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**Household frost-free refrigerating  
appliances — Refrigerators,  
refrigerator-freezers, frozen food storage  
cabinets and food freezers cooled by  
internal forced air circulation —  
Characteristics and test methods**

*Appareils de réfrigération ménagers à air pulsé — Réfrigérateurs,  
réfrigérateurs-congérateurs, conservateurs de denrées congelées et  
congérateurs à air pulsé intérieur — Caractéristiques et méthodes d'essai*



Reference number  
ISO 8561:1995(E)

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## 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 8561 was prepared by Technical Committee ISO/TC 86, *Refrigeration*, Subcommittee SC 5, *Construction and testing of household refrigerators*.

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

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# Household frost-free refrigerating appliances — Refrigerators, refrigerator-freezers, frozen food storage cabinets and food freezers cooled by internal forced air circulation — Characteristics and test methods

## 1 Scope

This International Standard specifies the essential characteristics for household frozen food storage cabinets and food freezers cooled by internal forced air circulation and for household refrigerators with or without cellar, ice-making or frozen food storage compartments, and of refrigerator-freezers with or without cellar compartment and with at least the food freezer and or frozen food storage compartment(s) cooled by internal forced air circulation, which are wholly factory assembled, and lays down the methods of test for the checking of these characteristics.

Appliances with one refrigerating system in which there are compartments, some cooled by forced air circulation and others by natural convection, shall be tested in accordance with this International Standard.

Compartments cooled by natural convection but having a separate independent refrigerating system shall be tested in accordance with the applicable referenced standard.

However, all compartments are automatically defrosted with automatic disposal of the defrost water.

This International Standard does not apply to household refrigerators (which are covered in ISO 7371), refrigerator-freezers (which are covered in ISO 8187) or frozen food storage cabinets and food freezers (which are covered in ISO 5155) not cooled by internal forced air circulation.

The tests described in this International Standard are type tests. When it is necessary to verify the performance of a refrigerating appliance 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 refrigerating appliances are specified in IEC 335-2-24. This International Standard does not apply to household frost-free refrigerating appliances operating on energy sources other than electricity.

Additional safety requirements applicable to the refrigerating systems of household refrigerating appliances are given in ISO 5149.

## 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:—<sup>1)</sup>, *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*.

### 3 Definitions

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

**3.1 household frost-free appliance:** Insulated cabinet of suitable volume and equipment for household use, cooled by one or more energy-consuming means, in which all compartments are automatically defrosted with automatic disposal of the defrost water, and at least one compartment is cooled by a frost-free system (see 3.1.5).

**3.1.1 household frost-free refrigerator** (hereinafter referred to as "refrigerator"): Frost-free appliance having one or more compartments intended for the preservation of food, one at least of which is suitable for the storage of fresh food.

**3.1.2 household frost-free refrigerator-freezer** (hereinafter referred to as "refrigerator-freezer"): Frost-free appliance having two or more compartments.

At least one compartment (the fresh food storage compartment) is suitable for the storage of fresh food, and at least one compartment (the food freezer compartment) is suitable for freezing fresh food and for the storage of frozen food under "three star" storage conditions (see 3.2.5.4).

**3.1.2.1 household refrigerator-freezer type I:** A refrigerator-freezer having a single temperature control device for regulating the temperatures of the fresh food storage and food freezer compartments.<sup>2)</sup>

**3.1.2.2 household refrigerator-freezer type II:** A refrigerator-freezer having the means for separate regulation of the temperatures of the fresh food storage and food freezer compartments.<sup>2)</sup>

**3.1.3 household frost-free frozen food storage cabinet** (hereinafter referred to as "frozen food storage cabinet"): Frost-free appliance having one or more compartments which is (are) suitable for the storage of frozen food under "three star" storage conditions (see 3.2.5.4).<sup>3)</sup>

**3.1.4 household frost-free food freezer** (hereinafter referred to as "food freezer"): Frost-free appliance having one or more compartments suitable for freezing, from + 25 °C to – 18 °C for class SN, N and ST appliances, + 32 °C to – 18 °C for class T appliances (see clause 4), a quantity of at least 4,5 kg of test packages per 100 l of its storage volume in 24 h, and in no case less than 2 kg, under the test conditions specified in clause 17, and which is also suitable for the storage of frozen food under "three star" storage conditions (see 3.2.5.4).<sup>3)</sup>

NOTE 1 From the point of view of installation, there are various types of household refrigerating appliances: freestanding, wall-mounted, built-in, etc.

**3.1.5 frost-free system:** System in which cooling is provided by forced air circulation and the evaporator(s) is (are) defrosted by an automatic defrost system. Characteristics of the "frost-free" system are:

- a) the system is automatically operated to prevent the permanent formation of frost on all refrigerated surfaces;
- b) no accumulation of ice or frost forms on the stored food;
- c) storage temperatures in the fresh food compartment, the frozen food storage and/or freezer compartment and the cellar compartment (if any) are maintained within the limits specified in this International Standard;
- d) the water from defrosting is disposed of automatically.

### 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.

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

2) In the case of a cellar compartment there can be an additional means for regulating the temperature of that compartment.

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

**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.

**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  $-6\text{ }^{\circ}\text{C}$ .

**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 “two star” section:** Part of a food freezer compartment (or cabinet) or of a “three star” compartment (or cabinet) 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  $-12\text{ }^{\circ}\text{C}$  (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  $-18\text{ }^{\circ}\text{C}$ .<sup>4)</sup>

**3.2.6 food freezer compartment:** Compartment suitable for freezing from  $+25\text{ }^{\circ}\text{C}$  to  $-18\text{ }^{\circ}\text{C}$  for class SN, N and ST appliances, and from  $+32\text{ }^{\circ}\text{C}$  to  $-18\text{ }^{\circ}\text{C}$  for class T appliances (see clause 4), a quantity of at least 4,5 kg of test packages per 100 l of its storage volume in 24 h, and in no case less than 2 kg, under the test conditions specified in clause 17, and which is also suitable for the storage

of frozen food under “three star” storage conditions (see 3.2.5.4).<sup>4)</sup>

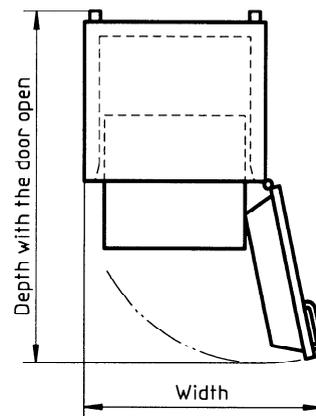
### 3.3 General definitions

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

**3.3.2 upright type:** Appliance 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 appliance 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 (see figure 1).



**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.

4) In certain instances, “two star” sections and/or compartments are permitted within the compartment (or cabinet) (see 7.2.6).

The gross volume is calculated by subtracting from the total volume the volume occupied by air ducts, evaporator, fan and other associated accessories.

**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), food freezer compartment [including any "two star" section(s), and/or compartment(s) contained therein], and cellar compartment(s), as applicable, 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), food freezer compartment [including any "two star" section(s) and/or compartment(s) contained therein] and cellar compartment(s), as applicable.

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

### 3.3.6 Storage surface

**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 an appliance 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 appliances) or + 32 °C (in the case of class T appliances (see clause 4) and measured under the conditions specified in clause 15.

NOTE 2 In some countries a different method for the measurement of energy consumption is required by law (see annex A).

**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 instantaneous temperatures  $t_1$ ,  $t_2$  and  $t_3$  measured in "M" packages (see 3.4.6) and placed at given points in the fresh food storage compartment as specified in 8.5 .

$t_{m,max}$  is the maximum value of  $t_m$ .

**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 instantaneous temperatures  $t_{c1}$ ,  $t_{c2}$  and  $t_{c3}$  (as appropriate) measured in "M" packages (see 3.4.6) and placed at given points in the cellar compartment as specified in 8.5.

$t_{cm,max}$  is the maximum value of  $t_{cm}$ .

**3.4.4 freezing capacity:** Mass of test packages whose temperature (taken as the instantaneous arithmetical mean temperature of all the "M" packages) can be lowered from the loading temperature of + 25 °C or + 32 °C (see 3.1.4 or 3.2.6) to - 18 °C in 24 h under the test conditions specified in clause 17. The freezing capacity is expressed in kilograms.

**3.4.4.1 rated freezing capacity:** Freezing capacity stated by the manufacturer.

### 3.4.5 Defrosting

**3.4.5.1 automatically defrosted:** An evaporator 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.

**3.4.5.2 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.

**3.4.6 "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.

### 3.4.7 Cycles

**3.4.7.1 operating cycle:** That period which commences at the initiation of a defrosting cycle and terminates at the moment of initiation of the next defrosting cycle.

**3.4.7.2 defrosting cycle:** The period between the moment when the means of defrosting the evaporator(s) is switched on and the moment when the refrigeration process is re-established.

**3.4.8 stable operating conditions:** Stable operating conditions exist when the appliance has been left running for a minimum time according to the manufacturer's instruction without any adjustment of temperature control setting(s) during this time, and when there is no marked trend away from the storage temperatures (see table 2) after this time.

**3.4.9 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 an operating cycle (see 3.4.7.1);

$D'$  is the total duration of the operating cycle minus the duration of the defrosting cycle (see 3.4.7.2), even if defrosting occurs by a hot-gas system (see also figure 2).

When calculating the percentage running time for an appliance in accordance with this International Stan-

dard, the duration of the defrosting cycle must be taken into account,  $R'$  has been introduced in order to have a clear distinction between this and the percentage running time  $R$  of conventional appliances.

For appliances with a hot-gas defrosting system, the time required for hot-gas defrosting shall not be included in the running time of the refrigerating unit.

**3.4.10 ice-making capacity:** Quantity of ice the appliance 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.

**3.4.11 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 at two points located 350 mm from the vertical centreline of the side walls of the appliance at 1 m above the floor line.

**3.4.12 temperature rise time:** Period between the moment when, under specified test conditions, the temperature of the warmest "M" package in the food freezer compartment (or cabinet) or in any "three star" compartment (or cabinet) reaches  $-18\text{ }^{\circ}\text{C}$  to the moment when any of the "M" packages (excluding any "two star" sections) first reaches a temperature of  $-9\text{ }^{\circ}\text{C}$  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 appliances

**3.6.1 compression-type appliance:** Appliance 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 (or cabinet).

**3.6.9 fan:** Device which provides cooling by means of a forced air stream to a condenser and/or to one or more compartments of the appliance.

**3.6.10 defrost timer:** Device which controls the initiation, duration and time lapse between defrost cycles.

**3.6.11 demand defrost:** System of defrost control in which the initiation of the defrost cycle is controlled by the rate of accumulation of frost on the evaporator surfaces.

**3.6.12 defrost heater:** Device which provides heat to the frost formed on the evaporator in order to facilitate the melting and removal of the ice.

## 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

Appliances 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 appliances shall not transmit odours or taste to food. When testing in accordance with clause 19, the mean value of the individual results during each evaluation for odour and taste shall not exceed mark 1.

Materials used inside appliances 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 appliance 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 appliance 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 appliance when subjected to the durability test of clause 11.

In the case of frozen food storage cabinets, food freezers and appliances with the food freezer compartment and the frozen food storage compartment, if any, having a separate access door or lid, the hinges and handles of the door or lid of that compartment (or cabinet) 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 appliances 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 cabinet) 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 appliance 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 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 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

A means shall be provided for completely collecting the defrost water in an external receptacle wherein the defrost water is evaporated.

The defrost water receptacle should have adequate volume and should have adequate evaporating means.

