Complete system, essentially comprising a hermetically sealed motor-driven compressor, a condenser, a pressure-reducing device, an evaporator, and all other parts containing refrigerant permanently interconnected by the manufacturer by welding, brazing or other means.

3.6.4 refrigerant compressor: Mechanically operated component which withdraws refrigerant vapour from the evaporator and discharges it at a higher pressure to the condenser.

3.6.5 expansion device: Device in which the pressure of the refrigerant is reduced from that of the condensed liquid to that of the evaporator.

3.6.6 condenser: Heat exchanger in which, after compression, vaporized refrigerant is liquefied by rejecting heat to an external cooling medium.

3.6.7 evaporator: Heat exchanger in which, after expansion, the liquid refrigerant is vaporized by absorbing heat from the medium to be refrigerated.

3.6.8 thermostat: Device which automatically regulates the operation of a refrigerating system according to the temperature of an evaporator or of a compartment.

3.7 Definitions relating to absorption-type refrigerators

3.7.1 absorption-type refrigerator: Refrigerator in which refrigeration is effected by evaporation of a liquid refrigerant in an evaporator, the vapour thus formed being then absorbed by an absorbent medium from which it is subsequently expelled at a higher partial vapour pressure by heating and then liquefied by cooling in a condenser.

3.7.2 absorption refrigerating system: Complete system essentially comprising a boiler, a condenser, an evaporator, an absorber, and all other parts containing refrigerant permanently interconnected by the manufacturer by welding, brazing or other means.

3.7.3 boiler: Heat exchanger in which the absorbed refrigerant is expelled from the absorbent medium by the application of heat.

3.7.4 absorber: Component in which the absorption of the refrigerant by an absorbent medium takes place, the heat emitted in the process being rejected to the environment.

3.7.5 condenser: Heat exchanger in which the vaporized refrigerant, after leaving the boiler, is liquefied by rejecting heat to an external cooling medium.

3.7.6 evaporator: Heat exchanger in which the liquid refrigerant, after a drop in its partial pressure, is vaporized by absorbing heat from the medium to be refrigerated.

4 Classification

With respect to the ability of appliances to operate in extreme ambient temperatures, this International Standard relates to the four climate classes given in table 1.

Table 1 — Climate classes

Values in degrees Celsius

Class	Symbol	Range of ambient temperatures in which the appliances are intended to be used, and for which the required storage temperatures shall be fulfilled (see 6.2.1)
Extended temperate	SN	+ 10 to + 32
Temperate	N	+ 16 to + 32
Subtropical	ST	+ 18 to + 38
Tropical	T	+ 18 to + 43

5 Materials, design and manufacture

5.1 General

Refrigerators shall be constructed in such a manner as to ensure adequate performance and durability in use. Their performance in use is checked by applying a series of relevant tests.

This clause defines some characteristics which are not tested but to which the attention of the manufacturer is drawn.

5.2 Materials and finishes

Materials used inside refrigerators shall not transmit odours or taste to food. When testing in accordance with clause 18, the mean value of the individual results during each evaluation for odour and taste shall not exceed mark 1.

Materials used inside refrigerators shall not contaminate food placed in contact with them nor transmit poisonous substances to food. They shall be resistant to the action of moisture and food acids.

All surface finishes shall, for the purpose intended, be resistant to impact, sufficiently hard, colour-fast, smooth, easily washable, and resistant to damage by moisture and by food acids.

5.3 Thermal insulation and airtightness

The thermal insulation of refrigerators should be efficient and permanently maintained. In particular, the insulating material shall not be subject to shrinkage and shall not allow, under normal working conditions, an excessive accumulation of moisture.

No running water shall appear externally when the refrigerator is subjected to the water vapour condensation test specified in clause 14.

When the door or lid is closed, there shall be no abnormal ingress of air into the interior.

A strip of paper shall not slide freely when door or lid seals are subjected to the airtightness test specified in clause 9.

5.4 Doors, lids and fittings

Hinges and handles shall be strong and resistant to corrosion.

External doors and lids of fresh food storage compartments and cellar compartments shall withstand 100 000 openings and closings without deterioration which may be prejudicial to the airtightness of the refrigerator when subjected to the durability test of clause 11.

