
International Standard



7371

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Performance of household refrigerating appliances — Refrigerators with or without low temperature compartment

Fonctionnement des appareils de réfrigération — Réfrigérateurs avec ou sans compartiment basse température

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Foreword

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Performance of household refrigerating appliances — Refrigerators with or without low temperature compartment

1 Scope and field of application

This International Standard specifies the essential characteristics of household refrigerators with or without chiller, ice-making or frozen food storage compartments 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 or combined refrigerator/freezers, which will be covered in separate documents.

It does not include refrigerating performance characteristics and tests or particular definitions for refrigerators cooled by internal forced air circulation.

The tests described in this International Standard are type tests. When it is desired to verify the performance of a refrigerator of a given type in relation to this International Standard, all the tests described should be in principle 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 shall be considered as a recommendation.

The safety requirements applicable to the electrical equipment of household refrigerators are covered by IEC publications IEC 335-2-24 and IEC 335-2-34.

The safety requirements applicable to refrigerating systems of household refrigerators are under consideration.

The safety requirements applicable to gaseous and liquid fuel heating equipment of absorption type household refrigerating systems will be covered by a separate International Standard.

2 References

ISO 534, *Paper and board — Determination of the thickness of single sheets (and method of calculation of the apparent density of board)*.

ISO 817, *Organic refrigerants — Number designation*.¹⁾

ISO 3055, *Kitchen equipment — Co-ordinating sizes*.

ISO 5731, *Kitchen equipment — Limit of size*.

ISO 5732, *Kitchen equipment — Sizes of openings for built-in appliances*.

IEC Publication 335-1, *Safety of household and similar electrical appliances — Part 1: General requirements*.

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

IEC Publication 335-2-34, *Safety of household and similar electrical appliances — Part 2: Particular requirements for motor-compressors*.

3 Definitions

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 — 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 Storage compartments

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 chiller compartment: Compartment intended for the storage of particular foods or beverages at a temperature warmer than that of the fresh food storage compartment.

NOTE — Requirements for chiller compartments are under consideration.

1) At present at the stage of draft. (Revision of ISO 817-1974.)

3.2.3 low temperature compartment: Compartment which may be either:

- an ice-making compartment, or
- a frozen food storage compartment.

A household 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 storage 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 $-6\text{ }^{\circ}\text{C}$.

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 $-12\text{ }^{\circ}\text{C}$.

3.2.5.3 "three-star" compartment: Compartment in which the storage temperature (see 3.4.3.2), measured as described in clause 13, is not warmer than $-18\text{ }^{\circ}\text{C}$.

3.3 General definitions

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

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

3.3.3 overall dimensions (doors or lids closed): Measurements of the rectangular parallelepiped, having a horizontal base, within which the refrigerator is inscribed, including the fittings but not the handle, the protrusion of which, if any, shall be specified separately.

3.3.4 overall space required in use (doors or lids open): Overall dimensions 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 up to that minimum angle at which all removable parts can be removed, such as containers and shelves, including the drip-tray with water if this has to be removed and emptied manually. (See figure 1.)

3.3.5 Volumes

3.3.5.1 gross volume: The total volume within the inside walls of the appliance, without internal fittings, doors or lids being closed.

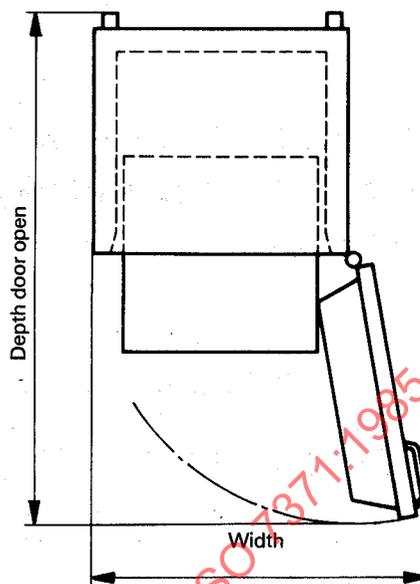


Figure 1 — Overall space required in use (upright type)

However, when cooling is provided by forced air, the gross volume is calculated by subtracting from the total volume the volume blocked by cold-air ducting, evaporator, fan and other associated accessories.

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

3.3.5.3 total gross volume: The sum of the gross volumes of the fresh food storage compartment(s), low temperature compartment(s) and chiller compartment(s), even if their doors are independent.

3.3.5.4 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 in 7.2.

3.3.5.5 rated storage volume: The storage volume stated by the manufacturer.

3.3.5.6 total storage volume: The sum of the storage volumes of the fresh food storage compartment(s), low temperature compartment(s) and chiller compartment(s), even if their doors are independent.

3.3.5.7 rated total storage volume: The total storage volume stated by the manufacturer.

3.3.6 Storage surfaces

3.3.6.1 shelf: For the purpose of this International Standard, 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: The 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: The storage shelf area stated by the manufacturer.

3.3.7 load limit: The surface enveloping the frozen food storage volume.

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

3.4 Definitions relating to some performance characteristics

3.4.1 energy consumption: The 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) and measured under the conditions specified in clause 15.

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

3.4.3 Storage temperatures

3.4.3.1 The fresh food storage temperature is t_m , where t_m is the average of the mean temperatures t_1 , t_2 and t_3 .

3.4.3.1.1 The temperatures t_1 , t_2 and t_3 are the mean internal temperatures measured in cylinders¹⁾ defined in 8.4 at given points 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: The maximum temperature of the warmest "M" package of a load placed in storage.

3.4.4 Defrosting

The method of defrosting may be one of three types.

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 accumulation and restoration to normal operation requires a further action by the user, the defrost water being removed manually or removed and disposed of automatically.

NOTE — When a refrigerator comprises two compartments or more, the method of defrosting shall be specified separately for each compartment.

The means of disposal of defrost water may be one of two types.

3.4.4.4 automatic disposal of defrost water: The 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: The 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: The period between two successive starts, or two successive stops, of the refrigerating system when controlled by a temperature control device under stable operating conditions.

3.4.7 stable operating conditions: In the case of cyclic operation of the refrigerating 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 $\pm 0,5$ K and there is no marked trend away from the mean temperature during a period of about 24 h.

In the case of continuous operation of the refrigerating 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.

1) The substitution of copper or brass cylinders by packages is under consideration in order to standardize with tests for refrigerator-freezers which will be covered by a separate International Standard and for which this problem is particularly important.

3.4.8 percentage running time (apparatus with on/off control for the refrigerating source): Percentage running time, under given conditions of ambient temperature and of mean internal temperature, is the ratio:

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

where

R is the percentage running time;

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

D is the total duration of the cycles.

3.4.9 ice-making: The 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: The temperature in the space surrounding the appliance under test. It is the arithmetical mean of the mean value of temperatures t_{a1} , t_{a2} , t_{a3} , measured at three points located 350 mm from the side walls and front walls of the appliance, on the normals passing through the geometrical centres of the surfaces of these walls.

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.

3.7.7 thermostat: Same definition as for compressor-type refrigerators (see 3.6.8).

4 Classification

Regarding the ability of appliances to operate in extreme ambient temperatures, this International Standard provides for the four following classes:

- Extended temperate class (SN): appliances intended for use in ambient temperatures from 10 to 32 °C.
- Temperate class (N): appliances intended for use in ambient temperatures from 16 to 32 °C.
- Subtropical class (ST): appliances intended for use in ambient temperatures from 18 to 38 °C.
- Tropical class (T): appliances intended for use in ambient temperatures from 18 to 43 °C.

5 Materials, design and manufacture

5.1 General

Household 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 manufacturers is drawn.

5.2 Materials and finishes

All materials used inside refrigerators shall not transmit odours. When tested in accordance with 17.1, the mean value of the individual results during each evaluation for odour or flavour shall not exceed mark 1.

All 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 the refrigerator should be efficient and permanently maintained. In particular, the insulating material should not be subject to shrinkage and should 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 is closed, there shall be no abnormal ingress of air into the interior.

The strip of paper shall not slide freely when the door or lid seal is 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 shall withstand 100 000 openings and closings without deterioration which, in particular, 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 to be easily closed and opened. It shall be efficient and capable of maintaining its proper function.

For refrigerators having any compartment 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 of clause 10. The volume is determined when all detachable shelves 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 put out of children's reach and not in the vicinity of the appliance.

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 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

Means shall be provided for completely collecting the defrost water either in a removable internal drip-tray or in an external receptacle in which 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 the refrigerator should not give rise to undue noise or vibration.

5.7.2 The design of the condenser should be such as to minimize the accumulation of dust.

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

The heat exchange surfaces should be made of corrosion-resistant material or 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 as defined in clause 13.

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.

5.7.7 The strength of pressure parts will be dealt with in a future International Standard.

6 Required characteristics

6.1 Dimensional characteristics

6.1.1 Rated gross volume

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

6.1.2 Rated storage volume

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

6.1.3 Rated storage shelf area

The rated storage shelf area shall not be greater than the measured 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 the required storage temperatures in the fresh food storage compartment as shown in table 1 for the appropriate climate class.

Refrigerators having a star-marked frozen food storage compartment shall comply simultaneously both with the conditions specified in table 1 for the appropriate climate class and with the relevant classification temperature specified in 3.2.5.

6.2.2 Energy consumption

If the energy consumption is stated by the manufacturer, the value measured in accordance with clause 15 on the first appliance 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 three further appliances.