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) (or cabinets).

### 5.7 Refrigerating system

**5.7.1** The mechanical operation of the appliance should 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 appliance 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 appliance 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.

Appliances having additional frozen food storage compartments shall comply simultaneously with the conditions specified in table 2 for the appropriate cli-

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

Values in degrees Celsius

		Fresh food storage compartment (see 3.4.3.1)		Frozen food storage or food freezer compartment, cabinet or section, as applicable (see 3.4.3.2 and 7.2.6)			Cellar compartment (see 3.4.3.3)
		$t_1, t_2, t_3$	$t_{m,max}$	$t^{***}$	$t^{**}$	$t^*$	$t_{cm,max}$
I	Storage temperatures	$0 \leq t_1, t_2, t_3 \leq +10$	$\leq +5$	$\leq -18$	$\leq -12$	$\leq -6$	$+8 \leq t_{cm,max} \leq +14$
II	Permitted temperature deviations (defrost cycle)	$0 \leq t_1, t_2, t_3 \leq +10$	$\leq +7$	$\leq -15$	$\leq -12$	$\leq -6$	$+8 \leq t_{cm,max} \leq +14$

#### NOTES

- The duration of the temperature deviation above the storage temperature (line "I") as a result of a defrost cycle shall not be greater than 4 h or 20 % of the duration of the operating cycle, whichever is the shorter.
- In the case of  $t^{***}$ , the duration of the deviation shall be measured from the moment when the first "M" package temperature exceeds  $-18$  °C to that moment when the last "M" package temperature returns permanently to  $-18$  °C or colder.
- In the case of  $t_m$ , the duration of the deviation shall be measured from the moment when  $t_m$  exceeds  $+5$  °C to that moment when  $t_m$  returns permanently to  $+5$  °C or colder.
- These two deviations need not occur simultaneously (see figure 2 for example).

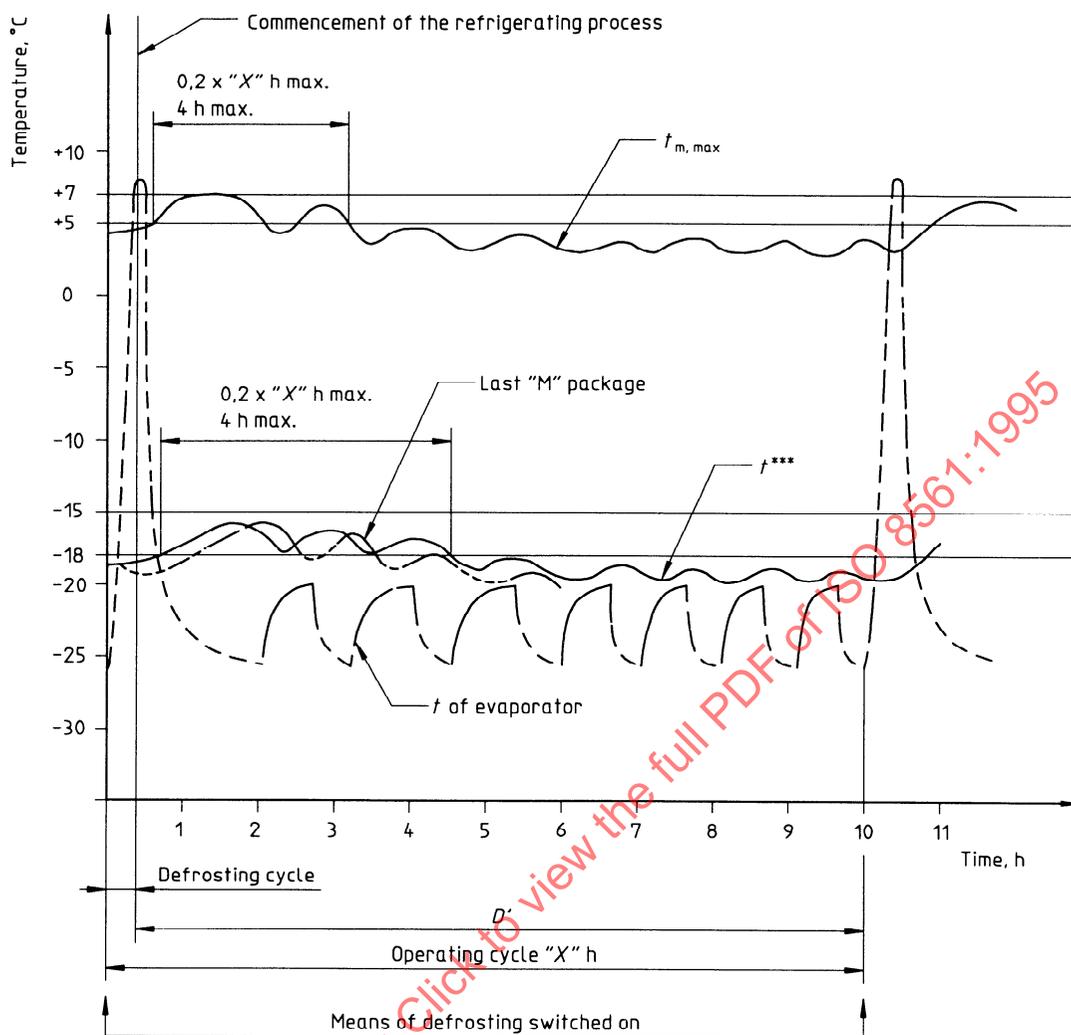


Figure 2 — Example of an operating cycle of a frost-free refrigerator-freezer

mate class and with the relevant classification temperature specified in 3.2.5.

### 6.2.2 Freezing capacity (if applicable)

The freezing capacity measured in accordance with clause 17 on the first appliance tested shall not be less than the rated freezing capacity by more than 15 % of the latter.

If the result of the test carried out 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 freezing capacity values of these three appliances shall be equal to or greater than the declared value minus 10 %.

The minimum freezing capacity in accordance with 3.1.4 or 3.2.6 and the requirement of 17.1.3.4, as appropriate, shall be respected.

### 6.2.3 Energy consumption

If the energy consumption is stated by the manufacturer, the value measured in the energy-consumption test 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 %.

**6.2.4 Ice making** (if applicable)

If the ice-making capacity is stated by the manufacturer, the value measured in accordance with clause 18 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 %.

**6.2.5 Temperature rise time** (if applicable)

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.

Any volume which is inaccessible because of air ducts, fans, evaporator and other associated accessories shall also be deducted [for examples see figures 18 a) to 18 d)].

**7.2.2 Determination of the total storage volume**

The total storage volume of the appliance shall be the sum of the storage volumes of the fresh food storage compartment(s), cellar compartment(s), ice-making compartment(s), frozen food storage compartment(s), and food freezer 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 (or cabinets) and food freezer compartment(s) (or cabinets), 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)

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.

### 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 food freezer compartments (or cabinets) and frozen food storage compartments (or cabinets)

For the determination of the storage volume of these compartments (or cabinets), 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 (for examples, see figure 19):

- 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;

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

NOTE 3 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 and freezing tests. 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 food freezer compartments (or cabinets) and in "three star" compartments (or cabinets)

A "two star" section or compartment is permitted both in the door and in the remaining storage volume when all the following conditions are met:

- the "two star" section(s) or compartment(s) is (are) marked with the appropriate identification symbol;
- the "two star" section(s) and/or compartment(s) is (are) separated from the "three star" volume by a partition, container, or similar construction;
- the rated total "two star" storage volume does not exceed 20 % of the "three star" storage volume of the compartment (or cabinet), or 30 l, whichever is the smaller value;
- the instructions for use give clear guidance regarding the "two star" section(s) and/or compartment(s);
- 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 20)

#### 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, if applicable.

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 14 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 14 b)]. When the door of an upright-type appliance is provided with shelves, this distance shall be determined by analogy [see figures 14 c) and 14 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 14 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 14 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 14 c)].

### 7.3.1.6 Baskets and containers

The area shall be the product of the two mean horizontal dimensions [see figure 15 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 full shelf or basket the vertical clearance may be reduced to not less than 80 mm [see figure 15 b)].

#### 7.3.1.7.3 Food freezer compartments (or cabinets) and low-temperature compartments (or cabinets)

Any part of full shelves, baskets or of the bottom of a food freezer compartment (or cabinet) or frozen food storage compartment (or cabinet) having less than 52 mm vertical clearance above, when all the shelves and baskets are in position, shall be excluded when calculating the storage area [see figure 15 b)].

In the case of an ice-making compartment, the minimum vertical clearance shall not be less than 40 mm.

### 7.3.2 Drip tray

The drip tray shall not be considered as a food shelf area.

### 7.3.3 Suspended containers

#### 7.3.3.1 Fresh food storage compartment and cellar compartment, if any

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 minimum clearance may be reduced to 80 mm to the extent where this possibility has not been applied for the shelves.

If the minimum vertical clearance within 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.

#### 7.3.3.2 Food freezer compartments (or cabinets) and low-temperature compartments (or cabinets)

For a food freezer compartment (or cabinet) or frozen food storage compartment (or cabinet), the dimension of the minimum vertical clearances specified in 7.3.3.1 is 52 mm in all cases.

For an ice-making compartment, the minimum vertical clearance dimension is 40 mm in all cases.

## 8 General test conditions

The order of carrying out the tests need not necessarily follow the sequence of the clauses given 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.

The manufacturer's storage plans shall be used, provided that they are in accordance with this International Standard (see 13.1.2).

### 8.1 Test room

The appliance 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 temperatures of refrigerators and refrigerator-freezers:
  - + 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 storage temperatures of frozen food storage cabinets and food freezers:<sup>5)</sup>
  - + 32 °C for class SN and N appliances
  - + 38 °C for class ST appliances
  - + 43 °C for class T appliances
- c) for checking the energy consumption<sup>6)</sup>, temperature rise time and food freezing capacity of all appliances, as applicable:

+ 25 °C for class SN, class N and class ST appliances

+ 32 °C for class T appliances

- d) for all other tests, at the temperature stated in the test specifications.

The temperature at each measurement point (see 3.4.11) shall be kept constant within  $\pm 0,5$  K of the nominal ambient temperature 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, painted dull black, open for free air circulation under the platform. The top of the platform shall be 0,3 m above the test room floor and shall extend at least 0,3 m, but not more than 0,6 m, beyond all sides of the appliance, except at the rear where it shall extend to the vertical partition.

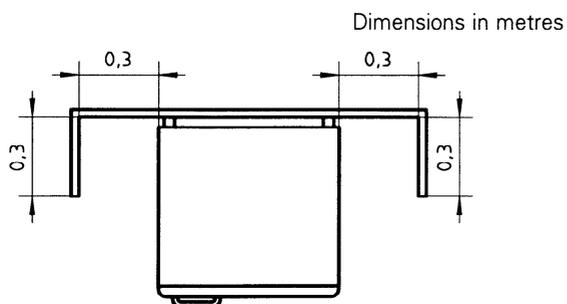
Circulation of air about the appliance shall be restricted by surrounding the appliance by three vertical partitions, painted dull black, arranged as follows:

- a) 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;
- b) the two other partitions shall be parallel to the sides of the cabinet, and shall be fixed on the platform 0,3 m from the sides of the cabinet; they shall be 0,3 m wide.

5) See annex A for particular conditions.

6) In some countries (see annex A) energy measurement tests for all climate classes are made at + 32 °C.

The whole partition structure shall have the form and dimensions shown in figure 3.



**Figure 3 — Partitions to restrict air circulation**  
(plan view)

The vertical partitions shall present no discontinuity. They shall be of such a height that they extend at least 0,3 m above the top of the appliance.

