इंटरनेट मानक

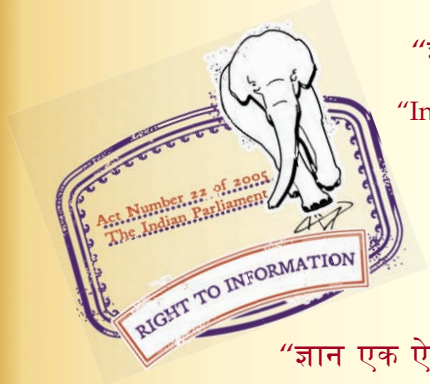
Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 1476-1 (2000): Performance of Household Refrigerating Appliance - Refrigerators with or Without Low Temperature Compartment, Part 1: Energy Consumption and Performance [MED 3: Mechanical Engineering]



"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

IS 1476(Part 1) :2000
(Reaffirmed 2010)

भारतीय मानक

घरेलू प्रशीतन साधित्र की कार्यकारिता — निम्न तापमान प्रकोष्ट सहित अथवा रहित

भाग 1 ऊर्जा खपत और कार्यकारिता

(तीसरा पुनरीक्षण)

Indian Standard

PERFORMANCE OF HOUSEHOLD REFRIGERATING APPLIANCE — REFRIGERATORS WITH OR WITHOUT LOW TEMPERATURE COMPARTMENT

PART 1 ENERGY CONSUMPTION AND PERFORMANCE

(Third Revision)

ICS 97.040.30

© BIS 2000

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

July 2000 **Price Group 9**

FOREWORD

This Indian Standard (Part 1) (Third Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Refrigeration and Air Conditioning Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard was first published in 1959 and was revised in 1971 and 1979. This third revision has been undertaken to bring this standard in line with ISO 7371 : 1995 'Household refrigerating appliances — Refrigerators — With or without low temperature compartment — Characteristics and test methods'.

Through Amendment No. 3 to IS 1476 : 1979, the rated energy consumption of the refrigerators was specified for various capacities. Recently, due to the Government policies, refrigerators with new capacities and design have been introduced in the Indian market. Even the designs of the existing refrigerators have been modified to ensure energy conservation. Accordingly, the energy consumption of refrigerators have been modified during this revision. Larger sizes of refrigerators have also been covered under this revision.

This Indian Standard has laid down requirements for Tropical Class (T) of the refrigerators only. However, ISO 7371 covers the requirements for four classes of refrigerators, namely, S, N, T and TN.

Though this standard has covered certain safety requirements, it is suggested that due care shall be taken to implement the requirement of the following standards during the design and manufacture of the refrigerators:

IS 302-2-24-1994	Safety of household and similar electrical appliances: Part 2 Particular requirements, Section 24 Refrigerators, food-freezers and ice-maker.
IS 660 : 1963	Safety code for mechanical refrigerators (*revised*).

Earlier IS 1476 and IS 3621 were covering the requirements for refrigeration for mechanical and absorption type respectively. In this revision the requirements for both types of refrigerators are covered. After the publication of this standard, IS 3621 is expected to be withdrawn.

In view of the prevailing energy scenario in the country, the Government of India is laying emphasis on the energy conservation through various means by emphasizing the use of energy efficient products. Accordingly, Government of India is considering introduction of scheme of energy labelling. Household refrigerator is one such item which is likely to be covered by this energy efficiency labelling product scheme.

With a view to segregate performance and energy labelling requirements, this standard has been split into two parts. The other part of the standard when formulated, would cover energy labelling requirements. The maximum energy consumption values specified in standards for various capacity ranges are based on the data collected from large number of refrigerator manufacturers. Regular R&D efforts should be employed to improve the energy consumption with the developments in technology.

A scheme of labelling environment friendly products with ECO logo known as ECO Mark has also been introduced at the instance of Ministry of Environment and Forests (MEF), Government of India. The ECO Mark would be administered by the Bureau of Indian Standards (BIS) under the *Bureau of Indian Standards Act,* 1986 as per Resolution No. 71 dated 21 February 1991 and No. 425 dated 28 October 1992 published in the Gazette of India. The Ministry of Environment and Forests, Government of India, issued a notification dated 17 May 1996 [GSR 214 (E)] for ECO labelling of refrigerators. These ECO labelling criteria relevant to refrigerator have been incorporated in this Indian Standard.

Under the Montreal Protocol and subsequent London Amendment India has agreed to phase out the use of ozone depleting substances according to a schedule. The above protocol grants a 10 year grace period on all phase out dates and interim reduction deadlines for developing countries whose per capita consumption of Annex A Chemicals (as identified in Annexures to Montreal Protocol) is less than 0.3 kg/year. Annex A Chemicals include CFC 11, 12, 113, 114, 115 and Halon 1211 and Halon 1301.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised)'*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

AMENDMENT NO. 1 MAY 2004
TO
IS 1476 (PART 1): 2000 PERFORMANCE OF HOUSEHOLD REFRIGERATING APPLIANCE — REFRIGERATORS WITH OR WITHOUT LOW TEMPERATURE COMPARTMENT

PART 1 ENERGY CONSUMPTION AND PERFORMANCE

(Third Revision)

(*Page* 7, *clause* **5.3.4,** *line* 3)— Substitute **'14.1'** *for* **'15.1'.**

[*Page* 18, *clause* **10.1**(k)] — Delete.

| *Page* 23, *clause* **14.9.2**(g), *second line*] — Substitute '– 5 ± 0.5°C' *for* '5 ± 0.5°C'.

(*Page* 24, *clause* **15.3,** *second line*) — Substitute **'14.1'** *for* **'15.1'**

(*Page* 24, *clause* **A-1.1**, *lines* 8, 10 *and* 11) — Substitute the words 'solid strip (plastic or metal)' *for* 'steel strip' and 'pasted with a suitable adhesive' *for* 'welded' respectively.

(ME 03)

Reprography Unit, BIS, New Delhi, India

Indian Standard

PERFORMANCE OF HOUSEHOLD REFRIGERATING APPLIANCE — REFRIGERATORS WITH OR WITHOUT LOW TEMPERATURE COMPARTMENT

PART 1 ENERGY CONSUMPTION AND PERFORMANCE

(Third Revision)

1 SCOPE

This standard (Part 1) specifies the essential characteristics of household refrigerators with or without crisper, ice-making or frozen food storage compartments which are wholly factory assembled, and lays down the methods of test for the checking of the characteristics.

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

The tests described in the Indian Standard are type tests and are applicable to Tropical Class (T) appliances.

When it is desired to verify the performance of a refrigerator of a given type in relation to this standard all the tests described should be in principle applied to one and same unit. These tests may also be made individually for the study of a particular characteristic.

2 REFERENCES

The Indian Standards listed below contain provisions which, through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
694 : 1990	PVC insulated cables for working voltage up to and including 1 100 V (*third revision*)
732 : 1989	Code of practice for electrical wiring installations (*third revision*)
1401 : 1970	Accessibility test probes (*first revision*)
9968 (Part 1) : 1988	Elastomer-insulated cables: Part 1 For working voltage up to and including 1 100 V *(first revision*)
10617(Part3) : 1983	Hermatic compressors: Part 3 Low temperature application group
11338 : 1985	Thermostats for use in refrigeration, air conditioners, water coolers, beverage coolers, etc

3 TERMINOLOGY

3.1 Household Refrigerator (hereinafter referred to as 'refrigerator')

Insulated cabinet of suitable volume and equipment for household use, cooled by one or more energy consuming means and having one or more compartments intended for the preservation of food, one at least of which is suitable for the storage of fresh food.

3.2 Storage Compartments

3.2.1 *Fresh Food Storage Compartment*

Compartment intended for the storage of unfrozen food which may be itself divided into sub-compartments, and in which the temperature can be maintained in accordance with **7.2.1**.

3.2.2 *Crisper 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 temperature can be maintained in accordance with **7.2.1**.

3.2.3 *Low Temperature Compartment*

Compartment which may be either:

— an ice-making compartment, or

— a frozen food storage compartment.

A household refrigerator may have one or several low temperature compartment. Alternatively, it may have no low temperature compartment.

3.2.4 *Ice-Making Compartment*

Compartment intended specifically for the freezing and storage of water ice-cubes.

3.3 General Definitions

3.3.1 *Drip Tray*

A tray located directly beneath the evaporator for water collection during defrosting.

3.3.2 *Crisper*

An enclosed container provided primarily to retard the dehydration of fruits and vegetables.

3.3.3 *Overall Dimensions (Doors or Lids Closed)*

Measurements of the rectangular parallelopiped, whose base is horizontal, within which the refrigerator is inscribed to include the complete appliance except for the handle, the protrusion of which, if any, is to be specified separately.

3.3.4 *Volumes*

3.3.4.1 *Gross volume*

The total volume within the inside walls of the appliances, without internal fittings, doors or lids being closed.

3.3.4.2 *Rated gross volume*

The gross volume stated by the manufacturer.

3.3.4.3 *Total gross volume*

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

3.3.4.3.1 *Rated total gross volume*

Total gross volume stated by the manufacturer.

3.3.4.4 *Storage volume*

That part of the gross volume of any compartment which remains after deduction of the volume of compartments and spaces recognized as unusable for the storage of food, determined by the method in **8.2**.

3.3.4.5 *Rated storage volume*

The storage volume stated by the manufacturer.

3.3.4.6 *Total storage volume*

The sum of the storage volume of the fresh food storage compartment(s), low temperature compartment and crisper compartment(s), even if these doors are independent.

3.3.4.7 *Rated total storage volume*

The total storage volume stated by the manufacturer.

3.3.5 *Storage Surfaces*

3.3.5.1 *Shelf*

For the purpose of this Indian Standard, any horizontal surface (shelves, partitions, etc) on which food can be placed. It may be formed by one component or by components fitted side by side, which may be fixed or removable.

3.4 Definitions Relating to Some Performance Characteristics

3.4.1 *Energy Consumption*

The consumption of a refrigerator over a period of 24 h, running under stable operating conditions at an ambient temperature of 32°C and measured under the conditions specified in **14.9.**

3.4.2 *Rated Energy Consumption*

The energy consumption stated by the manufacturer under conditions in accordance with **3.4.1.**

3.4.3 *Storage Temperatures*

3.4.3.1 *Fresh food storage temperature,* t_m

It is the arithmetical average of the mean temperatures t_1, t_2 and t_3 (as appropriate, *see* Fig. 1). The temperatures t_1, t_2 and t_3 are the mean internal temperatures measured in cylinders defined in **13.1.2,** that is, the arithmatic average of extreme values at each point during a complete control cycle.