If the arithmetic mean of the energy consumption values of these three appliances is equal to or less than the declared value plus 10 %, the declared value is confirmed. If not, the requirements of this International Standard are not met.

6.2.3 Ice-making

If the ice-making capacity is stated by the manufacturer, the value measured in accordance with clause 16 shall not be less than 90 % of the claimed value.

Throughout the ice-making test all the internal temperatures t_1 , t_2 , t_3 (see 3.4.3.1.1) shall be in accordance with table 1.

Should the ice-making capacity obtained from the first test be less than 90 % of the claimed value, two further tests shall be made and the result of each of these additional tests shall not be less than 90 % of the claimed value.

7 Determination of linear dimensions, volumes and areas

The measurements shall be carried out on the appliance as delivered and not operating.

Table 1 — Fresh food storage compartment temperatures

| Climate class | Ambient temperature | t_1, t_2, t_3 | $t_m, \text{max.}$ |
|---------------|-------------------------|---|--------------------|
| SN | from + 10 °C to + 32 °C | $-1\text{ °C} \leq t_1, t_2, t_3 \leq + 10\text{ °C}$ | + 7 °C |
| N | from + 16 °C to + 32 °C | $0\text{ °C} \leq t_1, t_2, t_3 \leq + 10\text{ °C}$ | + 5 °C |
| ST | from + 18 °C to + 38 °C | $0\text{ °C} \leq t_1, t_2, t_3 \leq + 12\text{ °C}$ | + 7 °C |
| T | from + 18 °C to + 43 °C | $0\text{ °C} \leq t_1, t_2, t_3 \leq + 12\text{ °C}$ | + 7 °C |

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 cubic decimetres or in litres.

7.2.1 Determination of gross volume

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

When the gross volume is determined, internal fittings such as shelves, 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 12).

If cooling is effected by forced air, any volume which is inaccessible because of air ducts, fans, evaporator and other associated accessories shall also be deducted.

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), chiller compartment(s), ice-making compartment(s) and frozen food storage compartment(s).

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 7.2.4 and 7.2.5 for low temperature compartments).

7.2.3 Storage volume of fresh food storage compartment

The storage volume of the fresh food storage compartment shall be its gross volume minus

- the volume of the evaporator space (see 7.2.3.1);
- the volume of any housings (such as those which may be provided for interior lights, thermostats and other control devices);
- the volume of shelves, partitions, retainers and other accessories the wall thickness of which is greater than 13 mm (see 7.2.3.2).

7.2.3.1 Volume of the evaporator space (see figure 13)

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

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.

7.2.3.2 Volumes of shelves and partitions (see figure 14)

7.2.3.2.1 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.

7.2.3.2.2 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 the latter three 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.

7.2.3.2.3 Fractional shelves and partitions

The volume of a fractional shelf or partition shall be the product of its thickness and its depth, width or height, whichever two of the latter three 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 farther 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 shelf or 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 shelf or partition.

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 refrigerator.

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, 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:

- a) the volume of spaces situated outside any load limit line (natural or marked by the manufacturer);
- b) the volume of spaces provided specifically for making and storing ice;
- c) the volume of spaces between the front stack(s) of the test package load (see 7.2.5.1) and the inner vertical surface of the door or any projection from the door where the hori-

zontal distance between the face of the stack(s) and the inner door surface or projection exceeds 15 mm;

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

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

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

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

h) any volume where it is impossible to place an "M" package.

7.2.5.1 Three-star frozen food storage compartments with external door and having shelves or containers in the door

A two-star classification is permitted in the door (shelves, containers, etc.) of such compartments, but only where the two-star section is marked with the appropriate identification symbol, the total two-star volume does not exceed 20 % of the measured three-star volume of the compartment and the instructions for use give clear guidance regarding the two-star section.

In such cases, the volumes of the two sections shall be stated separately.

Load limit lines are not permitted in the two-star section.

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 comprising a single part

In the case of a shelf comprising a single part, the area shall be the product of the width by the 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 real width of the shelf by more than 20 mm [see figure 9a)].

— depth: mean distance measured parallel to the surface of the shelf 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 9b)]. When the door of an upright-type appliance is provided with shelves, this distance shall be measured between the rear inner surface

of the enclosed space of the cabinet and the vertical plane tangential to the front of the cabinet shelf, provided that any gap between the rear edge of the shelf and the rear wall does not exceed 20 mm [see figure 9c)]. When considering the bottom of an upright-type appliance, the front reference plane shall be the edge of the enclosed space of the cabinet [see figure 9c)].

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 from the adjacent surfaces of the enclosed space of the cabinet to the farther edge of the shelf.

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, when the distance between two parts does not exceed 20 mm, the dimensions shall be measured as for a shelf comprising a single part. When the distance is more than 20 mm, the area shall be measured for each of the parts [see figure 9d)].

7.3.1.5 Particular cases

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 with reference to the vertical plane cutting this surface at the mid-height between the shelf under consideration and the shelf or horizontal surface immediately above.

Any part of full shelves, baskets or of the bottom of the appliance having less than 100 mm vertical clearance above, when all the shelves are in position, shall be excluded when calculating the storage area. However, it is admissible that for one full shelf or basket the vertical clearance may be reduced to not less than 80 mm (see figure 10).

7.3.1.6 Determination of the area of door shelves

The shelf area shall be the product of the width by the depth. These two dimensions shall be determined by analogy with 7.3.1.1.

- 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 9c)].

7.3.1.7 Low temperature compartment shelves

The areas of shelves and of compartment bottoms of low temperature compartments shall be included in the storage

shelf area, provided there is a clear vertical space of not less than 40 mm above such shelves and compartment bottoms in ice-making compartments and of not less than 55 mm in frozen food storage compartments.

7.3.2 Drip-tray

Whenever the space occupied by the drip-tray is included in the storage volume, the part of the shelf supporting the drip-tray or the bottom of the drip-tray shall be considered as a part of the storage shelf area, provided that a definite manual operation is needed to initiate defrosting.

7.3.3 Determination of the area of baskets

The basket area shall be the product of the two mean horizontal dimensions (see figure 10).

7.3.4 Suspended containers

The area of the interior surface of the bottom of a suspended container and the area of the shelf immediately below shall not both be counted unless the vertical clearance between this shelf and the exterior surface of the bottom of the container is at least 100 mm.

Nevertheless, in the case of one container (and one only), this clearance may be reduced to 80 mm to the extent where this possibility has not been applied for the shelves.

If the mean height vertically of a suspended container, as measured between the interior surface of the bottom and the cover or to the shelf immediately above, is less than 40 mm, the bottom area of the container shall not be added.

8 General test conditions

The order of carrying out the tests need not necessarily follow the sequence of the sub-clauses in this International Standard.

The results of the tests shall appear in a test report. When necessary, particular information to be noted in this report is mentioned as a special item of the sub-clause concerning the test.

It is recommended that the test authority should ask the manufacturer for the storage plans and take account of them provided that they are in accordance with this International Standard.

8.1 Test room

The appliances shall be set up in a test room as specified in 8.1.3.

8.1.1 Ambient temperature

Tests shall be carried out under the following conditions of ambient temperature:

- a) for checking the storage temperature:
 - + 10 °C and + 32 °C for class SN appliances;
 - + 16 °C and + 32 °C for class N appliances;
 - + 18 °C and + 38 °C for class ST appliances;
 - + 18 °C and + 43 °C for class T appliances;
- b) for checking the energy consumption:
 - + 25 °C for class SN, class N and class ST appliances;
 - + 32 °C for class T appliances;
- c) for all other tests, at the temperature stated in the test specifications.

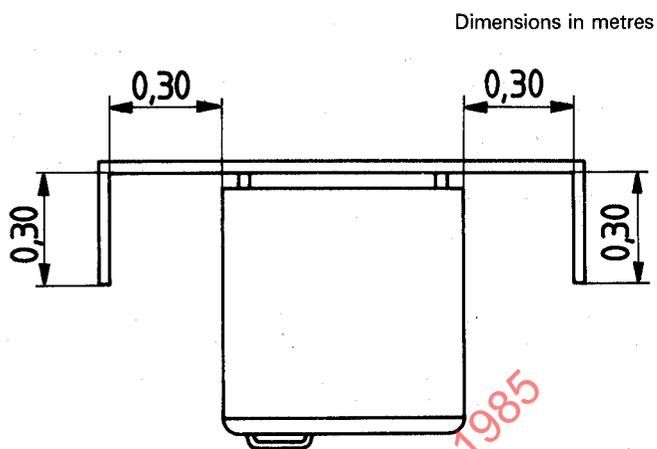


Figure 2 — Partitions to restrict air circulation (plan view)

The temperature at each measurement point (see 3.4.10) shall be kept constant within $\pm 0,5$ K both during the periods required for obtaining stable operating conditions and during the tests.

The vertical ambient temperature gradient from the platform specified in 8.1.3 to a height of 2 m shall not exceed 2 K/m.

8.1.2 Humidity

Unless otherwise specified, relative humidity shall be kept between 45 % and 75 %.

8.1.3 Installation of appliances

Each appliance shall be placed on a wooden solid-top platform, dull black painted, open for free air circulation under the platform. The top of the platform shall be 0,30 m above the test room floor and shall extend at least 0,30 m, but not more than 0,60 m, beyond all sides of the appliance, except at the rear where it shall extend to the vertical partition.