The appliance shall be so placed or shielded 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 in 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.

If the surface temperature of the floor of the test room, measured by thermocouples at points vertically below the ambient temperature measuring points, is within 1,5 K of the specified ambient temperature, the appliance may be placed directly on the floor.

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

Built-in appliances intended to be combined with appliances other than refrigerating appliances 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 in the form of right parallelepipeds shall be used.

### 8.2.1 Dimensions and tolerances

Their size, prior to freezing, and their mass, packaging included, shall be as specified in table 3.

**Table 3 — Dimensions and mass of test packages**

Dimensions mm	Mass g
25 × 50 × 100	125
50 × 100 × 100	500
50 × 100 × 200	1 000

Tolerances shall be as follows:

a) on linear dimensions:

± 1,5 mm for dimensions 25 mm and 50 mm

± 3,0 mm for dimensions 100 mm and 200 mm

b) on mass: ± 2 %.

### 8.2.2 Composition

The packages shall consist of the following.

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

230 g of oxyethylmethylcellulose

764,2 g of water<sup>7)</sup>

5 g of sodium chloride

0,8 g of 6-chloro-*m*-cresol.

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

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

The following alternative composition of test packages with a freezing point near  $-5\text{ }^{\circ}\text{C}$  may be used:

232 g oxyethylmethylcellulose

725 g of water

43 g of sodium chloride

0,8 g of 6-chloro-*m*-cresol.

In case of dispute, the first test package composition shall be used as reference test package.

- b) A wrapper, consisting of a sheet of plastic<sup>8)</sup> or any other suitable material of such a nature that exchange of moisture with the ambient medium is negligible. After filling, the wrapping sheet shall be sealed.

### 8.2.3 "M" packages

Some of the 500 g packages (50 mm  $\times$  100 mm  $\times$  100 mm) are equipped for temperature measurement, being fitted with thermocouples<sup>9)</sup> 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 shall be tested in the condition as delivered.

### 8.3.2 Anti-condensation heaters

If an appliance is fitted with an anti-condensation heater which can be switched on and off by the user, 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 Electric power supply<sup>10)</sup>

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

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

All shelves, and only those baskets, containers and trays which have been taken into consideration when determining the storage volume, shall be in position.

## 8.4 Measuring instruments

Temperatures shall be measured with temperature probes, the sensors of which are inserted either in "M" packages for measuring the internal temperatures (for all performance tests) or, for measuring the ambient temperature, in the centre of tin-covered solid copper or brass cylinders having a mass of 25 g and of minimum external area (diameter = height = about 15,2 mm). The temperatures shall be recorded. Temperature-measuring instruments shall be accurate to within  $\pm 0,3\text{ K}$ .

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 the dew point, is accurate to within  $\pm 0,3\text{ K}$ .

Watt-hour meters shall be readable to 0,01 kW-h and 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 and cellar compartment (if applicable)

The temperatures  $t_1, t_2, t_3$  (see 3.4.3.1) and  $t_{c1}, t_{c2}, t_{c3}$  (see 3.4.3.3) shall be measured in "M" packages, as specified in the particular test procedure, suspended with the largest surface horizontal, the temperature-sensing points  $T_1, T_2, T_3$  and  $T_{c1}, T_{c2}, T_{c3}$  being located at the places shown in figures 10 and 11 halfway be-

8) It is advisable to use a laminated sheet, consisting of a layer of high-pressure polyethylene, easily sealable, 120  $\mu\text{m}$  thick, together with an external sheet of polyterephthalate approximately 12,5  $\mu\text{m}$  thick, the two layers being bonded together.

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

10) See annex A for particular conditions.

tween the rear internal wall of the appliance and the internal wall of the closed door. The storage temperatures  $t_{m,max}$  and  $t_{cm,max}$  shall then be calculated as specified in 3.4.3.1 and 3.4.3.3. The conditions given in table 2 shall be respected.

The means of suspension shall have 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.

If internal components do not allow the temperatures  $t_1$ ,  $t_2$ ,  $t_3$  and  $t_{c1}$ ,  $t_{c2}$ ,  $t_{c3}$  to be read at the points specified, readings may be taken in positions such that one of the surfaces of the "M" package is no more than 25 mm from the point specified. If the interior arrangement of the fresh food storage compartment and cellar compartment does not conform to those shown in figures 10 and 11, the temperatures  $t_1$ ,  $t_2$ ,  $t_3$  and  $t_{c1}$ ,  $t_{c2}$ ,  $t_{c3}$  shall be read in positions determined by analogy with the positions indicated.

The temperatures shall be recorded. The "M" packages 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 food freezer compartments (or cabinets) and frozen food storage compartments (or cabinets) or sections (see also 7.2.6)

The temperatures shall be measured in "M" packages which are distributed throughout the load of test packages specified in the storage plan (see 13.1.2).

The temperature of each compartment (or cabinet) or section is then the maximum temperature of the warmest "M" package in that compartment (or cabinet) or section (see 3.4.3.2). The conditions given in table 2 shall be respected.

### 8.7 Test period

The test period shall start at least 24 h after stable operating conditions have been attained. The test period shall start at the beginning of an operating cycle; shall be of at least 24 h duration and shall comprise a whole number of operating cycles. If an operating cycle starts but is not completed during the 24 h period, the test shall continue until the end of that operating cycle.

If one operating cycle is not completed during a 72 h period, the test period shall be terminated at the end of 72 h.

## 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 °C 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 and 0,08 mm thick and of suitable length shall be inserted at any point of the seal, and the door or lid shall be closed normally on it. The verification of the thickness of the paper used shall be in accordance with ISO 534.

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

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

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

### 9.2 Test report

The test report shall indicate whether the tightness of the door or lid seal(s) meets the requirements of the last paragraph of 5.3.

## 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.

Compliance shall be checked by inspection and by the following test.

### 10.1 Procedure

The ambient temperature shall be between + 16 °C and + 32 °C. The appliance shall be switched off and 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 midpoint of the edge furthest from the hinge axis in a direction perpendicular to the plane of the door or lid.

The method of measurement shall be one of the following:

- 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);
- if the handle of the door or lid is at the midpoint of the edge furthest from the hinge axis, by applying a force to the handle, the value of the force required to open the door or lid 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 last paragraph of 5.4.

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

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

## 11.1 External door(s)

### 11.1.1 Procedure

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

The appliance shall be switched off.

The inner door(s) shall be loaded as specified in 12.1.2 or 13.1.2.7, as appropriate.

#### 11.1.1.1 Opening sequence (see figure 4)

The movement of the door shall be controlled from an angle of 0° to an angle of opening between 5° and 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.

#### 11.1.1.2 Closing sequence (see figure 4)

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 use.

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

## 11.2 Lid(s) and internal door(s)

Test procedure is under consideration.

## 11.3 Test report

The test report shall indicate whether the hinges and handles meet the requirements of 5.4, and whether the seals meet the requirements of the last paragraph of 5.3.

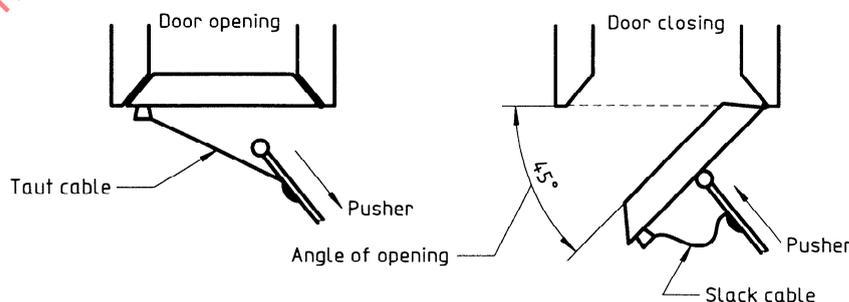


Figure 4 — Example of opening and closing of external door(s)

## 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).

### 12.1 Procedure

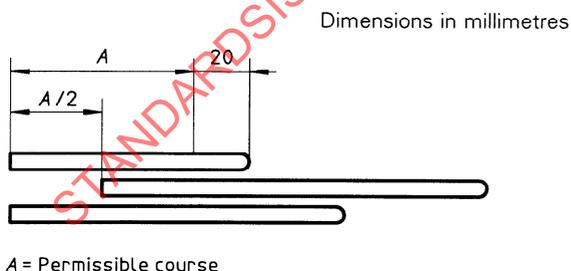
The ambient temperature shall be between + 16 °C and + 32 °C.

#### 12.1.1 Food freezer compartment (or cabinet), frozen food storage cabinet and low-temperature compartments (if applicable)

After the storage temperature test (see clause 13), and with the appliance switched off, the behaviour of all loaded shelves, baskets and containers and their supports shall be examined.

All sliding or revolving shelves and containers shall be moved, without modification of their load, to the half-way position,  $A/2$ , of their permissible course (see figure 5), 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.

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



**Figure 5 — Test position for sliding components which have no limiting stop**

#### 12.1.2 Fresh food storage and cellar compartments (if applicable)

The appliance shall be switched off, with the door(s) open.

The components to be tested shall be in turn loaded 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. Components which are specially designed to hold eggs shall not be loaded.

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.

In the case of sliding or revolving shelves and containers, the test shall be carried out as specified in 12.1.1.

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 temperatures

The purpose of this test is to check compliance with the requirements of 6.2.1 at each of the ambient temperatures (see 8.1.1) 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(s) 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 food freezer compartment (or cabinet) or frozen food storage compartment (or cabinet) having no specific subdivision to accommodate such trays. If the appliance has thermostat(s) and/or other temperature-control

device(s) which is (are) designed for adjustment by the user, the thermostat(s) and/or device(s) shall be set at the manufacturer's recommended position(s) for normal operation at the appropriate ambient temperature. When the thermostat(s) and/or device(s) is (are) not designed for adjustment by the user, the measurement shall be carried out on the appliance as delivered. The empty appliance shall be operated for at least 24 h to reach equilibrium.

The fresh food storage compartment and the cellar compartment, if any, shall be equipped with "M" packages in accordance with 8.4 and 8.5.

The food freezer compartment (or cabinet) and any frozen food storage compartment(s) (or cabinet) shall be equipped with test packages and "M" packages in accordance with the following storage plan.

### 13.1.2 Storage plan

The food freezer compartment (or cabinet) and any frozen food storage compartment(s) (or cabinet) shall be filled with as many test packages as they 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.

**13.1.2.1** 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 dimensions 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 13.1.2.7).

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 with 125 g packages also laid flat.

Four 125 g packages may be replaced by one 500 g package placed vertically.

**13.1.2.2** 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, and there is no physical contact between the highest package and that shelf or horizontal surface.

In the case of a top-opening cabinet without load limit line, a vertical clearance greater than 10 mm but less than 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 used in or immediately above, as appropriate, the middle of any stack.

The number of packages for each stack shall first be determined in accordance with their nominal thickness dimensions, 50 mm and 25 mm. For the actual loading, the packages shall then be chosen in such a way that, taking into account their individual thicknesses, the vertical clearance above each stack is within the above-mentioned limits.

**13.1.2.3** Stacks of packages shall be placed in direct contact with the horizontal loading surfaces and vertical surfaces except in the following cases.

- a) When the vertical surface is the inner surface of a door, the stacks shall be loaded as follows:
  - if there is a marked load limit line, the packages shall be loaded up to that line [see figure 12 a)];
  - if there is no load limit line but a natural load limit, the packages shall be loaded up to that limit [see figures 12 b) and 12 g)];
  - 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 that case, packages may overhang the front edge of any shelf [see figures 12 c) and 12 d)].
- b) When the intersection of a horizontal loading surface and a vertical surface is radiused, 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 figures 12 e), 12 f) and 12 h)].

