भारतीय मानक **IS 17550 (Part 2) : 2024**

Indian Standard

घरेलू प्रशीतन साधित्र — विशेषताएँ और परीक्षण पद्धतियाँ

भाग 2 कार्यकारिता अपेक्षाएँ

(पहला पुनरीक्षण)

Household Refrigerating Appliances — Characteristics and Test Methods

Part 2 Performance Requirements

(First Revision)

ICS 97.030; 97.040.30

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Refrigeration and Air Conditioning Sectional Committee, MED 03

FOREWORD

This Indian Standard (Part 2) (First 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 2021. This revision has been brought out to incorporating the modification found necessary as a result of experience gained in the use of this standard. In this revision has been brought out to bring the Indian Standard in the latest format in corporating the latest version of the referred standard..

The household refrigerating appliances, which are factory-assembled and cooled by internal natural convection including mechanical and absorption type (direct cool) or forced air circulation (frost-free) was earlier covered in two separate standards that is, IS 1476 (Part 1) and IS 15750 respectively.

In the light of the development taken place at the international level, the technical committee had decided to make a composite standard on refrigerator to cover the requirements of both direct cool and frost-free refrigerator in IS 17550 (Part 1 to Part 3) published in 2021.

This standard is published in several parts. The other parts of this series are:

Part 1 General requirements
Part 3 Energy consumption and volume determination

This revision has been taken up to keep pace with the latest technological developments and international practices. In this revision, following major changes have been made:

a) Scope has been revised;
b) Table 1 on test summary has been revised;
c) Requirement of storage test has been revised;
d) Freezing capacity test has been revised; and
e) Pull down test and temperature rise test has been revised.

This standard is based on IEC 62552-2 : 2015 issued by International Electrotechnical Commission (IEC) except for the following deviations:

a) Water vapour condensation test specified in Annex D applies to only class ST and T refrigerating appliances; and

b) Specific tolerance limits on the stated or declared value of the manufacturer in respect of the tests for pull down test, cooling capacity test, freezing capacity test, and ice making capacity test have been specified.

This standard contributes to the Sustainable Development Goal 9 — Industry, Innovation and Infrastructure: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

The composition of the Committee responsible for the formulation of this standard is given in Annex E.

In reporting the result of a test or analysis made in accordance with this standard, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

HOUSEHOLD REFRIGERATING APPLIANCES — CHARACTERISTICS AND TEST METHODS

PART 2 PERFORMANCE REQUIREMENTS

(First Revision)

1 SCOPE

1.1 This standard (Part 2) specifies the essential characteristics of household and similar refrigerating appliances cooled by internal natural convection or forced air circulation, and specifies test methods for checking the characteristics.

1.2 This standard describes the methods for the determination of performance requirements. Although there is some commonality in the set-ups for different tests (and so it may be an advantage to apply them all to one sample), these are separate tests to evaluate specific characteristics of the sample being tested.

1.3 This standard does not specify a procedure to generalise the results from sample test results to a prediction of the characteristics of the whole population from which that sample was selected.

2 REFERENCES

The standards given below contain provisions which, through reference in this text, constitute provisions 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 edition of these standards:

IS No.	*Title*
IS 17550	Household refrigerating appliances — Characteristics and test methods:
(Part 1) : 2021	General requirements
(Part 3) : 2021	Energy consumption and volume

3 TERMINOLOGY

For the purposes of this standard, the terms, definitions, and symbols given in IS 17550 (Part 1) shall apply.

4 PERFORMANCE REQUIREMENTS AND TESTS

4.1 General

This standard sets out tests to assess the performance of household and similar refrigerating appliances.

4.2 Storage Test

The storage test is used to establish whether the refrigerating appliance is capable of maintaining suitable internal storage temperatures in a range of ambient conditions defined under the climate classes for which it is rated (*see* **6**).

4.3 Cooling Capacity Test

The cooling capacity test is used to measure the load processing capability of fresh food compartments by determining the time to pull down a specified test load from ambient to a specified temperature (*see* 7).

4.4 Freezing Capacity Test

The freezing capacity test is used to measure the load processing capability of frozen compartments by determining the time to pull down a specified test load from ambient to a specified temperature. This test is required to establish whether a frozen compartment also qualifies for a four-star performance rating (*see* **8**).

4.5 Automatic Ice Making Capacity Test

The ice making capacity test is used to determine the quantity of new ice cubes that can be produced over a specified period of time (*see* **9**).

4.6 Other Tests

Other tests, as applicable to be performed are given in the annex. These tests are as follows:

a) *Pull-down test* (*see also* Annex A) — This test is performed to measure the reserve refrigerating capacity of a refrigerating

appliance. The time required to pull-down the appliance to the temperatures specified in Table 6 shall not be more than the value stated by the manufacturer by more than 10 percent of the latter;

b) *Wine storage test* (*see also* Annex B) — This test is performed to check compliance with the requirements of Part 2 at appropriate ambient temperatures for the various climate classes;

c) *Temperature rise test* (*see also* Annex C) — This test is performed to determine the time taken for the temperature to rise in the warmest test package from - 8 ºC to - 9 ºC after the power is disconnected. It is applicable to refrigerating appliances with one or more three-star or four-star compartments; and

d) *Water vapour condensation test* (*see also* Annex D) — This test is performed to determine the extent of water condensation on the external surface of the refrigerating appliance under specified ambient conditions.

4.7 Test Summary

Table 1 provide a summary of the tests to be performed.

5 GENERAL TEST CONDITIONS

Unless otherwise noted, test room set-up and instrumentation shall be as specified in Annex B of IS 17550 (Part 1).

Unless otherwise noted, installation, and set-up of shelves, drawers, bins, flaps, and controls etc, shall be as specified in Annex C of IS 17550 (Part 1).

6 STORAGE TEST

6.1 Objective

The purpose of this test is to check that the refrigerating appliance is capable of maintaining specified internal temperatures at different ambient temperatures.

Under the conditions specified in **6** and at the ambient temperatures for the appropriate climate classes as specified in **B-3.2.3** of IS 17550 (Part 1), the refrigerating appliance shall be capable of maintaining, simultaneously, the required compartment temperatures (within the permitted temperature deviations during the defrost and recovery period) as given in Table 2.

To meet these test requirements, there shall be for any ambient temperature between and including the minimum and maximum ambient temperatures defined by the rated climate class, at least one control setting at which all compartments meet the specified internal temperatures. The control(s) however, may be adjusted for testing at different ambient temperatures.

NOTE — Because the frozen compartment loading is largely the same as that for the freezing capacity test, there may be an advantage in doing these tests consecutively.

6.2 Preparation of Refrigerating Appliance

The test room ambient shall be as specified in **B-3.2.3** of IS 17550 (Part 1).

The refrigerating appliance shall be installed in the test room in accordance with Annex C of IS 17550 (Part 1).

Refrigerating appliances with anti-condensation heater(s) which are permanently on during normal use shall be tested with the heater(s) operating.

Anti-condensation heaters which can be manually controlled by the user shall be switched on and, if adjustable, they shall be set at their maximum heating rate.

Anti-condensation heaters which are automatically controlled shall be allowed to operate normally.

The unloaded refrigerating appliance should be set up and operated until it has reached equilibrium at, or close to, the temperatures specified in Table 2.

Thermal storage devices shall be placed in the dedicated positions in the respective compartments, in accordance with the manufacturer's instructions, and shall be independent of the location of the test packages. Instructions for loose placement of thermal storage devices in the appliance do not define dedicated positions.

NOTE — An instruction without specific indication of location or placement of the thermal storage devices is an example of loose placement. If dedicated positions are absent, the thermal storage devices shall be removed from the compartment.

Any automatic icemaker shall be configured so that no new ice is made during the test, but shall otherwise remain operational. However, connection to a water supply may be omitted if it can be demonstrated that the absence or presence of a connection to a water supply would make no difference to the results of this test.

6.3 Air Temperature Sensor Location and Test and M-Package Loading

6.3.1 *Unfrozen Compartments (Except Chill Compartment and Wine Storage Compartment)*

For determining the storage temperatures of these compartments, air temperature sensors shall be located in accordance with **E-2.2** of IS 17550 (Part 1).

NOTE — *See* Annex B, Wine storage appliances and compartments; storage test.

6.3.2 *Chill Compartments*

6.3.2.1 *General*

All test packages and M-packages shall be as specified in **D-2(b)** of IS 17550 (Part 1).

For determining the storage temperature of any chill compartment, the storage load shall be in accordance with **6.3.2.2**.

The temperatures of the chill compartment T_{cci} are the instantaneous temperatures of each M-package in that compartment. The temperatures and conditions specified in Table 2 shall apply.

All test packages and M-packages shall be positioned or suspended so that their largest surface is horizontal. They may be positioned directly on the floor of the compartment or drawer, but shall always be at least 25 mm away from all walls and ceilings and from the other packages of the test load. The test packages and M-packages shall be positioned as far as possible in the corners of the compartment and at two vertical levels:

a) Bottom level, which is the lowest horizontal surface intended for storage; and
b) Top level, where the packages have 25 mm clearance from the compartment ceiling. Supports can be used to position the packages.

Loading of packages shall be in the following order:

a) Front left corner of the bottom level;
b) Back right corner of the top level;
c) Front right corner of the top level;
d) Left back corner of the bottom level;
e) Front left corner of the top level;
f) Back right corner of the bottom level;
g) Front right corner of the bottom level;
h) Left back corner of the top level;
j) Centre of the bottom level; and
k) Centre of the top level.

Loading shall start using M-packages, up to the amount specified in Table 3. After the last M-package, normal test packages shall be loaded until the total number of packages is reached.

If a package cannot be placed in accordance with the required order, its position shall be skipped, and the number of packages shall be reduced. The number of M-packages shall not be reduced.

In the case of a compartment with special subdivisions (for example, shelves) that are part of the design, if the dimensions are too small to allow the horizontal positioning of the M-packages, it is permissible to position them vertically.

If the dimensions are too small to accommodate an M-package (for example, in door shelves), a special support shall be used to position the M-package next to the shelf and as close as possible to the door liner.

6.3.2.2 *Chill compartment storage load*

The compartment shall be loaded with the number of packages specified in Table 3.

6.3.3 *Frozen Compartments/Sections*

6.3.3.1 *General*

Temperatures shall be measured in M-packages, which are distributed throughout the load of test packages as specified in the test package placement (*see* **6.3.3.3**). They shall be placed as specified in **6.3.3.3.4**.

The temperature of each section, or compartment, is the maximum temperature of any M-package in that section or compartment. The temperatures and conditions specified in Table 2 shall apply.

6.3.3.2 *Packages*

All packages (test packages and M-packages) shall be as specified in Annex D of IS 17550 (Part 1).

The packages shall have previously been brought to the approximate compartment temperature as set out in Table 2.

Wetting of packages to freeze them together is not permitted but to keep packages aligned in a stack, they may be strapped together with non-metallic strapping.

The use of spacers to maintain free air spaces between stacks of packages is permissible provided that the spacers are of the smallest practicable cross-section and of low thermal mass and conductivity and are placed in such a way that they do not significantly interfere with normal air circulation. A few 15 mm diameter spherical plastic beads

threaded on vertical ties strapping stacks of packages together would meet these requirements.