Circulation of air about the appliance shall be restricted by surrounding the appliance by three vertical partitions, dull black painted, arranged as follows: one of the partitions shall be placed parallel to the rear of the appliance, against the stops or at the distance specified by the manufacturer in connection with the required overall space; the two other partitions shall be parallel to the sides of the cabinet and fixed on the platform 0,30 m from the sides of the cabinet: they are 0,30 m wide. The whole partition structure shall have the form and dimensions shown in figure 2.

The vertical partitions shall present no discontinuity. They shall be of such a height that they extend at least 0,30 m above the top of the appliance.

The appliance shall be placed or shielded so as to prevent direct radiation to or from the space cooling or heating equipment in the test room, and shall be placed far enough away from all other objects in the test room to eliminate any possibility of any point within the space in which it is situated being at a temperature other than ambient.

Air circulation in the test room shall be such that the specified ambient temperatures are obtained within the limits of the specified tolerances. The appliance under test shall be shielded from any air currents of velocity above 0,25 m/s.

The air circulation in the test room shall not interfere with the normal air circulation created by the appliance.

Appliances intended to be built-in shall be installed according to the manufacturer's instructions.

Built-in appliances intended to be combined with appliances other than food freezers shall be subjected to the tests while they are combined but with the other appliance not functioning.

8.2 Test packages

When tests are carried out with a loaded appliance, test packages of parallelepiped shape shall be used.

8.2.1 Sizes and tolerances

Their size, prior to freezing, and their mass, packaging included, shall be as given in table 2.

Table 2 — Sizes and tolerances of test packaging

| Size mm | Mass g |
|----------------|-----------|
| 25 × 50 × 100 | 125 |
| 50 × 100 × 100 | 500 |
| 50 × 100 × 200 | 1 000 |

Tolerances on linear dimensions:

- $\pm 1,5$ mm for dimensions 25 mm and 50 mm
- $\pm 3,0$ mm for dimensions 100 mm and 200 mm

Tolerance on mass: ± 2 %.

8.2.2 Composition

The packages shall consist of:

- a) a suitable filling material containing, per 1 000 g:

230 g of hydroxyethyl methyl cellulose

764,2 g of water¹⁾

5 g of sodium chloride

0,8 g of 4-chloro-3-methylphenol

The freezing point of this material is $-1\text{ }^{\circ}\text{C}$ (its thermal characteristics correspond to those of lean beef).

- b) a wrapper, consisting of a sheet of plastic²⁾ or any other suitable material of such a nature that exchange of moisture with the ambient medium is negligible.

After filling, the wrapping sheet is sealed.

8.2.3 "M" packages

Some 500 g packages (50 mm × 100 mm × 100 mm) are equipped for temperature measurement, being fitted with thermocouples³⁾ which are inserted in the geometrical centre of the packages in direct contact with the filling material. All precautions shall be taken to minimize extraneous conduction of heat. These packages are called "M" packages.

8.3 Operating requirements for the appliance

8.3.1 Thermostat setting

The thermostat setting requirements are specified for each test.

When the appliance is fitted with a thermostat which is not designed for adjustment by the user, the appliance is tested in the condition as delivered.

8.3.2 Anti-condensation heaters

If an appliance is fitted with an anti-condensation heater, this shall be switched on, except for the energy consumption test, when it shall be switched on only if it is needed to withstand the water vapour condensation test; if adjustable, it shall be set at maximum heating.

8.3.3 Power supply

8.3.3.1 Electric power supply

The appliance shall be tested at the rated voltage and frequency or at the mean of the rated working range $\pm 1\%$.

8.3.3.2 Power supply other than electric

Appliances other than those with electric power supply shall be tested under supply conditions corresponding to the information of the rating plate.

8.3.4 General conditions for the use of baskets, shelves and trays

All shelves, containers and trays shall be in position.

8.4 Measuring instruments

Temperatures shall be measured with temperature probes, the sensors of which are inserted either in the test packages or, for measuring the ambient temperature and t_1 , t_2 , t_3 , in the centre of a tinned solid copper or brass cylinder, having a mass of 25 g and of minimum external area (diameter = height = about 15,2 mm). The temperature shall be recorded. Temperature-measuring instruments shall be accurate to $\pm 0,3\text{ K}$.

The relative humidity shall be measured and recorded at a point which is representative. The accuracy of the measuring instruments shall be such that the result, expressed as dew point, is accurate within $\pm 0,3\text{ K}$.

Watt-hour meters shall be readable to 0,01 kWh and shall be accurate to within $\pm 1\%$. The measuring accuracy shall be stated in the test report.

8.5 Measurement of the temperature of the fresh food storage compartment

The temperatures t_1 , t_2 and t_3 (see 3.4.3.1.1) shall be measured in copper or brass cylinders suspended and located at sensing points T_1 , T_2 and T_3 as shown in figure 7, half-way between the rear internal wall of the appliance and the internal wall of the closed door. The mean internal temperature t_m shall then be calculated (see 3.4.3.1).

The means of suspension shall be of the smallest possible cross-section and the lowest possible thermal conductivity, arranged in such a way that they do not significantly interfere with the normal air circulation.

1) The addition of about 4 % of water is recommended in order to compensate for evaporation during the preparation of the filling material.

2) It is advisable to use a laminated sheet, consisting of a layer of high-pressure polyethylene, easily sealable, 120 μm thick, together with an external sheet of polyterephthalate approximately 12,5 μm thick, the two layers being bonded together.

3) Or any other temperature-measuring device giving equivalent precision.

If internal components do not allow the temperatures t_1 , t_2 and t_3 to be read at the points specified, readings may be taken in positions such that the sensing point is no more than 25 mm from the point specified. If the interior arrangement of the fresh food storage compartment does not conform with those shown in figure 7, the temperatures t_1 , t_2 and t_3 shall be read in positions determined by analogy with the positions indicated.

Temperatures shall be recorded. The copper or brass cylinders shall be separated from any heat conducting surface by at least 25 mm of air space. Connections from the measuring instruments shall be arranged in such a manner as not to interfere with the air seal of the food storage compartment.

8.6 Measurement of the temperature of the frozen food storage compartment

The temperatures in any frozen food storage compartment shall be measured in "M" packages which are distributed throughout the load of test packages specified in the storage plan in 13.1.2.

The temperature of the frozen food storage compartment is then (by definition 3.4.3.2) the maximum temperature of the warmest "M" package.

NOTE — The question of maintenance of frozen food storage temperature during defrosting of the frozen food storage compartment is under consideration.

8.7 Measurement of the percentage running time

8.7.1 When the appliance is operating under cycling conditions, the running time shall be measured during a test period of at least 24 h, as specified in 8.7.2.

a) Electrically driven refrigerators

Use shall be made of a synchronous clock that operates when the refrigerating system is running. When the current relay, inserted in series in the power supply circuit, is energized by the current flowing through it, it applies the voltage to the synchronous clock the reading of which is recorded at the beginning and end of the test. Running time is the difference between the two readings.

Alternatively, either the current or power may be plotted against time from a recording ammeter or wattmeter, and the running and idle periods computed from the graph.

b) Non-electrically driven refrigerators

Any suitable device may be used to record the running time of the refrigerating system.

8.7.2 Test period

The test period shall be at least 24 h after stable operating conditions have been attained.

For appliances with cyclic operation and without automatic defrosting, the test period shall comprise a whole number of control cycles.

For appliances with automatic defrosting, the test period shall be as follows:

- a) at least 24 h and comprising a whole number of defrost cycles;
- b) if the first defrost cycle starts, but is not completed, during the 24 h period, the test shall be terminated at the end of that defrost cycle;
- c) if no defrost cycle starts during the 24 h period, the test period shall be extended to 48 h and the provisions of a) and b) applied for the extended period;
- d) if no defrost cycle starts during the 48 h period, defrosting shall not be taken into consideration.

9 Testing the airtightness of door or lid seal(s)

The purpose of this test is to ensure that the gasket(s) of the door(s) or lid(s) of the appliance adequately prevent(s) any abnormal ingress of the surrounding air.

9.1 Procedure

The ambient temperature shall be between 16 and 32 °C. The appliance shall be switched off and shall be in equilibrium with the ambient temperature before carrying out the test.

A strip of paper 50 mm wide, 0,08 mm thick¹⁾ and of a suitable length shall be inserted at any point of the seal, and the door lid closed normally on it.

The seal shall be assessed by checking that the strip of paper does not slide freely.

The most unfavorable points may be found by inspecting the area round the seal with the appliance closed and illuminated from the inside.

This test shall be carried out before and after the mechanical durability test (see clause 11).

9.2 Test report

The test report shall include whether the tightness of the door or lid seal(s) meets the requirements of the fourth paragraph of 5.3 and the second and third paragraphs of 5.4.

1) The verification of the thickness of the paper used is made as laid down in ISO 534.

10 Testing the opening force of door(s) or lid(s)

The purpose of this test is to check that the door(s) or lid(s) can be opened from the inside.

10.1 Procedure

The ambient temperature shall be between 16 and 32 °C. The appliance shall be switched off and shall be in equilibrium with the ambient temperature. The door or lid shall be closed for a period of 1 h, after which an "opening" test shall be carried out under the following conditions.

The opening force of 70 N shall be considered as being applied to the inside of the door or lid of the appliance at the mid-point of the edge farthest from the hinge axis in a direction perpendicular to the plane of the door or lid.