In the case of refrigerators with a low-temperature compartment having a separate external access door or lid, the hinges and handles of the door or lid of that compartment shall withstand 10 000 openings and closings.

The fastening system shall be such as to enable the door or lid to be easily closed and opened. It shall be efficient and capable of maintaining its proper function.

For refrigerators having any compartment or section with a volume equal to or greater than 60 l, it shall be possible to open the door or lid of that compartment from the inside with a force not exceeding 70 N when subjected to the test specified in clause 10. The volume of any compartment or section shall be determined when all shelves, partitions and other internal components removable without the aid of a tool have been removed. However, if the door or lid is provided with a mechanical latch which can be locked by a removable key, and the door or lid cannot be closed with the key turned to the locked position, this requirement applies only when the latch is unlocked, provided that the refrigerator is accompanied by an instruction stating that the key shall be kept out of the reach of children and not kept in the vicinity of the refrigerator.

5.5 Shelves and containers

Shelves, containers and similar components shall have adequate mechanical strength. Those used for storing food shall withstand the loading test specified

in clause 12 without showing such distortion that they could no longer fulfil their intended function. In particular, sliding or revolving components shall be capable of their full movement when loaded.

Shelves, containers and similar components which are intended to be removable should be easily removable.

5.6 Disposal of defrost water

NOTE 3 This subclause applies to fresh food storage and cellar compartments only.

A means shall be provided for collecting completely the defrost water either in a removable internal drip tray, or in an external receptacle wherein the defrost water is evaporated, or by other means.

The drip tray or other defrost water receptacle should have adequate volume and, additionally, external drip trays should have adequate evaporating means.

The volume of drip trays (either internal or external) of evaporators which are semi-automatically or manually defrosted shall be at least equal to the volume calculated in multiplying by 1 mm the total external and internal area of the related evaporator(s).

Any drainage system shall be designed to ensure its proper function. It shall be easily accessible for the clearing of any blockage, and shall be designed so as to prevent any undue ingress of air into the food storage compartment(s).

5.7 Refrigerating system

5.7.1 The mechanical operation of refrigerators shall not give rise to undue noise or vibration.

5.7.2 The design of the condenser should be such as to reduce to a minimum the accumulation of dust.

5.7.3 The evaporator shall be so designed or protected so that it will not suffer any damage during the normal use of the appliance.

The heat exchange surfaces shall be made of corrosion-resistant material, or shall be finished with a corrosion-proof non-poisonous coating resistant to temperature changes and alternating frosting and defrosting.

5.7.4 The means of adjustment of temperature control devices, if intended to be adjusted by the user, should be readily accessible, and their function shall be such as to enable the refrigerator to meet the requirements of the performance tests.

5.7.5 Pipes and connections to moving or resiliently mounted parts should be arranged so as not to generate noise, not to touch nor to transmit vibrations to other parts, and should be so designed as to prevent failure due to fatigue. All other pipes and connections should be securely anchored. Where necessary, pipes and valves should be properly insulated.

5.7.6 Suitable means should be provided to prevent water condensed on cold parts from affecting the operation of the unit or its controls, or from causing any other damage to the refrigerator and its surroundings.

6 Required characteristics

6.1 Volumes and areas

6.1.1 Rated gross volume

The measured gross volume shall not be less than the rated gross volume by more than 3 % of the latter or 1 litre, whichever is the greater value.

6.1.2 Rated storage volume

The measured storage volume shall not be less than the rated storage volume by more than 3 % of the latter or 1 litre, whichever is the greater value.

6.1.3 Rated cellar compartment storage volume

The rated storage volume of any cellar compartment shall not be greater than the rated storage volume of the fresh food storage compartment. Where the volumes of the cellar compartment and fresh food storage compartment are adjustable relative to one another by the user, this requirement shall apply when the cellar compartment is adjusted to its minimum volume.

6.1.4 Rated storage shelf area

The measured storage shelf area, including that of any cellar compartment, shall not be less than the rated storage shelf area by more than 3 % of the latter.

6.2 Performance characteristics

6.2.1 Storage temperatures

Under the conditions specified in clause 13, the appliance shall be capable of maintaining, simultaneously, the required storage temperatures in the different compartments as shown in table 2 for the appropriate climate class.