6.3.3.3 *Package placement*

6.3.3.3.1 *General*

Packages shall be placed as follows:

a) The compartment (including any door storage) shall be filled with as many packages as possible while still complying with the air passage and clearance requirements in **6.3.3.3.2** and **6.3.3.3.3**;

b) Packages on shelves shall be placed so that the front of the front row is in line with the front of the shelf and they shall be arranged symmetrically about the front-to-back centre line of the shelf. Where lack of symmetry in the compartment makes this impossible, the stacking shall be as symmetrical as possible; and

c) Stacks shall be made directly on each horizontal surface intended for storage (*see* Fig. 2 and Fig. 3). The packages shall be stacked vertically (that is, with each package fully covering the one below with no off-sets in the stacks):

   1) Except for door storage, the packages shall be placed with their largest surface horizontal.

      Surfaces intended for storage with ribs, depressions, slight inclinations, etc are treated as horizontal surfaces. If necessary, packers may be used to stabilize stacks (*see* Fig. 1).

NOTE — Inclinations of less than 15 mm per 100 mm, which are equal to the width or length of a test package, are considered slight inclinations.

d) Packages in door storage shall be placed so that the free air spaces between the packages and the inner surface of the door and between the packages and the retainer are equal.

   1) For door storage, if there is not enough space to place packages horizontally, they shall be placed vertically. If there is sufficient height available, packages placed vertically shall be stacked [*see* Fig. 3 (e)].

      If required, because of the bottom shape of the door storage, minimal packaging may be used to keep the packages central and vertical.

e) When the vertical surface is the inner surface of a door, the stacks shall be loaded as follows:

   1) If there is a marked load limit line, the packages shall be loaded up to that line [*see* Fig. 2(a)]; and

   2) If there is no load limit line, but a natural load limit, the packages shall be loaded up to that limit [*see* Fig. 2(b)].

      Internal doors, edges of shelves, baskets, and flaps are considered natural load limits.

f) 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 [*see* Fig. 2(e)];

g) If a subdivision is provided specifically for non-automatic making and storing of ice and is not removable without the use of tools, the ice cube trays shall be filled with water, and the contents frozen and placed in position before the compartment is loaded with packages; otherwise, the ice cube trays and the subdivisions shall be removed and the whole compartment loaded with packages; and

h) In a refrigerating appliance fitted with an automatic icemaker, any dedicated ice storage bin shall remain in place and be filled with packages.

6.3.3.3.2 *Side clearance*

Minimum clearances of 15 mm shall be calculated from the nominal dimensions of the test packages and shall be left between adjacent stacks of packages and between package stacks and the compartment walls and ducts etc. (*see* Fig. 2). As far as practicable, spaces between packages shall be equal across each horizontal dimension.

Where the storage is in containers, as far as the internal radiuses allow, the packages shall be stacked right up to the internal walls of the containers.

Where packages, when frozen, are slightly larger than the nominal dimensions, the actual air spaces may be less than 15 mm in some cases. Refer to Annex D of IS 17550 (Part 1) for permitted tolerances on package dimensions.

6.3.3.3.3 *Top clearance*

The vertical clearance between the upper face of the highest package and the load limit, the shelf or the horizontal surface situated immediately above shall be less than 60 mm but not less than 10 mm (that is, 10 mm ≤ clearance < 60 mm).

Similarly, for a top-opening type of compartment without a load limit line, the vertical clearance between the upper face of the highest package and the inner surface of the lid above shall be less than 60 mm but not less than 10 mm (that is, 10 mm ≤ clearance < 60 mm).

The only exception is that for compartments with a height of less than 60 mm which have been claimed as volume, the vertical clearance between the upper edge of the highest package and the horizontal surface situated immediately above may be less than 10 mm (but the package shall still not touch the ceiling).

6.3.3.3.4 *Measurement package placement*

6.3.3.3.4.1 *Front opening compartments*

M-packages shall replace test packages as indicated in Fig. 3(a), 3(b), 3(c), 3(d), and 3(e).

The general arrangement is to place two M-packages in diagonally opposite corners in the top layer and in the opposite two diagonally opposite corners in the bottom layer.

If a front-opening compartment has an opening height of 1 m or greater, an M-package shall replace a test package at the geometric mid-point of the front stacks.

Where the compartment is at the bottom of the cabinet and there is a compressor step, another M-package shall replace the lowest test package that is most nearly directly above the compressor.

Where there are test packages in door storage, an M-package shall replace the topmost test package that is the opposite side of the cabinet from the front M-package on the top shelf. Another shall replace the lowest test package in the door storage that is the opposite side from the lowest front M-package. If the door storage space is over 1 m high, the middle front M-package shall be placed in the corresponding position in the door storage rather than in the cabinet itself [position $TMP_{8'}$ rather than TMP_8 in Fig. 3(e)].

Where it is not possible to place M-packages in the numbers or positions specified, they shall be loaded in numbers and positions as nearly as practicable to the specified location and in positions which will provide an equivalent result.

If a compartment is too small to accommodate the specified M-packages with the required clearances, then fewer packages, as appropriate, shall be used.

In all cases where the number or location of M-packages differs from that specified, the details of the adopted alternative shall be recorded for any test reporting.

6.3.3.3.4.2 *Top opening compartments including chest freezers*

M-packages shall replace test packages in the four corners and centre top, centre bottom and on top of the compressor. If there is no compressor step this package shall be placed in the bottom corner or end position which is likely to be warmest [*see* Fig. 3(f) and Fig. 3(g)].

6.4 Test Procedure

6.4.1 *Overview*

Once all temperatures are in compliance with Table 2, the test period is usually up to about 24 h long. A ‘pass’ requires temperatures to be in compliance with Table 2 (including allowed excursions) throughout the entire test period and average temperatures of each package in a 3 h block at the end (period *E*) to not be significantly warmer than their average temperature in the 3 h block at the start (period *S*) (*see* Fig. 4).

If the refrigerating appliance has a defrost control cycle at least one defrost and recovery period has to be included between the periods *S* and *E*.

6.4.2 *Details*

The test shall start after all temperatures are in compliance with Table 2.

Table 4 specifies where periods *S* and *E* are located and their lengths.

For refrigerating appliances with irregular cycles, the lengths of periods *S* and *E* and time between them may be increased.

Table 1 Test Summary

(*Foreword and Clause 4.7*)

Sl No.	Clause/Annex and Test	Ambient	—	Pantry and Cellar	Fresh Food	Chill	Zero Star	1 and 2 Star	3 and 4 Star	Temperature Requirements after Test has Started
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
i)	Clause 6 Storage	Various	Packages	No	No	Type b	No	1-star: Type a Other: Type a or b *Max*		To hold initial values
			Initial temperature	Mean	Mean	Instant	Mean			
ii)	Clause 7 Cooling capacity	25 °C	Packages	No	Type b	No				For test load final only
			Initial temperature	Table 2	+ 4 °C ± 0.5 °C	Table 2	Maximum/Minimum	Average/Minimum		
iii)	Clause 8 Freezing capacity	25 °C	Packages	M-packages only Type b		Type b	No	Type a		Yes excursion and final
			Initial temperature	Table 2		Not measured	Maximum/Minimum			
iv)	Clause 9 Auto ice making	25 °C	Packages	No						No
			Initial temperature	As for Table 2			Maximum/Minimum			
v)	Annex A Pull-down	*Max*	Packages	No						Final only
			Initial temperature	Maximum temperature according climate class rating						
vi)	Annex C Temperature rise	25 °C	Packages	No		Type b	No	Type a		For -18 °C compartments only

Table 1 (*Concluded*)

Sl No.	Clause/Annex and Test	Ambient	—	Pantry and Cellar	Fresh Food	Chill	Zero Star	1 and 2 Star	3 and 4 Star	Temperature Requirements after Test has Started
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
			Initial temperature	Not specified					-18 °C	
vii)	Annex D Condensation	32 °C for ST and T	Packages	No						To hold initial values
			Initial temperature	≤ Energy test temperatures as in Table 1 in IS 17550 (Part 1)						

NOTES

1 For definitions of symbols, *see* **3.7** in IS 17550 (Part 1).
2 In the event of any discrepancy between data in this table and the individual test procedures, the test procedures take precedence.
3 Wine storage test parameters are specified in Annex B.

Table 2 Compartment Temperatures

(*Clauses* Table 1, 6.1, 6.2, 6.3.2.1, 6.3.3.1, 6.3.3.2, 6.4.1, 6.4.2, 6.4.3, 6.5, 7.2.2, 7.3.1, 8.2, 8.3.2.1, 8.4.1, 8.5, 8.6, 9.2.2, B-2, B-4, *and* C-2.3)

Sl No.	Compartment Type								
	Fresh Food °C		Three- Star and Four-Star °C	Two-Star °C	One-Star °C	Zero-Star °C	Chill °C	Cellar °C	Pantry °C
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	T_{1m}, T_{2m}, T_{3m}	T_{ma}	$T^{***1)}$	$T^{**1)}$	$T^{*1)}$	T_{zma}	T_{cci}	T_{cma}	T_{pma}
ii)	$0 \le T_{1m}, T_{2m}, T_{3m} \le +8$	$\le +4$	$\le -18^{2)}$	$\le -12^{2)}$	≤ -6	≤ 0	$-3 \le T_{cci} \le +3$	$+2 \le T_{cma} \le +14$	$+14 \le T_{pma} \le +20$
	average	average	maximum	maximum	maximum	average	instantaneous	average	average

NOTE — For definitions of symbols, *see* **3.7** in IS 17550 (Part 1).

Table 3 Chill Compartment Storage Load

(*Clauses* 6.3.2.1 *and* 6.3.2.2)

Sl No.	Volume of Chill Compartment, *V* (in litre)	Number of Packages	M-Packages
(1)	(2)	(3)	(4)
i)	$V < 10$	2	2
ii)	$10 \le V < 20$	3	2
iii)	$20 \le V < 30$	4	2
iv)	$30 \le V < 40$	5	3
v)	$40 \le V < 50$	6	3
vi)	$50 \le V < 60$	7	4
vii)	$60 \le V < 70$	8	4
viii)	$70 \le V < 80$	9	5
ix)	$V \ge 80$	10	5

[1)] The superscripts attached to the symbol *T* correspond to the three-star and four-star, two-star, or one-star compartment temperature.

[2)] During a defrost and recovery period, these storage temperatures of frost-free refrigerating appliances are permitted to rise by not more than 3 K with respect to the storage temperature during period *S* (*see* 6.4). The storage temperature is defined as the maximum temperature of any M-package during a given time period (*see* Fig. 3).