**13.1.2.4** 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 with water, the contents frozen and placed in position before the compartment is loaded with test packages; otherwise, the ice trays and the subdivisions shall be removed and the whole compartment loaded with packages.

In the case of appliances fitted with automatic icemakers, the ice storage bucket shall be removed and the resulting volume considered as frozen food storage volume, unless it is specified in the instructions for use that this volume is suitable for the storage of ice only. The automatic icemaker shall not be in operation during the test.

**13.1.2.5** 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.

**13.1.2.6** "M" packages shall be placed where the highest temperatures are expected (for examples see figure 13). These places may be different for the storage temperatures, energy-consumption and temperature rise tests.

**13.1.2.7** 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. In the case of door shelves and compartments, the 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 Appliances with adjustable cellar compartment

If the appliance includes a cellar compartment and the volumes of this compartment and of the fresh food storage compartment can be changed in relation to one another by the user, the cellar compartment shall be adjusted to its minimum volume for the test in high ambient temperature and to its maximum volume for the test in low ambient temperature (see 8.1.1).

### 13.1.4 Measurements

For the appropriate ambient temperature, the thermostat(s) and other controls, if any, shall be adjusted, as necessary, to a position which is likely to give storage temperatures (see 8.5 and 8.6) which comply with 6.2.1, after stable operating conditions (see 3.4.8) have been attained.

### 13.2 Test report

The test report shall contain at least the following information for each ambient test temperature (as appropriate):

- a) the ambient temperature;
- b) the setting(s) of thermostat(s) and other controls, if any (if designed for adjustment by the user);
- c) the value of fresh food storage temperature  $t_{m,max}$  and the maximum and minimum values of  $t_1$ ,  $t_2$  and  $t_3$ ;
- d) the value of  $t_{m,max}$  and the maximum values of  $t_1$ ,  $t_2$  and  $t_3$  during the temperature deviation as a result of the defrost cycle, and the duration of the temperature deviation above + 5 °C and the duration of the operating cycle (see table 2);
- e) the value of the cellar compartment  $t_{cm,max}$  and the maximum values of  $t_{c1}$ ,  $t_{c2}$  and  $t_{c3}$ , as appropriate, during a complete operating cycle;
- f) a sketch of the loading arrangement in the food freezer compartment (or cabinet) and in any frozen food storage compartment (or cabinet), showing the locations of the "M" packages and the location of the "M" package with the highest maximum temperature in each of these compartments (or cabinets), and in any "two star" section, and the location of the "M" packages with the highest maximum temperature during the temperature deviation as a result of the defrost cycle;
- g) the values of the(se) highest maximum temperature(s) [see f)] and the duration of the temperature deviation above - 18 °C and the duration of the operating cycle (see table 2).

## 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 °C for class SN and N appliances

+ 32 °C for class ST and T appliances

and shall be controlled within the tolerances specified in 8.1.1.

### 14.1.2 Relative humidity

The relative humidity shall be such that the dew point is

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

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

### 14.1.3 Preparation of the appliance

The setting(s) of the thermostat(s) and other controls, if any, the installation and the loading of the appliance shall be the same as for the energy-consumption test.

If anti-condensation heaters are provided which can be switched on and off by the user, they shall not be switched on. If, however, the requirement of the second paragraph 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. The test period shall be selected during the period when condensation is most likely to occur.

## 14.2 Observations

During the test period, external surface areas exhibiting fog, droplets or running water shall be outlined and designated with the letters F, D and R, respectively (see 14.3).

## 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 6 shall be used.

The test report shall also indicate the selected test period and the duration of the period of observation and shall state whether any manual switch provided for anti-condensation heaters was switched on or off.

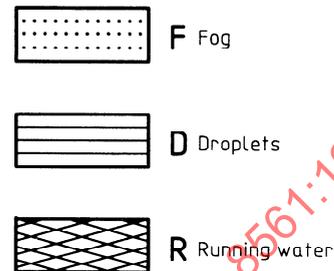


Figure 6 — Condensation code

## 15 Energy-consumption test

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

NOTE 4 In some countries, a different method of measuring energy consumption is required by law (see annex A).

### 15.1 Procedure

#### 15.1.1 Ambient temperature<sup>11)</sup>

The ambient temperature shall be

+ 25 °C for class SN, N and ST appliances

+ 32 °C for class T appliances

and shall be controlled within the tolerances specified in 8.1.1.

#### 15.1.2 Preparation of the appliance

The appliance shall be installed and loaded as for the storage temperature test (see 13.1). If, however, anti-condensation heaters are provided which can be switched on and off by the user but are not necessary to withstand the water vapour condensation test (see clause 14), they shall not be switched on.

<sup>11)</sup> See annex A for particular conditions.

If the appliance includes a cellar compartment and the volumes of this compartment and of the fresh food storage compartment are adjustable in relation to one another by the user, the cellar compartment shall be adjusted to its minimum volume.

**15.2 Measurements**

The energy consumption shall be measured during the test period (see 8.7).

The measurement of energy consumption shall be carried out under storage conditions with all compartments simultaneously being in operation.

**15.2.1 General temperature conditions**

The energy consumption is that which is obtained when all the storage temperature conditions (if applicable) in accordance with table 2 are met simultaneously, and which gives the lowest energy consumption.

**15.2.2 Guidance for the determination of energy consumption**

Appliances may have different operating characteristics. Table 4 describes characteristics for some typical appliances.

**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 h (kW·h/24 h), to two decimal places.

The report shall mention whether the declared energy consumption, if any, meets the requirements of 6.2.3.

**16 Temperature rise test (if applicable)**

The purpose of this test is to check the time for the temperature rise of test packages in “three star” storage under specified test conditions.

**16.1 Procedure**

**16.1.1 Ambient temperature<sup>11)</sup>**

The ambient temperature shall be in accordance with 8.1.1.

**16.1.2 Preparation of the appliance**

The appliance shall be prepared, stabilized and loaded as for the energy-consumption test (see clause 15).

**16.1.3 Setting of control devices**

Thermostats and other controls (flaps, etc.), if any, shall be set as for the energy-consumption test.

If the energy consumption was determined by interpolation from the results of two tests, the settings shall be those which gave the colder temperatures used for the interpolation.

**Table 4 — Different possible storage temperature conditions for determining energy consumption**  
(see also table 2)

Values in degrees Celsius

Storage temperature (as applicable)	Refrigerators and Type I refrigerator-freezers (see 15.2.2)				Type II refrigerator-freezers (see 15.2.2), with food freezer compartment thermostat						Frozen food storage cabinets and food freezers (see 15.2.2)	
					adjustable			not adjustable				
$t^{***}$	- 18	≤ - 18	≤ - 18	≤ - 18	- 18	≤ - 18	- 18	≤ - 18	≤ - 18	≤ - 18	- 18	≤ - 18
$t^{**}$	≤ - 12	- 12	≤ - 12	≤ - 12	≤ - 12	- 12	≤ - 12	- 12	≤ - 12	≤ - 12	≤ - 12	- 12
$t_{m,max}$	≤ + 5	≤ + 5	+ 5	≤ + 5	+ 5	≤ + 5			+ 5	≤ + 5	—	—
$t_{cm,max}$	≤ + 12	≤ + 12	≤ + 12	+ 12	≤ + 12		+ 12		≤ + 12	+ 12	—	—

NOTE — If there are any “two star” or “one star” compartments, the temperature conditions for these compartments shall be - 12 °C or below, or - 6 °C or below, as appropriate.

**16.2 Test period and measurements**

At the moment of initiation of a defrosting cycle (see 3.4.7.2) of the refrigerating system of the appliance, or of the system which refrigerates the food freezer compartment and any "three star" compartment, the power supply to the appliance shall be cut off.

The period of time shall be noted from the moment when the temperature of the warmest "M" package in the food freezer compartment (or cabinet) or in any "three star" compartment (or cabinet) reaches - 18 °C to the moment when any one of the "M" packages in any of these compartments (or cabinets) (excluding any "two star" sections) first reaches - 9 °C.

**16.3 Test report**

The test report shall contain the following information:

- a) the ambient temperature;
- b) the time for the temperature rise from - 18 °C to - 9 °C;
- c) whether the declared temperature rise time, if any, meets the requirements of 6.2.5.

**17 Freezing test (if applicable)**

The purpose of this test is to check the freezing capacity under specified test conditions.

**17.1 Procedure**

**17.1.1 Ambient temperature<sup>11)</sup>**

The ambient temperature shall be in accordance with 8.1.1.

**17.1.2 Preparation of the appliance**

The appliance shall be installed according to 8.1.3.

If the appliance includes a cellar compartment the volume of which can be changed by the user in relation to the volume of the fresh food storage compartment, the cellar compartment shall be adjusted to its maximum volume.

The empty appliance should be set up and operated for at least 24 h to reach equilibrium, as for the preparation for the storage temperature test (see 13.1.1).

**17.1.3 Loading of the appliance**

**17.1.3.1 Fresh food storage compartment, if any**

The fresh food storage compartment shall be loaded with three "M" packages at the sensing points in accordance with 8.5.

**17.1.3.2 Cellar compartment, if any**

The cellar compartment shall be loaded with "M" packages at the sensing points in accordance with 8.5.

**17.1.3.3 Food freezer compartment (or cabinet) — ballast load**

The food freezer compartment(s) (or cabinet) shall be loaded with test packages and "M" packages to form a ballast load, the mass of packages used being related to the total storage volume of the compartment(s) (or cabinet) [excluding any "two star" section(s) or compartments] in accordance with one of the three cases given in table 5.

**Table 5 — Mass of test packages**

Storage volume of food freezer compartment (or cabinet) excluding "two star" section(s), V litres	Mass of test packages kg/100 l of V
$V \leq 50$	As many packages as possible consistent with the storage plan (see 13.1.2), but leaving space to accommodate the light load (see 17.1.4.3)
$50 < V \leq 100$	40
$V > 100$	25

If it is not possible to accommodate the light load in the remaining space, the ballast load shall be reduced as necessary to 80 %, 60 % or 40 % of the above specified values.

If the manufacturer's instructions indicate that there is a separate section for freezing food, this section shall be used for the light load only.

In all cases the space left to accommodate the light load shall not exceed the higher value of the two following possibilities:

- a) 30 % of the total storage volume of the food freezer compartment(s) (or cabinet) and any "three star" compartment(s);
- b) 3 l/kg of light load.

"M" packages shall be uniformly distributed throughout the ballast load, their minimum number being determined by the higher value of the two following possibilities:

- a) four points;
- b) one point per 15 kg of load.

Additionally, door shelves and door containers, if any, within the compartment(s) (or cabinet) shall be loaded with one or two "M" packages, according to the space available.

Any "two star" section or compartment within the food freezer compartment (or cabinet) and any separate "three star" compartment(s) shall be fully loaded with test packages and "M" packages as for the storage test (see 13.1.2).

The test packages and the "M" packages shall be previously brought to a temperature approximately equal to  $-18\text{ }^{\circ}\text{C}$ .

The ballast load packages shall be laid flat and distributed uniformly within the food freezer compartment(s) (or cabinet), the space for the introduction of the light load (see 17.1.4.3) being left empty. Manufacturer's instructions which are not in conflict with the requirements of this International Standard shall also be taken into account. If the manufacturer has given no instructions, the packages shall be distributed evenly throughout the food freezer compartment(s) (or cabinet) and leaving space for the light load.