Table 2 — Storage temperatures for all climate classes (see clause 4)

Values in degrees Celsius

Climate class	Ambient temperatures	Fresh food storage compartment (see 3.4.3.1)		"Three star" compartment (see 3.4.3.2)	"Two star" compartment and sections (see 3.4.3.2 and 7.2.6)	"One star" compartment (see 3.4.3.2)	Cellar compartment (see 3.4.3.3)
		t_1, t_2, t_3	$t_{m,max}$	t^{***}	t^{**}	t^{*}	t_{cm}
SN N ST T	+ 10 and + 32 + 16 and + 32 + 18 and + 38 + 18 and + 43	$0 \leqslant t_1, t_2, t_3 \leqslant +10$	+ 5	$\leqslant -18$	$\leqslant -12$	$\leqslant -6$	$+8 \leqslant t_{cm} \leqslant +14$

Refrigerators having additional frozen food storage compartments shall comply simultaneously with the conditions specified in table 2 for the appropriate climate class and with the relevant classification temperature specified in 3.2.5.

The classification temperature of − 18 °C (and − 12 °C in any "two star" section or compartment) shall be maintained in the food freezer compartment and in any separate "three star" compartment when defrosting of the fresh food compartment takes place.

6.2.2 Energy consumption

If energy consumption is stated by the manufacturer, the value measured in accordance with clause 15 on the first appliance tested shall not be greater than the rated energy consumption by more than 15 % of the latter.

If the result of the test carried out on the first appliance is greater than the declared value plus 15 %, the test shall be carried out on a further three appliances.

The arithmetical mean of the energy consumption values of these three appliances shall be equal to or less than the declared value plus 10 %.

6.2.3 Ice-making capacity (if applicable)

If the ice-making capacity is stated by the manufacturer, the value measured in accordance with clause 17 shall not be less than the declared value by more than 15 % of the latter.

If the ice-making capacity obtained from the first test is less than the declared value minus 15 %, the test shall be carried out on a further three appliances.

The arithmetical mean of the ice-making capacity values of these three appliances shall be equal to or greater than the declared value minus 10 %.

6.2.4 Temperature rise time (applicable only to "three star" compartments)

If the temperature rise time is stated by the manufacturer, the value measured in accordance with clause 16 on the first appliance tested shall not be shorter than the declared value by more than 15 % of the latter.

If the result of the test on the first appliance is less than the declared value minus 15 %, the test shall be carried out on a further three appliances. The arithmetical mean of the periods of temperature rise of these three appliances shall be equal to or greater than the declared value minus 10 %.

7 Determination of linear dimensions, volumes and areas

The measurements are carried out on the appliance as delivered and not operating. If there is a cellar compartment the volume of which is adjustable, the measurements shall be made with this compartment adjusted to both its minimum and maximum volumes (see 6.1.3).

7.1 Determination of linear dimensions

Linear dimensions shall be measured to the nearest millimetre.

7.2 Determination of volumes

Volumes shall be expressed in a whole number of cubic decimetres or of litres.

7.2.1 Determination of gross volume

The gross volume shall be calculated by dividing the total volume into convenient units of volumes of geometric shapes which can easily be measured.

When the gross volume is determined, internal fittings such as shelves, removable partitions, containers, evaporators, thermostats and interior light housings shall be considered as not being in place. However, the gross volume shall take into account the exact shapes of the walls if they contain depressions or projections (for examples, see figure 15).

7.2.2 Determination of the total storage volume

The total storage volume of the refrigerator shall be the sum of the storage volumes of the fresh food storage compartment(s), cellar compartment(s), ice-making compartment(s) and frozen food storage compartment(s), as applicable.

For the determination of storage volumes, the total volume of devices and of spaces considered unusable for the storage of food shall be deducted from the gross volume calculated in accordance with 7.2.1 (see 7.2.3 for fresh food storage compartments and cellar compartments, and 7.2.4 and 7.2.5 for low-temperature compartments, if applicable).

7.2.3 Storage volume of fresh food storage and cellar compartments (if applicable)

The storage volume of the fresh food storage and cellar compartments shall be the gross volume of the compartment minus

— the volume of the evaporator space, as defined in 7.2.3.1 , if applicable;

— the volume of any housings (such as those for interior lights, thermostats and other devices);

— the volume of shelves, partitions, retainers and other accessories whose wall thickness is greater than 13 mm, as defined in 7.2.7;

— the space between the inner door protrusion (dykes) and the inner liner of the fresh food storage compartment and cellar compartment.