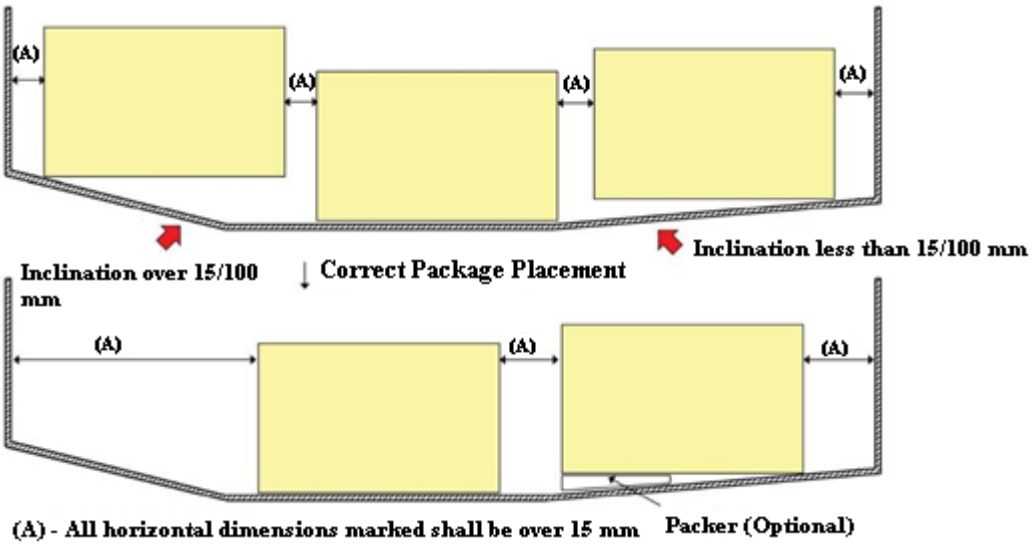
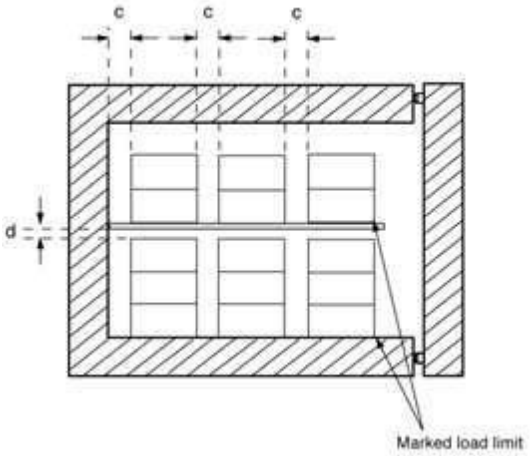
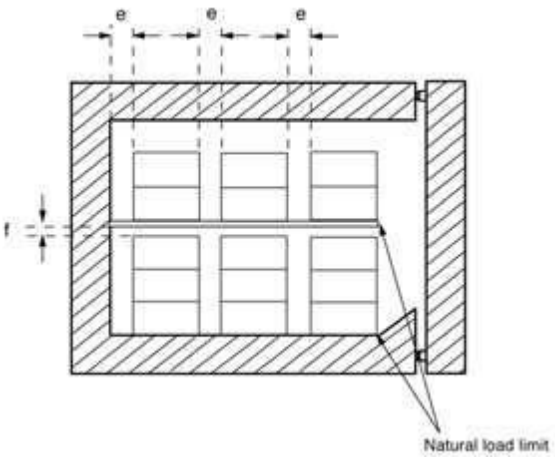


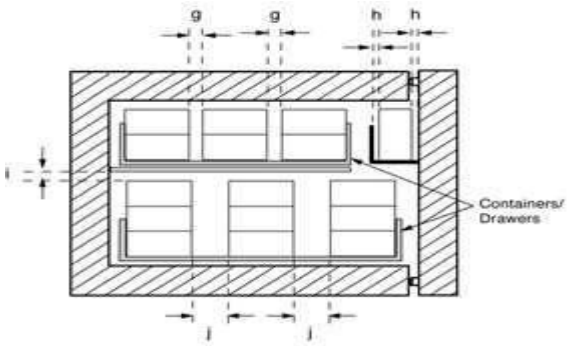
FIG. 1 PACKAGE PLACEMENT ILLUSTRATION FOR NON-FLAT SURFACES



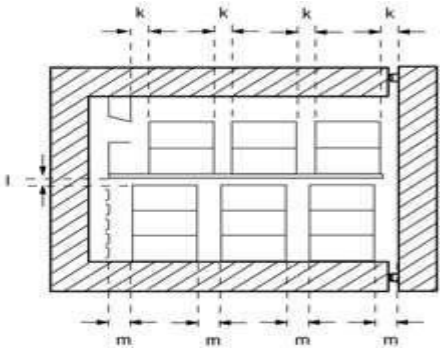
a) Side view – Marked load limit



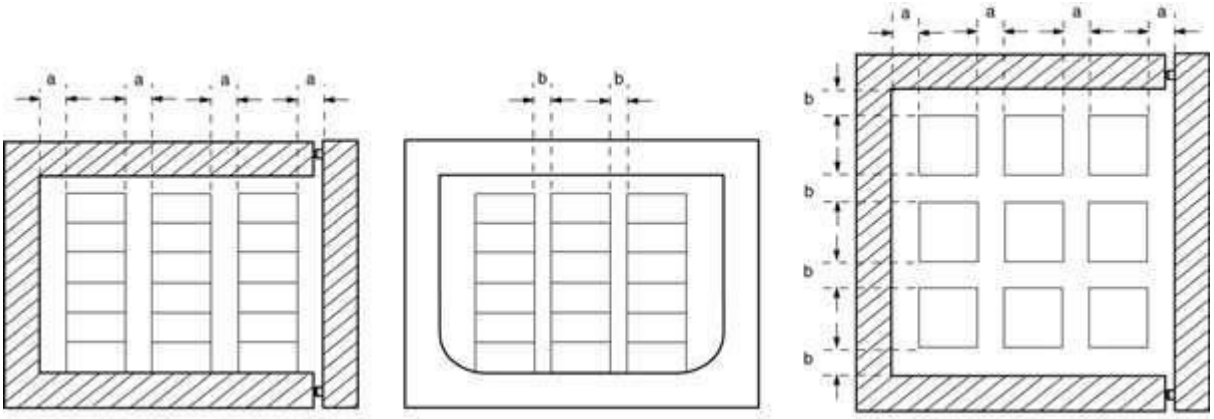
b) Side view – Natural load limit



c) Side view – With containers



d) Side view – Clearance maintained round ducts etc

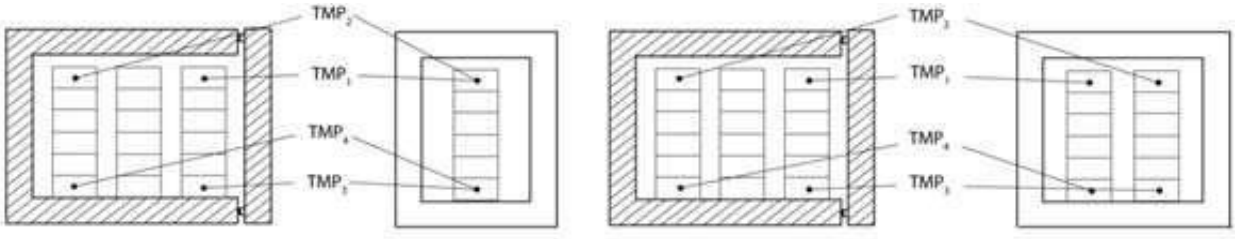


SIDE VIEW – NO SHELVES FRONT VIEW – NO SHELVES TOP VIEW – NO SHELVES

e) Loading on horizontal surface only

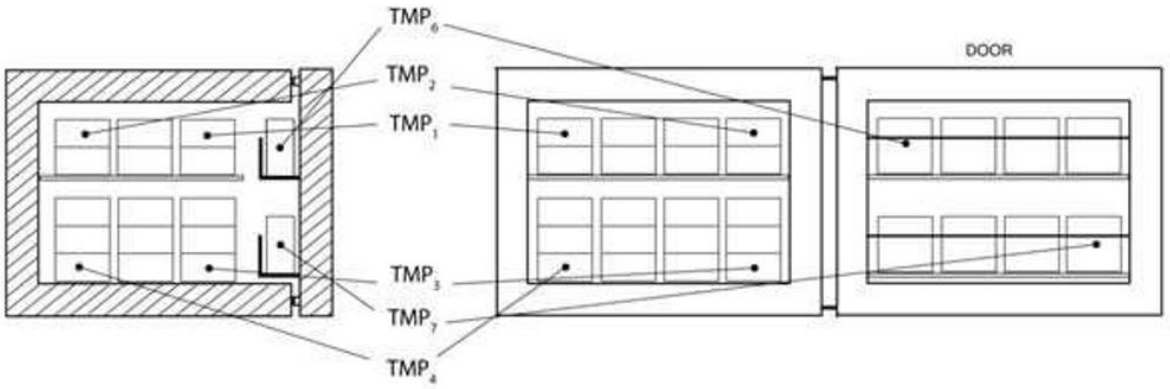
All horizontal dimensions marked shall be ≥ 15 mm.
All vertical clearances shall be ≥ 10 mm and < 60 mm.

FIG. 2 LOCATION OF PACKAGES IN FROZEN COMPARTMENT, SHOWING CLEARANCES



SIDE VIEW FRONT VIEW SIDE VIEW FRONT VIEW

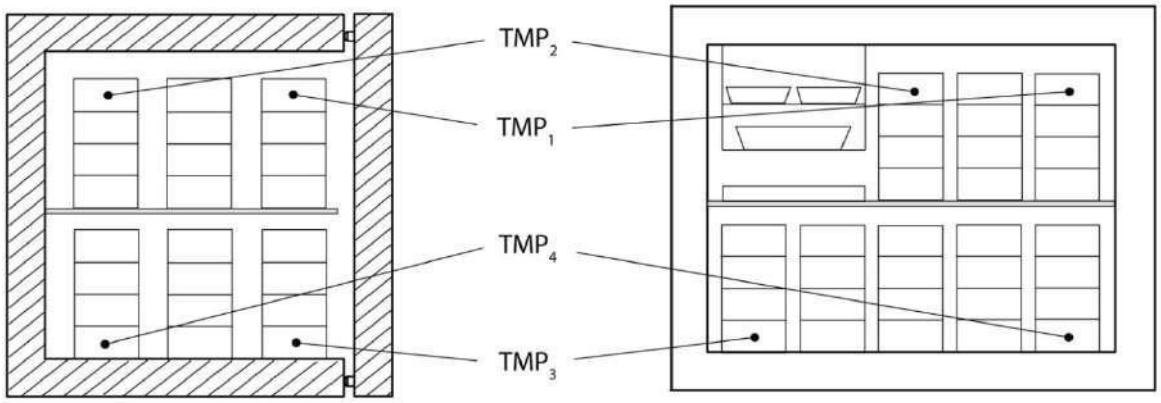
a) width < 245 mm b) 245 mm ≤ width < 360 mm



