भारतीय मानक

Indian Standard

IS 1391 (Part 1) : 2023

कक्ष वातानूकुलक — विशिष्टि

भाग 1 एकिक वातानूकुलक

(चौथा पुनरीक्षण)

Room Air Conditioners — Specification

Part 1 Unitary Air Conditioners

(Fourth Revision)

ICS 23.120; 27.080

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

August 2023 **Price Group 14**

Refrigeration and Air Conditioning Sectional Committee, MED 03

FOREWORD

This Indian Standard (Part 1) (Fourth 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 1960 and subsequently revised in 1971, 1992 and 2017.

In this revision, all amendments have been incorporated. Major changes in this revision are as follows:

a) The scope has been harmonized with ISO 5151;
b) The refrigerant requirement has been revised;
c) The requirement for pre-filter/HEPA filter have been added;
d) The requirement of drain plug has been incorporated;
e) The voltage adjustment for the maximum operating conditions test has been aligned with ISO 5151;
f) The motor overload protective device requirement has been added for the maximum operating conditions test;
g) The duct usage in psychrometric test has been defined for clarity;
h) The adjustment in the cooling capacity result has been incorporated;
j) The method of sound test has been revised;
k) For the requirements for ISEER measurement, IS 18154 (Part 1) has been referred;
m) The accuracy and resolution of the measuring instruments has been revised; and
n) The data to be recorded for various tests are added.

This standard is published in two parts. The other part in the series under the general title 'Room air conditioners — Specification' is:

Part 2 Split air conditioners

This standard provides construction, performance, rating, and safety requirements of unitary air conditioners, commonly known as window air conditioners. There is a separate safety standard for air conditioner, that is, IS/IEC 60335-2-40 : 2018 'Household and similar electrical appliances — Safety: Part 2-40 Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers'. The safety requirement as per Indian condition is under consideration.

For any deviation between the limit specified in this standard and the national regulations, the limits specified in the national regulations shall prevail.

In the preparation of this standard, considerable assistance has been derived from the following standard:

ISO 5151 : 2017 Non-ducted air conditioners and heat pumps — Testing and rating for performance

The unit of measurement in SI and metric system commonly used in air conditioning have been listed in Annex B.

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

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 or analysis shall be rounded off 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

ROOM AIR CONDITIONERS — SPECIFICATION

PART 1 UNITARY AIR CONDITIONERS

(Fourth Revision)

1 SCOPE

1.1 This standard (Part 1) specifies safety and performance requirements of single-phase non-ducted unitary with single-stage, two-stage, multi-stage, fixed and variable speed air conditioners and heat pumps for household and similar application of rated capacity up to and including 10 500 W their rated voltage not more than 250 V a.c., 50 Hz for single-phase employing air cooled condensers and test methods for determination of various ratings. This standard is limited to systems utilizing a single refrigeration circuit, having one evaporator and one condenser.

1.2 This standard is not applicable to the following:

a) Water-source heat pumps or water-cooled air conditioners;
b) Mobile (windowless) units having a condenser exhaust duct;
c) Individual assemblies not constituting a complete refrigeration system;
d) Equipment using the absorption refrigeration cycle; and
e) Portable air-conditioners.

2 REFERENCES

The standards listed in Annex A 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.

3 TERMINOLOGY AND SYMBOLS

3.1 Terminology

For the purpose of this standard, the definitions given in IS 3615 shall apply, in addition to the following:

Definitions relating to air flow (*see* **3.1.3** to **3.1.11**) are illustrated in Fig. 1.

3.1.1 *Unitary Air Conditioner* — An encased assembly designed as a self-contained unit primarily for mounting in a window or through the wall or as a console. It consists of compressor, heat exchangers, and air handling system installed in one cabinet. It is designed primarily to provide free delivery of conditioned air to an enclosed space, room, or zone (conditioned space). It includes a prime source of refrigeration for cooling and dehumidification and a means for the circulation and filtering of air. It shall include means for exhausting air. It may also include means for heating, humidifying, or inducting fresh air.

3.1.2 *Standard Barometric Pressure* — Barometric pressure at 1.013 25 bar (760 mm Hg).

3.1.3 *Room Discharge Airflow* — Rate of flow of air from the outlet of the unit into the conditioned space.

3.1.4 *Room Intake Airflow* — Rate of flow of air into the unit from the conditioned space.

3.1.5 *Outdoor Discharge Airflow* — Discharge rate of flow of air from the unit.

3.1.6 *Outdoor Intake Airflow* — Rate of flow of air into the unit from the outdoor-side.

3.1.7 *Exhaust Airflow* — Rate of flow of air from the room side through the unit to the outdoor-side.

3.1.8 *Leakage Airflow* — Rate of flow of air interchanged between the room side and outdoor side through the unit as a result of its construction features and sealing techniques.

3.1.9 *Bypassed Room Airflow* — Rate of flow of conditioned air directly from the room side outlet to the room side inlet of the unit.

3.1.10 *Bypassed Outdoor Airflow* — Rate of flow of air directly from the outdoor-side outlet to the outdoor-side inlet of the unit.

3.1.11 *Equalizer Opening Airflow* — Rate of flow of air through the equalizer opening in the partition wall of a calorimeter.

3.1.12 *Total Cooling Capacity* — The amount of sensible and latent heat that the unit can remove from the conditioned space in the definite interval of time.

3.1.13 *Rated Cooling Capacity* — Total cooling capacity at rated conditions.

3.1.14 *Total Heating Capacity* — The amount of heat that the unit can add to the conditioned space (but not including supplementary heater) in the definite interval of time.

3.1.15 *Test Room*

3.1.15.1 *Room calorimeter* — It is a test facility consisting of two contiguous calorimeters with a common partition. One is designated as the room side compartment, and the other as the outdoor compartment. Each side is equipped with instrumented reconditioning equipment whose output may be measured and controlled to counterbalance the room side humidifying and cooling effect and the outdoor side humidifying and heating effect of the unitary air conditioner under test.

3.1.15.2 *Room psychrometric* — It is facility consisting of two contiguous test rooms with a common partition. One is designed as the room side compartment and the other as the outdoor compartment. Each side is equipped with reconditioning equipment for maintaining the required room temperature and humidity.

3.1.16 *Rated Voltage* — Voltage shown on the nameplate of the unit.

3.1.17 *Rated Frequency* — Frequency shown on the nameplate of the unit.

3.1.18 *Fixed Capacity Unit* — Equipment which does not have possibility to change its capacity. This definition applies to each cooling and heating operation individually.

3.1.19 *Two-Stage Capacity Unit* — Equipment where the capacity is varied by no more than two steps. This definition applies to each cooling and heating operation individually.

3.1.20 *Multi-Stage Capacity Unit* — Equipment where the capacity is varied by 3 or 4 steps. This definition applies to each cooling and heating operation individually.

3.1.21 *Variable Capacity Unit* — Equipment where the capacity is varied to represent continuously variable capacity. This definition applies to each cooling and heating operation individually.

3.1.22 *Indian Seasonal Energy Efficiency Ratio (ISEER)* — Ratio of the total annual amount of heat that the equipment can remove from the indoor air when operated for cooling in active mode to the total annual amount of energy consumed by the equipment during the same period.

3.1.23 *Cooling Seasonal Total Load (CSTL)* — Total annual amount of heat that is removed from indoor air when equipment is operated for cooling active mode.

3.1.24 *Cooling Seasonal Energy Consumption (CSEC)* — Total annual amount of energy consumed by equipment when it is operated for cooling active mode.

3.2 Symbols

For the purpose of this standard, the letter symbols listed in Annex C have the meaning indicated against each, other symbols used in this standard have been explained at appropriate places.

4 CLASSIFICATION

According to function, unitary air conditioners shall be classified as follows:

a) Cooling only — Cooling and dehumidification during cooling mode; and
b) Cooling and heating — Cooling and dehumidification during cooling mode and heating during heating mode.