The method of measurement shall be either:

- by applying the force at a point on the outer surface of the door or lid corresponding to the internal measuring point (for example, with the aid of a suction pad); or
- if the handle of the door or lid is at the mid-point of the edge farthest from the hinge axis, by applying a force to the handle, the value of the force required to open the door from the inside being determined by proportional calculation from the distances of the handle and of the internal measuring point from the hinge axis.

This test shall be carried out both before and after the mechanical durability test (see clause 11).

10.2 Test report

The test report shall indicate whether the opening force of the door(s) or lid(s) meets the requirements of the fifth paragraph of 5.4.

11 Testing the durability of hinges and handles of external door(s) and lid(s)

The purpose of this test is to check the durability of the hinges and handles of external door(s) and lid(s).

11.1 Procedure

The ambient temperature shall be between 16 and 32 °C.

The refrigerator shall be switched off.

The inner door shall be loaded as specified in 12.1.

The angle of opening shall be 45°.

a) Opening sequence

The movement of the door shall be controlled from an angle of 0° to an angle of opening between 5° to 15°, followed by a free movement of the door, the controlled movement

being approximately sinusoidal. The opening of the door shall take place in the first quarter of the period of the cycle.

b) Closing sequence

The movement of the door shall be controlled from the angle of opening of 45° to an angle between 40° and 35°, followed by the free movement of the door and its closing as in normal operation.

The number of cycles per minute shall be 20 to 25.

11.2 Test report

The test report shall indicate whether the hinges and handles meet the requirements of the second and third paragraphs of 5.4 and whether the seals meet the requirements of the fourth paragraph of 5.3.

12 Testing the mechanical strength of shelves and similar components

The purpose of this test is to check the mechanical strength of the components used for storing food (shelves, containers, evaporators).

12.1 Procedure

The ambient temperature shall be between 16 and 32 °C.

The refrigerator shall be switched off, with the door open.

The components to be tested shall be loaded in turn with 80 mm diameter cylindrical weights of, in general, 1 000 g, but of only 500 g in the case of components above which the clear height in normal service cannot exceed 150 mm, with the exception of compartments specially designed to hold eggs.

The weights shall be placed with their axes vertical and in such a way that the maximum possible number is accommodated without one weight being placed over another and without overlapping the edge of the component under test.

All sliding or revolving shelves and containers shall be moved, without modification of their load, to the half-way position of their permissible course (see figure 3), except that if stops are provided which limit the movement to less than the half-way position the components shall be moved to their stop. They shall be left in this position for 1 h and then returned to their initial position.

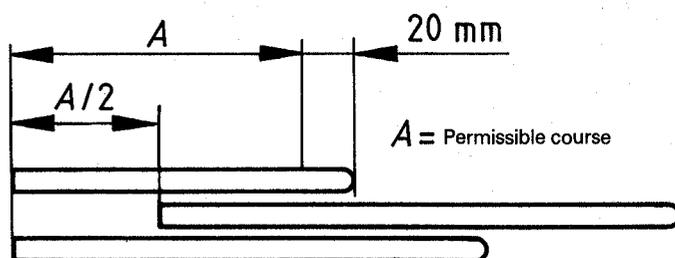


Figure 3 — Test position for sliding components which have no limiting stop

If the manufacturer has stated in the instructions for use that some shelves or containers slide out for maintenance or transportation, but shall remain in a definite position in normal use, they shall be considered as fixed.

In the case of door shelves, the diameter of the weights may be changed, if necessary, to adapt them to the shape of the shelves provided the load per unit area is the same. The applied loads shall remain in position for 1 h.

12.2 Test report

The test report shall indicate whether the shelves and containers for storing food meet the requirements of 5.5.

13 Testing the storage temperature(s)

The purpose of this test is to check compliance with the requirements of 6.2.1 at each of the ambient temperatures for the appropriate climate class.

13.1 Procedure

13.1.1 Preparation of the appliance

The appliance shall be installed in the test room in accordance with 8.1.3. The evaporator shall be defrosted, if necessary, and the internal walls and components of the appliance dried. The means of access (doors or lids) shall be kept closed during the tests.

The appliance shall be set up as in service in accordance with the manufacturer's instructions. All internal fittings supplied with the appliance, including ice-trays, shall be put in position except that the ice-trays shall be removed in the case of a frozen food storage compartment of an appliance having no specific subdivision to accommodate such trays. If the appliance has a thermostat and/or other temperature control device which is (are) designed for adjustment by the user, the thermostat and/or device shall be set at the manufacturer's recommended position for normal operation at the appropriate ambient temperature. When the thermostat and/or device is not designed for adjustment by the user, the measurement shall be carried out on the appliance as delivered. The appliance shall be operated and left for at least 24 h to reach equilibrium.

The fresh food storage compartment shall be equipped with copper or brass cylinders according to 8.4 and 8.5.

The ice-making compartment shall be loaded with the supplied ice-trays filled up to 5 mm from the top with cold water.

Any frozen food storage compartment shall, in addition, be equipped with test packages and "M" packages according to the following storage plan.

13.1.2 Storage plan

The frozen food storage compartment shall be filled with as many test packages as it can hold, the test packages having previously been brought to a temperature approximately equal to the classification temperature of the compartment.

The following conditions shall be met:

- a) On each horizontal surface intended for storage, the largest possible number of stacks of test packages having a base of 100 mm × 200 mm shall be made using 1 kg packages (50 mm × 100 mm × 200 mm) laid flat (i.e. with the face having the largest dimension horizontal).

When an "M" package (500 g and 50 mm × 100 mm × 100 mm) has to be placed in a stack, it shall also be placed flat, side by side with another 500 g package, with the exception of door shelves [see g) below].

The loading may, if necessary, be completed by stacks having a base of 100 mm × 100 mm made with 500 g packages laid flat, and then finally by stacks having a base of 50 mm × 100 mm made with 125 g packages also laid flat. Four 125 g packages may be replaced by one 500 g package placed vertically.

- b) The height of the stacks shall be such that the vertical clearance between the upper edge of the highest package and the load limit the shelf or the horizontal surface situated immediately above is not greater than 25 mm.

In the case of a top-opening cabinet without load limit line, a vertical clearance of between 10 and 35 mm shall be provided between the upper edge of the highest package and the inner surface of the lid.

In order to satisfy these requirements, 125 g packages (25 mm × 50 mm × 100 mm) laid flat may be introduced in or immediately above, as appropriate, the middle of any stack.

- c) Stacks of packages shall be placed in direct contact with the horizontal loading surfaces and vertical surfaces except in the following cases:

- 1) When the instructions for use indicate otherwise. In this case, the stacks shall be spaced away from such surfaces at a distance of 15 mm.

- 2) When the vertical surface is the inner surface of a door. In this case, the stacks shall be loaded as follows:

- i) If there is a marked load limit line, the packages shall be loaded up to that line [see figure 8a)].

- ii) If there is no load limit line but a natural load limit, the packages shall be loaded up to that limit [see figure 8b)].

- iii) If the manufacturer claims the whole volume of the compartment as storage volume, even if there is a natural load limit, the packages shall be loaded to within 15 mm from the inner vertical surface of the door or any projection from the door. In this case, packages may overhang the front edge of any shelf [see figure 8c and 8d)].

3) When the intersection of a horizontal loading surface and a vertical surface is radiused. In this case, the bottom package of any stack shall be placed in direct contact with the horizontal loading surface, and the remainder of the stacks shall project beyond the bottom package so as to be in contact with the vertical surface [see figure 8e)], unless the instructions for use indicate that food should not be placed in contact with that vertical surface, in which case the remainder of the stacks shall project beyond the bottom package to within 15 mm from the vertical surface [see figure 8f)].

d) If a subdivision is provided specifically for making and storing ice and is not removable without the use of tools, the ice-trays shall be filled up to 5 mm from the top with cold water and placed in position before the frozen food storage compartment is loaded with test packages; otherwise the ice-trays and the subdivisions shall be removed and the whole compartment loaded with packages.

e) Free air spaces of 15 mm minimum (calculated from the nominal dimensions of the test packages), as far as possible equal, shall be left between adjacent stacks of test packages.

The use of spacers to maintain free air spaces between stacks of test packages is permissible provided that the spacers are of the smallest possible cross-section and of the lowest possible thermal conductivity and are placed in such a way that they do not significantly interfere with normal air circulation.

f) "M" packages shall be placed where the highest temperatures are expected. These places may be different for the storage temperature(s) and energy consumption tests.

g) Door shelves and compartments shall also be loaded with as many packages as possible. Packages shall be placed in such a position that the free air spaces between the packages and the inner surface of the door and between the packages and the retainer are equal. Packages may, if necessary, be placed on end. However, 125 g packages shall only be placed flat and shall not be used as vertical wedges.

13.1.3 Measurements

For each ambient temperature, the thermostat shall be adjusted, as necessary, to a position which is likely to give storage temperature(s) (see 8.5 and 8.6) which comply with 6.2.1, after stable operating conditions (see 3.4.7) have been attained.

13.2 Test report

The test report shall contain at least the following information for each ambient test temperature:

a) the ambient temperature;

b) the thermostat setting (if designed for adjustment by the user);

c) the value of the fresh food storage temperature t_m , together with the values of t_1 , t_2 and t_3 ;

d) the observation whether the water in the ice-tray in the ice-making compartment has been completely frozen;

e) a sketch of the loading arrangement in any frozen food storage compartment, showing the locations of the "M" packages and the location of the "M" package with the highest maximum temperature;

f) the value of the maximum temperature;

g) the percentage running time (see 3.4.8) at an ambient temperature of 32 °C, 38 °C or 43 °C, as appropriate for the climate class of the appliance.