The conditions for loading described in the storage plan (see 13.1.2) — with the exception of the total quantity of test packages and the space for the light load — shall be fulfilled.

#### **17.1.3.4 Appliances with separate "three star" compartment**

If an appliance has a separate "three star" compartment with its own external access door or lid, and the manufacturer recommends that, before freezing, all frozen food already in storage is to be placed in that compartment, leaving the food freezer compartment empty to receive the load for freezing (i.e. the "three star" compartment is to be regarded as an extension of the food freezer compartment), a freezing capacity

claim based upon this method of use is permissible provided that the following conditions are met:

- a) the "three star" compartment is of sufficient volume to accommodate the ballast load calculated on the basis of the combined storage volumes of the food freezer compartment and the "three star" compartment (excluding any "two star" sections or compartments), in accordance with the storage plan (see 13.1.2);
- b) when tested according to this method of use the claimed freezing capacity is confirmed, and the temperature requirements for the other compartments [see 17.1.4.3.1 a) to f)], if applicable, are fulfilled during the freezing test;
- c) the claimed freezing capacity is at least equivalent to 4,5 kg/100 l of the combined storage volumes of the food freezer compartment and "three star" compartment.

### **17.1.4 Operating conditions of the appliance**

#### **17.1.4.1 Starting conditions**

The loaded appliance is left to run until stable operating conditions are reached. The thermostat setting or the setting of other control devices should be approximately the same as for the energy-consumption test (see clause 15).

After stable operating conditions have been attained, the temperature shall be in accordance with table 2, as applicable.

In some circumstances it may not be necessary to carry out the stabilization specified here before the stabilization specified in 17.1.4.2 .

#### **17.1.4.2 Setting of control devices**

Instructions given by the manufacturer shall be taken into account; changes of setting of manually operated controls are not permitted after the introduction of the light load to the end of the freezing process.

##### **17.1.4.2.1 First possibility**

The food freezer compartment (or cabinet) is controlled by a separate thermostat designed for adjustment by the user and, possibly, with a switch for continuous running.

After stable operating conditions in accordance with 17.1.4.1 have been attained, the food freezer compartment (or cabinet) shall be set in operation on continuous running or, if this is not possible, the

thermostat shall be set for the lowest temperature. The appliance shall be left in operation for 24 h, or in accordance with the manufacturer's instructions if a longer period is specified. The procedure described in 17.1.4.3 shall then be carried out in accordance with the manufacturer's instructions.

#### 17.1.4.2.2 Second possibility

The food freezer compartment (or cabinet) is controlled by a separate thermostat and fitted with a timer which sets the food freezer compartment (or cabinet) on continuous running and which reverts to thermostatic operation when the set time has elapsed (the timer may be graduated in terms of mass of food to be frozen instead of in terms of duration).

After stable operating conditions in accordance with 17.1.4.1 have been attained, the timer shall be set in operation and then the procedure described in 17.1.4.3 shall be carried out in accordance with the manufacturer's instructions.

#### 17.1.4.2.3 Third possibility

If the food freezer compartment (or cabinet) does not correspond to either of the above two possibilities, the procedure described in 17.1.4.3 shall be carried out in accordance with the manufacturer's instructions after the appliance has reached stable operating conditions in accordance with 17.1.4.1. Any devices for temperature regulation (thermostats, flaps, etc.) shall be set in accordance with these instructions.

If there are no special instructions, the procedure described in 17.1.4.3 shall be carried out after the appliance has reached stable operating conditions in accordance with the temperature requirements of 17.1.4.1.

#### 17.1.4.3 Freezing of the light load

After the conditions according to 17.1.4.2 have been attained, the light load shall be introduced at the commencement of a defrosting cycle (see 3.4.7.2).

The light load corresponds to the value stated by the manufacturer as that which can be frozen in 24 h and is made up of test packages which have previously been brought to a temperature of  $+25\text{ °C} \pm 1\text{ K}$  for class SN, N and ST appliances and to a temperature of  $+32\text{ °C} \pm 1\text{ K}$  for class T appliances.

The light load packages shall be placed flat, and positioned taking into account the manufacturer's instructions and the requirements of the loading plan

(see 13.1.2). If no instructions are given, the packages shall be placed in such a way that they will be frozen as rapidly as possible. The use of spacers between adjacent stacks of packages is permitted, but other methods are not permitted.

The light load shall not be placed in physical contact with the ballast load.

"M" packages shall be uniformly distributed throughout this light load; their minimum number shall be determined by the higher value of the two following possibilities:

- a) two points;
- b) one point per 3 kg of load.

The temperatures of the "M" packages in the ballast load and in the light load shall be recorded, together with those of the "M" packages in the other compartment(s), if any (see 17.1.3), until the arithmetic mean of the instantaneous temperatures of all the "M" packages in the light load reaches  $-18\text{ °C}$ . The time necessary for reaching this temperature shall be noted.

#### 17.1.4.3.1 First possibility

If this temperature is reached in a time between 22 h and 26 h, the mass which would be frozen in 24 h shall be determined from the actual freezing time by proportional calculation.

The test result shall be accepted only if (as applicable according to the type of appliance):

- a) the maximum temperature of any of the "M" packages of the ballast load remains equal to or colder than  $-15\text{ °C}$ ; at the end of the test the maximum temperature of the warmest "M" package of the ballast load shall be equal to or colder than  $-18\text{ °C}$ ;
- b) the maximum temperature of the warmest "M" package in any separate compartment which is not used for ballast in accordance with 17.1.3.4 remains equal to or colder than  $-18\text{ °C}$ ;
- c) the maximum temperature of the warmest "M" package in any "two star" section remains equal to or colder than  $-12\text{ °C}$ .
- d) the maximum temperature of the warmest "M" package in any "two star" compartment or in any "one star" compartment remains equal to or colder than  $-12\text{ °C}$  or  $-6\text{ °C}$  respectively;

- e) the temperature  $t_m$  of the fresh food storage compartment during the test does not exceed  $+7\text{ °C}$ , with  $t_1, t_2, t_3$  between  $0\text{ °C}$  and  $+10\text{ °C}$ ;
- f) the temperatures  $t_{c1}, t_{c2}, t_{c3}$ , as appropriate, of the cellar compartment, if any, do not drop below  $0\text{ °C}$ .

#### 17.1.4.3.2 Second possibility

If the actual freezing time is less than 22 h or more than 26 h and/or the conditions of 17.1.4.3.1 a) to f) are not fulfilled, further test(s) shall be carried out, if possible with more favourable starting conditions — but still maintaining the temperature limits in accordance with 17.1.4.1) — on the assumption that better results can be expected.

Otherwise, the test shall be repeated with a different load.

#### 17.1.4.3.3 Third possibility

If the actual freezing time is less than 22 h and the conditions of 17.1.4.3.1 a) to f) are fulfilled, but using a larger light load these conditions cannot be fulfilled, the actual load for which the conditions are met shall be considered (without any proportional calculation) to be the mass which can be frozen in 24 h.

### 17.2 Test report

The test report shall contain the following information:

- a) the mass, in kilograms, of the ballast load;
- b) the mass, in kilograms, of the light load;
- c) the freezing time, in hours, of the light load;
- d) the freezing capacity, in kilograms, determined during the light load freezing test;
- e) the warmest temperature measured in the "M" packages in the ballast load stored during the light load freezing test together with the warmest temperature measured in the "M" packages in any "three star" compartment, in any "two star" section or compartment and in any "one star" compartment;
- f) the highest and lowest values of  $t_m$  and  $t_{cm}$ , if applicable;
- g) the settings of all temperature control devices, including the timer, if any;

- h) the loading plan for the appliance showing the location of the "M" packages and the location of the warmest "M" package(s);
- i) if the food freezer compartment (or cabinet) is fitted with a device intended to set it in continuous operation when freezing and then to revert to thermostatic operation automatically, the time which elapsed before the food freezer compartment (or cabinet) reverted to thermostatically controlled operation;
- j) whether the declared freezing capacity meets the requirements of 6.2.2.

### 18 Ice-making test (if applicable)

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

NOTE 5 This test does not apply to automatic ice-makers.

#### 18.1 Procedure

##### 18.1.1 Ambient temperature

The ambient temperature shall be

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

and shall be controlled within the tolerances specified in 8.1.1.

##### 18.1.2 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 means of access (doors or lids) shall be kept closed during the test.

Ice trays shall be removed and the fresh food storage compartment and cellar compartment, if any, shall be equipped with "M" packages in accordance with 8.5.

The food freezer compartment (or cabinet) and any frozen food storage compartment(s) (or cabinet) 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 (clause 13).

The cellar compartment, if any, shall be as small as possible (if the volume is adjustable), with temperature control devices (flaps, etc.) set in the position in accordance with the manufacturer's instructions or the same as that for the storage test.

### 18.1.3 Measurements

After stable operating conditions (see 3.4.8) have been attained, the ice tray(s) shall be filled with water up to 5 mm from the top and placed in the appliance at the position recommended by the manufacturer at the commencement of a defrosting cycle (see 3.4.7.2).

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 placed in that subdivision.

The water temperature at the moment of placing the ice tray(s) in the appliance shall be

+ 20 °C ± 1 K for class SN, N and ST appliances

+ 30 °C ± 1 K for class T appliances.

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

Throughout the ice-making test, none of the instantaneous temperatures  $t_1$ ,  $t_2$ ,  $t_3$ ,  $t_{c1}$ ,  $t_{c2}$  or  $t_{c3}$  (see 3.4.3.1 and 3.4.3.3) shall fall below 0 °C.

## 18.2 Test report

The test report shall contain the following information:

- the quantity, in kilograms, of ice produced in a 24 h period or the time, expressed in hours and minutes, necessary to freeze the water in the ice tray(s) supplied with the appliance;
- whether the requirements in accordance with 6.2.4 are met.

If the ice-making capability is given by time, a conversion shall be made by proportional calculation to determine the ice-making capability in kilograms per 24 h.

## 19 Test for absence of odour and taste

The purpose of this test is to check that materials used for the internal components of the fresh food storage compartments and cellar compartments, if any, will not impart either taste or odour to food.

### 19.1 Procedure

#### 19.1.1 Ambient temperature

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

#### 19.1.2 Cleaning

The appliance shall be cleaned prior to the test in accordance with the manufacturer's instructions and afterwards with pure water.

#### 19.1.3 Thermostat setting

The appliance shall first be operated for 48 h, with the thermostat and other control devices set in a position which will give the following temperatures.

- Fresh food storage compartment:

$$t_{m,max} = + 5 \text{ °C} \pm 2 \text{ K}$$

- Cellar compartment:

$$+ 8 \text{ °C} \leq t_{cm,max} \leq + 14 \text{ °C}$$

#### 19.1.4 Samples

The analytical samples and check samples respectively for each compartment shall be:

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

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

The analytical samples shall be placed in Petri dishes and the check samples in 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 the complete absence of odour is obtained.

The analytical samples of water and butter shall be placed uncovered in the fresh food storage and cellar compartments.

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

### 19.1.5 Test period

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

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

## 19.2 Examination of samples

### 19.2.1 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 expert assessors familiar with the test method.

Each expert assessor shall receive

- 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 expert assessors. Examination for odour shall be carried out before examination for taste.

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

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

### 19.2.2 Evaluation

The evaluation of the analytical samples shall be carried out with reference to the following scale:

Mark 0: No foreign odour or foreign taste

Mark 1: Slight foreign odour or foreign taste

Mark 2: Definitely perceptible foreign odour or foreign taste

Mark 3: Distinct foreign odour or foreign taste.