Where the volumes of the cellar compartment and fresh food storage compartment are adjustable relative to one another by the user, the storage volumes of these compartments shall be determined with the cellar compartment adjusted to its minimum and maximum volumes.

7.2.3.1 Volume of the evaporator space (if applicable; for examples, see figure 17)

The volume of the evaporator space shall be the product of the depth, width and height, defined as follows.

7.2.3.1.1 Depth

The depth of the evaporator space shall be the mean horizontal distance between the front and rear surfaces of the enclosed space of the cabinet, measured at the level of the evaporator, unless there is a space provided in front of the evaporator for food storage.

Where a storage space is located in front of the evaporator, the depth of the evaporator space shall be taken as the mean horizontal distance from the inner surface of the rear of the enclosed space of the cabinet to the foremost part of the evaporator, or of the evaporator door if fitted.

7.2.3.1.2 Width

The width of the evaporator space shall be the overall horizontal width of the evaporator itself (neglecting suction headers near the top of the evaporator) or, if side ribs are used, the overall width including the ribs.

If there is less than 70 mm horizontal distance between the evaporator or the ribs and an inside wall of the enclosed space of the cabinet, such space shall be computed as part of the evaporator space.

7.2.3.1.3 Height

The height of the evaporator space shall be the mean vertical distance between the lower limit of the evaporator and the upper partition of the food storage compartment.

If the free space between the upper surface or top of the evaporator and the upper partition of the food storage compartment exceeds 40 mm, it shall be added to the storage volume of the fresh food storage compartment.

The evaporator height shall include any internal drip tray and/or drip collector, except in the case when the storage height of the drip tray is greater than 40 mm and a definite manual operation is also needed to initiate defrosting.

7.2.4 Storage volume of ice-making compartments

The storage volume of the ice-making compartments shall be the sum of the volumes of all the compartments of this type in the appliance.

The volumes of these compartments shall be determined in a similar manner to that specified in 7.2.2 and 7.2.3, as appropriate.

7.2.5 Storage volume of frozen food storage compartments

For the determination of the storage volume of these compartments, the total volume which is unsuitable for storage shall be determined and then deducted from the gross volume determined as indicated in 7.2.1 .

The total volume to be deducted shall comprise the following (for examples, see figure 18):

a) the volume of spaces situated outside any load limit (natural or marked by the manufacturer);

b) the volume of spaces provided specifically for making and storing ice, except in the case of appliances fitted with automatic icemakers, when the volume occupied by a removable storage bucket shall be included in the storage volume unless it is specified in the instructions for use that this volume is suitable for the storage of ice only;

c) the volume of spaces between the front stack(s) of the test package load (see 13.1.2.3) and the inner vertical surface of the door or any projection from the door where the horizontal distance between the front face of the stack(s) and the inner door surface or projection exceeds 15 mm;

d) the volume of all fixed components within the load limits;

e) the volume of spaces which are to be kept free for the good performance of the refrigerating system;

f) the volume of all removable parts which are stated by the manufacturer as necessary for the proper functioning of the appliance, except shelves and partitions whose thickness is not greater than 13 mm (see 7.2.7.1);

g) the volume rendered unusable by the use of removable parts (for example, baskets, shelves) necessary for obtaining satisfactory thermal and mechanical characteristics (see also 8.3.4);

h) any volume where the vertical clearance is less than 52 mm [see figure 13 b)];

i) any volume where it is impossible to place an "M" package of nominal dimensions.

NOTE 4 There is no equivalence between the value of the storage volume determined in accordance with the principles mentioned above and the volume of the packages loaded into the appliance for the storage test. The free spaces specified in the test methods could be utilized in normal use and their volume should not be deducted from the gross volume when calculating the storage volume.