14 Water vapour condensation test

The purpose of this test is to determine the extent of condensation of water on the external surface of the cabinet under specified ambient conditions.

14.1 Procedure

14.1.1 Ambient temperature

The ambient temperature shall be:

+ 25 ± 0,5 °C for class SN and N appliances;

+ 32 ± 0,5 °C for class ST and T appliances.

14.1.2 Relative humidity

The relative humidity shall be such that the dew point is:

+ 19 ± 0,5 °C for class SN and N appliances;

+ 27 ± 0,5 °C for class ST and T appliances.

14.1.3 Test conditions

The thermostat setting, the positioning and the loading of the appliance shall be the same as for the energy consumption test. If anti-condensation heaters are provided, they shall not be switched on. If, however, the requirement of 5.3 is not fulfilled, the test shall be repeated with the anti-condensation heaters switched on.

14.1.4 Test period

After stable operating conditions have been attained, all external surfaces of the cabinet shall be carefully wiped dry with a clean cloth and the test continued for a period of 24 h. If the appliance is fitted with automatic defrosting equipment, this test period shall be selected during the period when condensation is most likely to occur.

14.2 Observation

During this test period, external surface areas exhibiting fog, droplets or running water shall be outlined and designated with the letters F, D and R respectively.

14.3 Expression of results and test report

A coded sketch shall be made showing the maximum area and degree of condensation appearing during the test on all surfaces; the code shown in figure 4 shall be used.

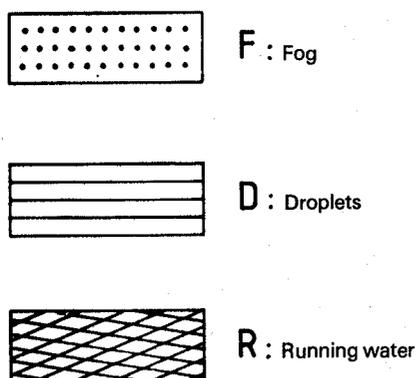


Figure 4 — Condensation code

The duration of the period of observation shall also be indicated in the test report.

15 Energy consumption test

The purpose of this test is to check the energy consumption of appliances under specified test conditions.

15.1 Procedure

15.1.1 Ambient temperature (see 8.1.1)

The ambient temperature shall be:

- + 25 °C for class SN, N and ST appliances;
- + 32 °C for class T appliances.

15.1.2 Preparation of the appliance

The appliance shall be installed and loaded as for the storage temperature test (see clause 13). If, however, anti-condensation heaters are provided which can be switched on and off by the user, but which are not necessary to withstand the water vapour condensation test, they shall not be switched on.

15.2 Measurements

The energy consumption (electrical, gas or any other) shall be measured during the test period (see 8.7.2).

In the case of cyclic operation, the initial and final values shall be read immediately after the thermostat cuts out.

The measurement of energy consumption shall be carried out under storage conditions, as follows.

15.2.1 Refrigerators without frozen food storage compartment

The thermostat shall be set in the position corresponding to $t_m = + 5$ °C, with t_1 , t_2 and t_3 between 0 and + 10 °C.

The energy consumption may be evaluated for two values of the mean internal temperature t_m , one above and one below + 5 °C within the limits of ± 2 K. The energy consumption corresponding to the temperature $t_m = + 5$ °C shall then be determined by interpolation.

15.2.2 Refrigerators with frozen food storage compartments

The energy consumption corresponds to the temperature $t_m = + 5$ °C and to the basic classification temperature of the compartment under consideration. As these two conditions cannot, in general, be obtained simultaneously, the energy consumption shall be that corresponding to one of the following temperature conditions:

- a) either $t_m = + 5$ °C, with t_1 , t_2 and t_3 between 0 and + 10 °C, and simultaneously the maximum temperature of the warmest "M" package colder than or equal to -6 °C, -12 °C or -18 °C, as appropriate; or,
- b) the maximum temperature of the warmest "M" package equal to -6 °C, -12 °C or -18 °C, as appropriate, and simultaneously t_m between 0 °C and + 5 °C, with t_1 , t_2 and t_3 between 0 and + 10 °C.

The energy consumption may be obtained by interpolation from the results of two tests, one giving a temperature above and one below the specified temperature $t_m = + 5$ °C for condition a) or one giving a temperature above and one below the classification temperature of the compartment -6 °C, -12 °C or -18 °C, as appropriate, for condition b).

The temperature deviation above and below + 5 °C in condition a) or above and below the classification temperature in condition b) shall be within the limits of ± 2 K.

15.3 Test report

The value of the energy consumption shall be calculated from the measured value for a period of exactly 24 h.

The energy consumption of electrically operated appliances shall be expressed in kilowatt hours per 24 hours (kWh/24 h) to two decimal places.

The report shall mention whether the declared energy consumption, if any, meets the requirements of 6.2.2.

16 Ice-making test

The purpose of this test is to check the claim, if any, for the ice-making capability of the appliance.

NOTE — This test does not apply to automatic ice-makers.

16.1 Procedure

16.1.1 Ambient temperature

The ambient temperature shall be:

- + 32 °C for class SN and N;
- + 38 °C for class ST;
- + 43 °C for class T.

16.1.2 Preparation of the appliance

The appliance shall be installed in the test room in accordance with 8.1.3 and set up as in service in accordance with the manufacturer's instructions. The evaporator shall be defrosted, if necessary, and the means of access (doors or lids) shall be kept closed during the test.

Ice-tray(s) shall be removed and the fresh food storage compartment shall be equipped with copper or brass cylinders in accordance with 8.5.

Any frozen food storage compartment shall not be equipped with test packages and "M" packages.

The thermostat shall be set in accordance with the manufacturer's instructions. When no instructions are given, the thermostat position shall be the same as that for the storage test.

16.1.3 Measurements

After stable operating conditions (see 3.4.7) have been attained, the ice-tray(s) shall be filled up to 5 mm from the top with water and promptly placed in the ice-making compartment or in the frozen food storage compartment, as recommended by the manufacturer.

The water temperature at the moment of placing the ice-tray into the ice compartment shall be:

- 20 ± 1 °C for class SN and N;
- 30 ± 1 °C for class ST and T.

The contact surface of the ice-tray(s) shall be wetted to provide proper contact with the evaporator.

The ice-tray(s) shall be examined after an interval equal to the freezing time stated by the manufacturer has elapsed or as estimated from the stated ice-making capabilities of the appliance.

Throughout the ice-making test, all the internal temperatures, t_1 , t_2 and t_3 (see 3.4.3.1.1) shall be in accordance with table 1.

16.2 Test report

The test report shall state:

- a) the quantity, in kilograms, of ice produced in a 24 h period or the time in hours and minutes necessary to freeze the water in the ice-tray(s) supplied with the appliance;
- b) whether the requirements in 6.2.3 are met.

17 Test for absence of odour

The purpose of this test is to check that the materials used for the internal components of the refrigerator will not impart taste or odour to food.

17.1 Procedure

17.1.1 Ambient temperature

The ambient temperature shall be between 16 and 32 °C.

17.1.2 Cleaning

The appliance shall be previously cleaned in accordance with the manufacturer's instructions and afterwards washed with pure water.

17.1.3 Thermostat setting

The appliance shall first be operated for 48 h with the thermostat set in a position which will give the following temperature:

Fresh food storage compartment:

- $t_m = 5 \pm 2$ °C for class N appliances;
- $t_m = 7 \pm 2$ °C for class SN, ST and T appliances.

17.1.4 Samples

The following samples shall be used:

- a) 100 ml potable water;
- b) a slice of fresh unsalted butter of 75 mm × 35 mm × 5 mm.

From each of a) and b), six samples at least are necessary to serve as analytical samples and six at least to serve as check samples.

The samples are placed in Petri dishes and glass containers, the latter being hermetically sealed.

Prior to the test, all Petri dishes and containers which are used for the test shall be cleaned with fuming nitric acid and subsequently washed with distilled water until complete absence of odour is obtained.

The analytical samples of water and butter shall be placed uncovered into the fresh food storage compartment.

The check samples in the hermetically sealed glass containers shall be placed close to the analytical samples.

17.1.5 Test time

The analytical samples and the check samples shall be left in the operating refrigerator with the door closed and at the specified temperature conditions for 48 h. After 48 h, the analytical samples shall be covered.

The analytical samples and check samples shall be removed and warmed up to approximately 20 °C by leaving them in the test room.

17.2 Examination of samples

17.2.1 Conditions

Examination shall be made about 2 h after removal of the samples from the appliance and shall be carried out by at least three experts familiarized with this test method.

Each examiner gets:

- two analytical samples of water;
- two check samples of water;
- two analytical samples of butter;
- two check samples of butter.

The identity of the samples shall not be made known to the examiners.

The samples of water shall be examined prior to the samples of butter, unless a separate examination by different examiners takes place.

The examiners shall record their remarks, independently of each other, in writing:

17.2.2 Evaluation

The evaluation shall be made using the following grading system:

- Mark 0: No foreign odour or foreign flavour
- Mark 1: Slight foreign odour or foreign flavour
- Mark 2: Definitely perceivable foreign odour or foreign flavour
- Mark 3: Distinct foreign odour or foreign flavour

If the requirement in 5.2 is not unambiguously complied with, the test may be repeated. The following provisions shall be made for this second test:

- defrosting of the evaporator;
- cleaning of the fresh food storage compartment and chiller compartment, if any;

- operation of the empty appliance for 1 week;
- repeat defrosting of the evaporator;
- temperature adjustment in the fresh food storage compartment for the second test for absence of odour.