5 CONSTRUCTION

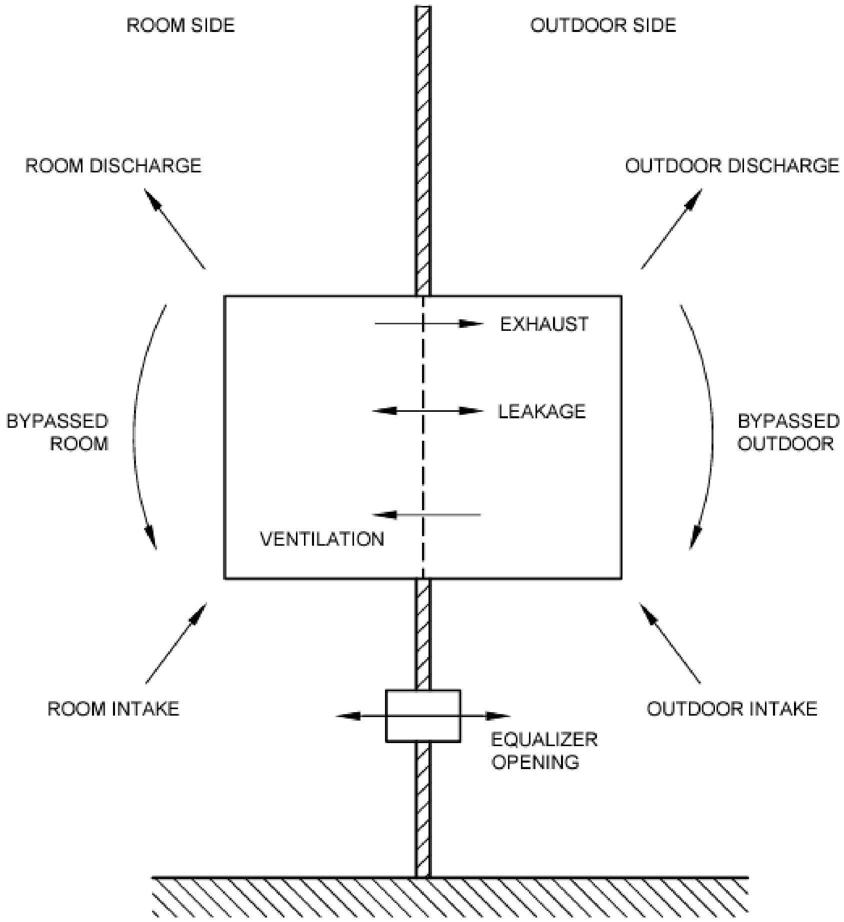
5.1 General

5.1.1 The air conditioner and its parts shall be constructed with the strength and rigidity adequate for normal conditions of handling, transport, and usage.

5.1.2 There shall be no sharp edges or corners liable to cause injury under normal conditions of use and all moving parts which constitute accident hazards shall be effectively guarded.

5.1.3 Parts which require periodic servicing shall be readily accessible.

5.1.4 Materials used in the construction of cabinet, front panel, etc shall comply with the corresponding Indian/ISO Standards if any, except where the specific requirement and compliance are specified in this standard.



NOTE — Airflow diagram illustration of the definitions given from **3.1.3** to **3.1.11**.

FIG. 1 AIRFLOW DIAGRAM

5.1.5 The material shall be free from defects which are liable to cause undue deterioration of failure.

5.1.6 Under normal conditions of use and maintenance, the materials used shall not shrink, deteriorate, warp, or cause mould or odours and shall be resistant to attack of vermin and destructive pests.

5.1.7 Sealing and insulating materials shall not lose their essential properties such as adhesion, moisture, and heat resistance.

5.1.8 Internal and external finishes shall be capable of being cleaned effectively without undue deterioration and shall be such as to afford protection against climatic action in all seasons under normal use. All metal parts which are exposed to moisture or ambient conditions shall be corrosion resistant or adequately protected against corrosion.

5.2 Electrically Charged Parts

5.2.1 The electrically live parts shall be protected from accidental contact of the user.

5.2.2 Electric conductors shall be of electrically, thermally, and mechanically stable and shall be made up of anti-corrosive materials such as copper and copper alloys.

5.2.3 Switches and the like shall work smoothly and keep good electrical contact.

5.2.4 Supply cord used shall be either polyvinyl chloride (PVC) insulated and sheathed cables conforming to IS 694 or elastomer insulated cables conforming to IS 9968 (Part 1).

5.2.5 Conductors for supply cord shall have a nominal

nominal cross-sectional area not less than those specified in **25.8** of IS 302 (Part 1).

5.3 Refrigerant Circuit

5.3.1 The refrigerant pipes and fittings shall be of approved quality, shall withstand maximum working pressures in refrigeration circuits of air conditioner, and shall conform to IS 10773 or material specified in Annex B of IS 11329.

5.3.2 The refrigerant designation and safety classification shall be as per IS 16656/ISO 817.

NOTE — Any regulation on the use of refrigerant type issued by the appropriate regulatory authority from time to time shall prevail.

5.4 Provision for Earthing

The earthing terminal and earthing lead wire shall be installed on a readily accessible place of the main body. Indication of earthing shall be marked on it or on the near spot as given in IS 302 (Part 1). The earthing terminal shall be so constructed that earthing wire can be easily and firmly fastened.

5.5 Air Filter

5.5.1 The filter used on the evaporator coil of the unit shall have a maximum 70 percent open area when measured in an area of 1 cm^2. The measurement shall be made by measuring the wire diameter.

The number of wires in 1 cm^2 is counted to calculate closed area and the overlap area is deducted to calculate the total closed area.

Actual open area percent = [(Total area – Closed area)/Total area] × 100

A specimen of the cut-piece removed from the filter for the purpose of measurement is shown in Fig. 2 for guidance.

5.5.2 The pre-filter if used shall be as per IS 17570 (Part 1)/ISO 16890-1. The high efficiency particulate air (HEPA) filters if used shall be as per IS 16753 (Part 1)/ISO 29463-1.

NOTE — In case manufacturers use any additional filters such as pre-filters or HEPA filters then performance test shall be carried with such filters in place.

5.6 Temperature Sensing Controls

The temperature sensing controls shall conform to **8** to **28** of IS/IEC 60730-2-9 as applicable.

NOTE — The temperature sensing control provided on the indoor side of the unit are commonly known as thermostat.

5.7 Hermetic Compressors

The hermetically sealed compressors shall conform to IS 10617.

5.8 Heat Exchanger

The heat exchanger used shall conform to IS 11329.

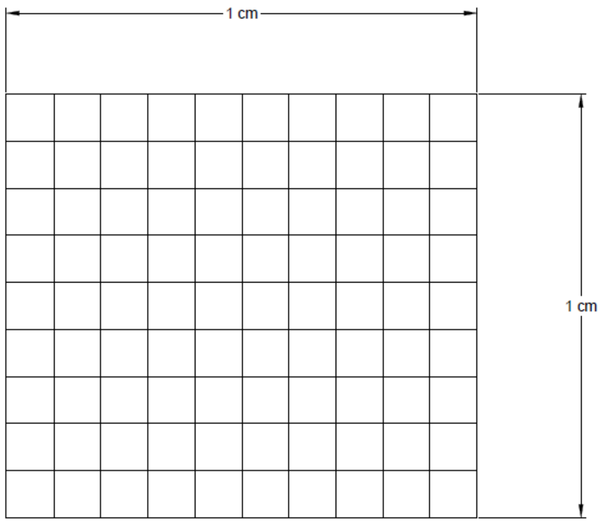


FIG. 2 A SPECIMEN OF THE FILTER CUT PIECE

5.9 Motors

The motor used for driving the fan/blower motor shall be either capacitor type induction motors or brushless d.c. (BLDC) motor.

The capacitor type induction motor shall comply with the requirements given in IS 996 as applicable for fan duty motors.

In the case of BLDC motors, the test for full load test shall be carried out at the rated frequency declared by the manufacturer. The measured power input and the speed shall be within ± 10 percent of the declared value. In addition, BLDC motors shall comply with the following requirements as specified in the respective clauses of IS 996 as applicable.

a) Dimensions (*see* **7.1**);
b) Terminal box (*see* **9.2**);
c) Mounting (*see* **9.3**);
d) Constructional features (*see* **9.4**);
e) Enclosure (*see* **10** of IS 996 and IP code as per IS/IEC 60529);
f) Method of cooling (*see* **11**);
g) Full load test for measurement of power input and full load speed at the declared frequency (*see* **12.5** and **F-6.2.4**);
h) Insulation resistance excluding the requirement of temperature rise test (*see* **12.7**);
j) High voltage (*see* **13.1**); and
k) Moisture proofness (*see* **13.2**).

NOTE — Separate standard for BLDC motor is under development. The requirements of overload protector, the centrifugal switch, and capacitor from IS 996 does not apply for BLDC motor.

5.10 Drain Plug

The unitary air conditioner shall have a drain hole having the provision of drain plug attachment which can be detachable or welded and preferably provided at the rear or bottom side of the unit. However, exact location of the drain hole shall be as per the manufacturers design requirement. The material of the drain plug may be of rubber, plastic, or metal. The drain plug shall be so designed that it allows the unit to drain excess water while operating the air conditioners. The drain plug may also be attached with a pipe made of rubber or plastic so that drain water does not soil the walls of the building.