7.2.6 "Two star" sections and/or compartments in "three star" compartments

"Two star" section(s) and/or compartment(s) is (are) permitted both in the door and in the remaining storage volume when all the following conditions are met:

a) the "two star" section(s) or compartment(s) is (are) marked with the appropriate identification symbol;

b) the "two star" section(s) and/or compartment(s) is (are) separated from the "three star" volume by a partition, container, or similar construction;

c) the rated total "two star" storage volume does not exceed 20 % of the "three star" storage volume of the compartment, or 30 l, whichever is the smaller value;

d) the instructions for use give clear guidance regarding the "two star" section(s) and/or compartment(s);

e) the storage volume of the "two star" section(s) and/or compartment(s) is stated separately and is not included in the "three star" volume.

7.2.7 Volumes of shelves and partitions (for examples, see figure 19)

7.2.7.1 Thickness

The thickness of a shelf or partition shall be the mean distance between its outer surfaces.

Where the surface of a shelf or partition is corrugated or fitted with external pipe grids, the surface shall be the plane joining the outer apices of the corrugations or pipes, unless the distance between adjacent corrugations or pipes is greater than 100 mm.

7.2.7.2 Full shelves and partitions

The volume of a full shelf or partition shall be the product of its thickness and its depth, width or height, whichever two of these are applicable. The depth, width and height shall be those dimensions of the

enclosed space of the cabinet which apply in the plane of the shelf or partition.

7.2.7.3 Fractional shelves and partitions (if applicable)

The volume of a fractional shelf or partition shall be the product of its thickness and its depth, width or height, whichever two of these are applicable.

The depth, width or height shall be the distances from the adjacent surfaces of the enclosed space of the cabinet, and normal to those surfaces, to the further edges of the shelf or partition, or to the evaporator in cases where the fractional shelf or partition touches it.

A horizontal shelf or partition, the edges of which are more than 70 mm from the surfaces of the enclosed space of the cabinet, shall be regarded as a fractional shelf or partition. A vertical partition, the edges of which are more than 100 mm from the surfaces of the enclosed space of the cabinet, shall be regarded as a fractional partition.

7.3 Determination of storage shelf area

The area shall be expressed in square decimetres.

7.3.1 Determination of the area of shelves

7.3.1.1 Full shelves composed of a single part

In the case of a full shelf composed of a single part, the area shall be the product of the width and depth. These two dimensions shall be determined as follows.

— Width: mean distance measured parallel to the surface of the shelf between the inner surfaces of the side walls of the enclosed space of the cabinet, where this dimension does not exceed the actual width of the shelf by more than 20 mm [see figure 12 a)].

— Depth: mean distance measured parallel to the surface of the shelf (or of the bottom of the appliance) between the inner surfaces of the front and rear walls of the enclosed space of the cabinet, where this dimension does not exceed the actual depth of the shelf by more than 20 mm [see figure 12 b)]. When the door of an upright-type appliance is provided with shelves, this distance shall be determined by analogy [see figures 12 c) and 12 d)].

7.3.1.2 Fractional shelves

For the purpose of calculating the area of fractional shelves, the width and depth shall be measured parallel to the surface of the shelves in a similar way to that for full shelves (see 7.3.1.1), but taking into account figure 12 e).

7.3.1.3 Cut-away shelves

When a shelf is cut away, the area of the portion cut out shall be deducted.

7.3.1.4 Juxtaposed shelves

In the case of juxtaposed shelves, the depth shall be determined in accordance with figure 12 d).

7.3.1.5 Door shelves

The area shall be the product of the width and depth. These two dimensions shall be determined by analogy with 7.3.1.1, as follows.

— Width: mean distance between the inner surfaces of the side walls of the door compartment or between the side edges of the retainer bar.

— Depth: mean distance between the surface of the door wall and the vertical plane tangential to the inner front surface of the shelf or retainer bar [see figure 12 c)].

7.3.1.6 Baskets and containers

The area shall be the product of the two mean horizontal dimensions [see figure 13 a)].

7.3.1.7 Particular cases

7.3.1.7.1 General

The bottom of the enclosed space of the cabinet shall be considered as a shelf.

When an inner wall is not vertical, the dimension of the shelf shall be measured at the mid-height between the shelf under consideration and the shelf or horizontal surface immediately above.

7.3.1.7.2 Fresh food storage compartment and cellar compartment, if any

Any part of full shelves, baskets or of the bottom of a compartment having less than 100 mm vertical clearance above, when all the shelves and baskets are in position, shall be excluded when calculating the storage area. However, it is admissible that for one