SIDE VIEW FRONT VIEW

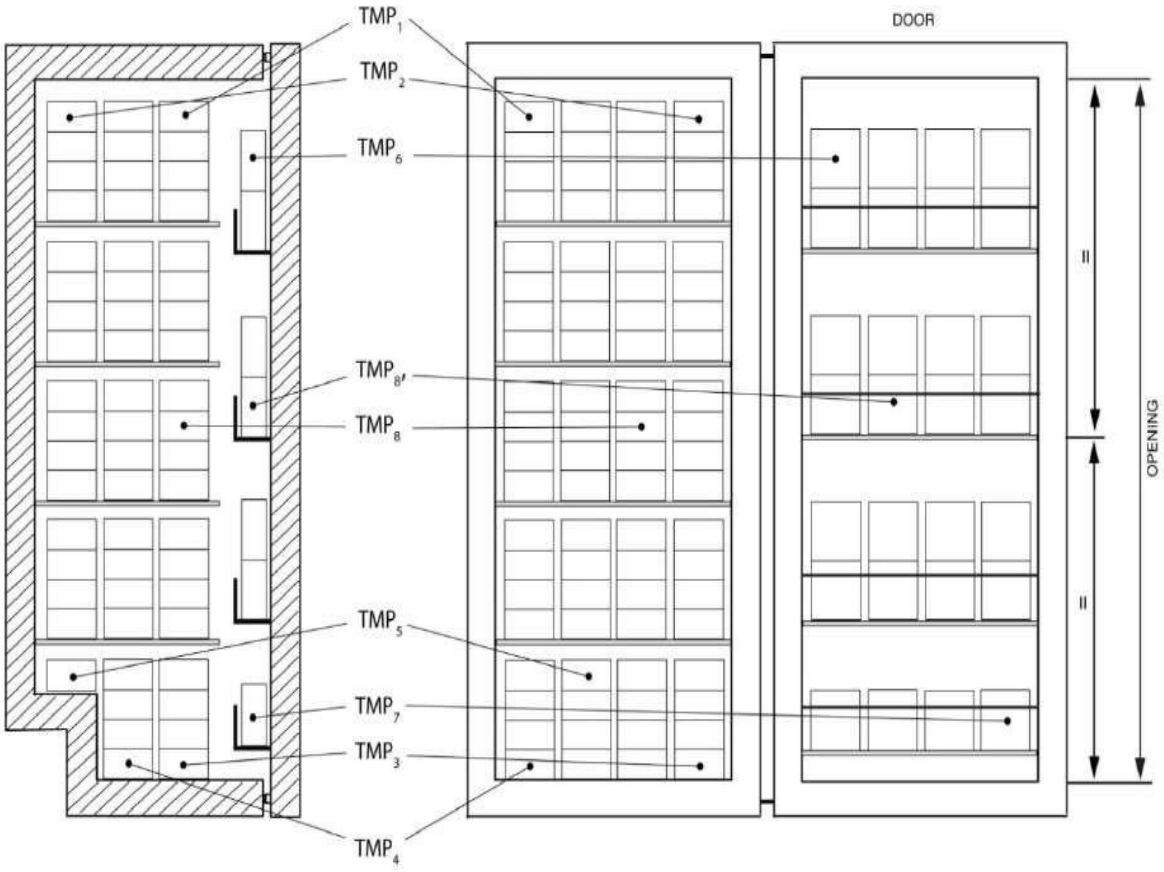
c) full width compartment with door storage

FIG. 3 LOCATION OF TEST PACKAGES AND M-PACKAGES, IN FROZEN COMPARTMENT (1 OF 3)



SIDE VIEW FRONT VIEW

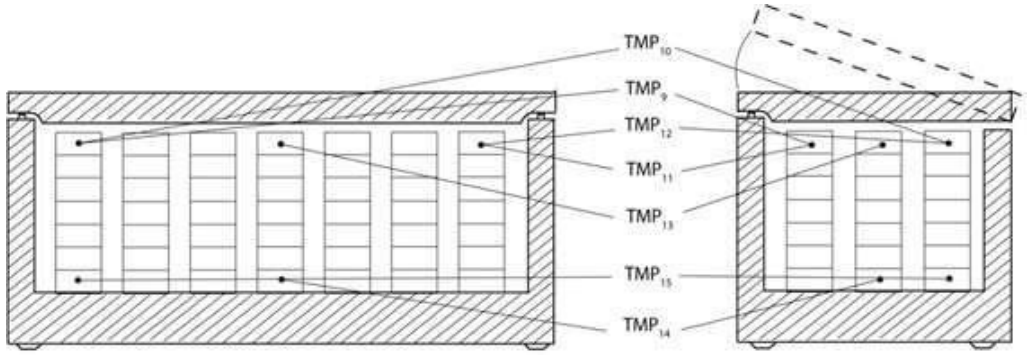
d) Full width compartment with fixed ice cube tray racks, ice bins with mirror M-package positions



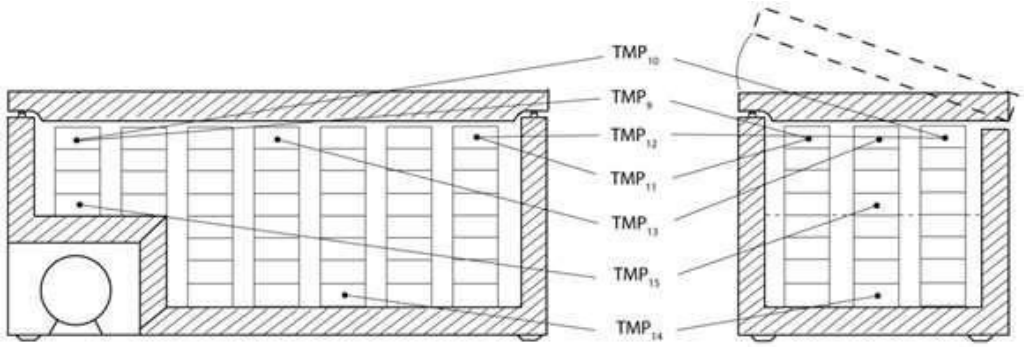
SIDE VIEW FRONT VIEW

e) Tall compartment showing mid-height M-package added

FIG. 3 LOCATION OF TEST PACKAGES AND M-PACKAGES, IN FROZEN COMPARTMENT (2 OF 3)



f) Chest freezer



g) Chest freezer (stepped liner)

Key to Fig. 3
Front opening compartments:

TMP_1	=	Top front left[1)] M-package
TMP_2	=	Top back right[1)] M-package
TMP_3	=	Bottom front right[1)] M-package
TMP_4	=	Bottom back left[1)] M-package
TMP_5	=	Compressor step M-package
TMP_6	=	Door top right[1)] M-package (right when the door is shut)
TMP_7	=	Door bottom left[1)] M-package (left when the door is shut)
TMP_8	=	Mid height, mid width package when opening height ≥ 1 m
$TMP_{8'}$	=	Alternative location for TMP_8 when a tall compartment has door storage

Chest freezers and other top opening compartments:

TMP_9	=	Top left front M-package
TMP_{10}	=	Top left back M-package
TMP_{11}	=	Top right front M-package
TMP_{12}	=	Top right back M-package
TMP_{13}	=	Centre top
TMP_{14}	=	Centre bottom
TMP_{15}	=	Above the compressor or bottom corner or end likely to be warmest

[1)] If asymmetry is such that it is better to put TMP_1 in the top front right corner (for example as in Fig. 3 (d), then all other M-packages shall also be swapped to the opposite side (that is, all 'lefts' become 'rights' and all 'rights' become 'lefts') Left and right are from the viewpoint of the front of the cabinet with the door shut.

FIG. 3 LOCATION OF TEST PACKAGES AND M-PACKAGES, IN FROZEN COMPARTMENT (3 OF 3)

Table 4 Requirements for Periods *S* and *E*

(*Clause* 6.4.2)

Sl No.	Item	Are there Temperature Control Cycles?	Without Defrost Control Cycles	With more than One Defrost Control Cycles Starting within a 24 h Test	With only one Defrost Control Cycle Starting within a 24 h Test
(1)	(2)	(3)	(4)	(5)	(6)
i)	Length of periods *S* and *E*	No	Each period shall be at least 3 h long.		
		Yes	Each period shall consist of the same integral number of temperature control cycles totalling not less than 3 h.		
ii)	Location of period *S*	No	Any convenient time.	Period *S* ends just before a defrost and recovery period begins.	
		Yes			
iii)	Location of period *E*	No	Period *E* ends at least 24 h after period *S* begins.	Period *E* ends just before the first defrost and recovery period that begins after 24 h after the start of period *S*.	Period *E* ends at least 24 h after period *S* begins and before the beginning of the next defrost and recovery period.
		Yes	Period *E* ends with the conclusion of a temperature control cycle that is in progress at least 24 h after the beginning of period *S*.	Period *E* ends with the conclusion of the last temperature control cycle completed before the first defrost and recovery period that begins after 24 h after the start of period *S*.	Period *E* ends with the conclusion of a temperature control cycle that is in progress at least 24 h after period *S* begins and before the beginning of the next defrost and recovery period.

Examples:

1) For a refrigerating appliance with a defrost control cycle of 10 h, if period *S* is 3 h long, the second defrost and recovery period will start 13 h from the beginning of the test and the third will start 23 h from the beginning of the test. Thus, the test will include two complete defrost control cycles and end about 23 h after period *S* begins;
2) For a refrigerating appliance with a defrost control cycle of 11 h, if period *S* is 3 h long, the second defrost and recovery period will start 14 h from the beginning of the test and the third would start 25 h from the beginning of the test. Thus, the test will include only one complete defrost control cycle and end about 14 h after period *S* begins; and
3) For a refrigerating appliance with a defrost control cycle of 22 h, if period *S* is 3 h long, the second defrost and recovery period would start 25 h from the beginning of the test. Thus, the test will include only one complete defrost control cycle and end about 24 h after period *S* begins.

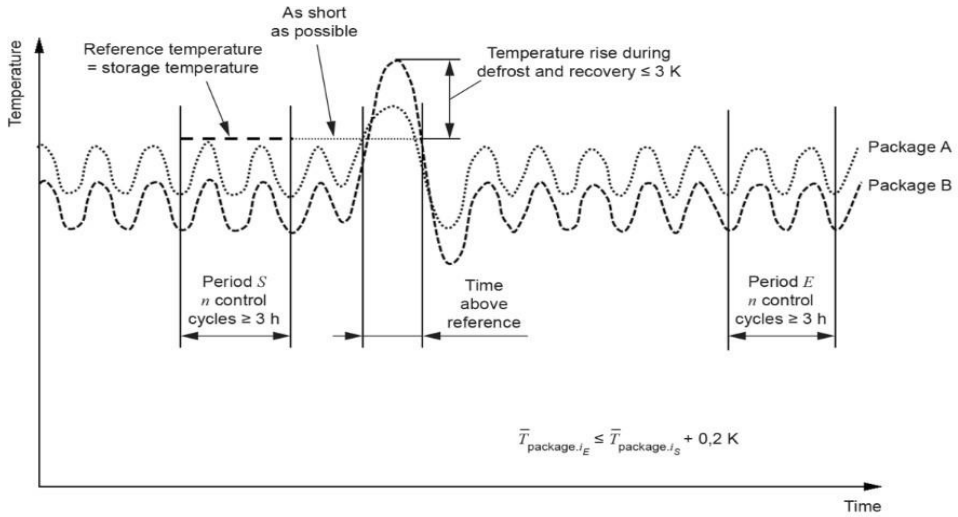


FIG. 4 STORAGE TEST SEQUENCE ILLUSTRATION

6.4.3 *Compliance Criteria*

Throughout the entire test period all temperatures shall be in compliance with Table 2 (including allowed defrost and recovery period excursions).

The average temperature of no package in period *E* shall be more than 0.2 K higher than its average temperature in period *S*.

6.5 Storage Temperature

The refrigerating appliance shall maintain simultaneously, the required storage temperatures in the different compartments (and the permitted temperature deviations during defrost and recovery period) as given in Table 2.