17.3 Test report

The test report shall indicate whether the requirements of 5.2 are met.

NOTE — A test for chiller compartments is under consideration.

18 Final test report

The final test report shall comprise the measurements and test results of the following:

- a) overall dimensions (see 3.3.3);
- b) overall space required in use (see 3.3.4);
- c) gross volume (see 7.2.1);
- d) storage volume(s) (see 7.2.3, 7.2.4, 7.2.5);
- e) total storage volume (see 7.2.2);
- f) storage shelf area (see 7.3);
- g) defrosting type for each compartment (automatic, semi-automatic or manual) (see 3.4.4);
- h) airtightness test of door(s) or lid(s) (see clause 9);
- j) opening force test of door(s) or lid(s) (see clause 10);
- k) durability test (see clause 11);
- m) mechanical strength test (see clause 12);
- n) storage temperature(s) test (see clause 13);
- p) water vapour condensation test (see clause 14);
- q) energy consumption test (see clause 15);
- r) ice-making (if any) test (see clause 16);
- s) absence of odour test (see clause 17);

19 Designation

Household refrigerators shall be designated according to:

- a) the kind (upright or top opening type);
- b) the operating principle;
 - compression or absorption and
 - if absorption, the energy source (electricity, gas or liquid fuel);
- c) the class (extended temperate — SN, temperate — N, sub-tropical — ST or tropical — T);
- d) the rated gross volume;
- e) the rated total storage volume (see 3.3.5.6 and 3.3.5.7), together with the rated storage volume and the star classification of the frozen food storage compartment, if any.

Example of designation

Upright compressor type household refrigerator, class N, total gross volume 400 dm³, total storage volume 360 dm³, including 50 dm³ 3-star compartment.

20 Marking**20.1 Rating plate**

Each appliance shall have on one or several securely fastened rating plates, the following information marked in a permanent and legible manner, either preferably readily visible in normal use or when the appliance is away from a wall or after the removal, without any tool, of a flap or grille:

- the indication "refrigerator";
- the trade-mark or name of the manufacturer or vendor responsible;
- the model designation;
- the serial number and/or date of manufacture, which may be coded;
- the rated total gross volume, either in cubic decimetres or in litres;
- the rated storage volume of the fresh food storage compartment, either in cubic decimetres or in litres;
- the rated storage volume of the low temperature compartment(s), if any, either in cubic decimetres or in litres;
- the symbol of the class (SN, N, ST or T);
- the designation and mass, in grams, of the refrigerant (see ISO 817);
- all information relating to the energy source, including those laid down by safety regulations;

For built-in or under-counter appliances, the information given in b) to d) for servicing requirements shall be visible when the appliance is in normal use.

The manufacturer is free to add any other information he considers desirable.

20.2 Identification of frozen food storage compartments

Frozen food storage compartments shall be identified by a symbol, placed on their front¹⁾, door or lid. Six-pointed stars within a frame with curved sides, as shown in figure 5, shall be used for the identification on the compartments as specified in 3.2.5.

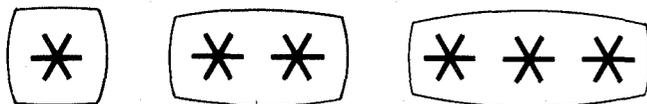


Figure 5 — Identification symbols
(for details, see figure 11)

The symbol shall not make use of more than two colours nor exhibit more than two contrasting surface finishes. (For the purpose of this requirement, white and black are considered as colours.) There shall be no marking or decoration anywhere on the appliance which can be confused with the star identification symbol.

20.3 Load limit line

Load limit lines are permitted only in relation to three-star frozen food storage volumes in compartments with independent external door.

If, within the gross volume of any frozen food storage compartment,

- no space is acknowledged as being unsuitable for food storage (as defined in 3.2.5),
- or the load limits are determined by the particular construction (for example baskets, flaps, etc...),
- or the load limits are determined by natural load limits (see figure 8) and the loading conditions are specially described in the instructions for use,

then no load limit line is necessary.

In all other cases, the limits of storage volume shall be indicated conspicuously and indelibly by a load line or lines in the form shown in figure 6. Dimensions are given for information. They may be reduced to not less than half their values while maintaining the same proportions.

It is recommended that the manufacturer should avoid, as far as possible, the provision of storage spaces outside the load limits.

21 Technical and advertising literature

Whenever technical and advertising literature is supplied, it shall contain the characteristics stated in Designation of appliance (see clause 19) and if, additionally, it contains all or some of the following data, such data shall be in accordance with this International Standard.

- name of manufacturer or vendor responsible;
- the model designation;
- the range of ambient temperatures of the class (SN, N, ST or T) for which the appliance is designed;
- overall space required in use (see 3.3.4), with sketches showing the appliance with the means of access open and closed;
- for appliances which are suitable for building in, the recess dimensions, together with any additional ventilation requirements;

1) If the outside of the cabinet is intended to be decorated by the purchaser, the symbol shall be placed inside the appliance.

Dimensions in millimetres

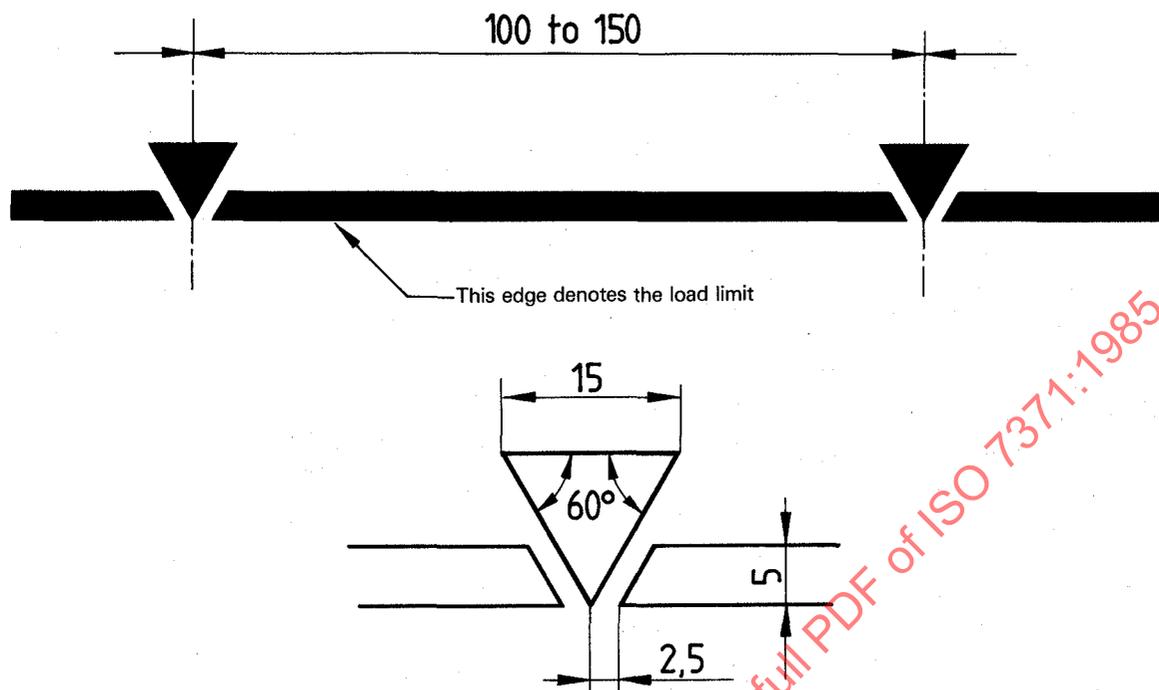


Figure 6 — Marking of load limit

- f) direction of opening the door(s), and whether reversible;
- g) rated energy consumption (see clause 15), with a reference to the ambient temperature at which this value is measured;
- h) percentage running time, measured in accordance with clause 8.7, or a statement that the percentage running time is in conformity with the minimum requirements, if any, of the national standard;
- j) ice-making capacity, measured in accordance with clause 16, or a statement that the ice-making capacity or the time to make ice is in conformity with the minimum requirements, if any, of the national standard;
- k) rated storage shelf area, measured in accordance with 7.3;
- m) any other information that the manufacturer considers useful.