3.4.3.2 *Crisper compartment temperature,* t_{cm}

Arithmetical average of the mean temperature t_{c1}, t_{c2} and t_{c3} (as appropriate, *see* Fig. 1 A), which are the mean internal temperatures measured in copper or brass cylinders *(see* **13.1.2)** placed at given points in the crisper compartment, as specified in **13.2.2**, that is, the arithmetical average of the extreme values at these points during a complete control cycle *(see* **3.4.5**).

3.4.4 *Defrosting*

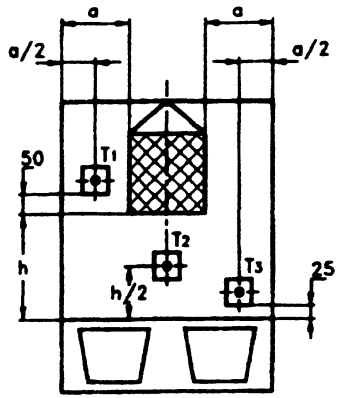
The method of defrosting may be one of three types.

3.4.4.1 *Automatically defrosted*

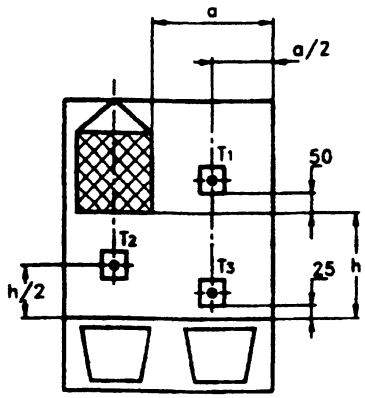
A compartment is automatically defrosted where no action is necessary by the user to initiate the removal of frost accumulation nor to restore normal operation, and where the disposal of the defrost water is automatic.

3.4.4.2 *Semi-automatically defrosted*

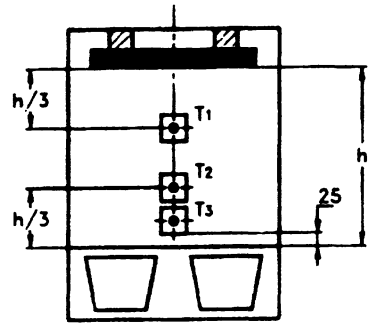
A compartment is semi-automatically defrosted where an action is necessary by the user to initiate the removal of frost accumulation and normal operation is restored automatically, the defrost water being removed manually or removed and disposed of automatically. A compartment is also semi-automatically



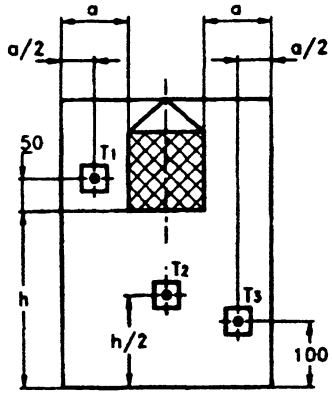
Arrangement 1 (a)



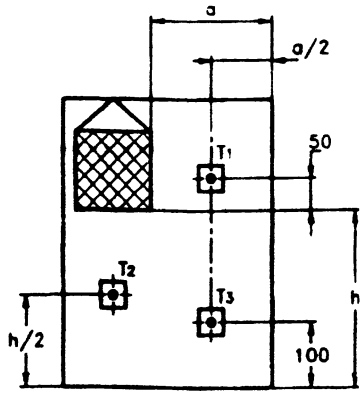
Arrangement 2(a)



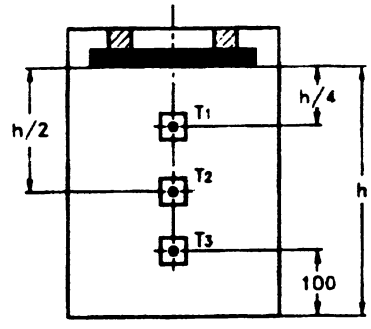
Arrangement 3(a)



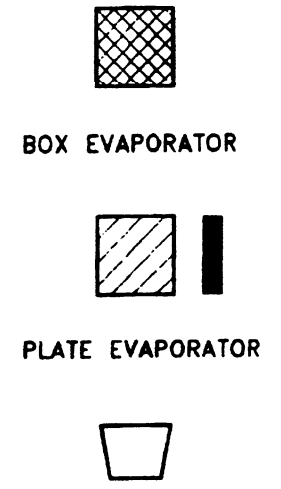
Arrangement 1(b)



Arrangement 2(b)



Arrangement 3(b)



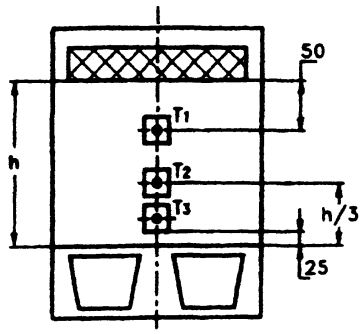
NOTES

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

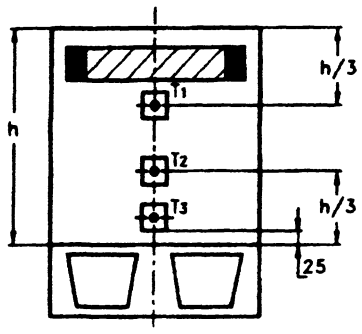
2 These figures relate to temperature-measurement points in copper or brass cylinders.

All dimensions in millimetres.

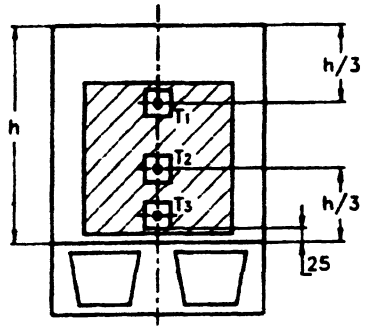
FIG. 1 TEMPERATURE-MEASUREMENT POINTS IN FRESH FOOD STORAGE COMPARTMENTS WITH DIFFERENT ARRANGEMENTS OF EVAPORATOR — *Continued*



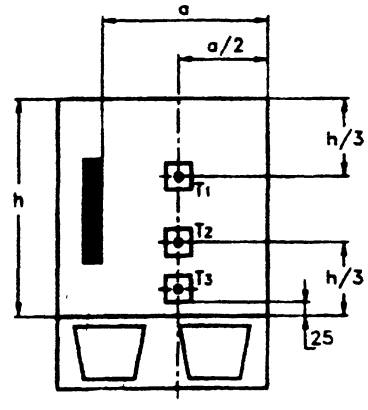
Arrangement 4 (a)



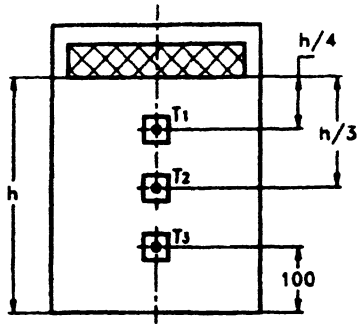
Arrangement 5 (a)



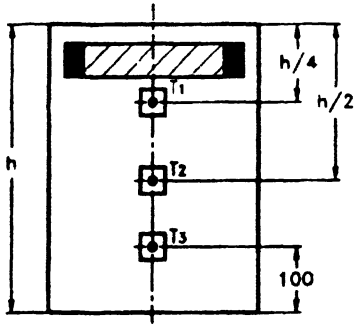
Arrangement 6 (a)



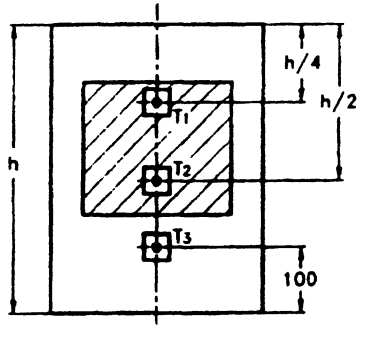
Arrangement 7(a)



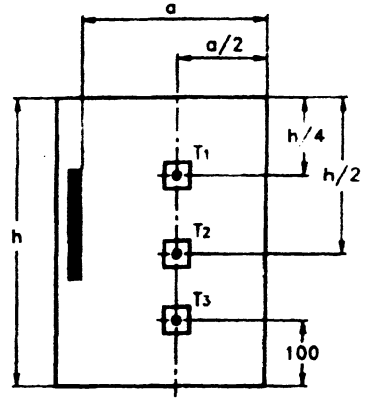
Arrangement 4 (b)



Arrangement 5 (b)



Arrangement 6 (b)