6.6 Data to be Recorded

The following data shall be recorded for each test (as applicable):

a) The ambient temperature;

b) The setting(s) of any user-adjustable temperature control device(s) and any other user-adjustable control(s), damper(s) etc;

c) The value of the fresh food storage temperature T_{ma}, and the values of T_{1m}, T_{2m} and T_{3m};

d) For frozen compartments the values of the maximum temperature(s) of the warmest M-package [*see* **6.6**(k)] during period *S* (reference temperature), the duration of the temperature rise above the reference temperature during the defrost and recovery period and the maximum temperature rise above the reference temperature during the defrost and recovery period;

e) The average temperature and the maximum temperature for each M-package in period *E* and period *S*;

f) The value of the zero-star storage temperature T_{zma}, and the values of T_{z1m}, T_{z2m}, and T_{z3m};

g) The value of the maximum and minimum recorded chill compartment T_{cci} and the values of T_{ccim} for each of the M-packages;

h) The value of the cellar compartment T_{cma} and the values of T_{c1m}, T_{c2m}, T_{c3m}, as appropriate;

j) The value of the pantry compartment T_{pma} and the values of T_{p1m}, T_{p2m}, T_{p3m}, as appropriate;

k) A diagram of the storage plan showing locations of test packages and M-packages in all compartments as applicable;

m) A diagram or tabulation of the location of the M-package with the highest maximum temperature in each of these compartments and in any two-star section, and the location of the M-packages with the highest maximum temperature during any temperature deviation as a result of the defrost control cycle; and

n) The rating of the compartment (or parts of compartments) by type.

7 COOLING CAPACITY TEST

7.1 Objective

The purpose of this test is to measure the cooling capability of fresh food compartments by determining the time for a load of 4.5 kg per 100 litre of volume to be cooled from + 25 °C to + 10 °C.

7.2 Set-Up Procedure

7.2.1 *Ambient Temperature*

The ambient temperature shall be 25 °C [*see* **B- 3.2.3** of IS 17550 (Part 1)].

7.2.2 *Installation*

The refrigerating appliance shall be installed in accordance with Annex C of IS 17550 (Part 1).

Refrigerating appliances with anti-condensation heater(s) which are permanently on during normal use shall be tested with the heater(s) operating.

Anti-condensation heaters which can be manually controlled by the user shall be switched on and, if adjustable, they shall be set at their maximum heating rate.

Anti-condensation heaters which are automatically controlled shall be allowed to operate normally.

All internal accessories supplied with the refrigerating appliance shall be in their respective positions.

Before the test load is added, all compartments shall be empty. Their temperatures shall be determined as specified in Annex E of IS 17550 (Part 1).

After stable operating conditions have been attained, for all compartments except for the fresh food compartment (*see* **7.3**), the temperatures shall be in accordance with Table 2 with the following exceptions:

a) The average starting temperature of any compartment(s) with no lower temperature limit(s) specified in Table 2 shall be no more than 2 K below the target temperature;
b) In the case of a refrigerating appliance where the compartment temperatures cannot be adjusted independently, if such a setting is not possible, the non-complying compartments below the bottom limit shall be set to be as warm as possible; and
c) For the frozen compartments, the target temperatures shall be reached by the average compartment temperatures (T_{fma}) instead of the warmest temperatures of the M-packages.

7.2.3 *Adjustment of Compartments*

Where the volumes of a cellar or chill compartment and the fresh food compartment can be adjusted by the user in relation to each other, the fresh food compartment shall be adjusted to its greatest possible volume. This volume is used as a basis for the test.

7.2.4 *Arrangement of Shelves*

If adjustable, a shelf shall be positioned at each of three levels so that the centres of M-packages placed directly on the shelves (or bottom of the baskets etc.) have the smallest possible vertical distance to the temperature measurement points TMP_1, TMP_2, and TMP_3 as specified in Annex E of IS 17550 (Part 1).

Packages shall not be placed in vegetable drawers, crispers, or similar containers. However, when drawers and/or bins wholly or predominantly occupy the space within a fresh food compartment the bottoms of the drawers or bins shall be regarded as shelves. Packages shall be placed within these drawers or bins in positions specified below.

NOTE — For compartments without vegetable drawers, crispers, or similar containers, the bottom of the inner container or any divider(s) separating compartments is considered to be the lowest shelf.

If no appropriate position can be found for 3 levels in refrigerating appliances with little height, for example box evaporators as shown in (a) of Fig. 13 of IS 17550 (Part 1) only levels TMP_1 and TMP_2 shall be used for testing.

Shelves with adjustable positions which are not used for the loading shall be distributed uniformly in the refrigerating appliance with care taken that the positions selected have as little influence as possible on the cooling time of the packages.

A minimum vertical distance of 15 mm shall be maintained between the packages and any shelf (or basket) located above them.

7.3 Test Procedure

7.3.1 *General*

The fresh food compartment shall have a mean temperature of $T_{\mathrm{ma}} = +4\ ℃ \pm 0.5$ K at stable operating conditions. If the mean temperature cannot be adjusted within these limits, the result shall be determined from two measurements by interpolation, whereby the temperature during one test shall be colder and the temperature during the other test shall be warmer than the target temperature. The difference between the two test temperatures shall not be greater than 4 K.

Except as in the paragraph below changes of the settings of the control devices are not permitted once stable temperatures complying with Table 2 have been reached at the beginning of the test.

If the refrigerating appliance is provided with a 'quick cooling' (fast cooling) function this should be activated, according to the instructions, at the moment of inserting the load.

NOTE — To qualify as a 'quick cooling' function, the operation of the function will automatically terminate at a later time. Manually setting the thermostat colder and then manually setting it warmer at a later time, does not qualify as a 'quick cooling' function.

Test packages and M-packages, as specified in Annex D of IS 17550 (Part 1), shall be used for loading.

Before insertion, the test packages and M-packages shall be stabilised at a temperature of + 25 °C ± 0.5 K.

For models with defrost control cycles, the packages should be added when stability has been regained and temperature criteria met after defrost and recovery period. The test should not overlap defrost and recovery period.

The packages shall be placed quickly into the compartment. Where required by the loading, the measuring devices for measuring points TMP_1, TMP_2 and TMP_3 may be removed or moved aside.

The temperatures of the M-packages shall be recorded until the arithmetic mean of the instantaneous temperatures of all M-packages has reached + 10 °C. The time required to reach this temperature shall be recorded.

7.3.2 *Positioning of the Load in the Fresh Food Compartment*

The loading shall be 4.5 kilogram per 100 litres volume of the fresh food compartment. The calculated load shall be rounded to the nearest 0.5 kg.

When possible, the same number of packages shall be allocated to each shelf. Where the number of packages to be distributed is not an exact multiple of the number of shelves, any extra packages shall be allocated one per shelf starting from the bottom, that is the difference between the final loadings on different shelves shall not be greater than one package.

The packages shall be placed horizontally in the refrigerating appliance, that is, with their greatest area in direct contact with the appropriate shelf (or compartment floor or bin or basket bottom).

As far as practicable, spaces between packages shall be equal across each horizontal dimension. A minimum side-to-side and front-to-back clearance of 15 mm shall be maintained between packages and between packages and walls or solid-wall containers. Dedicated ventilation openings in the shelves shall not be covered. The packages shall not extend beyond the edges of the shelves.

The first layer of packages shall be distributed evenly across the width and depth of each shelf and arranged symmetrically about the front-to-back centreline (*see* Fig. 5). Where lack of symmetry makes this impossible, the loading shall be as symmetrical as possible.

If the loading at any level is physically prevented from being arranged as specified (as, for example, if a layer were required at a level where storage provided by two equal width bins would prevent the placement of a central row, or where there is less than 360 mm shelf depth in front of a compressor step) then alternative positions shall be selected which most nearly match those specified. The alternative positions selected shall be recorded.

Package shall be arranged in, at most, a 3 × 3 configuration, that is no more than nine packages shall be placed in any one layer.

If the maximum allowed allocation of packages for the first layer on any shelf has been made, and further packages are still required to be placed on that shelf, a second layer shall follow the same stacking sequence as for the first layer. Packages in any subsequent layers shall be stacked vertically, that is with each package fully covering the one below with no off-sets in the stacks.

NOTE — The text in this sub-clause describes how the package positions are selected, not necessarily the sequence in which they are loaded for a test.

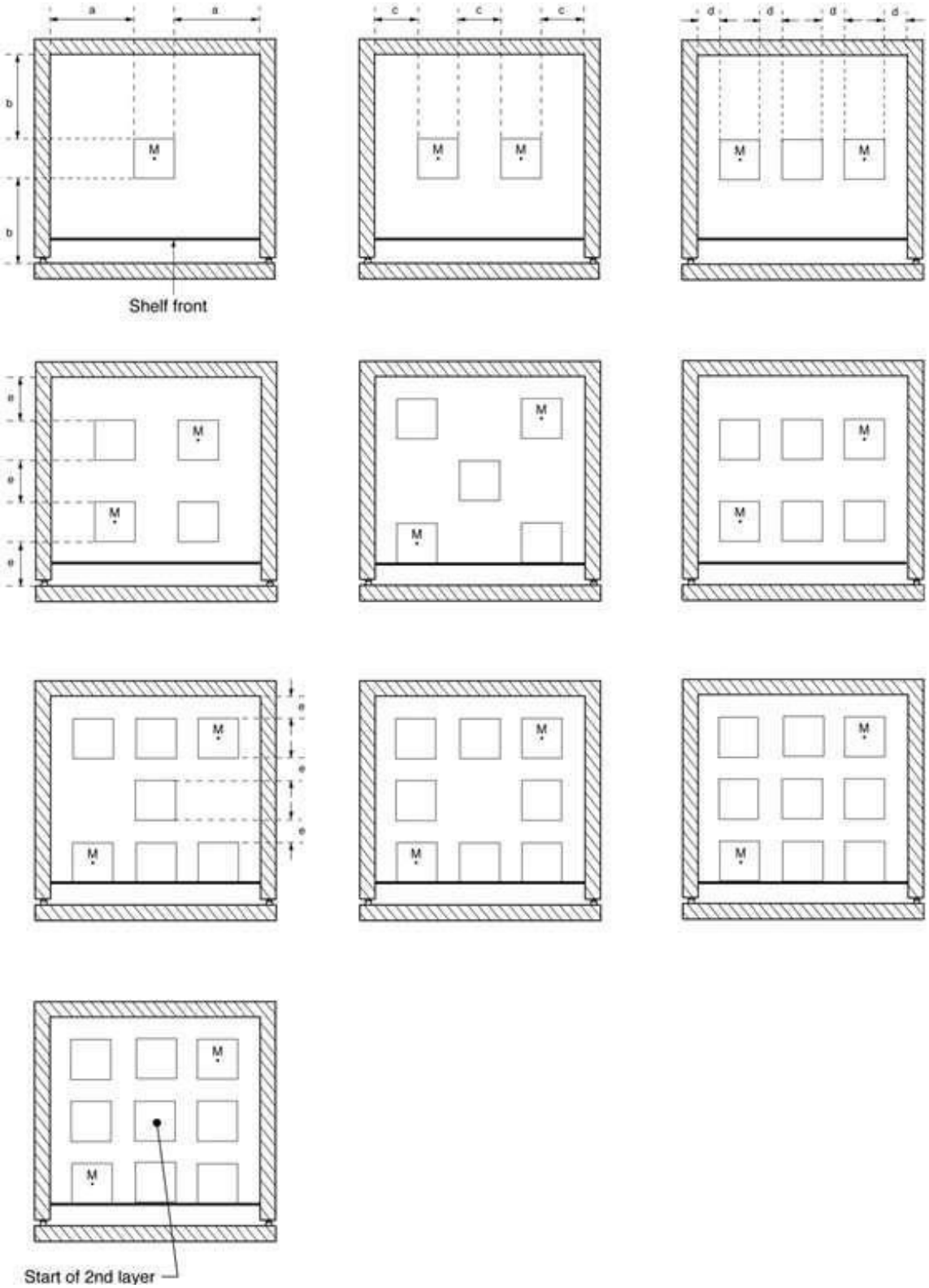
7.3.3 *M-packages*

Unless the total loading is less than 3 kg, six M-packages shall be used for all types of refrigerating appliances. If the total loading is 3 kg or less, M-packages alone shall be used. A maximum of two M-packages shall be placed in the bottom layer of each of the three levels.