The compliance shall be checked by inspection.

6 RATING REQUIREMENTS

The declared ratings of the air conditioner shall be based on conditions specified in **6.1** to **6.5**.

6.1 Cooling Capacity Ratings

The cooling capacity ratings shall be based on tests conducted under conditions specified in **8.1.1** and as per the test methods described in **9.10.4**. The ratings shall include the total cooling capacity stated in watt (W).

6.2 Heating Capacity Ratings

The heating capacity ratings shall be based on tests conducted under the conditions specified in **8.2.1** as per the test methods described in **9.11** and shall be stated in watt (W).

6.3 Power Consumption Ratings for Cooling and Heating by Heat Pump

6.3.1 The rate of power consumption for cooling by air conditioner shall be based on tests conducted as per **9.8** and shall be stated in watt (W).

6.3.2 The rate of power consumption for heating by heat pump shall be based on tests conducted under the conditions as per **9.9** and shall be stated in watt (W).

6.4 Electrical Ratings

The ratings in watt (W) for room air conditioner shall be based on standard voltage which shall be 230 V, single phase, 50 Hz. The units, however, shall be capable of working at any voltage within ± 10 percent of the standard voltage.

6.5 Sound Ratings

The sound ratings of the unitary air conditioner shall be conducted under test conditions specified in **8.1.1** and test method as per **9.14**.

7 RATINGS BASED ON FUNCTION

7.1 For the purpose of rating, information shall be provided regarding functions which the unit performs, namely:

a) Cooling;
b) Dehumidifying; and
c) Heating, if provided.

7.2 In addition to the above, the following information may be furnished by the manufacturer as and when desired:

a) Manufacturer's name and address;
b) Model number;
c) Overall dimensions;
d) Total cooling capacity;
e) Total dehumidifying effect;
f) Total sensible cooling effect;
g) Name of refrigerant;
h) Mass of the refrigerant charged into the unit;
j) Dehumidifying and sensible capacity;
k) Total power input;
m) Name plate ratings of each motor;
n) Power input for heating in watts;
p) Heating capacity, if provided;
q) Pre-filter and HEPA filter, if provided; and
r) Manufacturer's instructions and requirements which may affect performance.

8 RATING AND TEST CONDITIONS

8.1 Cooling Test

8.1.1 *Cooling Capacity Test Conditions*

The unitary air conditioner shall have nameplate rating determined by tests conducted at the standard rating conditions specified below:

a) Room air temperature:

1) Dry bulb temperature : 27 °C
2) Wet bulb temperature : 19 °C

b) Outside air temperature:

1) Dry bulb temperature : 35 °C
2) Wet bulb temperature : 24 °C

c) Test voltage : Rated voltage

d) Test frequency : Rated frequency

8.1.2 *Maximum Operating Test Conditions*

The maximum operating tests shall be conducted under the conditions specified below:

a) Room air temperature:

1) Dry bulb temperature : 35 °C
2) Wet bulb temperature : 24 °C

b) Outside air temperature:

1) Dry bulb temperature : 46 °C
2) Wet bulb temperature : 27 °C

c) Test voltage : 90 percent and 110 percent of rated voltage

d) Test frequency : Rated frequency

8.1.3 *Freeze-Up Test Conditions*

The freeze-up tests shall be conducted under the conditions specified below:

a) Room air temperature:

1) Dry bulb temperature : 21 °C
2) Wet bulb temperature : 15 °C

b) Outside air temperature:

1) Dry bulb temperature : 21 °C
2) Wet bulb temperature : Not applicable

c) Test voltage : Rated voltage

d) Test frequency : Rated frequency

e) The controls, fan speeds, dampers, and grilles of the equipment shall be set to maximize the tendency to produce frost or ice on the evaporator, provided such settings are not contrary to the manufacturer's operating instructions.

8.1.4 *Enclosure Sweat Test Conditions*

The enclosure sweat test shall be conducted under the conditions given below:

a) Room air temperature:

1) Dry bulb temperature : 27 °C
2) Wet bulb temperature : 24 °C

b) Outside air temperature:

1) Dry bulb temperature : 27 °C
2) Wet bulb temperature : 24 °C

c) Test voltage : Rated voltage

d) Test frequency : Rated frequency

e) The controls, fans, dampers, and grilles of the equipment shall be set to produce the maximum tendency to sweat, provided such settings are not contrary to the manufacturer's operating instructions.

8.1.5 *Condensate Disposal Test Conditions*

The condensate disposal test shall be conducted under the same conditions as those specified for the enclosure sweat tests (*see* **8.1.4**).

8.2 Heating Test

8.2.1 *Heating Capacity Test Conditions*

The heating capacity rating shall be conducted under the conditions given below:

a) Room air temperature:

1) Dry bulb temperature : 20 °C
2) Wet bulb temperature : 15 °C

b) Outside air temperature:

1) Dry bulb temperature : 7 °C
2) Wet bulb temperature : 6 °C

c) Test voltage : Rated voltage

d) Test frequency : Rated frequency

e) On the indoor-side of the heat pump, grille positions, damper positions, fan speeds, etc shall be set in accordance with the manufacturer's published installation instructions, which are normally provided with the equipment. In the absence of such installation instructions, grille positions, damper positions, fan speeds, etc shall be set to provide the maximum heating capacity when testing at the temperature conditions as given in this clause.

NOTE — In case a defrosting cycle occurs during heating capacity test, test under conditions is accomplished using either the calorimeter or the indoor air enthalpy method as per **9.11** and Annex J.

8.2.2 *Heating by Heat Pump Overload Rating Test Conditions* (*Maximum Heating Performance Test*)

The maximum operating tests shall be conducted under the conditions specified below:

a) Room air temperature:

1) Dry bulb temperature : 27 °C
2) Wet bulb temperature : Not applicable

b) Outside air temperature:

1) Dry bulb temperature : 24 °C
2) Wet bulb temperature : 18 °C

c) Test voltage : 90 percent and 110 percent of rated voltage

d) Test frequency : Rated frequency

8.3 Method of Measurement of Indian Seasonal Energy Efficiency Ratio (ISEER)

Temperature and humidity conditions as well as default values for calculation shall be as specified in Table 1.

Table 1 Temperature and Humidity Conditions and Default Values for Cooling at Moderate Climate Condition

(*Clause* 8.3)

Sl No.	Test	Characteristics	Fixed	2-Stage	Multi-Stage	Variable	Default Value
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Standard cooling capacity a) Indoor DB 27 °C WB 19 °C b) Outdoor DB 35 °C WB 24 °C	Full capacity $\varnothing_{ful}$ (35) (W)	■	■	■	■	
		Full power input P_{ful} (35) (W)					
		Half capacity $\varnothing_{half}$ (35) (W)	—	—	○	■	$\varnothing_{half}(29)$ $/1.077$
		Half power input P_{half} (35) (W)					$P_{half}(29)$ $/0.914$
		Minimum capacity $\varnothing_{min}$ (35) (W)	—	○	○	○	$\varnothing_{min}(29)$ $/1.077$
		Minimum power input P_{min} (35) (W)					$P_{min}(29)$ $/0.914$

Key

■ Indicates required test
○ Indicates optional test

9 PERFORMANCE REQUIREMENTS

9.1 Variations Allowed in Performance Test Conditions

The conditions specified for the test shall be average values within the following variations:

a) ± 1 percent of the standard voltage and frequency; and
b) ± 0.3 °C for the specified dry bulb temperature, ± 0.2 °C for the specified wet bulb temperature during the cooling capacity test and ± 0.5 °C for the specified temperature for all other test.

9.2 Safety

Electrical safety tests shall be carried as per **12.3.3**. Air conditioner using A3 refrigerants shall comply with **22.112** to **22.118** of IEC 60335-2-40.

9.3 Power Factor Test

When operating under full load capacity under the test conditions specified in **8.1.1** with controls set for maximum cooling and with ventilating air damper and exhaust damper, if any, closed, the unitary air conditioner shall have an overall power factor, measured at rated voltage and frequency of not less than 0.90.

9.4 Maximum Operating Conditions Test

9.4.1 *Purpose*

The purpose of this test is to prove that the air conditioner is capable of operating satisfactorily under maximum operating conditions.

9.4.2 *Test Conditions*

The maximum operating conditions test shall be conducted under the condition specified in **8.1.2** for cooling and **8.2.2** for heating. The unit controls shall be set for maximum cooling and all ventilating air dampers and exhaust air dampers shall be closed.