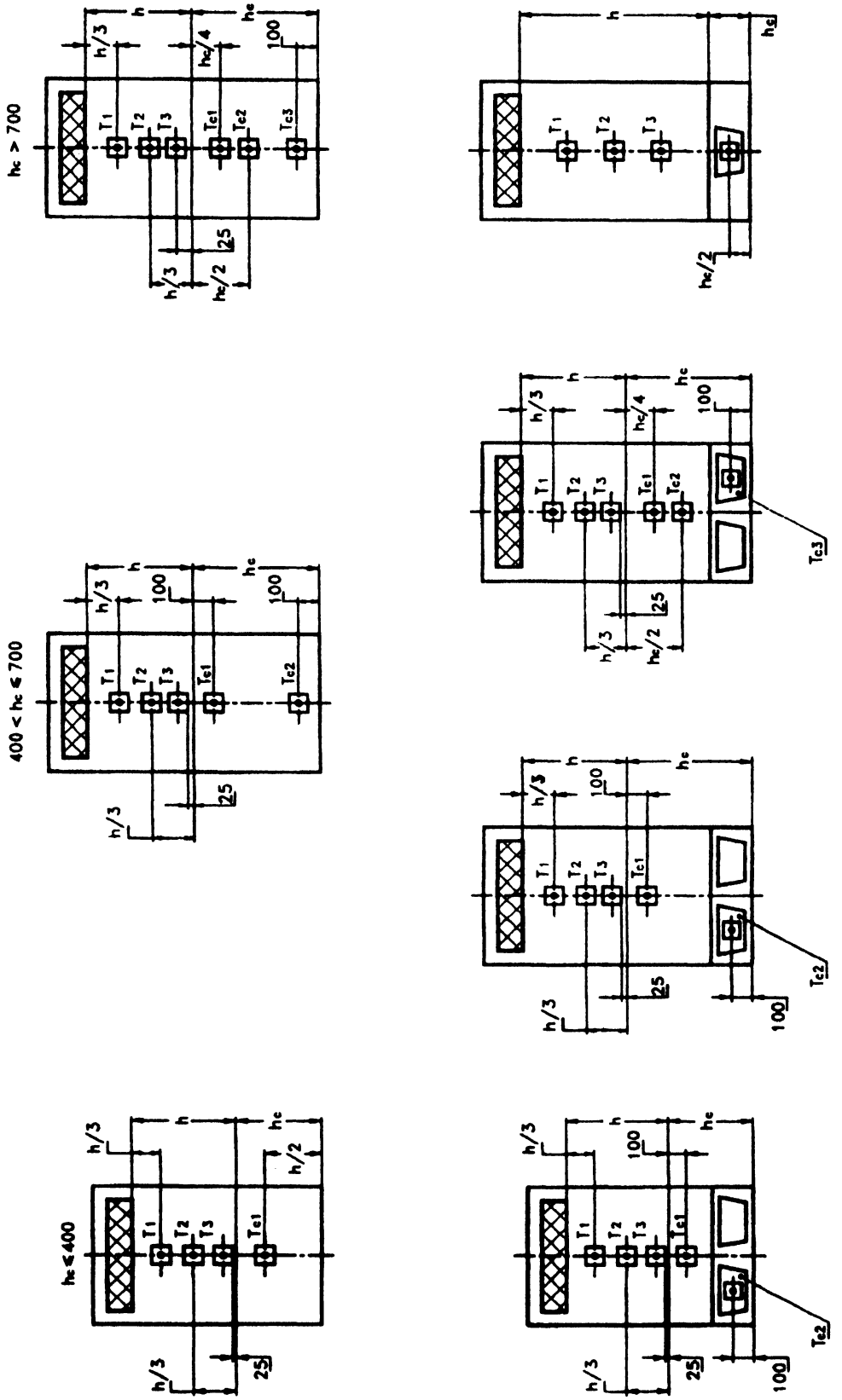


Arrangement 7 (b)

NOTE — These figures relate to temperature-measurement points in copper or brass cylinders.

All dimensions in millimetres

FIG. 1 TEMPERATURE-MEASUREMENT POINTS IN FRESH FOOD STORAGE COMPARTMENTS WITH DIFFERENT ARRANGEMENTS OF EVAPORATOR



NOTE — These figures relate to temperature-measurement points in copper or brass cylinders. They also apply to arrangements 1(a) to 7(b) of Fig 1.
All dimensions in millimetres.

FIG. 1A TEMPERATURE-MEASUREMENT POINTS IN CELLAR COMPARTMENTS IN RELATION TO THEIR HEIGHT, h_c AND INTERNAL FITTINGS

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

3.4.4.3 *Manually defrosted*

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

NOTE — When a refrigerator comprises two compartments or more, the method of defrosting shall be specified separately for one compartment. The means of disposal of defrost water may be of one of the two types.

3.4.4.4 *Automatic disposal of defrost water*

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

3.4.4.5 *Manual removal of defrost water*

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

3.4.5 *Control Cycle*

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

3.4.6 *Percentage Running Time (Apparatus with On/Off Control for the Refrigerating Source)*

Percentage running time, under given conditions of ambient temperature and of mean internal temperature, is the ratio:

$$R = (d/D) \times 100$$

where

R is the percentage running time,

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

D is total duration of the cycles.

3.4.7 *Ice-Making Time*

The time necessary for the freezing of the water in the ice-tray(s) supplied with the appliance.

3.4.8 *Ambient Temperature*

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

3.4.9 *Liner*

The interior surface of the refrigerator.

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.

3.6 Definitions Relating to Compression-Type Refrigerators

3.6.1 *Compression-Type Refrigerator*

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

3.6.2 *Hermetically-Sealed Motor-Driven Refrigerating Compressor*

Motor-compressor in which the compressor and the electric motor (for 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. The compressor shall be as per IS 10617 (Part3).

3.6.3 *Hermetically-Sealed Compressor Refrigerating System*

Complete system, essentially comprising a hermetically-sealed motor-driven compressor, 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 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. The thermostat should be as per IS 11338.

3.7 Definitions Relating to Absorption-Type Refrigerators

3.7.1 *Absorption-Type Refrigerator*

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

3.7.2 *Absorption Refrigerating System*

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

3.7.3 *Boiler*

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

3.7.4 *Absorber*

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

3.7.5 *Condenser*

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

3.7.6 *Evaporator*

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

4 CLASSIFICATION

Household refrigerating appliances covered by this standard are classified as Tropical Class (T) appliances and are intended for use in ambient temperatures from +18 to + 43°C.

5 MATERIALS, DESIGNS AND MANUFACTURE

5.1 General

Household refrigerators shall be constructed in such a manner as to ensure adequate performance and durability in use. Their performance in use is checked by applying a series of relevant tests. This clause defines some characteristics which are not tested but to which the attention of manufacturers is drawn.

5.2 Materials and Finishes

All materials used inside refrigerators shall not transmit odours. All materials used inside refrigerators shall not contaminate food placed in contact with them nor transmit poisonous substances to food. They shall be resistant to the action of moisture and food acids. All surface finishes shall, for the purpose intended be resistant to impact, sufficiently hard, colour-fast, smooth, easily washable and resistant to damage by moisture and by food acids.

5.3 Thermal Insulation and Air Tightness

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

5.3.2 No running water shall appear externally when the refrigerator is subject to the water vapour condensation test specified in **14.7**.

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

5.3.4 The strip of paper shall not slide freely when the door or lid seal is subjected to the airtightness test specified in **15.1**.

5.4 Door, Lids and Fittings

5.4.1 Hinges and handles shall be strong and resistant to corrosion.

5.4.2 External doors and lids shall withstand 100 000 openings and closings without deterioration which, in particular, may be prejudicial to the airtightness of the refrigerator, when subjected to the durability test of **5.4.2.1**.

5.4.2.1 *External doors*

a) *Procedure* — The ambient temperature during the test shall be between +18°C and + 32°C and the appliance shall be switched off. The components of the door shall be loaded as specified in **14.2.2**.

b) *Opening sequence (see* Fig. 2) — The movement of the door shall be controlled from an angle of 0° to an angle of opening between 5° and

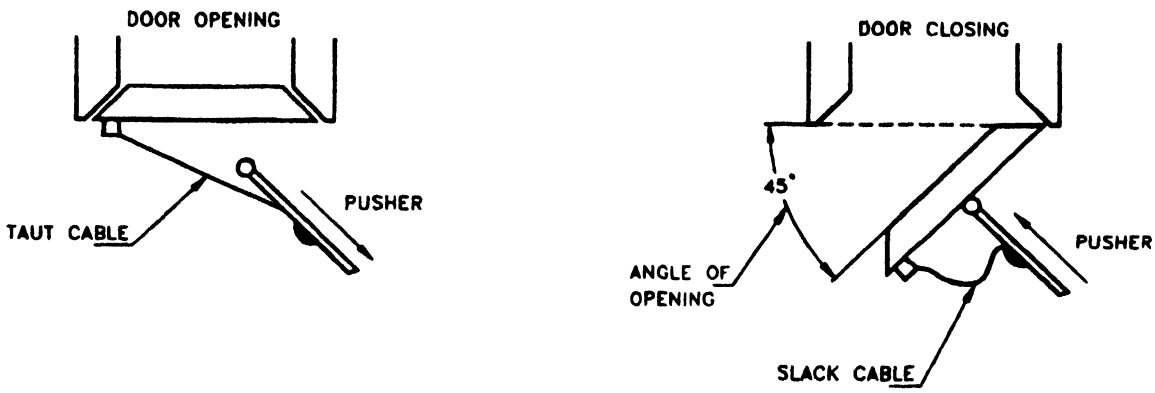


FIG. 2 EXAMPLE OF OPENING AND CLOSING or EXTERNAL DOOR(S)

15° followed by 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.

c) *Closing sequence* (*see* Fig. 2) — 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.

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

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

5.4.5 For refrigerator having any compartment with a volume equal to or greater than 60 l, it shall be possible to open the door or lid of that compartment from inside with a force not exceeding 70 N when subjecting to the test of **5.4.5.1.** The volume is determined when all detachable shelves have been removed. However, if the door or lid is provided with a mechanical latch which can be locked by a removable key, and the door or lid cannot be closed with the key turned to the locked position, this requirement applies only when the latch is unlocked, provided that the refrigerator is accompanied by an instruction stating that key shall be put out of children reach and not kept in the vicinity of the appliance.

5.4.5.1 *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 inside. Compliance shall be checked by inspection and by the test specified in **5.4.5.2** to **5.4.5.5.**

5.4.5.2 *Procedure*

The ambient temperature shall be between +18°C and + 43°C. The appliance shall be switched off and be in equilibrium with the temperature. The door or lid shall be closed for a period of one hour, after which an 'opening' test shall be carried out under the following conditions.

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

5.4.5.4 The method of measurement shall be one of the following:

a) 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).

b) If the handle of the door or lid is at the mid point of the edge farthest from the hinge axis, by applying a force to the handle, the value of the force required to open the door 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.

5.4.5.5 The test shall be carried out both before and after the mechanical durability test (*see* **5.4.2.1**).

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 **14** without showing such distortion that they could no longer fulfill their intended function. In particular, sliding components shall be capable of their full movement when loaded. Shelves, containers and

similar components which are intended to be removable should be easily removable.

5.6 Disposal of Defrost Water

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

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

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 undue ingress of air into the food storage compartment(s).

5.7 Refrigerating System

5.7.1 The mechanical operation of the refrigerator should not give rise to undue noise or vibration. *(see also* **11.3**).

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

5.7.3 The evaporator should be so designed or protected that it will not suffer any damage during normal use of the appliance. The heat exchange surface should be made of corrosion resistant material or finished with a corrosion proof non-poisonous coating resistant to temperature changes and alternating frosting and defrosting.

5.7.4 The means of adjustment of temperature control devices, if intended to be adjusted by the user, should be readily accessible and their function shall be such as to enable the refrigerator to meet the requirement of the performance tests as defined in **14**.

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 so as to prevent failure due to fatigue. All other pipes and connections should be securely anchored. Where necessary, pipes and valves should be properly insulated.

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

6 ELECTRICAL COMPONENTS

6.1 Fractional horse power electric motors for hermetically sealed compressors shall be so constructed that the constant presence of oil and refrigerant under working pressure and temperature has no action on the insulation and windings.

6.1.1 Electric motors for driving open type compressors shall be of a type which have a sufficient starting torque. They shall have adequate capacity to operate under normal conditions.

6.1.2 Hermetically sealed compressors shall conform to IS 10617 (Part 3).

6.2 Overload Protectors

The motors shall be connected through a current and temperature sensitive protective device which is capable of automatically disconnecting the motor from the line in case the motor is overloaded either during starting or running.