- b) overall space required in use (see 3.3.4), with sketches showing the appliance with the means of access open and closed;
- c) for appliances which are intended to be built-in, the recess dimensions, together with any additional ventilation requirements;
- d) operating conditions (starting and stopping procedures);
- e) instructions for use of the various controls (such as thermostat, indicator lights, air circulation and defrosting controls);
- f) the fact that the temperature within the compartment(s) may be affected by such factors as the location of the appliance, ambient temperature and the frequency of door opening. If appropriate, a warning shall be given that the setting of the thermostat or other temperature control devices might have to be varied to allow for these factors;
- g) recommendations on loading the appliance [in particular, for the frozen food storage compartment(s) and the ice-making compartment];
- h) care required for best performance, such as: loading the appliance (especially when the storage volume is smaller than the gross volume and when no load limit lines exist);
- j) maintenance and cleaning of the appliance;
- k) defrosting;
- m) the fact that effervescent drinks should not be stored in low temperature compartments and that some products such as ice-lollies should not be consumed too cold;

22 Instructions for use and maintenance

Every appliance shall be accompanied on delivery by instructions for its use and maintenance, in the language used in the country where it is for sale. These instructions shall include, in particular, information as to:

- a) installation requirements (best location; levelling; connection, if required, for defrost water; connections to energy source);

n) the need not to exceed the storage time(s) recommended by the food manufacturers for commercially quick frozen food in compartments marked with the *, ** or *** symbol;

p) precautions necessary to prevent undue rise in temperature of the frozen food while defrosting, such as wrapping the frozen food in several thicknesses of newspaper;

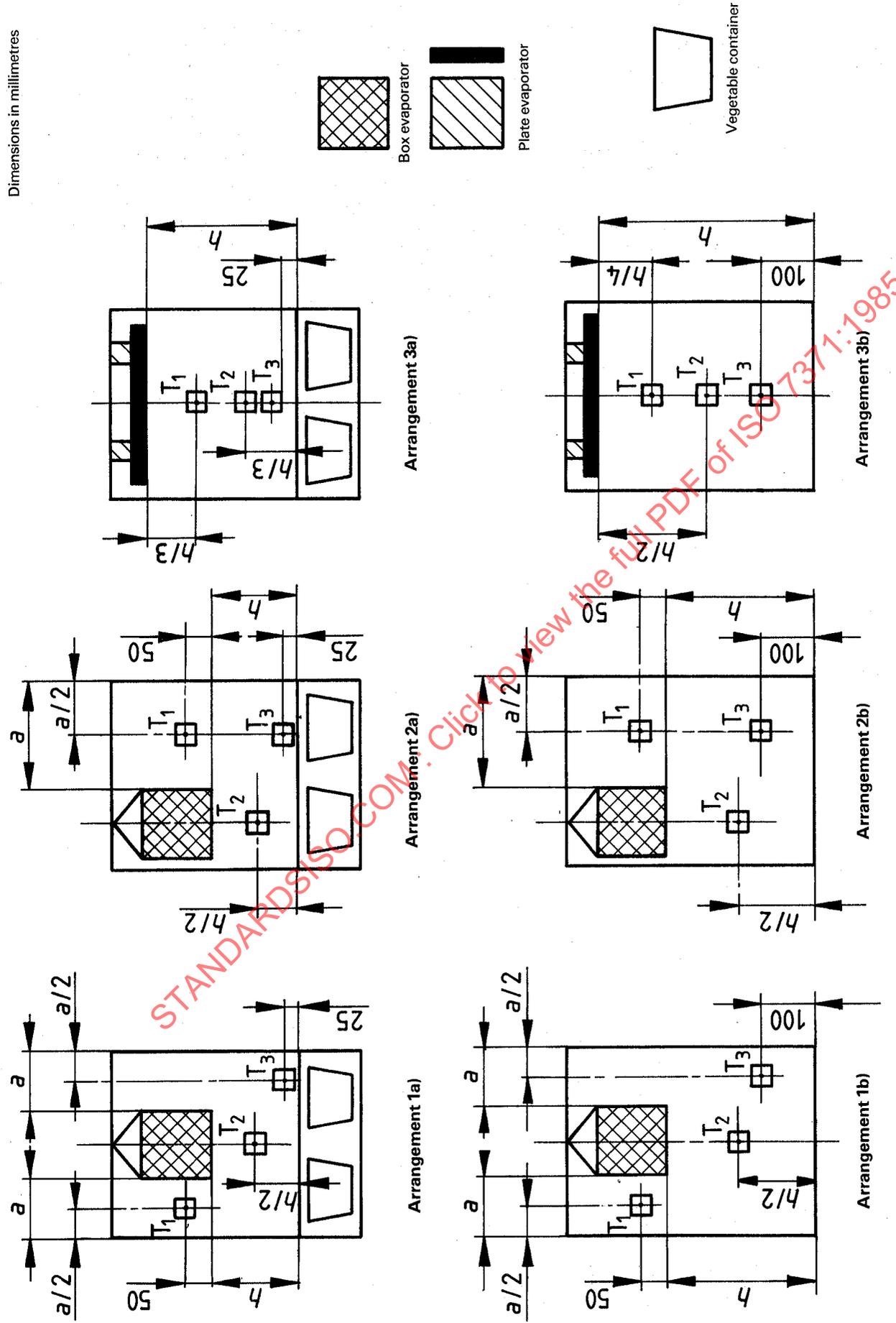
q) the fact that a rise of temperature of the frozen food during defrosting may shorten the storage life;

r) the care required in the event of the prolonged non-running of the appliance (interruption in the power-supply or failure of the refrigerating system);

s) the action to be taken when the appliance is switched off and taken out of service temporarily or for an extended period — for example emptied, defrosted, cleaned and dried, and the door(s) or lid(s) propped ajar;

t) the necessity that, for doors or lids fitted with locks and keys, the keys should be kept out of the reach of children and not in the vicinity of the appliance, in order to prevent children from being locked inside.

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For arrangements 1a), 1b), 2a), 2b): $a \geq 150$ mm. Otherwise see 4a) or 4b).

Figure 7 — Temperature measurement points in refrigerators with different arrangements of evaporator

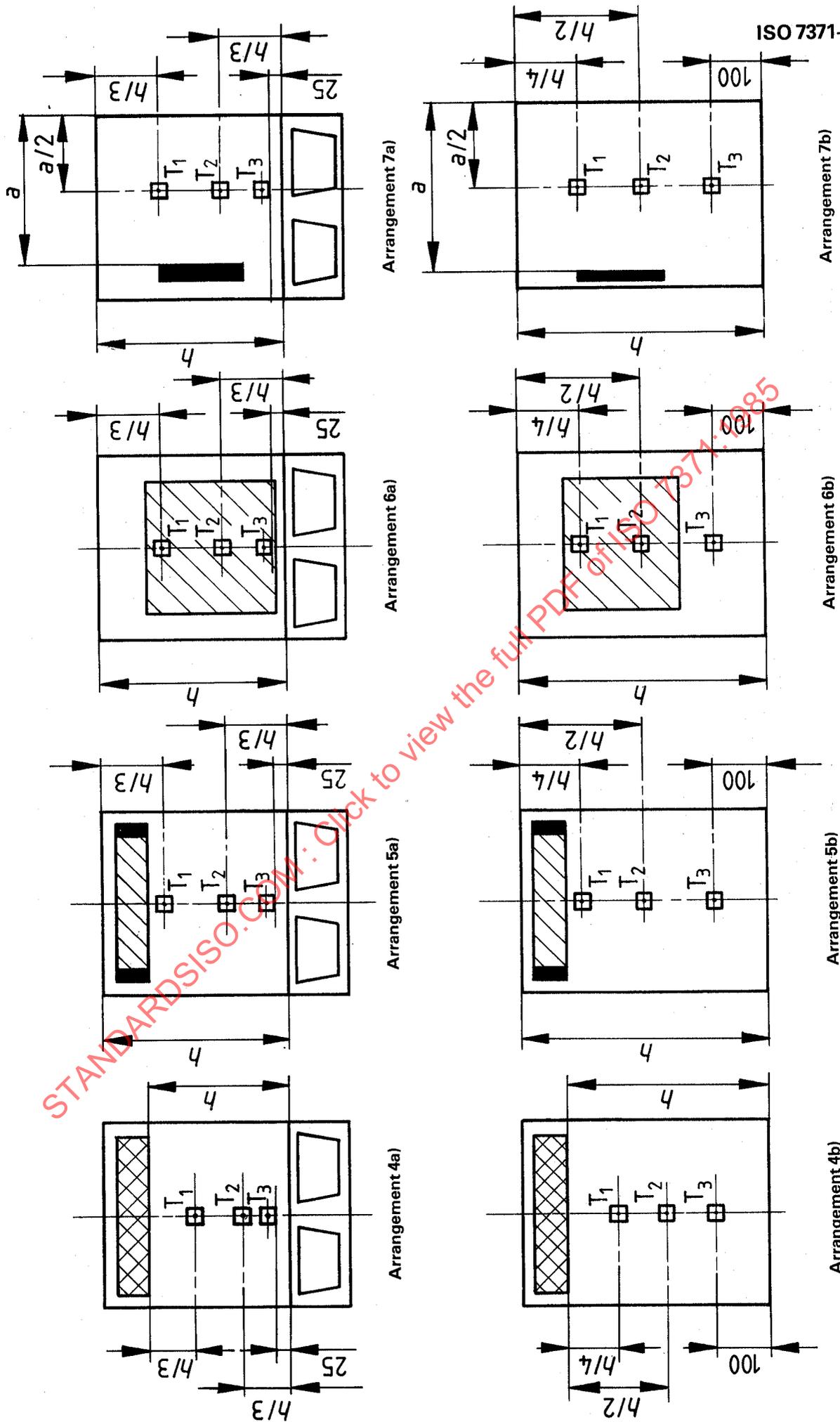


Figure 7 — Temperature measurement points in refrigerators with different arrangements of evaporator (concluded)