If the requirement in accordance with paragraph 1 of 5.2 is not clearly met, the test shall be repeated. The following provisions shall be made for the second test:

- a) cleaning of the compartments;
- b) operation of the empty appliance for one week;
- c) temperature adjustment in the fresh food storage and cellar compartment for the second test for absence of odour and taste.

## 19.3 Test report

The test report shall indicate the evaluation and whether the requirements of paragraph 1 of 5.2 are met.

## 20 Final test report

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

- a) the overall dimensions (see 3.3.3);
- b) the overall space required in use (see 3.3.4);
- c) the total gross volume (see 3.3.5.3 and 7.2.1);
- d) the storage volume(s) (see 3.3.5.5, 7.2.3, 7.2.4 and 7.2.5);
- e) the total storage volume (see 3.3.5.7 and 7.2.2);
- f) the storage shelf area (see 3.3.6.2 and 7.3);
- g) airtightness of door(s) or lid(s) (see clause 9);
- h) opening force test of door(s) or lid(s) (see clause 10);
- i) durability test (see clause 11);
- j) mechanical strength test (see clause 12);
- k) storage temperature(s) test (see clause 13);
- l) water vapour condensation test (see clause 14);
- m) energy-consumption test (see clause 15);

- n) temperature rise test, if applicable (see clause 16);
- o) freezing test, if applicable (see clause 17);
- p) ice-making test, if applicable (see clause 18);
- q) absence of odour and taste test, if applicable (see clause 19).

## 21 Designation

Household appliances shall be designated according to

- a) the kind (for example, single door or double door, frost-free refrigerator, food freezer, etc.);
- b) the operating principle (compression);
- c) the class (extended temperate — SN, temperate — N, subtropical — ST, tropical — T);
- d) the rated total gross volume, either in cubic decimetres or in litres;
- e) the rated total storage volume, either in cubic decimetres or in litres, together with the rated storage volume of the food freezer compartment, and the star classification(s) and rated storage volume(s) of any frozen food storage compartment(s) and any "two star" section(s), if applicable;
- f) the rated freezing capacity, in kilograms, if applicable.

### Example of designation

Two-door compression-type, frost-free household refrigerator-freezer, class N, total gross volume 400 dm<sup>3</sup>, total storage volume 360 dm<sup>3</sup>, including a food freezer compartment having 42 dm<sup>3</sup> "three star" and 8 dm<sup>3</sup> "two star" volume, freezing capacity 7 kg.

## 22 Marking

### 22.1 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:

- a) the indication "frost-free refrigerator", "frost-free refrigerator-freezer", "frost-free frozen food storage cabinet" or "frost-free food freezer";
- b) the trademark or name of the manufacturer or responsible vendor;
- c) the model designation;
- d) the serial number and/or date of manufacture, which may be coded;
- e) the rated total gross volume, either in cubic decimetres or in litres;
- f) the rated storage volume, either in cubic decimetres or in litres, of the following:
  - the food freezer compartment (excluding any "two star" section or compartment therein),
  - the "three star" frozen food storage compartment(s), if any (excluding any "two star" section or compartment therein),
  - the "two star" section(s) or compartment(s), if any, within the food freezer compartment and "three star" frozen food storage compartment,
  - the "two star" compartment(s), if any,
  - the "one star" compartment(s), if any,
  - the fresh food storage compartment,
  - the cellar compartment, if any;
- g) the symbol of the class (SN, N, ST or T);
- h) the designation and mass, in grams, of the refrigerant (see ISO 817);
- i) all information relating to the energy source, including those laid down by safety regulations;
- j) the rated freezing capacity, in kilograms.

Items b) to d) (necessary for service) shall be visible when the appliance is in its position for normal use.

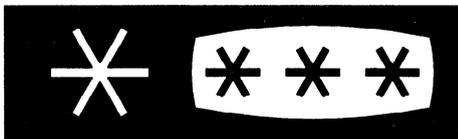
The manufacturer is free to show any other information considered desirable.

**22.2 Identification of food freezers and food freezer compartments**

Food freezers and food freezer compartments (as specified in 3.1.4 and 3.2.6) shall be identified by a symbol placed on their front, doors or lids, conforming to that shown in figure 7 and defined as follows: a rectangular frame enclosing a large six-pointed star followed by the symbol for a “three star” frozen food storage compartment.

In the case of a “two star” section in a food freezer compartment/cabinet, the standard two star symbol shall appear close to the standard four star symbol wherever it appears.

If the exterior of the appliance is intended to be decorated by the purchaser, and the symbol would then be hidden, the symbol shall be placed on the appropriate compartment inside the appliance.



**Figure 7 — Identification symbol for food freezers and food freezer compartments** (for further details, see figure 16)

The dimensions shall be such that the height of the large star is equal to the height of the curved frame at its midpoint (the long axis of the frame being horizontal).

The symbol shall not make use of more than two colours or exhibit more than two contrasting surface finishes. The colour (or the surface finish) of the large star shall be different from that of the three other stars. (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 could be confused with the food freezer identification symbol.



**Figure 8 — Identification symbols for frozen food storage compartments (or cabinets)** (for further details, see figure 17)

**22.3 Identification of frozen food storage compartments (or cabinets)**

Frozen food storage compartments (or cabinets) shall be identified by a symbol, placed on either front, doors or lids. In the case of a “two star” section in a “three star” food storage compartment/cabinet, the standard two star symbol shall appear close to the standard three star symbol wherever it appears. Six-pointed stars within a frame with curved sides, as shown in figure 8, shall be used for the identification on the compartments (or cabinets) as specified in 3.1.3 and 3.2.5.

If the exterior of the appliance is intended to be decorated by the purchaser, and the symbol would then be hidden, the symbol shall be placed on the appropriate compartment inside the appliance.

The symbol shall not make use of more than two colours or 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 could be confused with the star identification symbols.

**22.4 Load limit line(s)**

Load limit lines are permitted only in relation to food freezer volumes and “three star” frozen food storage volumes in cabinets or compartments with an independent external door.

No load limit line is necessary if, within the gross volume of any cabinet or compartment which is suitable for “three star” storage

- no space is acknowledged as being unsuitable for “three star” storage (as defined in 3.2.5.4), or
- the load limits are determined by the particular construction (e.g. baskets, containers, flaps, etc.), or
- the load limits are determined by natural load limits (see figures 12 and 13) and the loading conditions are specially described in the instructions for use.

In all other cases, the limits of "three star" storage volume shall be indicated in a conspicuous and indelible fashion by a load limit line or lines in the form shown in figure 9.

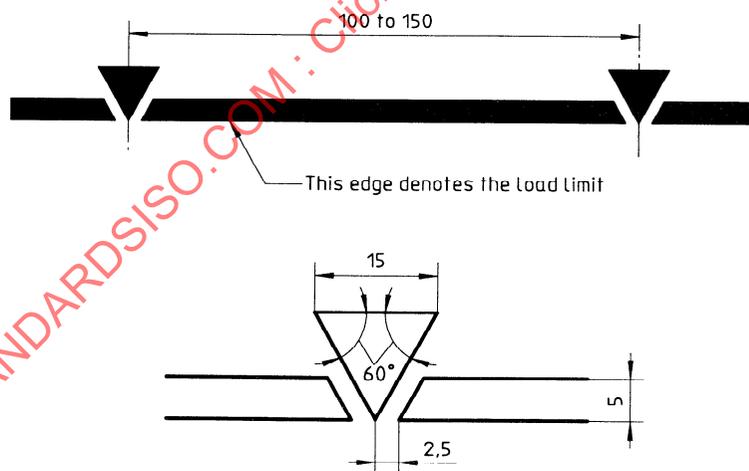
It is recommended that the manufacturer should avoid, as far as possible, the provision of storage spaces outside the load limits and outside any "two star" section or compartments (see 7.2.6).

### 23 Technical and advertising literature

Whenever technical and advertising literature is supplied, it should contain the characteristics stated in clause 21 and if, additionally, it contains all or some of the following data, such data shall be in accordance with this International Standard:

- a) the name of manufacturer or responsible vendor;
- b) the model designation;
- c) the range of ambient temperature of the class (SN, N, ST or T) for which the appliance is designed<sup>12)</sup>;
- d) the overall space required in use (see 3.3.4), with sketches showing the appliance with the means of access open and closed;
- e) for appliances which are intended to be built-in, the recess dimensions, together with any additional ventilation requirements;
- f) the direction of opening of the door(s), and whether reversible;
- g) the rated energy consumption (see clause 15), with a reference to the ambient temperature at which the value was measured;
- h) the temperature rise time, measured in accordance with clause 16, if applicable;
- i) the rated freezing capacity, measured in accordance with clause 17, if applicable;
- j) the ice-making capability, measured in accordance with clause 18, if applicable;
- k) the rated total storage volume, measured in accordance with 7.2;
- l) the rated storage shelf area, measured in accordance with 7.3.

Dimensions in millimetres



NOTE — Dimensions are given for information. They may be reduced while maintaining the same proportions but shall not be less than half the values shown.

**Figure 9 — Marking of load limit**

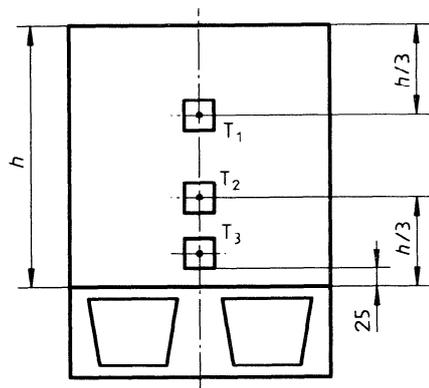
12) The purchaser should be advised that refrigerators and refrigerator-freezers may not operate consistently when sited for an extended period below the cold end of the range of temperatures for which the appliance is designed.

## 24 Instructions for use and maintenance

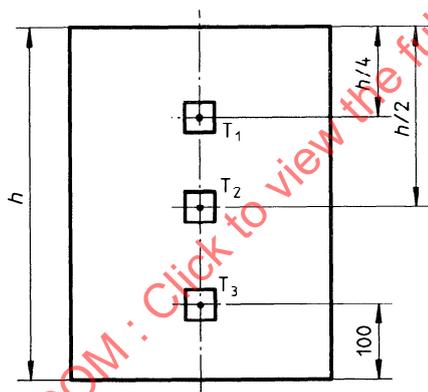
Every appliance shall be accompanied on delivery by instructions for its use and maintenance, in the language of the country where it is for sale. These instructions shall include, in particular, information as to:

- a) the installation requirements (best location, levelling, connection — if required — for defrost water, connections to energy source);
- b) the 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) the operating conditions (starting and stopping procedures);
- e) the instructions for use of the various controls [such as thermostat(s), fast freeze switch, indicator lights, air circulation and defrosting control(s)];
- f) the limit values of the range of ambient temperature for the climate classes for which the appliance is designed and the fact that the internal temperatures 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) the care required for best performance, such as:
  - 1) loading the appliance (and especially when the storage volume of the food freezer compartment (or cabinet) or any "three star" compartment(s) (or cabinet) is smaller than the corresponding gross volume and when no load limit lines exist),
    - 2) the use of baskets and, where appropriate, a warning on the risk of poor performance when the baskets are not used,
    - 3) the arrangement of food for storage, in particular the need to avoid cross-contamination,
    - 4) the arrangement of food for storage and for freezing, where applicable, including, in particular, advice that food to be frozen shall not be placed in direct contact with food in storage and, if appropriate, that it may be necessary to reduce the quantity to be frozen if freezing every day is anticipated;
- h) the maintenance and cleaning of the appliance;
- i) the fact that effervescent drinks should not be stored in food freezer compartments (or cabinets) or in low-temperature compartments (or cabinets), and that some products such as water ices should not be consumed too cold;
- j) the need not to exceed the storage time(s) recommended by the food manufacturers for commercially quick frozen food in food freezer and frozen food storage compartments (or cabinets);
- k) the care required with regard to frozen food in storage in the event of an extended non-running of the appliance (interruption of power supply or failure of the refrigerating system);
- l) 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, cleaned and dried, and the door(s) or lid(s) propped ajar;
- m) 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.