6.3 Electric Contacts in Thermostats, Overload Protectors and Relays

The electrical contacts shall be of a snap-action type and shall be of an ample capacity to easily handle the locked-rotor current.

6.4 Flexible Wires or Cords and Cables

Wires and cables used in the refrigerator shall be of a good quality and shall have ample capacity to carry the maximum current required, without showing any sign of strain. They shall conform to the requirements of IS 9968 (Part 1) or IS 694 whichever is applicable. The wires shall be so arranged that there is no mechanical damage nor any damage due to heat, oil, moisture or corrosion. Whenever electrical connections have to be made, they shall be done with a suitable mechanical connector or the joints shall be soldered or brazed. The insulation used to electrically insulate these joints shall be not less than the value in any respect of the original insulation used on the wires. The electrical connections shall be either made by means of suitable connectors or their ends shall be soldered and formed into eyelets so that they can be securely held in position. Care shall be taken that the insulation is not destroyed whilst performing the soldering operation. Corrosive fluxes shall not be used. All electrical connections and components shall be adequately guarded and insulated so that there is no chance of getting accidental electrical shocks at any time during normal usage. Where any cord or cable passes through metal holes, such holes shall be so shaped as to protect the cord from damage from abrasion.

6.5 As an additional measure of safety against electrical shocks, an efficient earthing terminal shall be provided which shall have good electrical contact with all exposed metallic parts likely to become alive. This should not have resistance of more than one ohm.

The lamp holder, thermostat and the door switch in the refrigerator shall be adequately protected against condensation of moisture.

6.6 Wiring

Electrical wiring and connections shall conform to the requirements of IS 732 and also to the *Indian Electricity Act,* 1910 and *Indian Electricity Rules,* 1956. All electrical joints shall be electrically and mechanically secure.

6.7 Live parts shall be protected by suitable guards, shields or screens of adequate strength and durability to avoid the possibility of making inadvertent contact therewith during normal service conditions. It shall not be possible to touch live parts with the accessibility test probes following the procedure described in IS 1401 even after the removal of covers or casings which can be removed without the use of tools, or during replacement of the lamp.

7 REQUIRED CHARACTERISTICS

7.1 Dimensional Characteristics

7.1.1 *Rated Gross Volumes*

The measured gross volume shall not be less than rated gross volume by more than 3 percent of the latter.

7.1.2 *Rated Storage Volumes*

The measured storage volume shall not be less than rated storage volume by 3 percent of the latter.

7.1.3 *Rated Storage Shelf Area*

The rated storage shelf area shall not be greater than the measured storage shelf area by 3 percent of the latter.

7.2 Performance Characteristics

7.2.1 *Storage Temperatures*

The appliance shall be capable of maintaining the required storage temperatures at an ambient temperature of +18 to +43°C as follows:

a) Storage temperature in the fresh food storage compartment:

Ambient temperature	from +18 to +43°C
t_1, t_2, t_3	$+0°C < t_1, t_2, t_3 < +10°C$
$t_m(Max)$	+7°C

b) Storage temperature in the crisper compartment:

t_{cm}	$+8°C < t_{cm} < +14°C$

7.2.2 *Energy Consumption*

7.2.2.1 The energy consumption for refrigerators under test conditions as specified at **14.9.2** shall not be more than the values specified below for the following capacity refrigerators:

Up to 65 l	–	0.85 kWh/24 h
66 to 165 l	–	1.1 kWh/24 h
166 to 240 l	–	1.4 kWh/24 h
241 to 310 l	–	1.6 kWh/24 h
311 to 450 l	–	1.9 kWh/24 h

7.2.2.2 The limit of energy consumption for double door refrigerators shall be 30 percent more than specified above.

7.2.2.3 *Rated energy consumption*

If energy consumption is stated by the manufacturer, the value measured in accordance with **14** on the first appliance tested shall not be greater than the rated energy consumption by more than 15 percent of the latter.

If the result of the test carried out on the first appliance is greater than the declared value +15 percent, the test shall be carried out on 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 +10 percent.

However the energy consumption shall not exceed the values specified in **7.2.2.1**.

7.2.3 *Ice-Making*

The time taken for the freezing of the water in the ice-trays supplied with the appliance shall not exceed the value stated by the manufacturer by more than 10 percent.

8 DETERMINATION OF LINEAR DIMENSIONS, VOLUME AND AREAS

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

8.1 Determination of Linear Dimensions

Linear dimensions shall be measured to the nearest millimetre.

8.2 Determination of Volume

Volumes shall be expressed in whole numbers of litres.

8.2.1 *Determination of Gross Volume*

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

the gross volume is determined, internal fittings such as shelves, partitions, containers, evaporators, thermostats and interior light housings shall be considered as not being in place. However, the gross volume shall take into account the exact shapes of the walls. Determination of volumes shall be in accordance with Annex A.

8.2.2 *Determination of the Total Storage Volume*

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

For the determination of storage volumes, the total volume of devices and of spaces considered unusable for the storage of food shall be deducted from the gross volume calculated in accordance with **8.2.1** *(see* **8.2.3** for fresh food storage compartments and **8.2.4** and **8.2.5** for low temperature compartments).

8.2.3 *Storage Volume of Fresh Food Storage Compartment*

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

— the volume of the evaporator space *(see* **8.2.3.1**);

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

– the volume of shelves, partitions, retainers and other accessories the wall thickness of which is greater than 13 mm (*see* **8.2.3.2**).

8.2.3.1 *Volume of the evaporator space (see* Fig. 3)

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

a) *Depth* — The depth of the evaporator space shall be the mean horizontal distance between the front and rear surface 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.

b) *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 inside wall of the enclosed space of the cabinet, such space shall be computed as part of the evaporator space.

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

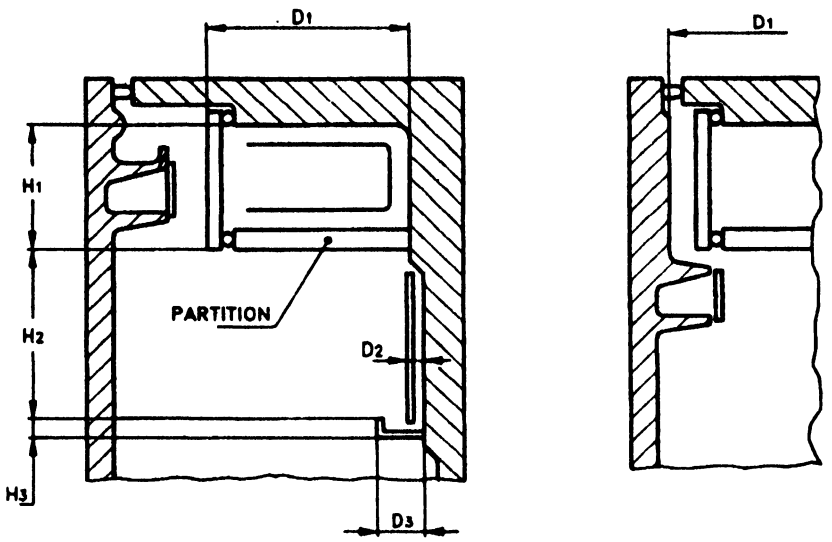
8.2.3.2 *Volume of shelves and partitions (see* Fig. 4)

a) *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.

b) *Full shelves and partitions* — The volume of a full shelf or partition shall be the product of its thickness and its depth, width or height. whichever two of the latter three are applicable. The depth, width and height shall be those dimensions of the enclosed space of the cabinet which apply in the plane of the shelf or partition.

c) *Fractional shelves and partitions* The volume of a fractional shelf or partition shall be the product of its thickness and its depth. width or height, whichever two of the latter three are applicable.

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



Volume to be calculated

$V = (D_1 \times H_1 \times W_1)$

$= (D_2 \times H_2 \times W_2)$

$= (D_1 \times H_1 \times W_1)$

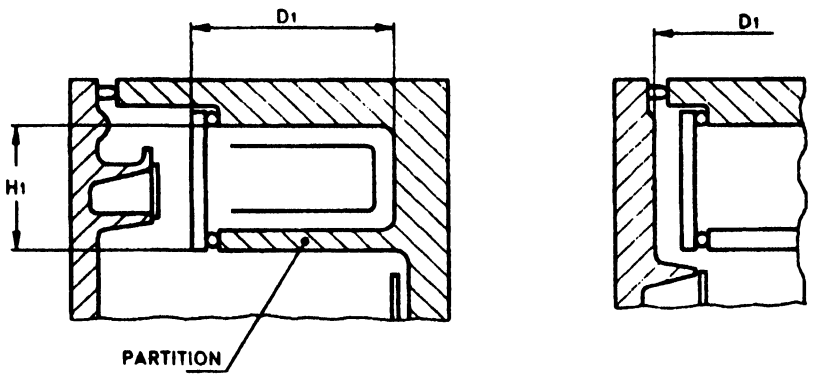
where

W_1 is equal to the width of low - temperature compartment evaparator space.

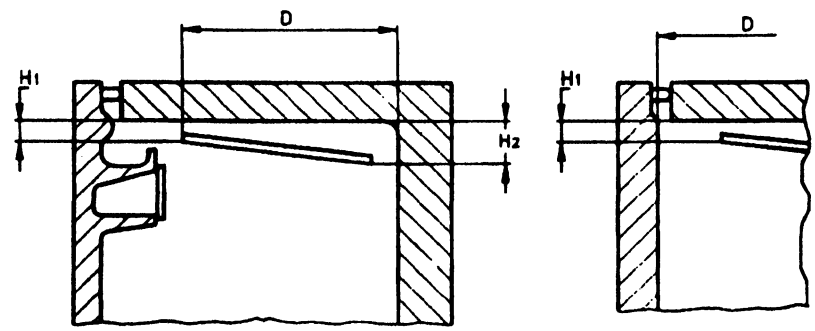
W_2 is equal to the width of fresh food storage compartment evaparator space. and

W_3 is equal to the width of drip-tray space.