For a loading of more than 3 packages the M-packages shall be arranged diagonally at the outer positions of loading as in Fig. 5.

The M-packages shall be used in the bottom layers only of relevant levels. Any further layer required shall be made up of test packages only.

Diagonally opposite positions for M-packages shall be chosen alternately for shelves positioned directly one above the other.



All dimensions marked shall be ≥ 15 mm.

FIG. 5 FILLING OF A SHELF WITH TEST PACKAGES AND M-PACKAGES FOR COOLING CAPACITY TEST

7.4 Data to be Recorded

The following data shall be recorded:

a) Load mass, in kg;
b) Volume of the fresh food compartment used for testing;
c) Cooling time, in hours (to one decimal place);
d) Any shelf, drawer or bin positions which differ from those specified;
e) Any package positions which differ from those specified; and
f) Settings of any 'quick cooling' functions used.

7.5 The cooling capacity shall not be less than 10 percent of the value stated by the manufacturer.

8 FREEZING CAPACITY TEST

8.1 Objective

The purpose of this test is to measure the freezing capacity of freezer compartment(s) by adding warm test packages (the light load) into the compartment. If the freezing capacity is greater than, or equal to, the specified minimum capacity (*see* **8.4.3**), the compartment(s) may be rated as a four-star compartment(s).

8.2 Method Overview

Apart from space for the light load, ballast packages are loaded into the frozen compartment(s) as for the storage test (*see* **6**). The refrigerating appliance is operated until temperatures are stable and in compliance with Table 2. Then a load of packages at + 25 °C is added. This is the so-called light load representing a food load to be processed. The time to freeze this load to − 18 °C is measured. When this can be achieved in no more than 24 h and other maximum temperature-excursion conditions are met, a four-star compartment rating may be claimed.

NOTE — Because the frozen compartment loading is largely the same as for the storage test, there can be an advantage in doing these tests consecutively.

8.3 Set-up Procedure

8.3.1 *Ambient Temperature*

The ambient temperature shall be 25 °C (*see* **B-3.2.3** of Part 1).

8.3.2 *Preparation of the Refrigerating Appliance*

8.3.2.1 *General*

The refrigerating appliance shall be installed in accordance with Annex C of IS 17550 (Part 1). If the configuration of the refrigerating appliance can be changed by the user, the configuration with the greatest volume at the lowest temperatures shall be used for this test.

Refrigerating appliances with anti-condensation heater(s) which are permanently on during normal use shall be tested with the heater(s) operating.

Anti-condensation heaters which can be manually controlled by the user shall be switched on and, if adjustable, they shall be set at their maximum heating rate.

Anti-condensation heaters which are automatically controlled shall be allowed to operate normally.

Thermal storage devices shall be placed in the dedicated positions in the respective compartments, in accordance with the manufacturer's instructions, and shall be independent of the location of the test packages. Instructions for loose placement of thermal storage devices in the appliance do not define dedicated positions.

Refrigerating appliances with anti-condensation heater(s) which are permanently on during normal use shall be tested with the heater(s) operating.

NOTE — Instructions without specific indication of location or placement of the thermal storage devices is an example of loose placement.

If dedicated positions are absent, the thermal storage devices shall be removed from the compartment.

The unloaded refrigerating appliance should be set up and operated until it has reached equilibrium at, or close to, the temperatures specified in Table 2.

8.3.2.2 *Measurement of temperature of chill compartment and all compartments operating above* 0 °C

During the test, the chill compartment temperature is not measured, but it shall be loaded with test packages as for the storage temperature measurement (*see* **6.3.2**). For determining the storage temperature of the compartments normally operating above 0 °C, measurement points shall be as per Annex E of IS 17550 (Part 1), but with M- packages used instead of cylinders.

8.3.3 *Loading of Refrigerating Appliance*

8.3.3.1 *Frozen compartment(s) — Ballast load*

8.3.3.1.1 *General*

Apart from space for the light load in the appropriate - 18 °C compartment(s), ballast packages are brought to the approximate

compartment temperatures and loaded into the frozen compartments(s), as for the storage test (*see* 6).

A load stack can be comprised of one or more load packages.

In the - 18 °C compartment(s), ballast load may be removed to accommodate the light load. Light load positioning shall take into account the instructions regarding the location to be used for freezing. If no instructions are given, the packages shall be placed such that they are likely to be frozen as rapidly as possible.

Furthermore, the following constraints shall be fulfilled:

a) The minimum number of stacks shall be removed;

b) The height of a light load stack shall be 2 packages, with the following exceptions:

   1) If the light load is to be composed of an odd number of packages, then one light load stack of 1 package is allowed;
   2) If the ballast load to be removed only exists out of stacks of 1 package, then it is allowed to replace these by light load stacks of 1 package; and
   3) If the ballast load stack to be removed contains 6 or more packages, then it shall be replaced with a light load stack of half the number of packages in the ballast load stack (rounded down).

c) The minimum ballast load is 1 M-package;

d) Light load packages shall be placed flat;

e) Light load positioning shall take into account the instructions regarding the location to be used for freezing. If no instructions are given, the packages shall be placed such that they are likely to be frozen as rapidly as possible; and

f) Light load packages shall be separated by at least 15 mm from ballast load packages. The use of spacers between adjacent stacks of packages is permitted, but other spacing methods are not (*see* **6.3.3.2**).

8.3.3.1.2 *M-package placement in the ballast load to accommodate the light load*

M-packages in the ballast load shall be placed in the same manner as for the storage test, apart from in any locations that are disrupted by the need to leave space for the light load. In that case, the M-packages shall be placed in the nearest equivalent position to that specified for the storage test and the new positions recorded. If there are stacks of ballast load packages beside the light load, an M-package shall also replace the top test package in at least one of those stacks on each side of the light load. If there is ballast load above the light load, an M-package shall replace a test package in the centre of the layer immediately above the light load. If there is ballast load below the light load, an M-package may replace a test package in the centre of the layer immediately below the light load.

8.3.3.2 *Refrigerating appliances with separate three-star compartment*

If a refrigerating appliance has a separate three-star compartment with its own external access door or lid, and the instructions recommend that, before freezing, frozen food already in storage be placed in that compartment while leaving space in the freezer compartment to receive the load for freezing (that is, the three-star compartment is to be regarded as an extension of the freezer compartment), a freezing time claim based upon this method of use is permissible, provided that:

a) When tested according to this method of use, the claimed freezing time is confirmed and the temperature requirements for the other compartments [*see* **8.5**(a) to **8.5**(g)], if applicable, are fulfilled during the freezing capacity test ; and

b) The light load used in the freezer compartment is at least equivalent to 3.5 kilogram per 100 litres of the combined volumes of the freezer compartment and three-star compartment.

8.4 Test Procedure

8.4.1 *Starting Conditions*

After all relevant control devices have been adjusted as required, the loaded refrigerating appliance is left to run until stable operating conditions are reached.

After stable operating conditions have been attained, internal temperature(s) shall be in accordance with Table 2, except that the starting temperature of any compartment(s) with no lower temperature limit(s) specified in that table shall be no more than 2 K below the target temperature.

In the case of a refrigerating appliance where the compartment temperatures cannot be adjusted independently, if such a setting is not possible, the non-complying compartments below the bottom limit shall be set to be as warm as possible. The temperature indication succession from left to right in Table 2 also indicates the order of

precedence in the case of several temperature possibilities.

In some circumstances, it might be unnecessary to carry out the stabilization specified here before the stabilization specified in 8.4.2.

8.4.2 *Setting of Control Devices*

If the refrigerating appliance is provided with means for a pre-freezing (fast-freezing or quick-freezing) operation, after stable operating conditions in accordance with 8.4.1 have been attained, the refrigerating appliance shall be set in operation in the pre-freezing condition according to the instructions. The procedure specified in 8.4.3 shall then be carried out.

If there are no special instructions for pre-freezing, the procedure described in 8.4.3 shall be carried out after the refrigerating appliance has reached stable operating conditions in accordance with the temperature requirements of 8.4.1.

8.4.3 *Freezing of the Light Load*

After the conditions specified in 8.4.2 have been attained, the light load shall be introduced. For models with defrost control cycles, the light load should be added when stability has been regained and temperature criteria met after defrost and recovery period. This test should not overlap defrost and recovery period. When stability has been achieved prior to the introduction of the light load, apart from as in 8.4.2, changes of setting of manually adjustable controls are no longer permitted.

The light load shall be 3.5 kilogram per 100 litres of the total volume of all compartments operating at − 18 °C (three and four stars). The calculated load shall be rounded up to the nearest 0.5 kg, except that in no case shall it be less than 2.0 kg.

The light load is made from packages which have previously been brought to a temperature of + 25 °C ± 1 K.

M-packages shall be uniformly distributed throughout the light load with at least one as close as practicable to its geometric center. The number of M-packages to apply is given in Table 5.

8.4.4 *Intermediate Test Data to be Recorded*

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. This shall be done until the arithmetic mean of the instantaneous temperatures of all the M-packages in the light load reaches ≤ - 18 °C and all other criteria in 8.5 are satisfied. The time necessary for reaching this condition shall be recorded as the freezing time.

If, during the test, an M-package exhibits a supercooling effect, the test is invalid and shall be repeated, possibly with a replaced M-package.

Supercooling, also known as undercooling, is the process of lowering the temperature of a liquid below its freezing point without it becoming a solid. It can be observed during the test as a rapid increase of the temperature in an M-package. If the increase is more than 3 K, the test shall be considered invalid.

8.5 Criteria to Achieve a Four-Star Compartment Rating

A compartment achieves a four-star rating if the arithmetic mean of the instantaneous temperatures of all the M-packages in the light load reaches ≤ − 18 °C in no more than 24 h and:

a) Unless a defrost and recovery period overlaps the test, the maximum temperature of any M-packages of the ballast load remains ≤ − 15 °C and at the end of the test the maximum temperature of the warmest M-package of the ballast load is ≤ − 18 °C;

b) If a defrost and recovery period does overlap the test, the maximum temperature of any M-packages of the ballast load remains ≤ − 12 °C during the defrost and recovery period and at the end of the test the maximum temperature of the warmest M-package of the ballast load is ≤ − 18 °C;

c) The maximum temperature of the warmest M-package in any separate three-star compartment not used for ballast in accordance with 8.3.3.2 remains ≤ − 18 °C (plus the allowed excursions during any defrost and recovery period as specified in Table 2);

d) The maximum temperature of the warmest M-package in any two-star section or two-star compartment remains ≤ − 12 °C (plus the allowed excursions during a defrost and recovery period as specified in Table 2);

e) The maximum temperature of the warmest M-package in any one-star compartment remains ≤ − 6 °C;

f) The instantaneous compartment average temperature Ta of the fresh food compartment during the test does not exceed + 7 °C, with T_1, T_2, T_3 each remaining between − 1 °C and + 10 °C; and

g) The instantaneous temperatures T_{c1},T_{c2}, T_{c3} as appropriate of the cellar compartment do not drop below 0 °C.