NOTE — (*See also* **E-3.1**).

9.4.3 *Voltage Adjustment*

Test voltages shall be as specified in **8.1.2** for cooling only and **8.2.2** for heating by heat pumps. These voltages shall be maintained at the specified percentages under running conditions. In addition, the test voltage shall be adjusted so that it is not less than 86 percent of the rated voltage at the moment of restarting the equipment after the shutdown. After the service has been adjusted to accomplish this result, no subsequent adjustment shall be made during either test.

9.4.4 *Procedure*

9.4.4.1 The unitary air conditioner shall be operated continuously for 1 h after the specified air temperatures and equilibrium condensate level have been established.

9.4.4.2 All power to the unitary air conditioner shall then be cut off for 3 min and then restored. During this test no water shall be sprinkled on to the condenser by external means other than what is condensed in the evaporator.

9.4.4.3 The operation of the equipment may be restarted either automatically or through the use of a remote controller or similar device. The test shall continue for 60 min after the equipment restarts. Refer Fig. 3.

9.4.5 *Requirements*

9.4.5.1 During one entire test, the unitary air conditioner shall operate without visible or audible indication of damage and without tripping.

9.4.5.2 The motor of unitary air conditioner shall operate continuously for the first 1 h of the test without tripping any protective devices.

After the interruption of power, the equipment shall resume operation within 30 min and run continuously for 1 h.

9.4.5.3 The motor overload protective device may trip only during the first 5 min after the shutdown period of 3 min. During the remainder of that 1 h test period, no motor overload protective device shall trip.

9.4.5.4 For those models so designed that resumption of operation does not occur after initial trip within the first 5 min, the unit may remain out of operation for no longer than 30 min. It shall then operate continuously for 1 h.

9.5 Freeze-Up Tests

9.5.1 *Purpose*

The freeze-up air blockage and freeze-up drip performance tests shall be conducted. This test is done to determine the ability of the air conditioner to operate satisfactorily under conditions with the maximum tendency to frost or ice on the evaporator.

9.5.2 *Test Conditions*

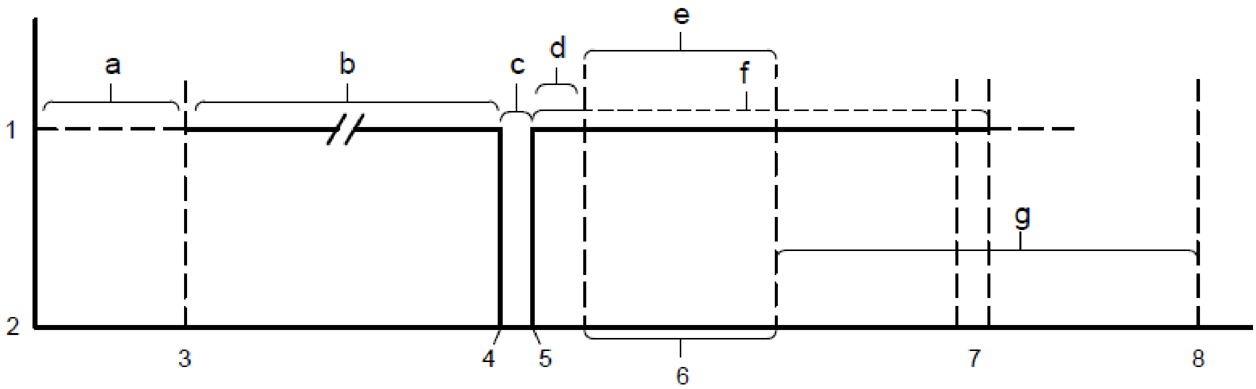
Freeze-up test shall be conducted under the conditions given in **8.1.3**. Temperature control and fan speed shall be set at the lowest and all dampers closed to produce the maximum tendency to frost or ice the evaporator, provided such settings are not contrary to the manufacturer's operating instructions.

NOTE — (*See also* **E-3.1**).

9.5.3 *Air Blockage Test*

9.5.3.1 *Procedure*

The test shall be continuous, with the unit on the cooling cycle for 4 h after establishment of the specified temperature conditions.



Key

1	Power supply to equipment unit on
2	Power supply to equipment off
3	Official test period begins
4	Power supply to equipment turned off
5	Power supply to equipment turned back on
6	Maximum time before equipment resumes continues operation
7	End of test, if equipment restarted upon re-energization of power
8	End of test, if equipment utilized full 30 min for protective device to reset
a	30 min, steady-state operation
b	60 min, continuous operation running at reduced or increased supply voltage
c	3 min, power off
d	5 min, in which a protective device may trip
e	30 min
f, g	60 min of continuous operation after equipment restarts

FIG. 3 SCHEMATIC REPRESENTATION OF MAXIMUM OPERATING CONDITION TEST

9.5.3.2 *Requirements*

At the end of 4 h of operation, any accumulation of ice or frost on the evaporator shall not cover more than 50 percent of the indoor side face area of the evaporator coil.

9.5.4 *Drip Test*

9.5.4.1 *Procedure*

The unit shall be operated for 4 h with the room side air inlet covered to completely block the passage of air so as to attempt to achieve complete blockage of the evaporator coil by frost.

9.5.4.2 After the 4 h operating period, the unit shall be stopped and the air inlet covering removed until the accumulation of ice or frost has melted by itself. The unit shall then be turned ON again, with the fans operating at the highest speed, for 5 min.

9.5.4.3 *Requirements*

During the test no ice shall drop from the unit, and no water shall drip or blow off from the unit on the room side.

9.6 Enclosure Sweat Test

9.6.1 *Purpose*

The purpose of this test is to determine the resistance to sweating of the air conditioner when operating under conditions of high humidity.

9.6.2 *Test Conditions*

An enclosure sweat test shall be conducted under the conditions specified in **8.1.4**. The unit controls, fans, dampers, and grilles shall be set to produce the maximum tendency to sweat provided such settings are not contrary to manufacturer's operating instructions.

NOTE — (*See also* **E-3.1**)

9.6.3 *Procedure*

After establishment of the specified temperature conditions, the unit shall be operated continuously for a period of 4 h.

9.6.4 *Requirements*

During the test, no condensed water shall drip, run, or blow off from the unit.

9.7 Condensate Disposal Test

9.7.1 *Purpose*

The purpose of this test is to determine the capability of the air conditioner to dispose of condensate.

9.7.2 *Test Conditions*

The condensate disposal test shall be conducted under the conditions specified in **8.1.5**. The unit, controls, fans, dampers, and grilles shall be set to produce maximum tendency to sweat, provided such settings are not contrary to the manufacturer's operating instructions.

NOTES

1 This test may be conducted concurrently with the enclosure sweat test (*see* **9.6**).

2 *See also* **E-3.1**.

9.7.3 *Procedure*

After establishment of the specified temperature conditions, the unitary air conditioner shall be started with its condensate collection pan filled to the overflowing point, and shall be operated continuously for 4 h after the condensate level has reached equilibrium.

9.7.4 *Requirements*

During the test, the unitary air conditioner shall have the ability to dispose of all condensate and there shall be no dripping or blowing off of water from the unit such that the building or surroundings may become wet. This observation shall be made after equilibrium is reached.

9.8 Power Consumption Test for Cooling

9.8.1 *Purpose*

The purpose of the power consumption test is to determine the power in watt (W).

9.8.2 *Test Conditions*

The power measurement shall be determined during the cooling capacity test under the conditions given in **8.1.1**.

9.8.3 *Procedure*

The power measurement shall be the average power measurement in watt measured during the cooling capacity test (*see* **9.10**).

9.8.4 *Requirements*

The power consumption under rated conditions shall not exceed by 10 percent of the declared value provided the measured value does not exceed the value given in the Table 2 for air conditioner tested under the conditions laid in **8.1.1**.

9.9 Power Consumption Test for Heating by Heat Pump

9.9.1 *Purpose*

The purpose of the power consumption test is to determine the power in watt (W).

9.9.2 *Test Conditions*

The power measurement shall be determined during the heat pump rating test under the conditions given in **8.2.1**.

9.9.3 *Procedure*

The power measurement shall be the average power measurement in watt measured during the heat pump heating capacity test (*see* **9.11**).

9.9.4 *Requirements*

The rate of power consumption for heat pump tested under the conditions laid in **8.2.1** shall not exceed 110 percent of the rated energy for heating by heat pump.

9.10 Cooling Capacity Test

9.10.1 *Purpose*

The purpose of the cooling capacity test is to determine the magnitude of the following functions:

a) Total cooling effect;
b) Total dehumidifying effect;
c) Total sensible cooling effect; and
d) Total air capacity for cooling.