3A Partition as a Separate Part



3B Partition not as a Separate Part

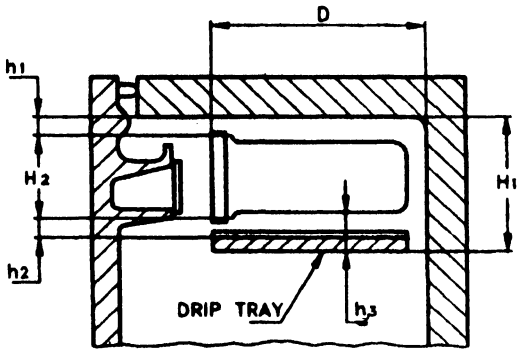


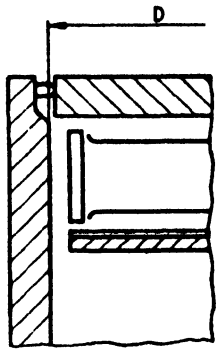
$$V = D \times \frac{H_1 + H_2}{2} \times W$$

(*see* Fig. 3E for *W*)

3C Inclined Plate Evaporator

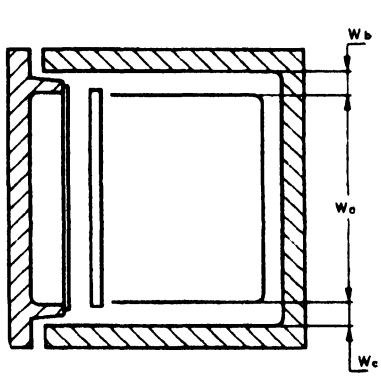
FIG. 3 DETERMINATION OF VOLUME OF EVAPORATOR SPACE — *Continued*

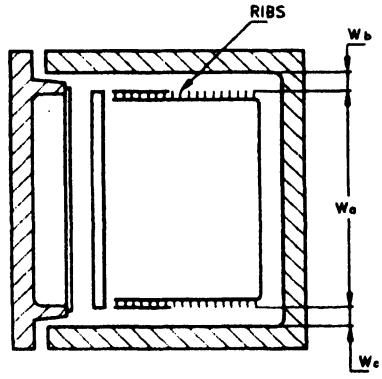




If h_1 and $h_2 \leq 40$ mm:
$V = D \times H_1 \times W$
If $h_1 > 40$ mm and $h_2 \leq 40$ mm:
$V = D \times (H_1 + h_1) \times W$
If $h_2 > 40$ mm and $h_1 \leq 40$ mm:
$V = D \times (H_2 + h_1) \times W$
If $h_2 > 40$ mm and $h_1 > 40$ mm:
$V = D \times H_2 \times W$
(*see* Fig. 3E for W)
= and a definite manual operation is needed to initiate defrosting

3D Box Evaporation with Drip Tray





If W_b and $W_c < 70$ mm:
$W = W_a + W_b + W_c$
If $W_b < 70$ mm and $W_c \geq 70$ mm:
$W = W_a + W_b$
If W_b and $W_c \geq 70$ mm:
$W = W_a$

3E Determination of Width (Plan Views)

FIG. 3 DETERMINATION OF VOLUME OF EVAPORATOR SPACE

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

8.2.4 *Storage Volume of Ice-Making Compartments*

The storage volume of the ice-making compartment shall be the sum of the volumes of all the compartments of this type in the refrigerator. The volumes of these compartments shall be determined in a similar manner that specified in **8.2.2** and **8.2.3** as appropriate.

8.2.5 *Storage Volume of Frozen Food Storage Compartments (see* Fig. 5)

For the determination of the storage volume of these compartments, the total volume which is unsuitable for storage shall be determined and then deducted from the gross volume determined as indicated in **8.2.1**.

The total volume to be deducted shall comprise:

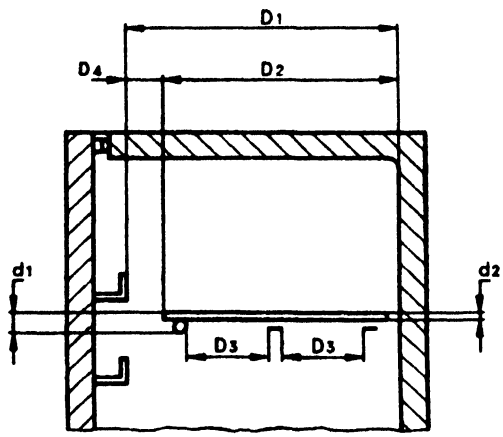
a) the volume of spaces provided specifically for making the storing ice;

b) the volume of spaces between the front stack(s) and the inner vertical surface of door or any projection from the door where the horizontal distance between the face of the stack(s) and the inner door surface or projection exceeds 15 mm;

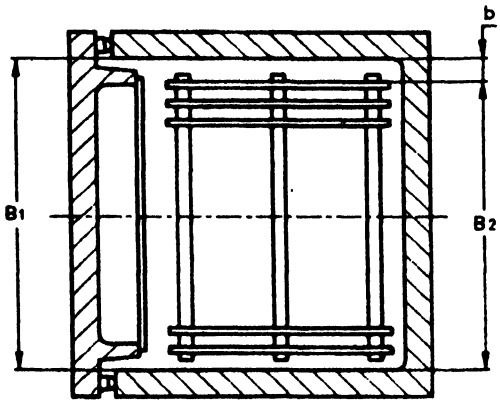
c) the volume of spaces which shall be kept free for the good performance of the refrigerator system;

d) 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 the thickness of which is not greater than 13 mm; and

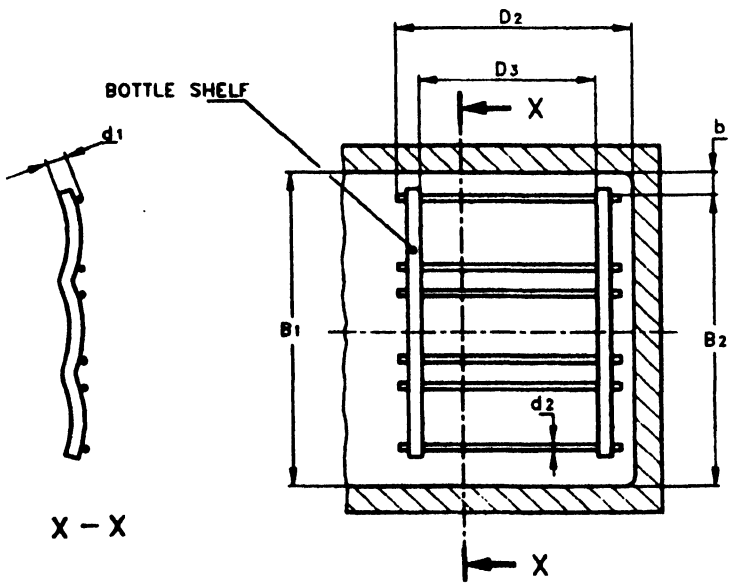
e) the volume rendered unusable by the use of removable parts (for example, baskets, shelves) necessary for obtaining satisfactory thermal and mechanical characteristics.



4A Side Cross-Sectional View



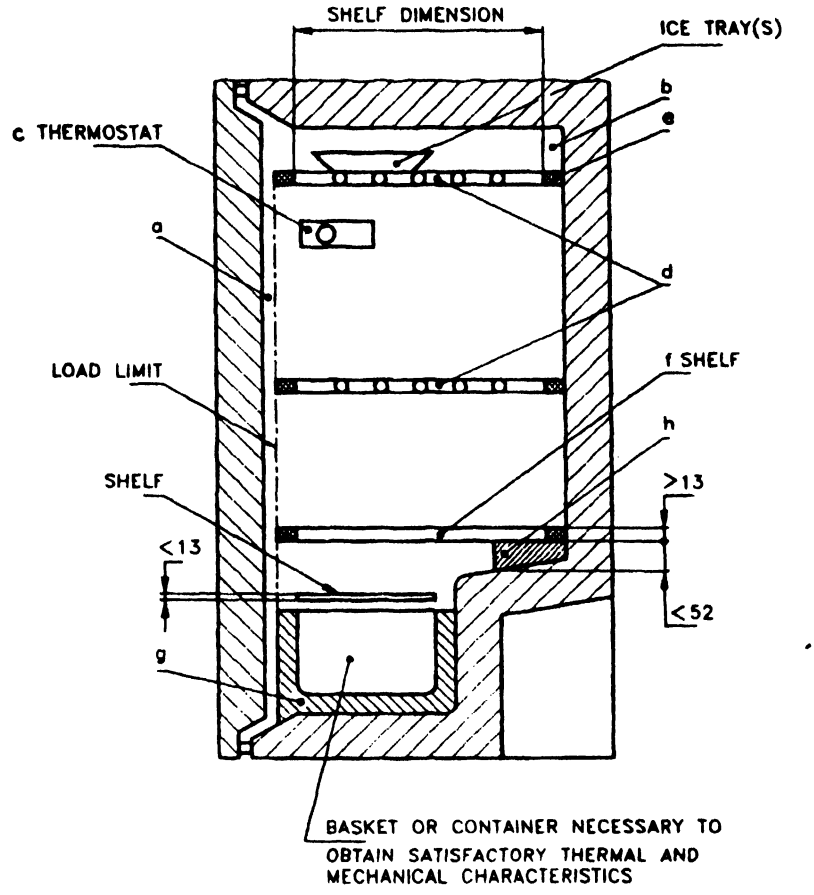
4B Top Cross-Sectional View



4 C Top Cross-Sectional View

Conditions				*Volume to be deducted*
1)	d_1 and d_2	≤	13 mm	0
2)	d_1	>	13 mm	0
	d_2	≤	13 mm	
	D_3	>	100 mm	
3)	d_1	>	13 mm	$d_1 \times D_1 \times B_1$
	$d_2 \leq d_1$			
	D_3	≤	100 mm	
	D_4	≤	70 mm	
	b	≤	70 mm	
4)	d_1	>	13 mm	$d_1 \times D_2 \times B_1$
	$d_2 \leq d_1$			
	D_3	≤	100 mm	
	D_4	>	70 mm	
	b	≤	70 mm	
5)	d_2	>	13 mm	$d_2 \times D_1 \times B_1$
	D_3	>	100 mm	
	D_4	≤	70 mm	
	b	≤	70 mm	
6)	d_2	>	13 mm	$d_2 \times D_2 \times B_1$
	D_3	>	100 mm	
	D_4	>	70 mm	
	b	≤	70 mm	
7)	If b > 70 mm take B_2 instead of B_1 (fractional shelf).			

FIG. 4 DETERMINATION OF VOLUMES OF SHELVES AND PARTITIONS



NOTE — The volumes marked *a*, *b*, *c*, *d*, *e*, *f*, *g* and *h* shall be deducted from the gross volume (*see* **8.2.1**).

All dimensions in millimetres.

FIG. 5 EXAMPLE OF DETERMINATION OF THE STORAGE VOLUME OF FROZEN FOOD STORAGE COMPARTMENTS

8.3 Determination of Storage Shelf Area

The area shall be expressed in square decimetres.