8.6 Data to be Recorded

a) The mass, in kg, of the ballast load;
b) The mass, in kg, of the light load;
c) The freezing time, in h, of the light load;
d) The volume of the relevant compartments;
e) The warmest temperature measured in the M-packages in the ballast load stored during the light-load freezing capacity test, together with the warmest temperature measured in the M-packages in any three-star compartment, two-star section or compartment and in any one-star compartment and the duration of the temperature deviation above − 18 °C (or − 12 °C as appropriate) and the duration of any defrost control cycle (*see* Table 2);
f) The highest and lowest values of T_1, T_2, T_3 and T_{c1}, T_{c2}, T_{c3}, if applicable;
g) The settings of all temperature control devices, including timer(s), if any;
h) A diagram of the storage plan for the refrigerating appliance showing the location of the M-packages and the location of the warmest M-package(s) for both the ballast load and the light load;
j) If the refrigerating appliance is fitted with a device intended to set the refrigeration of the freezer compartment into continuous operation when freezing and then to revert to thermostatic operation automatically, the time which elapsed before it reverted to normal thermostatically controlled operation;
k) Whether the time to freeze the light load is achieved in no more than 24 h;
m) The specific freezing capacity (x) in [kg/12 h] = $\frac{12\,M_1}{\Delta t_f}$.

where

M_1 = Light load, in kg; and
Δt_f = Freezing time, in h.

8.7 The specific freezing capacity shall not be less than 10 percent of the value stated by the manufacturer.

9 AUTOMATIC ICE MAKING CAPACITY TEST

9.1 Objective

The purpose of this test is to determine the ice making capacity of automatic icemakers in refrigerating appliance.

9.2 Procedure

9.2.1 *Ambient and Water Temperatures*

The ambient temperature and water supply temperature shall be 25 °C (*see* **B-3.2.3** of IS 17550 (Part 1).

If the refrigerating appliance is connected to a water supply, the water temperature shall be measured at the point of connection to the refrigerating appliance.

9.2.2 *Preparation of Refrigerating Appliance*

The refrigerating appliance shall be installed in accordance with Annex C of IS 17550 (Part 1).

All compartment shall be empty. Their average air temperatures shall be determined as specified in Annex E of IS 17550 (Part 1).

Refrigerating appliances with anti-condensation heater(s) which are permanently on during normal use shall be tested with the heater(s) operating.

Anti-condensation heaters which can be manually controlled by the user shall be switched on and, if adjustable, they shall be set at their maximum heating rate.

Anti-condensation heaters which are automatically controlled shall be allowed to operate normally.

All internal accessories supplied with the refrigerating appliance shall be in their respective positions except that any manually filled ice cube trays shall be removed.

After stable operating conditions have been attained, internal temperature(s) shall be in accordance with Table 2 except that the average starting temperature of any compartment(s) with no lower temperature limit(s) specified in that table shall be no more than 2 K below the target temperature.

In the case of a refrigerating appliance where the compartment temperatures cannot be adjusted independently, if such a setting is not possible, the non-complying compartments below the bottom limit shall be set to be as warm as possible.

The cellar compartment shall be as small as possible (if the size is adjustable), with temperature control devices (flaps, etc) set in accordance with the instructions or, in the absence of any instructions, set to achieve the temperatures in Table 2.

Where the refrigerating appliance has a defrost control cycle, it shall remain in operation for this test but the ice making capacity test should not overlap defrost and recovery period.

9.2.3 *Test Procedures*

9.2.3.1 *Direct water connection type*

Automatic icemakers of the direct water connection type shall be connected in accordance with the instructions to a water supply having a temperature of 25 °C ± 1 °C. Prior to initiation of the ice making capacity test, the automatic icemaker shall have been operating for a sufficient time to ensure proper operation. There shall be no evidence of free water having entered the storage bin.

For cycling icemakers, the test shall begin at the completion of the water-fill portion of a cycle. For continuous (non-cycling) ice making devices, the test may be started at any time after steady state ice making conditions have been established. The ice storage bin shall be emptied and repositioned at the time the test is started.

The test shall continue uninterrupted for a minimum of 12 h for continuous icemakers and for 12 h plus the additional time required to complete a whole number of cycles for cycling icemakers. If the storage bin is emptied during the test to ensure uninterrupted operation, the ice shall be weighted and this amount added to the weight of the ice in the storage bin at the termination of the test.

At completion of the test, the ice in the storage bin shall be weighed. If there is evidence of free water having entered the storage bin, the test shall be repeated at least once. If this condition continues, the test shall be stopped and the condition reported.

The time duration of the test shall be recorded for use in calculating the ice making capacity in kilograms per twenty-four hours.

9.2.3.2 *Tank-type*

To ensure proper operation, prior to initiation of the ice making capacity test, the automatic icemaker shall have 300 g of water with an initial temperature of 25 °C ± 1 °C in the tank and shall operate for a minimum of 12 h until the minimum water level is reached and no more ice is being made. There shall be no evidence of free water having entered the ice storage bin.

The door which gives access to the ice storage bin shall be opened and the ice in the ice storage bin shall be removed. The door shall be kept open for one minute.

The tank shall be filled with the maximum quantity of water (at 25 °C ± 1 °C) that is specified in the instructions. The tank shall be reinstalled. The time between tank removal and reinstallation shall be less than one minute. The door of the compartment which gives access to the tank shall be kept open for 1 min.

The test start shall be at the time of first water filling of the ice mould after the tank has been re-installed.

The test shall continue uninterrupted for a minimum of 12 h for continuous ice making and for 12 h plus the additional time required to complete a whole number of cycles for cycling icemakers. At the completion of the test, the ice in the ice storage bin shall be weighed.

The cycles may be detected by monitoring temperature on the bottom of the ice mould.

The duration of the test shall be recorded for use in calculating the ice making capacity in kilograms per twenty-four hours.

9.3 Data to be Recorded

The following data shall be recorded for each test (as applicable):

a) Type, model number, and serial number of the icemaker;
b) Average compartment temperature for each compartment at the beginning of the test;
c) The ice making capacity in kg/24 h; and
d) Temperature control settings.

9.4 The ice making capacity shall not be less than 10 percent of the value stated by the manufacturer.

9.5 The schedule of type, acceptance, and routine tests are given in **20** of IS 17550 (Part 1) of this standard.

Table 5 M-Packages in the Light Load

(*Clause* 8.4.3)

Sl No.	Light Load kg	Number of M-Package Inside the Light Load
(1)	(2)	(3)
i)	2	2
ii)	2.5 or 3	3
iii)	3.5 or 4	4
iv)	4.5 or 5	5
v)	> 5	6

ANNEX A
(*Clauses* 4.6 *and* Table 1)
PULL-DOWN TEST

A-1 GENERAL

The purpose of this test is to measure the reserve capacity of a refrigerating appliance, particularly for high ambient temperature environments. This test is not applicable to stand-alone wine storage appliance or wine storage compartments within the refrigerating appliance. This test is to be applied at the maximum ambient temperature in accordance with the T-class.

A-2 METHOD OVERVIEW

The pull-down part of the test begins when the whole refrigerating appliance, including the inside, is in thermal equilibrium with the test room. The refrigerating appliance is then switched on and run to determine the time taken to meet pull-down temperature(s) as specified in Table 6.

A-3 SET-UP PROCEDURE

A-3.1 Test Room Ambient Temperature

The temperature of the test room shall be set at the required ambient temperature throughout the temperature stabilization period and for the duration of the test. It shall be maintained at the required ambient temperature minus 0.5 K or warmer, except when verifying a supplier’s claimed performance, when it shall be maintained at the required ambient temperature ± 0.5 K.

A-3.2 Installation

The refrigerating appliance shall be installed according to Annex C of IS 17550 (Part 1).

A-3.3 Disconnection of Devices

Compressor overload devices shall not be disconnected or bridged. Any other device which might prevent continuous operation of the refrigerating system during a pull down test and which can be controlled by the user shall be disabled or set so that continuous operation of the cooling system occurs for the duration of test. Temperature controls shall be set (or bridged) and, where possible and necessary, automatic defrost systems disabled to ensure continuous operation for this test. Where the defrost system cannot be disabled without adversely affecting the performance, the controls shall be set to the manufacturer’s default or recommended position.

A-3.4 User-Adjustable Features

User-adjustable features such as baffles, temperature controls, and special short-term controls (that are automatically terminated) shall be set to obtain an optimum result. If available, controls shall be set in accordance with the manufacturer's instructions.

This includes those on multi-function compartments, if any, where such adjustment does not take the temperature performance of those compartments outside the specified range for their coldest claimed functions.

This excludes baffles and controls on convenience features. These shall be set on the coldest setting.

A-3.5 Internal Components

Any thermal storage devices, for example, ice-bricks, or similar that are removable without the use of a tool shall be removed for all tests, irrespective of instructions.

All other internal components shall be positioned (or removed) as specified in **C-2.5.1** of IS 17550 (Part 1).

Any remaining ice cube trays shall be empty for the duration of the test.

A-3.6 Determination of Compartment Temperature

Air temperature sensors shall be located in all compartments as specified in Annex E of IS 17550 (Part 1), except for zero-star compartments, where no temperature measurements are required.

A-4 TEST PROCEDURE

A-4.1 General

The test procedure shall be as follows:

A-4.2 Heat Soak

With the test room ambient at the required ambient temperature, and the refrigerating appliance switched off, open all doors, drawers, and lids on the refrigerating appliance and let it stand to allow the whole refrigerating appliance to reach the ambient temperature.

NOTE — Experience suggests that at least six hours with the refrigerating appliance's door(s) open in the test room is

usually required to meet the equilibrium requirements below.

Close the doors but do not switch the refrigerating appliance on. The refrigerating appliance has reached the required starting condition for a pull-down test when, over a period of 30 min, either of the following applies:

The average compartment temperature in each compartment does not vary by more than 0.3 °C.

or

For a test to determine the performance of a refrigerating appliance, the average compartment temperature in each compartment does not fall below the required ambient temperature; and for a test to verify claimed performance, the average temperature of each compartment does not rise above the required ambient temperature.

A-4.3 Pull down

Start the refrigerating appliance and operate it until the average air temperature in all compartments is simultaneously at or below their applicable pull down temperatures in Table 6.

NOTE — As the compartment temperature is continuously falling during a pull-down test, the instantaneous compartment temperature at any time is the arithmetic mean of the air temperatures of all measurement points within the compartment or sub-compartment at that time.

A-5 TEST END-POINT

The test can be terminated when the average air temperature in all compartment is simultaneously at or below their applicable pull-down temperatures. Pull-down temperatures shall be as specified in Table 6.