9.10.2 *Test Conditions*

Cooling capacity test shall be conducted under the conditions specified in **8.1.1** and within the allowable variation given in Table 3. The air conditioner shall be in the condition as normally intended for use. Filters and grilles where supplied shall be in position.

9.10.2.1 The test shall be conducted at the selected conditions with no changes in fan speed or system resistance made to correct the variations from the standard barometric pressure (*see* **3.2**). Test results shall be used to determine capacities without adjustment for permissible variations in the test conditions. Air enthalpies, specific volumes, and isobaric specific heat capacities shall be based on the measured barometric pressure. For calorimetric testing, variations from standard barometric pressure may have an impact on the measured capacity. If capacity, adjusted for standard barometric pressure is additionally reported an explanation of the adjustment method shall be included in the report.

9.10.3 Variations allowed in capacity test conditions shall be as given in Table 3.

Table 2 Power Consumption Rating

(*Clause* 9.8.4)

Sl No.	**Rated Cooling Capacity** (W)	**Maximum Power Consumption at Rated Conditions** (W)
(1)	(2)	(3)
i)	≤ 3 500	1 400
ii)	3 501 ≤ 5 200	2 080
iii)	5 201 ≤ 7 000	2 790
iv)	7 001 ≤ 8 700	3 470
v)	8 701 ≤ 10 500	4 200

Table 3 Variations Allowed in Capacity Test Conditions

(*Clauses* 9.10.2, 9.10.3, 9.11.5.1 *and* 9.11.6.2)

Sl No.	Reading	Variation of Arithmetical Average from Rating Conditions, °C	Maximum Variation of Individual 10 min Readings from the Rating Conditions, °C
(1)	(2)	(3)	(4)
i)	All entering air temperature:		
	a) Dry bulb	0.3	0.5
	b) Wet bulb	0.2	0.3
ii)	Air temperature surrounding balanced ambient calorimeter		
	a) Dry bulb	0.5	1.0
	b) Wet bulb	0.3	0.5

9.10.4 *Procedure for Testing Air Conditioner*

The capacity test can be conducted using one of the following methods:

a) Calorimeter method — This procedure shall be applicable when the air conditioner is tested in calorimeter. The air conditioner shall be tested in calorimeter complying with Annex G. Simultaneous methods for determining capacities shall be used. One method shall determine capacity on the room side and the other shall determine the capacity on the outdoor side. These two simultaneous determinations shall agree within 4 percent of the value obtained on the room side for the test to be valid; or

b) Air enthalpy method/Psychrometric method — This procedure shall be applicable when the air conditioner is tested in psychrometric room. The capacities will be determined from measurements of entering and leaving dry-bulb and wet-bulb temperatures and the associated airflow rate. Air leaving the equipment under the test shall lead directly to the discharge chamber. If a direct connection cannot be made between the equipment and the discharge chamber, a short plenum shall be attached to the equipment. The static pressure difference between the discharge chamber and intake opening of the equipment under test shall be zero. Airflow measurements shall be made in accordance with Annex F.

For the cooling capacity calculations described in Annex H, the indoor-side room discharge airflow rate shall be expressed in units of cubic metre per second (m^3/s) of the air-water vapour mixture. For reporting purposes, the indoor-side air volume flow rate shall be expressed in units of cubic metre per sec (m^3/s) of standard air.

Test conditions shall be maintained until equilibrium has been reached, and maintained for not less than 1 h before recording data for the capacity test. The test shall then be run for 1 h recording data every 10 min, giving 7 sets of reading.

NOTE — The data to be recorded is given in Annex D.

9.10.5 *Requirements*

The capacity of the production unit as determined on the room side shall be not less than 95 percent of the nameplate rating.

9.11 Heating Capacity Test

9.11.1 *General Conditions*

9.11.1.1 For all heating capacity tests, the requirements specified in Annex E shall apply. Testing shall be conducted using the calorimeter test method (*see* Annex G) or indoor air enthalpy test method (*see* Annex H).

9.11.1.2 Selectable resistive elements used for heating indoor air shall be prevented from operating during all heating capacity tests, except those used only during a defrost cycle.

9.11.1.3 The test set-up shall include instrumentation to allow measurement of the temperature change across the indoor coil. If using the indoor air enthalpy method, the same dry-bulb temperature sensors as used to measure capacity may be used. If using the calorimeter test method, the temperature change shall be determined using the sensors specified in Annex G.

9.11.1.4 Standard rating conditions for heating capacity tests are specified in **8.2.1**.

9.11.2 *Airflow Conditions*

9.11.2.1 *Heat pump set-up requirements*

On the indoor side of the heat pump, grille positions, damper positions, fan speeds, etc shall be set in accordance with the manufacturer's published installation instructions, which are normally provided with the equipment. In the absence of such installation instructions, grille positions, damper positions, fan speeds, etc shall be set to provide the maximum heating.

9.11.2.2 *Requirements when using the indoor air enthalpy method*

Heating capacity test shall be conducted with the external static pressure at each unit maintaining the zero static pressure difference between the discharge chamber and intake opening of the equipment under test. For the heating capacity calculations described in Annex H, the indoor-side air volume flow rate shall be expressed in units of cubic metre per second (m^3/s) of the air-water vapour mixture. For reporting purposes, the indoor-side air volume flow rate shall be expressed in units of cubic metre per second (m^3/s) of standard air.

For the heating capacity calculations described in Annex H, the indoor-side room discharge airflow rate shall be expressed in units of cubic metre per second (m^3/s) of the air-water vapour mixture. For reporting purposes, the indoor-side air volume flow rate shall be expressed in units of cubic metre per second of standard air.

NOTE — This test is applicable for fixed speed only.

9.11.3 *Defrost Operation*

9.11.3.1 Overriding of automatic defrost controls shall be prohibited. The controls may only be overridden when manually initiating a defrost cycle during pre-conditioning.

9.11.3.2 If the heat pump turns the indoor fan off during the defrost cycle, airflow through the indoor coil shall cease.

9.11.4 *Test Procedure — General*

The test procedure consists of three periods: a pre-conditioning period, an equilibrium period, and a data collection period. The duration of the data collection period differs depending on whether the heat pump's operation is steady-state.

9.11.5 *Pre-conditioning Period*

9.11.5.1 The test room re-conditioning apparatus and the heat pump under test shall be operated until the test tolerances specified in Table 3 are attained for at least 10 min.

9.11.5.2 A defrost cycle may end a pre-conditioning period. If a defrost cycle does end a pre-conditioning period, the heat pump shall operate in the heating mode for at least 10 min after defrost termination prior to beginning the equilibrium period.

9.11.5.3 It is recommended that the pre-conditioning period end with an automatic or manually-initiated defrost cycle.

9.11.6 *Equilibrium Period*

9.11.6.1 A complete equilibrium period is 1 h in duration.

9.11.6.2 The heat pump shall operate while meeting the Table 3 test tolerances.

9.11.7 *Data Collection Period*

9.11.7.1 The data collection period immediately follows the equilibrium period.

9.11.7.2 Data shall be collected as specified for the test method(s) chosen from **9.11.1.1**. If using the calorimeter method, heating capacity shall be calculated as specified in Annex G. If using the indoor air enthalpy method, heating capacity shall be calculated as specified in Annex H.

9.11.7.3 An integrating electrical power (watt-hour) meter or measuring system shall be used for measuring the electrical energy supplied to the equipment. During defrost cycles and for the first 10 min following a defrost termination, the meter or measuring system shall have a sampling rate of at least every 10 s.

9.11.7.4 Except as specified in **9.11.7.3**, data shall be sampled at equal intervals that span 30 s or less.

NOTE — The data to be recorded is given in Annex D.

9.11.7.5 During defrost cycles, plus the first 10 min following defrost termination, certain data used in evaluating the integrated heating capacity of the heat pump shall be sampled more frequently, at equal intervals that span 10 s or less. When using the indoor air enthalpy method, these more-frequently sampled data include the change in indoor-side dry-bulb temperature. When using the calorimeter method, these more-frequently sampled data include all measurements required to determine the indoor-side capacity.

9.11.7.6 For heat pumps that automatically cycle off the indoor fan during a defrost, the contribution of the net heating delivered and/or the change in indoor-side dry-bulb temperature shall be assigned the value of zero when the indoor fan is off, if using the indoor air enthalpy method. If using the calorimeter test method, the integration of capacity shall continue while the indoor fan is off.