Dimensions in millimetres



Arrangement A

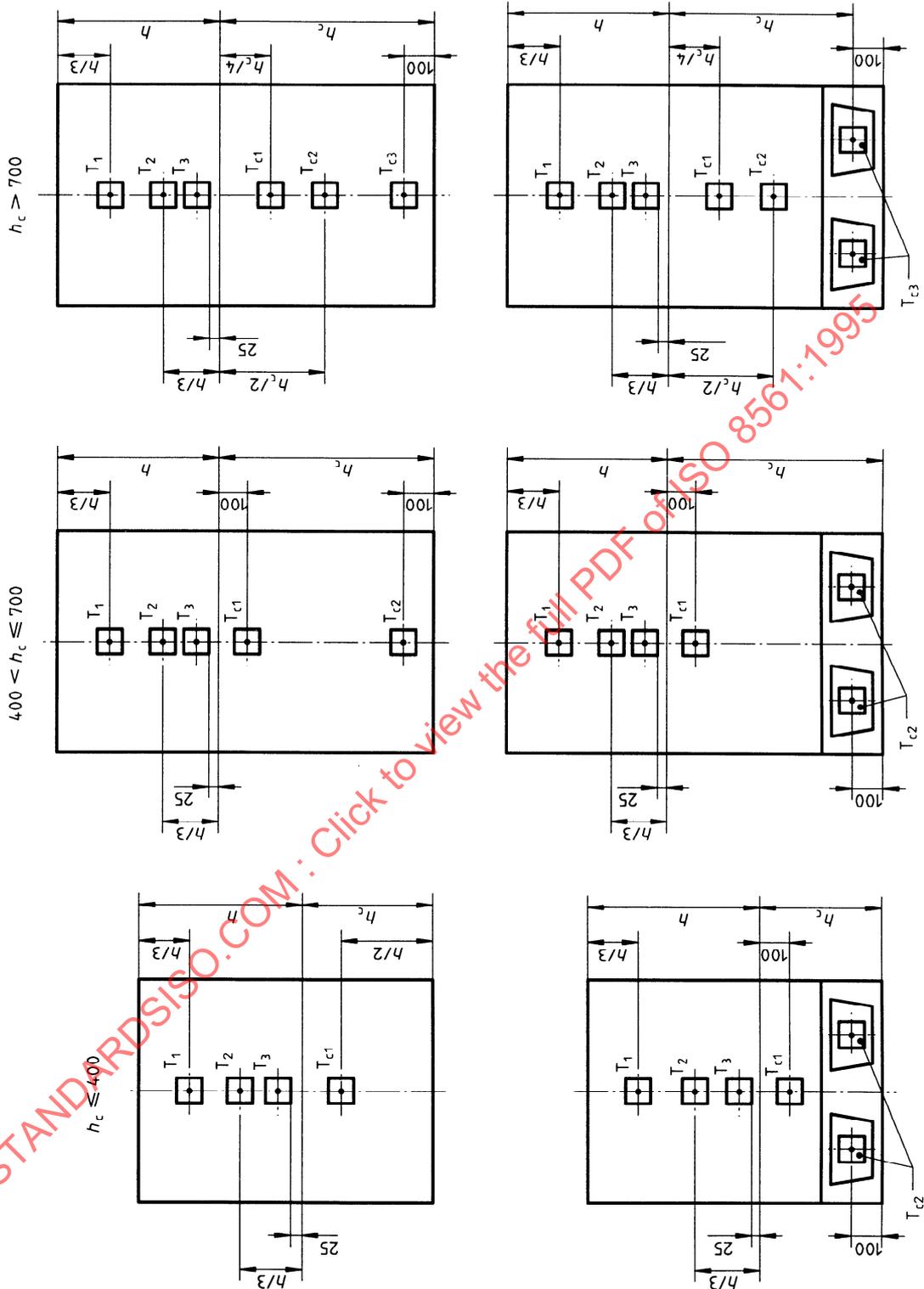


Arrangement B

NOTE — These figures relate to temperature-measurement points in "M" packages.

**Figure 10 — Temperature-measurement points in fresh food storage compartments**

Dimensions in millimetres



NOTE — These figures relate to temperature-measurement points in “M” packages. The temperature-measurement points  $T_{c2}$  or  $T_{c3}$  shall be placed in those containers in which the warmer temperature is expected.

**Figure 11 — Temperature-measurement points in cellar compartments in relation to their height,  $h_c$ , and internal fittings**

Dimensions in millimetres

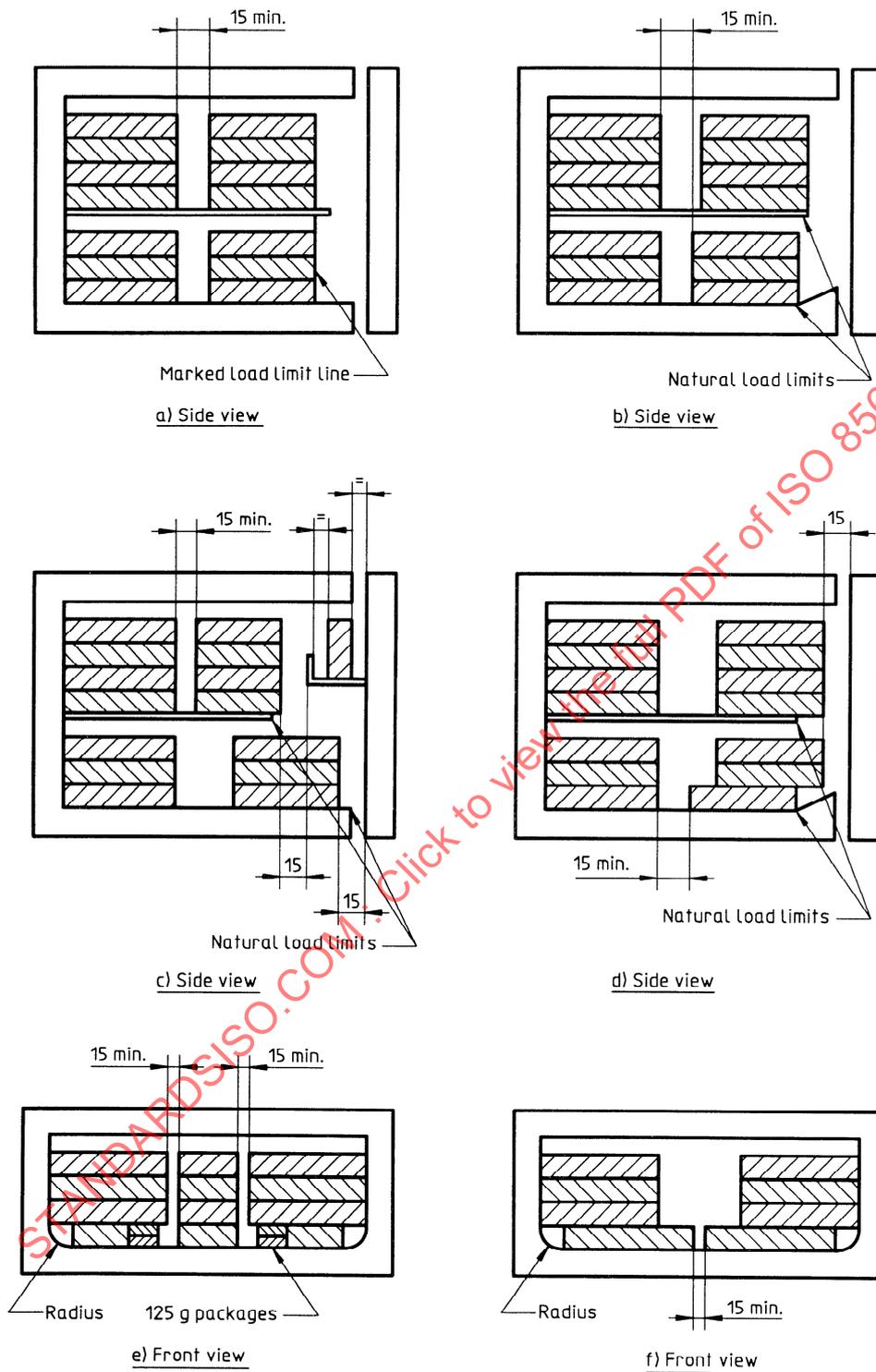
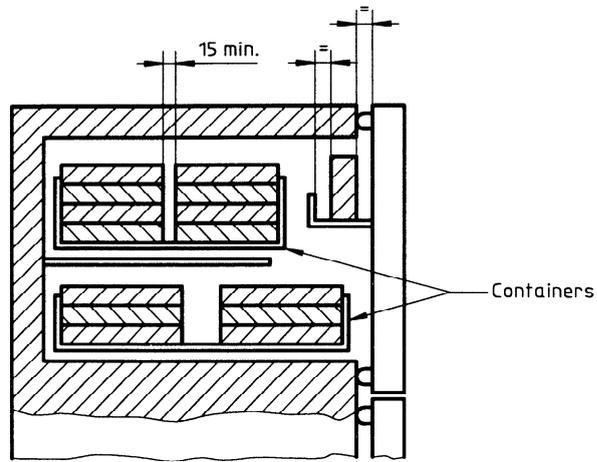
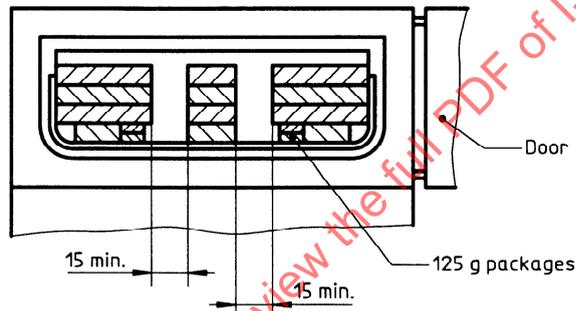


Figure 12 — Examples of storage plan (see 13.1.2)