A-6 DATA TO BE RECORDED

The following data shall be recorded for each test (as applicable):

a) The period from the start of the test until all compartments are simultaneously at or below the target temperatures in Table 6;

b) The average air temperature reached in each compartment;

c) Where applicable, any alternative positions for air temperature sensors (all in accordance with Annex E of IS 17550 (Part 1);

d) The function selected for each multi-use compartment;

e) The position of each user-adjustable baffle which may affect operating temperatures in any space in the refrigerating appliance (including space in convenience features as well as in compartments);

f) Settings of all user-adjustable temperature controls;

g) Settings of all other user-adjustable switches and controls; and

h) Any disconnection, bridging, or modification in any way of any devices for the test.

Table 6 Pull-Down Temperatures for Compartments

(*Clauses* 4.6, A-2, A-4.3, A-5, *and* A-6)

Sl No.	Compartment Type	Average Air Temperature °C
(1)	(2)	(3)
i)	Pantry	20
ii)	Cellar	15
iii)	Fresh food	8
iv)	Chill	6
v)	Zero star	No requirement
vi)	1 star	− 1
vii)	2 star	− 7
viii)	3 and 4 star	− 12

ANNEX B

(*Clauses* 4.6 , 6.3.1 *and* Table 1)

WINE STORAGE APPLIANCES AND COMPARTMENTS; STORAGE TEST

B-1 OBJECTIVE

The purpose of this test is to check compliance with the requirements of this standard at each of the ambient temperatures [*see* **B-3.2.3** in IS 17550 (Part 1) for the appropriate climate class].

B-2 STORAGE TEMPERATURE REQUIREMENTS

Under the conditions specified in this clause and for each claimed climate class, the wine storage appliance shall be capable of maintaining, simultaneously, the required storage temperatures in all compartments (and the permitted temperature deviations during defrost and recovery period where applicable) as defined below:

Storage temperature requirements:

Allowed operating range for a wine storage compartment.

$$T_{\mathrm{wim}}: +5\ ^{\circ}\mathrm{C} \leq T_{\mathrm{wim}} \leq +20\ ^{\circ}\mathrm{C}$$

Temperature for a wine storage compartment shall be able to operate down to:

$$T_{\mathrm{wma}} \leq +12\ ^{\circ}\mathrm{C}$$

If a wine storage appliance or compartment cannot achieve ≤ + 12 °C in this test, it will be classified and tested as a pantry compartment. It cannot claim to be a wine storage compartment according to this standard.

If there are two or more wine storage compartments in one refrigerating appliance, the temperature setting range can be subdivided with only part of the temperature range in each wine storage compartment. (For example, a wine storage appliance with two compartments, one rated from + 6 °C to + 14 °C and the other from + 10 °C to + 18 °C would comply with this requirement).

During defrost and recovery period the temperatures T_{wma} of any wine storage compartment is not permitted to rise by more than 1.5 K above the average of that compartment.

NOTES

1 This is a smaller excursion than allowed in footnote (b) to Table 2.

2 An example of a defrost control cycle for a frost-free refrigerator-freezer is given in Fig. 1 of IS 17550 (Part 1).

B-3 MEASUREMENT OF COMPARTMENT TEMPERATURE

For determining the storage temperature of these compartments, M-packages shall be located in accordance with **H-6** of IS 17550 (Part 1).

B-4 PREPARATION OF REFRIGERATING APPLIANCE

The wine storage appliance shall be installed in the test room in accordance with Annex C of IS 17550 (Part 1). If the wine storage appliance has user-adjustable temperature control devices, they shall be set at the positions recommended in the instructions for normal use at the appropriate ambient temperature. When the devices are not user- adjustable, the measurement shall be carried out on the refrigerating appliance as delivered. Readjustment of user-adjustable temperature controls is allowed.

If the wine storage appliance includes more than one wine storage compartment and the volumes of those compartments can be changed in relation to one another by the user, the compartments shall be adjusted so that the compartment with the temperature furthest from the test-room ambient has the largest volume.

If a wine storage compartment volume is adjustable in relation to another colder compartment type as specified in Table 2 the wine storage compartment shall be adjusted to its minimum volume.

Where a wine storage compartment has setting options for both uniform temperature and multiple temperature zones, the uniform temperature setting shall be selected for testing. Wine storage appliances and compartments with anti-condensation heater(s) which are permanently on during normal use shall be tested with the heater(s) operating.

Anti-condensation heaters which can be manually controlled by the user shall be switched on and, if adjustable, they shall be set at their maximum heating rate.

Anti-condensation heaters which are automatically controlled shall be allowed to operate normally.

B-5 MEASUREMENTS

B-5.1 General

For the appropriate ambient temperature, temperature

control device(s), and other controls, if any, shall be adjusted, as necessary, to a position which is likely to give storage temperatures which comply with requirements in this clause, after stable operating conditions have been attained.

B-5.2 Conditions for Demonstration of Compliance

The following conditions shall all be met to demonstrate compliance:

Except during any freezing or cooling capacity test, the average of all temperature amplitudes at each measurement point in each wine storage compartment T_{wi} during the whole test period shall stay within ± 0.5 K (*see* **H-7** of IS 17550 (Part 1); During any freezing or cooling capacity test the average of all temperature amplitudes at each measurement point in each wine storage compartment T_{wi} during the whole test period shall stay within ± 1.5 K (*see* **H-7** of IS 17550 (Part 1); and The integrated time averages of the temperatures T_{wim} shall stay between + 5 °C and + 20 °C. The arithmetic average T_{wma} of T_{w1m}, T_{w2m}, T_{w3m} shall be equal to or below + 12 °C [*see* **H-3.1** of IS 17550 (Part 1)].

B-6 DATA TO BE RECORDED

The following data shall be recorded for each test (as applicable):

a) The ambient temperature(s);

b) For each ambient, the setting(s) of temperature control device(s) and other controls, if any (if user-adjustable);

c) For each ambient the value of the wine storage temperature T_{wma}, and the values of T_{w1m}, T_{w2m}, and T_{w3m}; and

d) For each ambient the average of all temperature amplitudes at each measurement point.

ANNEX C
(*Clauses* 4.6 *and* Table 1)
TEMPERATURE RISE TEST

C-1 OBJECTIVE

The purpose of this test is to check the time for the temperature rise of packages in a refrigerating appliance with one or more three-star or four-star compartments.

C-2 PROCEDURE

C-2.1 Ambient Temperature

The ambient temperature shall be 25 °C [*see* **B-3.2.3** of IS 17550 (Part 1)].

C-2.2 Preparation of Refrigerating Appliance

The refrigerating appliance shall be installed according to Annex C of IS 17550 (Part 1).

It shall be prepared, stabilized, and loaded with test packages and M-packages (as for the storage test (*see* **6**).

C-2.3 Operation of the Refrigerating Appliance

The controls shall be set and the refrigerating appliance operated till all frozen compartments are at or colder than the temperatures specified in Table 2.

C-3 TEST PERIOD AND MEASUREMENTS

The power supply to the refrigerating appliance shall be switched off once stable operating conditions have been achieved. For automatic-defrosting refrigerating appliances, this shall be during the stable part of the defrost control cycle.

The times shall be noted when the warmest of the M-packages in any three-star or four-star compartment reaches − 18 °C and when the warmest of the M-packages in any of these compartments reaches − 9 °C.

NOTE — The warmest M-package to reach − 18 °C might not be same package as the warmest M-package reaching − 9 °C.

C-4 TEMPERATURE RISE TIME

This is the difference between the two times noted in **C-3**.

C-5 DATA TO BE RECORDED

The following data shall be recorded for each test (as applicable):

a) The ambient temperature; and
b) The time for the temperature rise from − 18 °C to − 9 °C.

C-6 COMPLIANCE REQUIREMENT

At the end of the test, time for the temperature rise shall be greater than the declared value.

ANNEX D

(*Foreword*, *Clauses* 4.6 *and* Table 1)

WATER VAPOUR CONDENSATION TEST

D-1 OBJECTIVE

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

D-2 PROCEDURE

D-2.1 Ambient Temperature

The ambient temperature shall be:

+ 32 °C for class ST and T refrigerating appliances.

D-2.2 Relative Humidity

The humidity shall be such that the time averaged value of the dew point is:

+ 27 °C ± 0.5 °C for class ST and T refrigerating appliances.

Two times the standard deviation of the recorded dew point values during the test shall be less than 0.5 kelvin.

For relevant conversions between dew point, relative humidity, and wet bulb temperatures (*see* Table 7).

D-2.3 Preparation of Refrigerating Appliance

The refrigerating appliance shall be installed in accordance with Annex C of IS 17550 (Part 1).

Compartment average air temperatures shall be determined as specified in Annex E of IS 17550 (Part 1) and throughout the test average compartment air temperatures shall be at or below the target temperatures for an energy test in specified in Table 1 of IS 17550 (Part 3).

D-2.4 Operation of the Refrigerating Appliance

If anti-condensation heaters are provided which can be switched on and off by the user, these shall be switched off. If, however, running water appears on the external surface of the refrigerating appliance, the test shall be repeated with the anti-condensation heaters swit ched on and, if adjustable, set at maximum heating. Anti-condensation heaters which are automatically controlled shall be allowed to operate normally.

Anti-condensation heater control settings or adjustment for refrigerating appliances with any anti-condensation heaters which are partly automatically controlled shall be set as requested by the person or authority requesting the test.

D-2.5 Test Period

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

D-3 OBSERVATIONS

During the test period, external surface areas exhibiting fog, droplets or running water shall be outlined and coded by the letters ‘A’, ‘B’ and ‘C’, respectively (*see* Fig. 6).

D-4 DATA TO BE RECORDED

The following data shall be recorded for each test (as applicable):

a) A coded sketch may be made showing the running water area appearing during the test on all external surfaces. Code C as shown in Fig. 6 may be used to indicate this. Codes A and B may also be included;

b) The selected test period;

c) The duration of the period of observation;

d) Whether any manual switch provided for anti-condensation heaters was switched on or off or adjusted in accordance with **D-2.4**;

e) Whether any semi-automatic anti-condensation heaters control was present, how it was set and how it functioned; and

f) Whether any automatic anti-condensation heaters control was present and how it functioned.

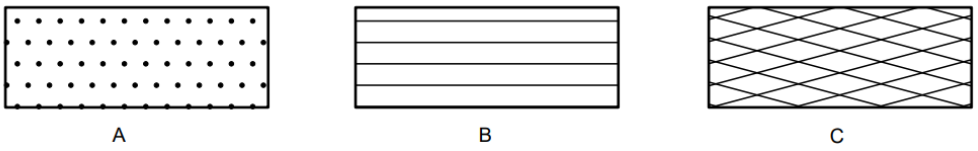
D-5 COMPLIANCE REQUIREMENT

At the end of the test, there shall be no running water.

Table 7 Humidity Conversions

(*Clause* D-2.2)

Sl No.	Ambient Temperature	Dew Point Temperature	Relative Humidity	Wet Bulb Temperature at 1 013.25 mbar
(1)	(2)	(3)	(4)	(5)
i)	32 °C	27 °C	75 percent	28.3 °C



key

A – Fog
B – Droplets
C – Running water

FIG. 6 CONDENSATION CODES

ANNEX E

(*Foreword*)

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