9.11.7.7 For both the indoor air enthalpy and the calorimeter test methods, the difference between the dry-bulb temperature of the air leaving and entering the indoor coil shall be measured. For each 5 min interval during the data collection period, an average temperature difference shall be calculated, $\Delta t_i\ (\tau)$. The average temperature difference for the first 5 min of the data collection period, $\Delta t_i\ (\tau=0)$, shall be saved for the purpose of calculating the change Δt, expressed as a percentage, as given in equation below:

$$\%\Delta t = \left(\frac{\Delta t_{i(\tau=0)} - \Delta t_{i(\tau)}}{\Delta t_{i(\tau=0)}}\right) \times 100$$

9.11.8 *Test Procedure when a Defrost Cycle (Whether Automatically or Manually Initiated) Ends the Preconditioning Period*

9.11.8.1 If the quantity % Δt exceeds 2.5 percent during the first 35 min of the data collection period, the heating capacity test shall be designated as a transient test (*see* **9.11.10**). Likewise, if the heat pump initiates a defrost cycle during the equilibrium period or during the first 35 min of the data collection period, the heating capacity test shall be designated as a transient test.

9.11.8.2 If the conditions specified in **9.11.8.1** do not occur and the test tolerances given in **9.10.3** are satisfied during both the equilibrium period and the first 35 min of the data collection period, then the heating capacity test shall be designated as a steady-state test. Steady-state tests shall be terminated after 35 min of data collection.

9.11.9 *Test Procedure when a Defrost Cycle does not end The Preconditioning Period*

9.11.9.1 If the heat pump initiates a defrost cycle during the equilibrium period or during the first 35 min of the data collection period, the heating capacity test shall be restarted as specified in **9.11.9.3**.

9.11.9.2 If the quantity % Δt exceeds 2.5 percent any time during the first 35 min of the data collection period, the heating capacity test shall be restarted as specified in **9.11.9.3**. Prior to the restart, a defrost cycle shall occur. This defrost cycle may be manually initiated or delayed until the heat pump initiates an automatic defrost.

9.11.9.3 If either **9.11.9.1** or **9.11.9.2** applies, then the restart shall begin 10 min after the defrost cycle terminates with a new, hour-long equilibrium period. This second attempt shall follow the requirements of **9.11.6** and **9.11.7** and the test procedure of **9.11.8**.

9.11.9.4 If the conditions specified in **9.11.9.1** or **9.11.9.2** do not occur and the test tolerances given in **9.10.3** are satisfied during both the equilibrium period and the first 35 min of the data collection period, then the heating capacity test shall be designated as a steady-state test. Steady-state tests shall be terminated after 35 min of data collection.

9.11.10 *Test Procedure for Transient Tests*

9.11.10.1 When, in accordance with **9.11.8.1**, a heating capacity test is designated as a transient test, the adjustments specified in **9.11.10.2** to **9.11.10.6** shall apply.

9.11.10.2 In all cases, the normal outdoor-side airflow of the heat pump shall not be disturbed. If applicable, the outdoor enthalpy test apparatus shall be disconnected and the transient heating capacity test shall be restarted from the beginning with a new **9.11.5** pre-conditioning period.

9.11.10.3 To constitute a valid transient heating capacity test, the test tolerances specified in Table 4 shall be achieved during both the equilibrium period and the data collection period. As noted in Table 4 the test tolerances are specified for two subintervals. Interval H consists of data collected during each heating interval, with the exception of the first 10 min after defrost termination. Interval D consists of data collected during each defrost cycle plus the first 10 min of the subsequent heating interval.

9.11.10.4 The test tolerance parameters in Table 4 shall be determined throughout the equilibrium and data collection periods. All data collected during each interval, H or D, shall be used to evaluate compliance with the Table 4 test tolerances. Data from two or more H intervals or two or more D intervals shall not be combined and then used in evaluating Table 4 compliance. Compliance is based on evaluating data from each interval separately.

9.11.10.5 If using the indoor air enthalpy method, the data collection period shall be extended until 3 h have elapsed or until the heat pump completes three complete cycles during the period, whichever occurs first. If at an elapsed time of 3 h, the heat pump is conducting a defrost cycle, the cycle shall be completed before terminating the collection of data. A complete cycle consists of a heating period and a defrost period; from defrost termination to defrost termination.

9.11.10.6 If using the calorimeter method, the data collection period shall be extended until 6 h have elapsed or until the heat pump completes six complete cycles during the period, whichever occurs first. If at an elapsed time of 6 h, the heat pump is conducting a defrost cycle, the cycle shall be completed before terminating the collection of data. A complete cycle consists of a heating period and a defrost period; from defrost termination to defrost termination.

9.11.11 The measured standard heating capacity at full capacity shall not be less than 90 percent of the rated value.

NOTE — The method of calculation heating seasonal performance and the bin temperature distribution and bin hours are under development.

9.12 Method of Measurement of Indian Seasonal Energy Efficiency Ratio (ISEER)

The test condition for measurement of ISEER for cooling shall be as specified in **8.3**. The method of calculation and the bin temperature distribution shall be as given in **6** of IS 18154 (Part 1). The ISEER of the unit shall be not less than 95 percent of the name plate rating. The measured standard cooling at 50 percent of full capacity shall be ± 5 percent of full load capacity and the measured power consumption for standard cooling at fifty percent of full capacity shall not be more than 10 percent of the rated power consumption at 50 percent of full capacity.

9.13 Maximum Heating Performance Test

9.13.1 *General Conditions*

The conditions given in **8.2.2** shall be used during the maximum heating performance test. The test voltages given in **8.2.2** shall be maintained at the specified percentages under running conditions. The determination of heating capacity and electrical power input is not required for this performance test.

Table 4 Variations Allowed in Heating Capacity Tests when Using the Transient (T) Test Procedure

(*Clauses* 9.11.10.3 *and* 9.11.10.4)

Sl No.	Reading	Variation of Arithmetical Mean Values from Specified Test Conditions		Variation of Individual Readings from Specified Test Conditions	
		Interval H[a]	Interval D[b]	Interval H[a]	Interval D[b]
(1)	(2)	(3)	(4)	(5)	(6)
i)	Temperature of air entering indoor-side:				
	a) Dry-bulb	± 0.6 K	± 1.5 K	± 1.0 K	± 2.5 K
	b) Wet-bulb	—	—	—	—
ii)	Temperature of air entering outdoor-side:				
	a) Dry-bulb	± 0.6 K	± 1.5 K	± 1.0 K	± 5.0 K
	b) Wet-bulb	± 0.3 K	± 1.0 K	± 0.6 K	—
iii)	Voltage	—	—	± 2 percent	± 2 percent

[a] Applies when the heat pump is in the heating mode, except for the first 10 min after termination of a defrost cycle.

[b] Applies during a defrost cycle and during the first 10 min after the termination of a defrost cycle when the heat pump is operating in the heating mode.

NOTE — K denotes difference in temperature.

9.13.2 *Airflow Conditions*

9.13.2.1 The maximum heating performance test shall be conducted with an indoor-side fan speed setting as determined in **8.2.1**.

9.13.3 *Test Conditions*

9.13.3.1 *Pre-conditions*

The controls of the equipment shall be set for maximum heating. All ventilating air dampers and exhaust air dampers, if provided, shall be closed.

9.13.3.2 *Duration of the test*

The equipment shall be operated for 1 h after the specified air temperatures have been attained. The equipment shall be permitted to stop and start under the control of an automatic limit device, if provided.

9.13.3.3 *Performance requirements*

The equipment shall operate under the conditions specified in **8.2.2** and **9.13.3.2**, without indication of damage. The equipment shall be permitted to stop and start under the control of an automatic limit device, if provided. After the interruption of operation, the equipment shall resume operation within 30 min.

9.14 Sound Pressure Test

The sound level measurement shall be made with the A-weighted sound pressure level or dBA scale. For sound test, the air conditioner shall be installed in a sound measuring room as per **9.14.2**. The measuring instrument shall be in accordance to **9.14.3**. The test room conditions shall be maintained as given in **9.14.7**. The unitary air conditioner shall be operated at the conditions given in **9.14.8**. The sound level shall be measured in accordance with the method described in **9.14.9** and shall not exceed the values given in Table 5.

9.14.1 *Purpose*

The purpose of this test is to verify the sound pressure level of the unit.

9.14.2 *Sound Measuring Room*

The sound measuring room for indoor and outdoor side shall be of any of the following:

a) Anechoic room or hemi-anechoic room in accordance to **5** and Annex A of ISO 3745; or
b) Regular performance test laboratory, as installed for cooling capacity test (alternate room).