8.3.1 *Determination of the Area of Shelves (see* Fig. 6)

8.3.1.1 *Full shelves comprising of a single part*

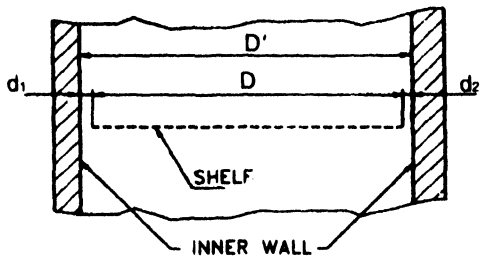
In case of a shelf comprising of a single part, the area shall be the product of the width by the depth. These two dimensions shall be determined as follows:

Width — Mean distance measured parallel to the surface of the shelf between the inner surface of the side walls of the enclosed spaces of the cabinet, where this dimension does not exceed the actual width of the shelf by more than 20 mm (*see* Fig. 6A).

Depth — Mean distance measured parallel to the surface of the shelf between 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* Fig. 6B). When the door of an upright type appliance is provided with shelves this distance shall be measured between the rear surface of the enclosed space of the cabinet and vertical plane tangential to the front of the cabinet shelf, provided that any gap between the rear edge of the shelf and the rear wall does not exceed 20 mm (*see* Fig. 6C). When considering the bottom of an upright type appliance, the front reference/ plane shall be the edge of the enclosed space of the cabinet (*see* Fig. 6C).

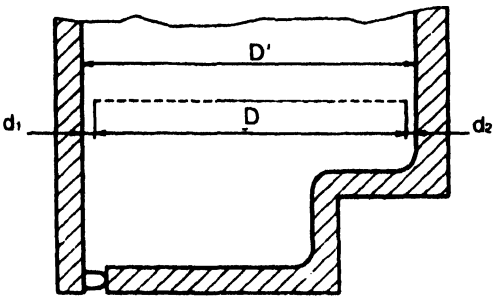
8.3.1.2 *Fractional shelves*

For the purpose of calculating the area of fractional shelves, the width and depth shall be measured parallel to the surface of the shelves from the adjacent surface of the enclosed space of the cabinet to the farther edge of the shelf.



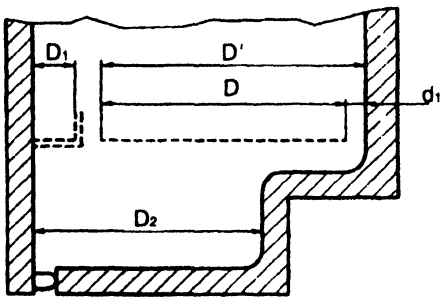
If $d_1 + d_2 \leq 20$ mm
Dimension of the shelf = D'
If $d_1 + d_2 > 20$ mm
Dimension of the shelf = D

6A Determination of Width



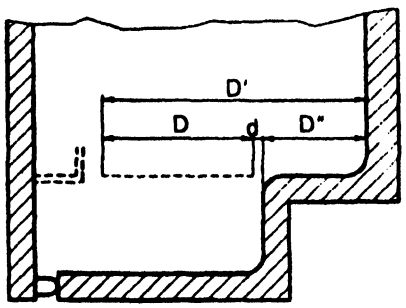
If $d_1 + d_2 \leq 20$ mm
Dimension of the shelf = D'
If $d_1 + d_2 > 20$ mm
Dimension of the shelf = D

6B Determination of Depth - Upright - Type Appliance Without Storage in the Door



If $d_1 \leq 20$ mm
Dimension of the shelf = D'
If $d_1 > 20$ mm
Dimension of the shelf = D
Dimension of the door shelf = D_1
Dimension of the bottom of the appliance = D_2

6C Determination of Depth - Upright - Type Appliance With Storage in the Door



If $d \leq 20$ mm
Dimension of the shelf = D'
If $d > 20$ mm
2 Shelves of dimension D and D"

6D Determination of Depth - Shelf With Juxtaposed Parts

FIG. 6 EXAMPLE OF DETERMINATION OF THE DIMENSIONS FOR CALCULATING THE AREA OF A SHELF
(*see* **8.3.1, 8.3.1.1** and **8.3.1.6**)

8.3.1.3 *Cut-away shelves*

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

8.3.1.4 *Juxtaposed shelves*

In the case of juxtaposed shelves, when distance between two parts does not exceed 20 mm, the dimensions shall be measured as for a shelf comprising a single part. When the distance is more than 20 mm, the area shall be measured for each of the parts *(see* Fig.6D).

8.3.1.5 *Particular cases*

The bottom of the enclosed space of the cabinet shall be considered as shelf. When an inner wall is not vertical, the dimension of the shelf shall be measured with reference to the vertical plane cutting this surface at the mid-height between the shelf under consideration and the shelf or horizontal immediately above.

Any part of full shelves, baskets or of the bottom of the appliance having less than 100 mm vertical clearance above, when all the shelves are in position, shall be excluded when calculating the storage area. However, it is admissible that for one full shelf or basket the vertical clearance may be reduced to not less than 80 mm (*see* Fig. 7).

8.3.1.6 *Determination of the area of door shelves*

The shelf area shall be the product of the width by the depth. These two dimensions shall be determined by analogy with **8.3.1.1.**

Width — Mean distance between the inner surface of the side walls of the door compartment or between the edges of the retainer bar.

Depth — Mean distance between the surface the door wall and the vertical plane tangential to the inner front surface of the shelf or retainer bar (*see* Fig. 6C).

8.3.1.7 *Low temperature compartment shelves*

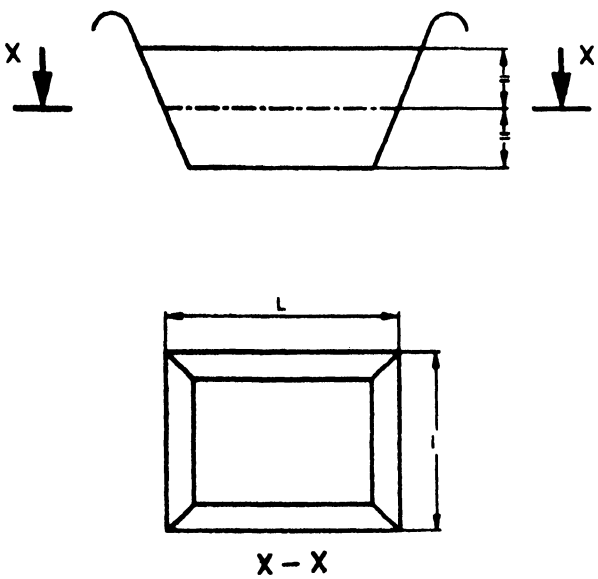
The areas of shelves and of compartment bottom of low temperature shall be included in the storage shelf areas, provided there is a clear vertical space of not less than 40 mm above such shelves and compartment bottom in ice-making compartment and of not less than 52 mm in frozen food storage compartments.

8.3.2 *Drip-Tray*

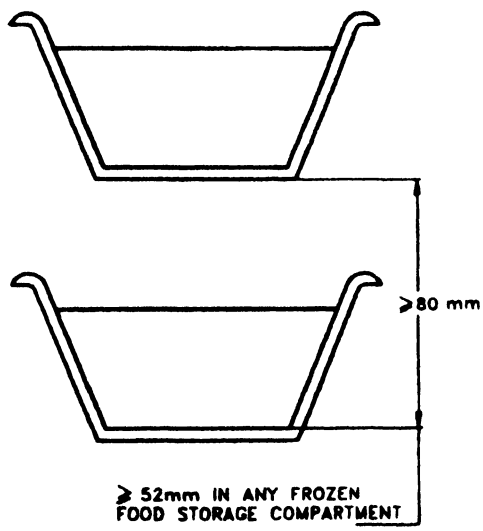
Whenever the space occupied by the drip-tray is included in the storage volume, the part of the shelf supporting the drip-tray or the bottom of the drip-tray shall be considered as a part of the storage shelf area, provided that a definite manual operation is needed to initiate defrosting.

8.3.3 *Determination of the Area of Baskets*

The basket area shall be the product of the two mean horizontal dimensions (*see* Fig. 7).



7A Aera of Basket



7B Vertical Clearance Above a Basket

FIG. 7 EXAMPLES OF DETERMINATION OF MEAN DIMENSIONS FOR CALCULATING THE AREA OF A BASKET
(*see* **8.3.1.5** and **8.3.3**)

8.3.4 *Suspended Containers*

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

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

If the 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.

9 OPERATIONAL REQUIREMENTS

9.1 No-Load Adjustment Check

It should be possible to obtain the following temperatures at least for one position of the thermostat, as recommended by the manufacturer other than defrost position:

a) At ambient temperature of + 18°C, none of the temperatures t_1, t_2 and t_3 of the general storage compartment shall be below +0°C at any part of the cycle.

b) At ambient temperature of +43°C, the mean internal temperature t_m of the general storage compartment shall not be above +7°C the temperature being measured at the three specified points in the compartment ranging from +0 to +10°C; and

c) At ambient temperature of +43°C, the temperature at the geometric centre of the evaporator shall not exceed -5°C.

9.2 No-Load Performance (No-Load Efficiency) of the Refrigerating Unit

9.2.1 With the refrigerator working under no-load condition as specified in **14.5** the following shall be measured at ambient temperature of +43°C:

a) The time required to pull down to the mean cabinet air temperature from +43 to + 7°C without the thermostat in the circuit.

b) The percentage running time with the thermostat set in the position corresponding to t_m = +7°C as specified in **9.1**(b).

9.2.2 The pull down time and percentage running time as measured shall not be above the value stated by the manufacturer by more than 5 percent of the latter.

9.3 Ice-Making Time

9.3.1 The ice trays conforming to IS 5038 shall be provided such that they have a minimum total capacity of 0.175 litre for refrigerators up to and including 100 litres capacity and minimum total capacity of 0.3 litre for refrigerators above 100 litres capacity. The ice trays will be so designed that it gives ice pieces having dimensions not less than 12 mm when measured in any direction.

9.3.1.1 The measured value of the ice-making time shall not exceed the value stated by the manufacturer by more than 10 percent.

9.3.2 In case the manufacturer intends to supply non-standard ice trays to the consumer, the time necessary for freezing of water in two of these ice trays having minimum capacity as laid down in **9.3.1** shall also be measured under the conditions specified in **14.6** at ambient temperature of +43°C.

9.3.2.1 The measured value of the ice-making time shall not exceed the value stated by the manufacturer (for the trays actually supplied) by more than 10 percent.