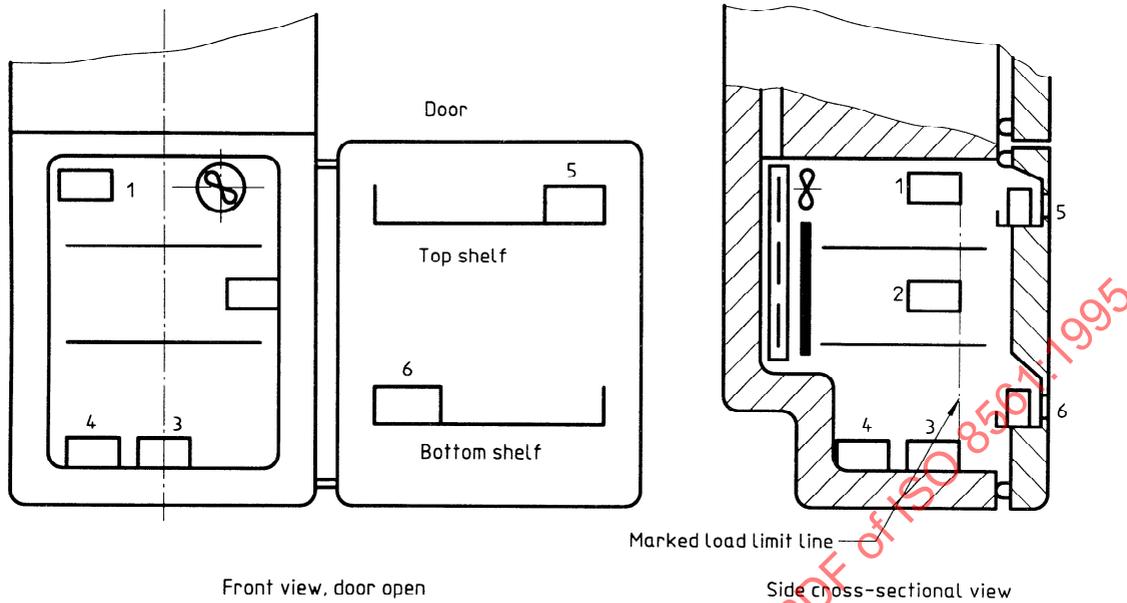
g) Side view with containers



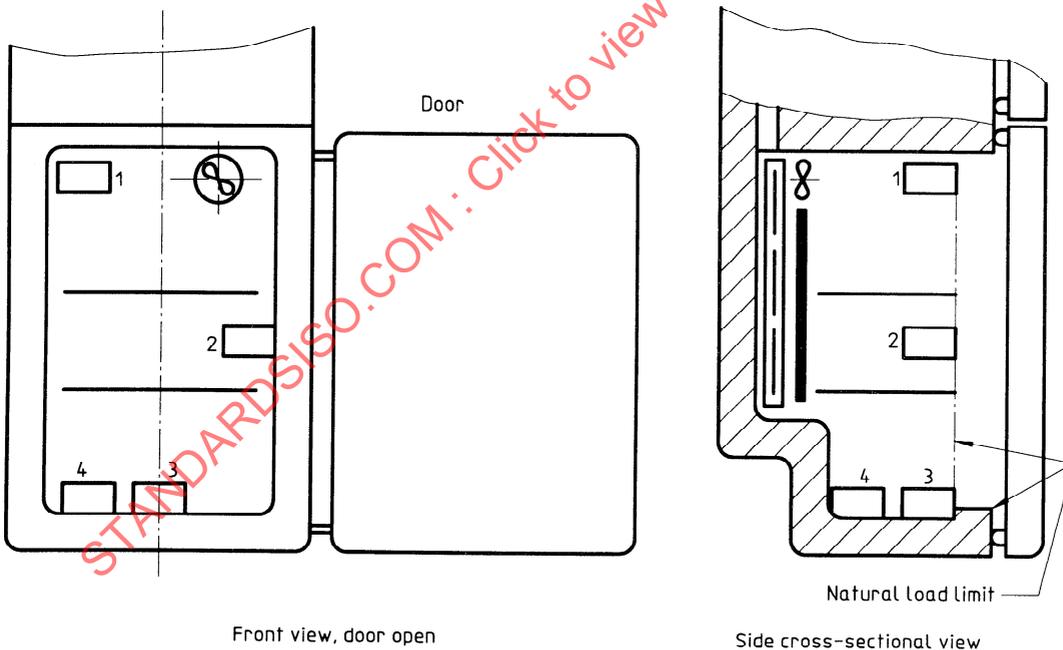
h) Front view, containers with radiused corners

Figure 12 — Examples of storage plan (see 13.1.2) (concluded)

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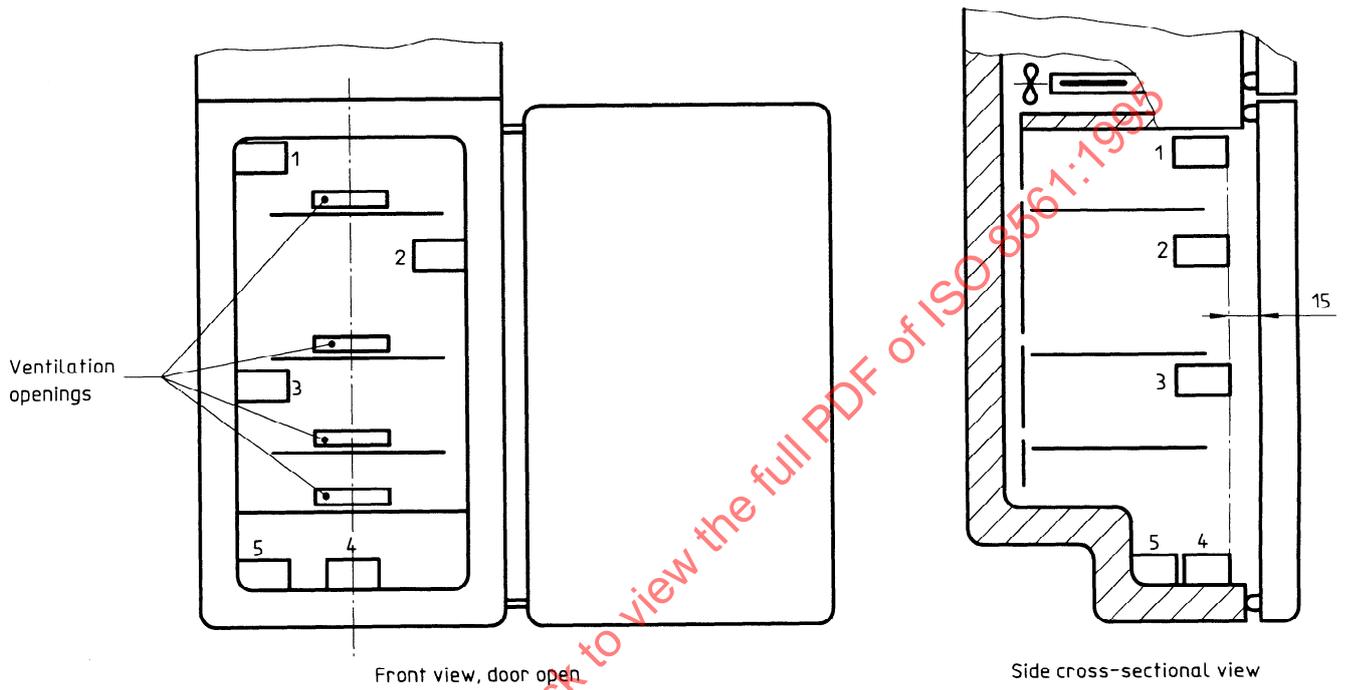


- a) Food freezer compartment or frozen food storage compartment
- with door storage
  - with  $n$  shelves
  - with marked load limit line



- b) Food freezer compartment or frozen food storage compartment
- with door storage
  - with  $n$  shelves
  - with natural load limit

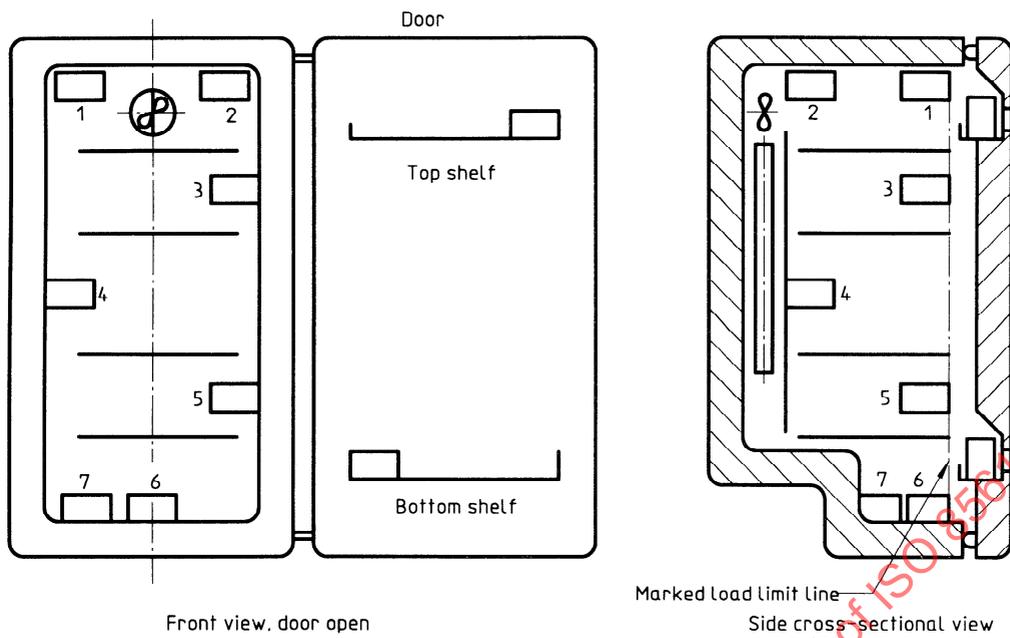
Figure 13 — Examples of positioning of “M” packages



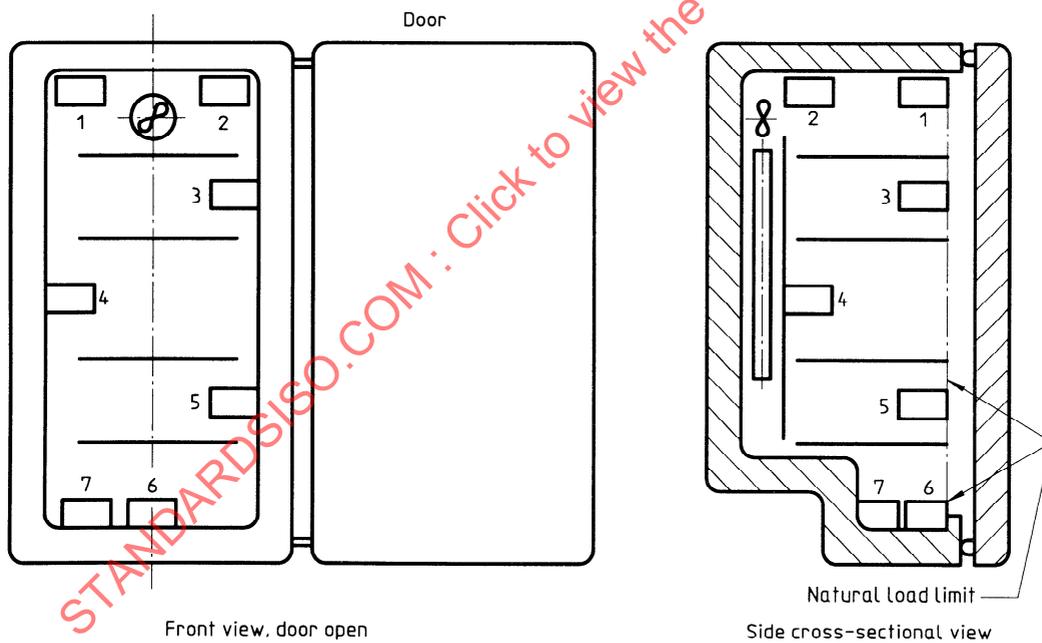
c) Food freezer compartment or frozen food storage compartment

- with door storage
- with  $n$  shelves
- without any marked load limit line or natural load limit

**Figure 13** — Examples of positioning of "M" packages (continued)



d) Food freezer or frozen food storage cabinet  
 - with door storage  
 - with  $n$  shelves



e) Food freezer or frozen food storage cabinet  
 - without door storage  
 - with  $n$  shelves  
 - with natural load limit

Figure 13 — Examples of positioning of "M" packages (concluded)