9.14.3 *Test Equipment*

a) A sound level meter or dBA meter for sound pressure level. The sound level meter shall be of minimum class 2 as specified in IS 15575 (Part 1)/IEC 61672-1. The equipment should be able to provide the A-rating or dBA sound pressure level; and
b) Measurement of the length shall be done with measuring scale or tape with an accuracy of ± 2 mm.

Table 5 Sound Pressure Level

(*Clause* 9.14)

Sl No.	**Rating Cooling Capacity** (W)	**Maximum Sound Pressure Level** (dBA)	
		Indoor Side	Outdoor Side
(1)	(2)	(3)	(4)
i)	Up to 4 400	58	65
ii)	More than 4 400	65	68

NOTE — During starting and stopping it shall be ensured that there is no abnormal noise form the unit under measurement

9.14.4 *Correction for Background Noise*

Background noise correction is applied to the sound pressure level to account for the influence of background noise, if any. Background noise correction is expressed in decibels in the case of A-weighting is denoted K_{1A}. The background sound level should be minimum 10 dBA lower than rated sound pressure level or 20 dBA, whichever is higher. Further, care should be taken that the distance between the wall and microphone should be such that the effect of sound reflected from the wall should be negligible.

The background noise readings when the machine is not on test shall be determined using the same instrument and at the same points as for the test. In case any other equipment (other than the equipment under test) is expected to run during the sound test, the same shall be running during the background sound test. The readings at each point with the machine under test are expected to exceed those due to the background noise alone by at least 10 dBA for good measurement. In case, the differences are less than 3 dBA, the test environment shall be termed as inappropriate for the sound measurement and the test shall be repeated after reducing the background noise.

$$K_{1A} = -10\ Lg(1 - 10^{-0.1\Delta Lp})\ \text{dBA}$$

where

$\Delta L_p = L_{p\ (ST)} - L_{p\ (B)}$

$L_{p\ (ST)}$ is the sound pressure level measured with the noise source test (ST) in operation, in dBA; and

$L_{p\ (B)}$ is the sound pressure level of background (B) noise, in dBA.

9.14.5 *Environmental Correction*

Environmental correction is the correction applied to the sound pressure level to account for the influence of reflected or absorbed sound. Environmental correction is expressed in decibels in the case of A-weighting is denoted K_{2A}.

The environmental correction, K_{2A}, is assumed to be zero for measurements made in Anechoic Rooms and hemi-anechoic rooms which meet the requirements of ISO 3745.

The environmental correction, K_{2A} shall be evaluated based on room absorption method as follows.

The environmental correction, K_{2A}, shall be calculated from the following equation:

$$K_{2A} = 10\ lg\ [1 + 4\tfrac{S}{A}]\ \text{dBA}$$

where

A is the equivalent sound absorption area, in square metres, of the room; and

S is the area, in square metres, of the measurement surface.

For the determination of the equivalent absorption area A, an approximate method for measurements made with A-weighting shall be used. This test method shall be used only in rooms of length and width each less than three times the ceiling height. K_{2A} shall be determined using a value of A given by the following equation:

$$A = \alpha \times S_V$$

where

α is the mean sound absorption coefficient, given for A-weighted quantities in Table 6; and

S_V is the total area, in square metres, of the boundary surfaces of the test room (walls, ceiling and floor).

For the purpose for this standard, to maintain the uniformity of the measurement, standard shapes of measurement surfaces have been considered. Window air conditioner outdoor side, a right parallelepiped with sides parallel to those of the reference box with sides spaced as shown in Fig. 4. For window air conditioner indoor side, a hemisphere of radius 1 m is considered.

For window air conditioner (wall flushed) indoor side,

$$S = 3\pi r^2 = 9.42$$

where

r = radius of hemisphere (r is considered to be 1)

For window air conditioner (protruding) outdoor side,

$$S = (l + 2).(h + 2) + 2(l + 2).(d + 1) + 2(d + 1).(h + 2)$$

where

l = length of unit;
h = height of unit; and
d = depth of unit from the wall surface.

Table 6 Approximate Values of the Mean Sound Absorption Coefficient, α

(*Clause* 9.14.5)

Sl No.	Mean Sound Absorption Coefficient, α	Description of Room
(1)	(2)	(3)
i)	0.05	Nearly empty room with smooth hard walls made of concrete, brick, plaster or tile
ii)	0.10	Partly empty room; room with smooth walls
iii)	0.15	Right cuboid room with furniture; right cuboid machinery room or industrial room
iv)	0.20	Irregularly shaped room with furniture; irregularly shaped machinery room or industrial room
v)	0.25	Room with upholstered furniture; machinery or industrial room with sound-absorbing material on part of ceiling or walls
vi)	0.30	Room with sound-absorbing ceiling, but no sound-absorbing materials on walls
vii)	0.35	Room with sound-absorbing materials on both ceiling and walls
viii)	0.50	Room with large amounts of sound-absorbing materials on ceiling and walls

NOTE — For partly empty psychrometric or calorimetric test room with sheet metal panel surface mean sound absorption coefficient, α shall be considered as 0.05.

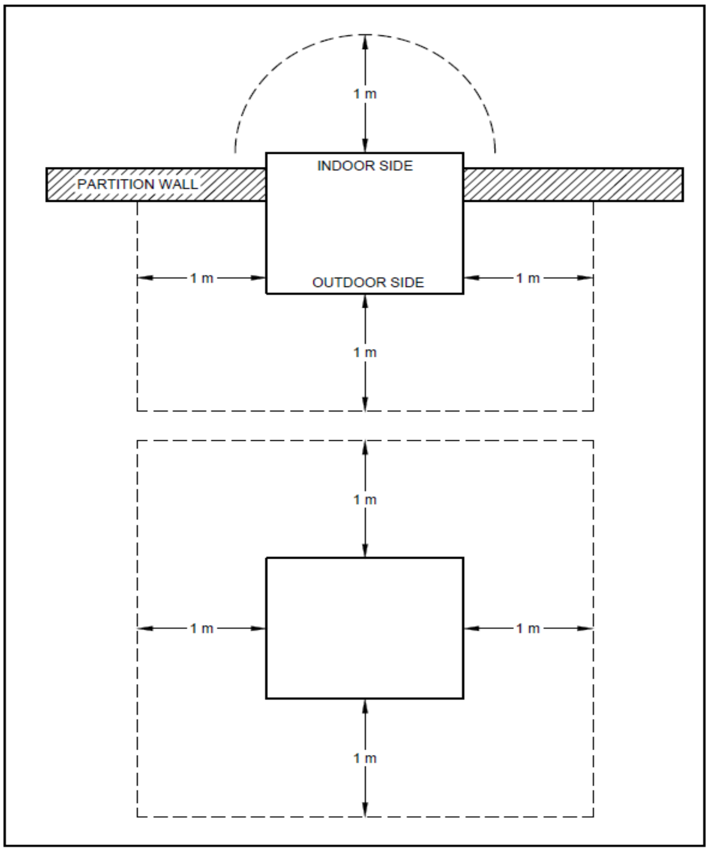


FIG. 4 STANDARD SHAPES MEASUREMENT SURFACE — WINDOW TYPE ROOM AIR CONDITIONER

9.14.6 *Equipment/Sensor Location for Sound Pressure Measurement*

The room air conditioner shall be mounted firmly in the central/partition wall and the microphone shall be located at the position shown in Fig. 5 as applicable with tolerance of ± 0.1 m on horizontal and vertical distance. Measurement to be done at microphone positions on the indoor and outdoor side as shown in Fig. 5.

9.14.7 *Sound Room Temperature Conditions*

a) Indoor : 27 °C ± 5 °C
b) Outdoor : 35 °C ± 5 °C
c) Power supply : Rated power of the units
d) Test voltage : Rated voltage

9.14.8 *Operating Conditions*

a) Fixed speed air conditioner machine compressor shall be in running condition with fan speeds equal to the rated condition fan speeds; and
b) Variable speed air conditioner machine compressor (the controller setting of the two stage/multi-stage/variable capacity compressor) shall be running at the rated 100 percent load speed at the rated condition with fan speeds equal to the rated condition fan speeds.

NOTE — Controller setting for compressor speed at 100 percent load to be provided by the manufacturer.

9.14.9 *Method of Measurement for Room Air Conditioner*

Before starting the readings, machine shall run and stabilize for minimum 10 min for fixed speed machine and 30 min minimum for variable speed machine. Once the unit under test is stabilized and the conditions are achieved as per **9.14.7** and **9.14.8**, the sound test can be started immediately. Average of 3 readings shall be taken.