10 TESTS

10.1 Type Tests

The following shall constitute the type tests:

a) Door seal test,

b) Mechanical strength of shelf and similar components,

c) Door and fittings tests,

d) No-load adjustment test,

e) No-load performance test,

f) Ice-making test,

g) Thermal insulation test,

h) High voltage test,

j) Rated energy consumption test, and

k) Internal frost accumulation and defrost test— Purpose of this test is to determine under severe operating conditions the frost accumulation on the refrigerated surface in the cabinet and the effectiveness of defrost water disposal (if applicable).

10.1.1 Once a refrigerator has undergone type tests, any major alteration which the manufacturer intends to make in the refrigerator shall be reported to the appropriate testing authority and further type tests shall be carried out on the modified refrigerators in accordance with the procedure laid down in the standards.

10.2 Production Routine Tests

Every domestic refrigerator after completion shall be subjected to the following routine tests at the manufacturer's works which shall be carried out without loading the refrigerator:

a) Thermostat test,

b) Insulation resistance test, and

c) Door seal test.

10.2.1 The manufacturer shall furnish with each domestic refrigerator a certificate that the production routine test prescribed in **10.2** have been conducted in accordance with the procedure given in **15** and that the unit conforms to the requirements of the standard.

10.3 Acceptance Tests

If the purchaser desires any of the production routine tests *(see* **10.2**) to be repeated then where agreed to between the purchaser and the manufacturer the test may be conducted at the manufacturer's works.

10.4 Samples for Tests

10.4.1 *Type Tests*

One refrigerator of each size shall be sent along with manufacturer's detailed specification to the appropriate testing authority for purposes of type tests. These samples shall be accompanied by identical liners with necessary accessories in case the gross volume is to be measured by the method described in Annex A.

10.4.2 *Acceptance Tests*

The number of samples shall be as agreed to between the purchaser and the manufacturer.

11 ADDITIONAL REQUIREMENTS FOR ECO MARK

11.1 The refrigerator shall conform to the requirements for quality, safety and performance prescribed under **5** to **10**.

11.2 The manufacturer shall produce the consent clearance as per the provisions of *Water (Prevention and Control of Pollution) Act,* 1974, *Water (Prevention and Control of Pollution) Cess Act,* 1977 and *Air (Prevention and Control of Pollution) Act,* 1981, alongwith the authorization, if required under the *Environment (Protection) Act,* 1986 to BIS while applying for ECO Mark.

11.3 Noise Level

For ECO Mark the refrigerator shall conform to the noise levels as notified under the *Environment (Protection) Act,* 1986 from time to time.

11.4 Instructions

The refrigerator shall be sold along with the instructions for proper use so as to maximize product performance, minimize wastage and method of safe disposal of used product.

11.5 Packing

The refrigerator shall be packed in such packages which are made of recyclable or bio-degradable materials.

11.6 Energy Consumption

The energy consumption shall be at least 5 percent less than those specified in **7.2.2**.

11.7 Refrigerants which are ozone depleting such as CFC 11/12 as identified under Montreal Protcol shall not be used in the manufacture and operation of these refrigerators.

12 GENERAL TEST CONDITIONS

12.1 Refrigerator State

Unless otherwise specified the tests shall be made on the refrigerator installed as for normal use, with the defrosting tray, ice trays, shelves and other fitting, if any,in their normal positions in accordance with the manufacturer's instructions. The ice trays and trays and generally speaking all containers shall be empty.

12.2 General Operating Conditions

12.2.1 *Stable Operating Conditions*

Stable operating conditions are deemed to be reached when during a time of 2 h the mean temperatures measured at the same position of the control cycle do not vary by more than ± 0.5°C from the final regulated figure.

Stable operating conditions are deemed to be maintained during the test when the temperatures measured at the same moment of the control cycle do not vary by more than ± 0.5°C during 6 h.

After the mean internal temperature has been changed, the refrigerator shall be left for at least 5 h before another test; and after the ambient conditions in the test room have been changed, the refrigerator shall be left at least 12 h before another test.

12.2.2 *Electrical Power Supply*

For the test during which they will be in operation electric power supply to the domestic refrigerator shall be subject to variations of ±2 percent in the voltage.

12.2.3 *Power Supply Other Than Electric*

Appliances other than those for electric power supply

shall be tested under supply conditions corresponding to the information on the rating plate.

12.2.3.1 *Multiple power supplies*

Appliances which are equipped on different power supplies shall be tested for each of the supply conditions indicated on the rating plate *(see* **12.2.2** and **12.2.3**).

12.2.4 *Adjustment of the Thermostat*

When a given temperature is specified for the internal mean temperature t_m for the purpose of test, this means that the thermostat is placed at the beginning of the test, in a position such that the temperature t_m is obtained with a tolerance of ±0.5°C. The adjustment of the thermostat is determined, for example, by a preliminary test and not changed during the test.

If greater accuracy is required for a particular test the operating characteristic to be measured is estimated by determining its values at two values of the mean internal temperature t_m within the range of ±2°C. The operating characteristic at the specified internal temperature is then determined by interpolation.

12.3 Test Room

12.3.1 *Ambient Temperature*

This standard specifies ambient temperatures with wide limits (+18 to + 43°C) which can normally be obtained in laboratories without any special precautions, and ambient temperatures designated by a single value to which close limits apply. In the latter case the temperature, at each measurement point, shall be kept constant within ±1 °C both during the periods required for obtaining stable working conditions and during the tests.

The vertical ambient temperature gradient from the platform specified in **12.3.2.1** to a height of 2 m shall be within 1 °C for each one metre of vertical distance.

NOTE — The minimum value of the gradient is required to ensure conditions as close as possible to those which occur in actual operation, where a gradient usually exists. On the other hand, a zero gradient would involve air circulation in the test room which is not obtainable under the conditions of **12.3.2.3.**

12.3.2 Installation of refrigerators for carrying out tests should be made at an ambient temperature with close tolerance *(see* **12.3.1).**

12.3.2.1 Each refrigerator should be placed on a separate solid-top platform with all sides open for free air circulation under the platform. The top of the platform should be 30 cm above the test room floor and should extend at least 30 cm but not more than 60 cm beyond each side of the refrigerator.

12.3.2.2 Circulation of the air about the refrigerator shall be restricted by enclosing the refrigerator on three sides with three vertical false partitions arranged as follows:

One of the partitions placed parallel with the rear of the refrigerator, against the stop or the distance specified by the manufacturer in connection with the required overall space; the two other partitions shall be placed parallel with the sides of the refrigerator, fixed on the platform 30 cm from the sides of the cabinet; they shall each be 30 cm wide. The whole arrangement in plan shall be *n* or n-shaped and shall present no discontinuity. The three partitions shall be of such a height that they extend at least 30 cm above the top of the refrigerator.

The refrigerator 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 enclosed being at a temperature other than the ambient.

12.3.2.3 The refrigerator shall be so placed or shielded as to prevent direct radiation to or from the space-cooling or space-heating equipment in the test room.

Air circulation in the test room shall be such that the specified ambient temperature are obtained within the limits of the specified tolerances. The refrigerator under test shall be shielded from direct air currents.

12.3.2.4 Before the stabilization period preceding the test, the interior of the food storage compartment or compartments shall be dried, the evaporator defrosted and the drip tray emptied. The doors of the food storage compartment or compartments shall be kept closed during the tests.

13 MEASUREMENT

13.1 Measuring Instruments — Instrument Accuracy

13.1.1 Watt-hour meters shall be accurate to at least ±1 percent.

13.1.2 The temperature shall be measured with thermocouples, or other temperature measuring probes, the sensitive parts of which are inserted in the centre of a tinned copper cylinder, weighing 25 g, and of minimum external area (diameter = height = about 15.2 mm). Temperature measuring instruments shall be accurate to ±0.3°C.

13.1.3 Relative humidity shall be measured at points specified for the measurement of ambient temperature *(see* **3.4.8**), either by means of ventilated psychrometers having thermometers of an accuracy of ± 0.5°C or with recording apparatus of equivalent accuracy. When psychrometers are used, it will be necessary to carry out measurements at regular intervals.

13.2 Temperature Measurement Conditions

13.2.1 *Ambient Temperature*

The temperature t_{a1}, t_{a2} and t_{a3} shall be measured at the places defined in **3.4.8** and the ambient temperature calculated as indicated.

13.2.2 *Temperature of Fresh Food Storage Compartment and Crisper Compartment*

The temperature t_1, t_2 and t_3 *(see* **3.4.3.1**) and t_{c1}, t_{c2} and t_{c3} *(see* **3.4.3.2**) shall be measured in copper cylinders *(see* **13.1.2**) suspended or located at temperature measuring points T_1, T_2, T_3 and T_{c1}, T_{c2} and T_{c3} as shown in Fig. 1 and Fig. 1 A, half way between the rear wall of the refrigerator and the internal side of the closed door. The mean internal temperature t_m and t_{cm} shall then be calculated as specified in **3.4.3.1** and **3.4.3.2**.

13.2.3 If internal fitments do not allow the temperature t_1, t_2 and t_3 and t_{c1}, t_{c2} and t_{c3} to be read at the points specified, readings shall be taken in positions no more than 25 mm from the points specified. If the interior arrangement of the fresh food storage compartment and crisper compartment does not conform with those shown in Fig. 1 and Fig. 1(A), the temperatures t_1, t_2 and t_3 and t_{c1}, t_{c2} and t_{c3} shall be read in positions determined by analogy with the positions indicated.

13.2.4 The temperatures may be read or, preferably, recorded. The temperature sensitive element of the temperature measuring instruments shall be separated from any heat conducting surface by at least 13 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 storage compartment.

13.3 Operating Time Measurement Conditions

When the refrigerator is run on/off the operating time shall be recorded/measured.

NOTE — In the case of automatic defrost, the measurement is carried out:

a) with the automatic defrost controls disconnected if the defrost occurs once a day, and

b) with the automatic defrost controls connected if the defrost occurs at each cycle.

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

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

14 DESCRIPTION OF TYPE TESTS

14.1 Door Seal Test

14.1.1 *Purpose*

The purpose of this test is to ensure that the gasket of the door of the refrigerator adequately prevents any ingress of the surrounding air.

14.1.2 *Procedure*

With the refrigerator at rest, a strip of paper 50 mm wide 0.08 mm thick and of suitable length shall be inserted at any point of the seal and the door closed normally on it. The strip of paper shall not slide freely.

NOTE — The most unfavourable points may be found by inspecting the area round the seal with the refrigerator closed and lighted from the inside.