Dimensions in millimetres

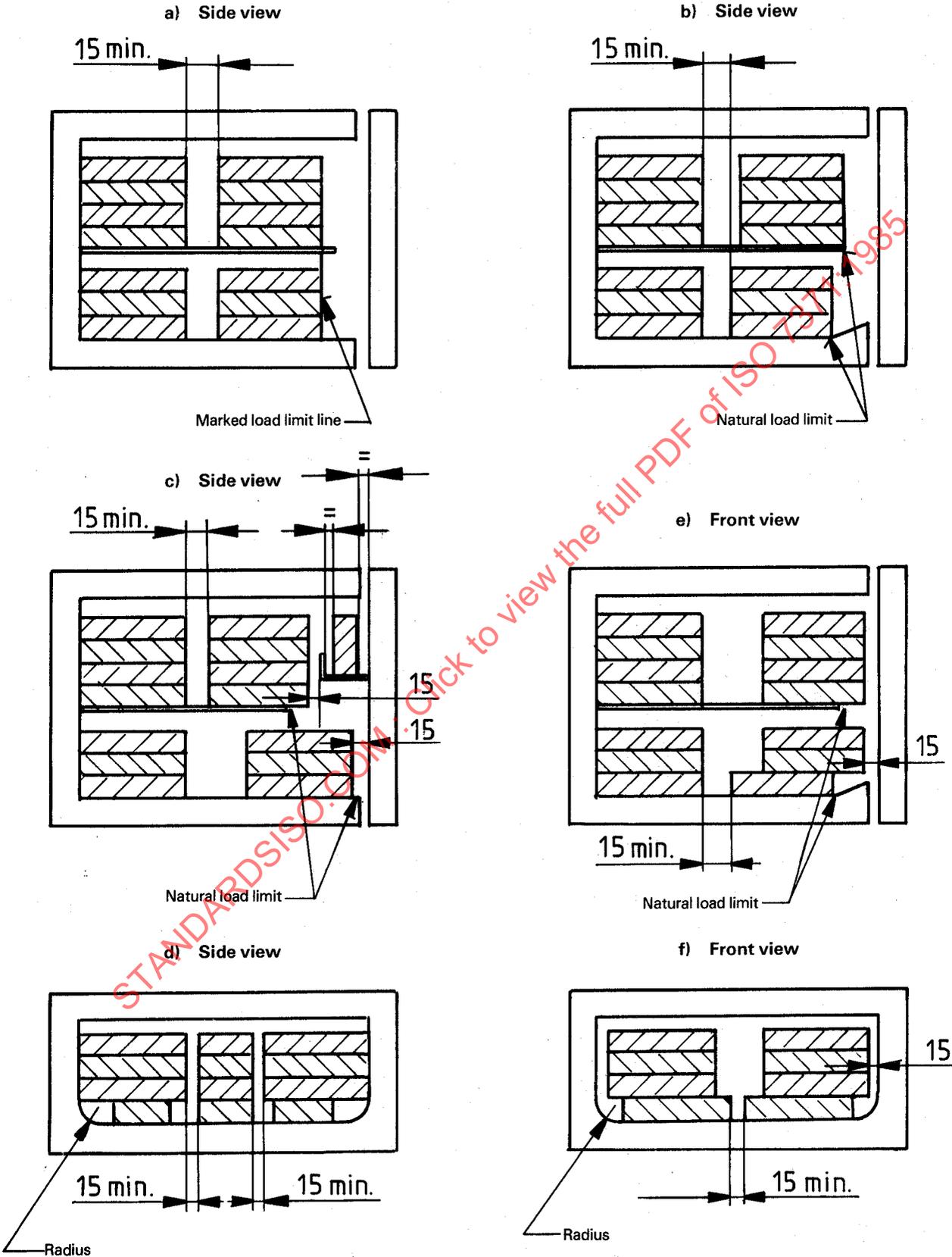
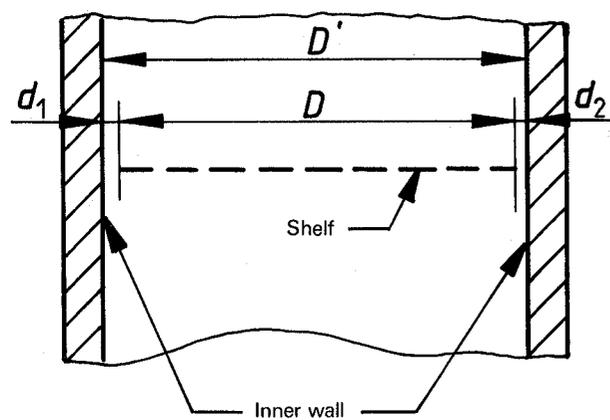


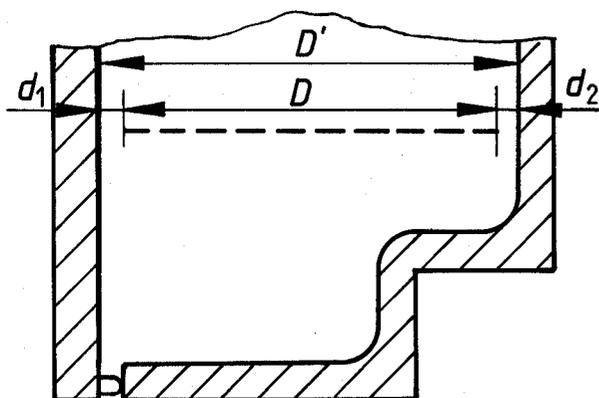
Figure 8 — Examples of storage plan (see 13.1.2)



a) Determination of width

If $d_1 + d_2 < 20$ mm:
dimension of the shelf = D'

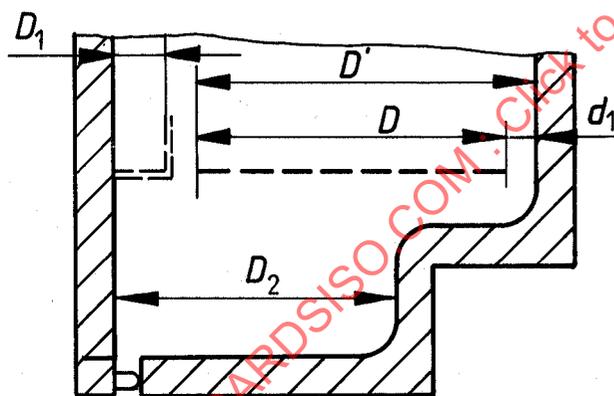
If $d_1 + d_2 > 20$ mm:
dimension of the shelf = D



b) Determination of depth — Upright-type appliance without storage in the door

If $d_1 + d_2 < 20$ mm:
dimension of the shelf = D'

If $d_1 + d_2 > 20$ mm:
dimension of the shelf = D



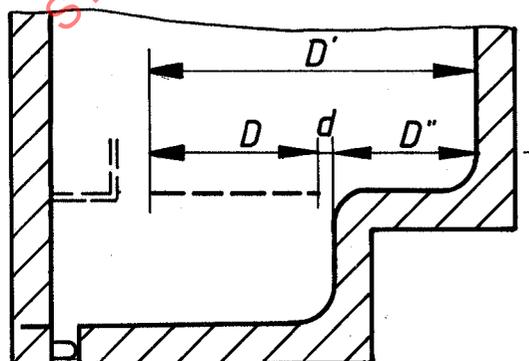
c) Determination of depth — Upright-type appliance with storage in the door

If $d_1 < 20$ mm:
dimension of the shelf = D'

If $d_1 > 20$ mm:
dimension of the shelf = D

Dimension of the door shelf = D_1

Dimension of the bottom of the appliance = D_2

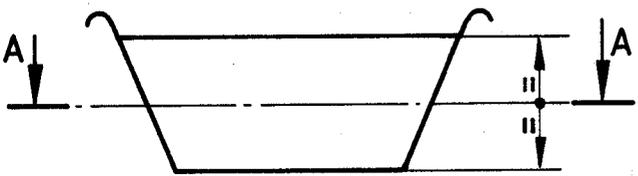


d) Determination of depth — Shelf with juxtaposed parts

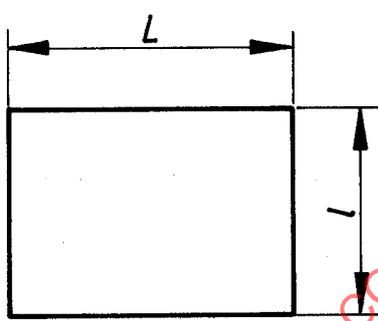
If $d < 20$ mm:
dimension of the shelf = D'

If $d > 20$ mm:
2 shelves of dimension D and D''

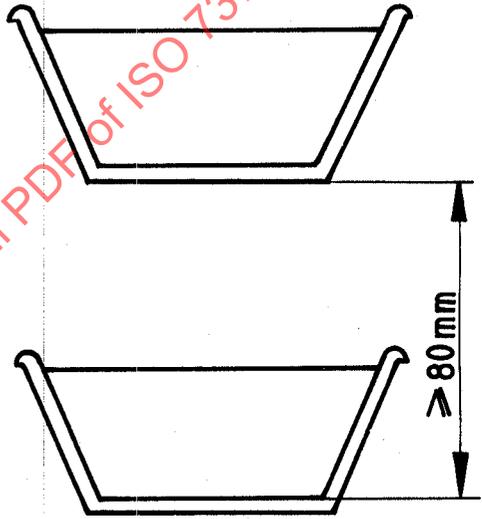
Figure 9 — Examples of determination of the area of a shelf (see 7.3.1)



A-A



Area of basket



Vertical clearance above a basket

Figure 10 — Example of determination of mean dimensions for calculation of the area of a basket (see 7.3.3)