14.2 Mechanical Strength of Shelves and Similar Components

14.2.1 *Purpose*

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

14.2.2 *Procedure*

With the refrigerator at rest, and the door open the test shall be conducted as follows:

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 with the exception of compartments specially designed to hold eggs. The weights shall be placed with their axes vertical and in such a way that the maximum possible number is accommodated without one weight being placed over another and without overlapping the perimeter wire of the shelf under test. In the case of shelves or of sliding or revolving containers for which the movement is limited by a stop, the door being kept open, the test shall be carried out on the shelf or container in its most favourable position. 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.

14.2.3 The components under test shall remain in position throughout the test and should show no visible distortion after removal of the weights.

14.3 Doors and Fittings Tests

14.3.1 *Purpose*

The purpose of these tests is to check the opening conditions of the doors.

14.3.2 *Opening of the Door*

14.3.2.1 *Procedure*

With the refrigerator at rest, it should be verified that the refrigerator door is capable of being opened from the inside. The force for opening shall be applied to the handle at the point farthest from the hinges in directions perpendicular to the door by means of spring balance.

14.3.2.2 The force required for opening the door shall not exceed 70 N.

14.4 No-Load Adjustment Tests

14.4.1 *Purpose*

The purpose of these tests is to determine the adjustable range of the thermostat while providing a satisfactory temperature range.

14.4.2 *First Test — Low Ambient Temperature*

14.4.2.1 *Procedure*

a) *Ambient temperature* — This shall be +18°C.

b) *Test time* — This should be the time required after stable operating conditions are obtained for performing the prescribed measurements.

14.4.2.2 *Measurements*

The temperatures t_1, t_2 and t_3 of the general storage compartment shall be measured.

14.4.2.3 The requirements laid in **9.1**(a) shall be met.

14.4.3 *Second Test — High Ambient Temperature*

14.4.3.1 *Procedure*

a) *Ambient temperature* — This shall be +43°C.

b) *Test time* — This should be the time required, after stable operating conditions are obtained, for performing the prescribed measurements.

14.4.3.2 *Measurements*

The following temperatures shall be measured:

a) Temperatures t_1, t_2 and t_3 of the general storage compartment;

b) Mean internal temperature t_m of the general storage compartment; and

c) Evaporator temperature at its geometric centre.

14.4.3.3 The requirements laid down in **9.1** (b) and **9.1** (c) shall be met.

14.5 No-Load Performance Test

14.5.1 *Purpose*

The purpose of this test is to check the no-load characteristics of the refrigerating unit, that is, pull down time, the no-load power consumption and the percentage running time.

14.5.2 The ambient temperature shall be +43°C.

14.5.3 *Procedure*

14.5.3.1 *Pull down test*

The cabinet with all compartment doors open, is to have been electrically disconnected for at least 8 h in +43°C ambient temperature immediately preceeding the start of the test. During the test, all refrigeration system controls (thermostat, automatic defrost controls, etc) are to be electrically disconnected or inactivated to ensure continuous operation of the compressor, but the motor overload protector, if provided, is not to be disconnected or inactivated. After soaking, the cabinet door (s) is to be closed and the time required to pull down the mean cabinet air temperature from +43 to +7°C shall be measured.

14.5.3.2 *Percentage run test*

The thermostat shall be set in position corresponding to t_m = +7°C. This closed door test shall be conducted after stable operating conditions are obtained. The percentage running time shall be measured for a minimum period of 6 h.

14.5.4 The requirements laid down in **9.2** shall be met.

14.6 Ice-Making Test

14.6.1 *Purpose*

The purpose of this test is to check the ice-making capability of the refrigerator.

14.6.2 *Procedure*

14.6.2.1 Ambient temperature shall be +43°C.

14.6.2.2 *Test time*

After stable operating conditions are obtained, the test shall be continued until freezing time as defined in **9.3**.

14.6.2.3 *Thermostat setting*

The thermostat shall be set in the coldest position and stable operating conditions obtained before starting the test.

14.6.2.4 The ice trays shall then be filled with water up to 5 mm from the top and promptly placed in the evaporator.

14.6.2.5 The water temperature at the moment of placing the ice tray into ice compartment, shall be 30±1°C.

14.6.2.6 The contact surface of the ice tray or trays shall be wetted with water to improve thermal contact.

14.6.3 Through the freezing time, no t_1, t_2, t_3 temperatures shall drop below 0°C.

14.6.3.1 The ice trays shall be examined at an interval after freezing time stated by the manufacturer to ascertain that the requirements laid down in **9.3** have been met.

14.6.3.2 Should the first test fail, two further tests should be made and the result from each should be positive.

14.7 Thermal Insulation Test

14.7.1 *Purpose*

The purpose of this is to check the efficiency of the thermal insulation of the refrigerator.

14.7.2 *Procedure*

a) *Ambient temperature* — This shall be 32 ± 0.5°C

b) *Relative humidity* — This shall be 70 to 80 percent.

c) *Thermostat setting* — The thermostat should be in the position corresponding to t_m 5.0 ± 0.5°C.

e) *Test time* — The test should continue for 1 h after obtaining stable operating conditions.

14.7.3 *Observations*

Moisture condensed on the external surface of the refrigerator shall be noted.

14.7.4 Moisture condensed on the external surface shall not be visible to the unaided eye during the test.

14.8 High Voltage Test

The electrical insulation of all electric circuits included in the refrigerator shall be such as to withstand a high voltage test of 1 000 V rms applied for not less than two seconds between all electric circuits and all accessible metal parts (electrically connected together for this test) at normal room temperature. For refrigerators to be connected to circuits of 50 V and below the high voltage shall be 500 V rms. The test voltage shall be alternating, of approximately sinewave form, and of any convenient frequency between 25 and 100 Hz.

14.9 Rated Energy Consumption Test

14.9.1 *Purpose*

Purpose of this test is to give the comparative value of the energy consumption for the refrigerator under identical conditions of operations for the refrigerators made by different manufacturers.

14.9.2 *Test Procedure*

The test will be conducted under the following conditions:

a) The ambient temperature shall be +32°C.

b) The refrigerator shall be tested in the standard test room as prescribed in **12.3.**

c) The operating conditions will be stabilized as specified in **12.2.**

d) The measuring instruments will be used as prescribed in **13.**

e) The thermostat will be set at the position of the setting such as to obtain conditions (g) and(h).

f) The refrigerator will be run under no-load conditions.

g) The temperature at the geometric centre of the evaporator shall not exceed 5 ± 0.5°C.

h) The mean internal temperature of the general storage compartment shall be 5 ± 0.5°C the temperature being measured at 3 specified points in the compartment.

j) The refrigerator shall be run at rated voltage of 230 V ± 2 percent and at rated frequency 50 Hz ± 2 percent.

k) The energy consumption (including gaseous and liquid fuel used in case of absorption type refrigerator) shall be measured for the 6 h period after stabilized conditions have been reached as defined in **12.2.**

m) The energy consumption as measured above shall be multiplied by 4 to give the energy consumption for the day.

15 DESCRIPTION OF PRODUCTION ROUTINE TEST

15.1 Thermostat Test

The thermostat setting should be such that when set at any point, it should not cut in before the system is balanced under any operating conditions.

15.2 Insulation Resistance

The insulation resistance between all electric circuits

included in the refrigerator and the earthed metal parts when measured at normal room temperature at the manufacture's work with dc voltage of 500 V shall be not less than 1 megohm.

15.3 Door Seal Test

Door seal shall be tested for tightness as described in **15.1.**

16 MARKING AND INFORMATION

16.1 Each refrigerator shall have the following information marked in a permanent and legible manner on one or several locations where it is readily visible either when the refrigerator is away from a wall or after the removal, without the help of the tools, of the small door or ventilating grating.

a) The manufacturer's name or trade-mark,

b) The model (or commercial designation) of the refrigerator and serial number,

c) The rated gross volume in cubic decimetres or litres,

d) The name of the refrigerant used in system and its quantity,

e) Voltage range,

f) Supply characteristics,

g) Wiring diagrams,

h) Rated energy consumption *(see* **14.9**),

j) Ice-making time,

k) Overall dimensions,

m) Name of fuel used (applicable in case of absorption type refrigerator), and

n) Rated storage volume.

16.2 Each refrigerator shall be accompanied on delivery by instructions for its use and maintenance printed on strong paper, cardboard, or similar material. These instructions shall at least contain information on:

a) Installation requirements (in particular levelling of the refrigerator);

b) Conditions of operation (starting, stopping);

c) Use of various control devices (thermostat, defrosting, etc); and

d) Maintenance and cleaning the refrigerator.

16.3 Standard Mark

The domestic refrigerator may also be marked with the Standard Mark.

16.3.1 The use of BIS Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act,* 1986 and the Rules and Regulations made there-under. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

ANNEX A

(*Clause* 8.2.1)

DETERMINATION OF GROSS VOLUME OF THE FOOD STORAGE COMPARTMENT

A-1 PROCEDURE

A-1.1 The liner should be assembled in the refrigerator and sealed with the metal cabinet to prevent leakage of water. The cabinet should be placed horizontally such that the door liner will remain above it in the top position. The door liner should then be placed over the cabinet such that the door liner is exactly at a distance equal the gasket thickness from cabinet. The gasket should be replaced by a steel strip of thickness equal to that of gasket between the main cabinet and the door liner. This steel strip should be welded on the cabinet top face, and then door liner should be scaled with this steel strip with sealing compound. The top most position on the door liner should be drilled with a hole with venting holes made on the door liner inside face. Water should then be poured from the top position hole in a measured quantity and till the water fills the entire surface between the main liner and the door liner so that the water start coming out from venting holes.

A-1.2 The main liner should be stiffened by rigid supports of steel plates behind the liner so as to prevent the bulging of the liner due to water pressure. The gross volume capacity should then be taken as the water volume capacity as held between the main liner and the door liner.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act,* 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises of the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards : Monthly Additions'.

This Indian Standard has been developed from Doc : No. MED 03 (0396).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 323 01 31, 323 94 02, 323 33 75

Telegrams: Manaksanstha (Common to all offices)

Regional Offices:	Telephone
Central: Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002	323 76 17, 323 38 41
Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola, CALCUTTA 700054	337 84 99, 337 85 61, 337 86 26, 337 86 62
Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 38 43, 60 20 25
Southern : C. I. T. Campus, IV Cross Road, CHENNAI 600113	235 02 16, 235 04 42, 235 15 19, 235 23 15
Western : Manakalaya, E9 MIDC, Marol, Andheri (East), MUMBAI 400093	832 92 95, 832 78 58, 832 78 91, 832 78 92

Branches : AHMADABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PATNA. PUNE. THIRUVANANTHAPURAM.

Printed at New India Printing Press, Khurja, India