The A-weighted sound pressure level L_{pA} shall be calculated by correcting the sound pressure level, $L_{p(ST)}$, for background noise (K_{1A}) and for the influence of the test environment (K_{2A}) using below equation.

$$L_{pA} = L_{p(ST)} - K_{1A} - K_{2A}$$

The sound test room type as per **9.14.2**, shall be mentioned while declaring the sound values in the test report.

The conditioning equipment may be switched OFF to minimize the background noise. In case the conditioning equipment is to be switched OFF, the sound test shall be finished within 15 min of switching OFF the conditioning equipment.

10 CALCULATIONS

Cooling/Heating capacity shall be calculated in terms of watt (W).

10.1 Cooling Capacity

The capacity calculation will be done as per Annex G or Annex H.

10.2 Heating Capacity

The capacity calculation will be done as per Annex G or Annex H.

10.3 ISEER Calculation

The ISEER calculation shall be done as per **6** of IS 18154 (Part 1).

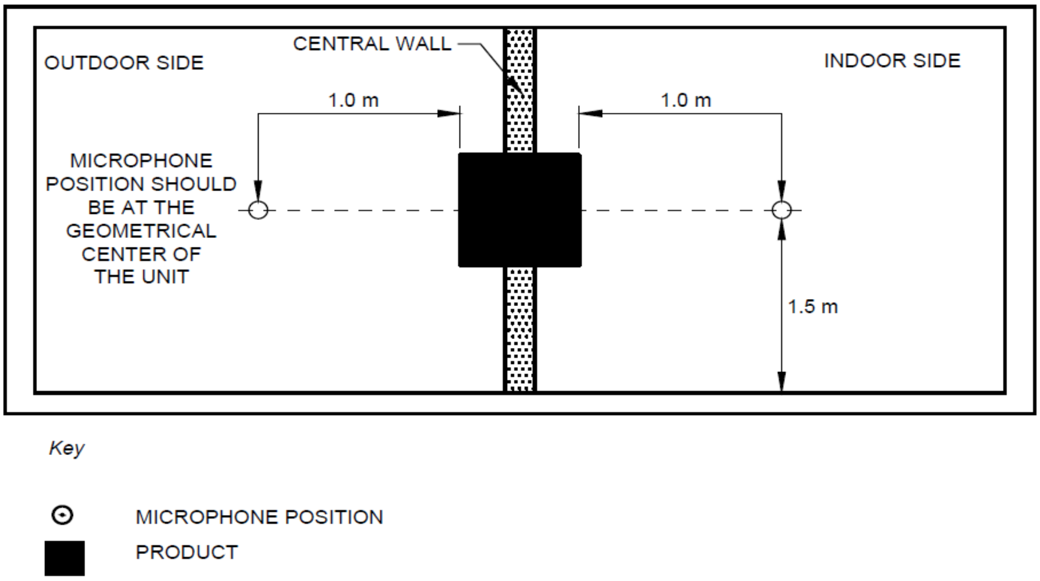
11 INSTRUMENTS

11.1 Temperature Measuring Instruments

11.1.1 Temperature measurements shall be made with one or more of the following instruments:

a) Thermocouples;
b) Electric resistance thermometers/Resistance temperature detectors (RTD); and
c) Electronic temperature indicator.

11.1.2 Instrument accuracy shall be within the limits specified in the Table 7.



NOTE — Microphone height to be adjusted to ensure microphone location is at the geometrical centre of the unit.

FIG. 5 WINDOW TYPE ROOM AIR CONDITIONER INSTALLATION FOR SOUND MEASUREMENT

Table 7 Accuracy and Resolution of Test Equipment

(*Clause* 11.1.2)

Sl No.	Parameter	Unit	Accuracy	Resolution
(1)	(2)	(3)	(4)	(5)
i)	Temperature			
	a) Wet bulb and dry bulb temperatures of reconditioned air in room side	°C	± 0.1	At least 2 decimal place (0.01)
	b) Water temperatures, outdoor side compartment conditioning coil	°C	± 0.1	At least 2 decimal place (0.01)
	c) All other temperatures	°C	± 0.5	At least 1 decimal place (0.1)
ii)	Pressure	Pa	± 1 percent of reading	At least 1 decimal place (0.1)
iii)	Atmospheric pressure (Barometer)	kPa	± 0.5 percent of reading	At least 2 decimal place (0.01)
iv)	Voltage	V	± 0.5 percent of reading	At least 2 decimal place (0.01)
v)	Amperes	A	± 0.5 percent of reading	At least 2 decimal place (0.01)
vi)	Frequency	Hz	± 0.5 percent of reading	At least 2 decimal place (0.01)
vii)	Power	W	± 0.5 percent of reading	At least 1 decimal place (0.1)
viii)	Power factor	φ	± 0.5 percent of reading	At least 2 decimal place (0.01)
ix)	Sound (Pressure)	dB	At least class 2	At least 1 decimal place (0.1)
x)	Time	sec	± 2 percent of reading	At least 2 decimal place (0.01)
xi)	Mass	kg	± 1 percent of reading	At least 2 decimal place (0.01)
xii)	Flow	l/s	± 1 percent of reading	At least 2 decimal place (0.01)

NOTES

1 In all wet bulb temperature, sufficient wetting should be provided, and sufficient time shall be allowed for the state of evaporative equilibrium to be attained.

2 Temperature of fluids within conduits should be measured by inserting temperature instruments directly within the fluid or within a well inserted into the fluid.

3 Electrical measurements shall be made with either indicating type or integrating type of instruments.

12 TESTS

12.1 Classification of Tests

Tests shall be classified into the following three groups:

a) Production routine tests;
b) Type tests; and
c) Acceptance tests.

12.2 Production Routine Tests

These shall consist of routine tests that would be conducted on each and every unit after completion at the manufacturer's works.

12.2.1 *General Running Test*

The air conditioner/heat pump shall be run by supplying the rated voltage and measure the power. The measured power input shall meet the limits prescribed by the manufacturers when tested at the prevailing ambient conditions during the manufacturing process.

12.2.2 *Leakage Test*

The unit shall be subjected to leak test after refrigerant/gas charging to ensure that there is no leakage in the refrigerant circuit using leak detector.

12.2.3 *High Voltage Test*

The electrical insulation of all circuits shall be such as to withstand a test voltage of 1 000 V rms applied for not less than 1 s when tested as per Annex A of IS 302 (Part 1). For inverter unit's compressor drive, earthing wire from accessible metal part may be removed before testing.

12.2.4 *Leakage Current Test*

The leakage current shall not exceed 3.5 mA at rated voltage when tested as per method given in **13.2** of IS 302 (Part 1).

NOTE — The leakage current test when carried out as type test [*see* **12.3.3** (d)] and acceptance test (*see* **12.4.3**) shall be carried out at 1.06 times the rated voltage as specified in **13.1** of IS 302 (Part 1) for motor operated appliances.

12.2.5 *Provisions for Earthing* (*Earth Resistance Test*)

The earth resistance of the unit shall not exceed 0.1 Ω, when tested as per **27** of IS 302 (Part 1).

12.3 Type Tests

The type tests shall consist of the tests that would be necessary to check up the performance and characteristics of the units and components, and shall be carried out by a recognized testing authority. Once a room air conditioner has undergone type tests, any minor or essential alterations which the manufacturer intends to make shall be reported to the testing authority.

12.3.1 Besides all the routine tests outlined in **12.2**, the type tests shall comprise of the following:

a) Power factor test (*see* **9.3**);
b) Maximum operating conditions test (*see* **9.4**);
c) Freeze-up test (*see* **9.5**);
d) Enclosure sweat test (*see* **9.6**);
e) Condensate disposal test (*see* **9.7**);
f) Power consumption test (*see* **9.8** and **9.9**);
g) Cooling capacity test (*see* **9.10**);
h) Heating capacity test (*see* **9.11**);
j) Maximum heating performance test (*see* **9.13**); and
k) Sound pressure test (*see* **9.14**).

12.3.2 The type test report shall also contain the name-plate particulars of the air conditioner for purpose of identification.

12.3.3 *Safety Tests*

The following safety tests shall be carried out as per IS 302 (Part 1):

a) Protection against access to the live part (*see* **8**);
b) Electric strength test (*see* **13.3**);
c) Provision for earthing (*see* **27**); and
d) Electrical leakage current at operating temperature (*see* **13.2**).

12.4 Acceptance Test

If the purchaser desires any of the production routine tests to be repeated at the time of purchase, then, where agreed to between the purchaser and the manufacturer, the tests may be carried out at the manufacturer's works; alternatively, the tests may be repeated at the place specified by the purchaser provided that all the arrangements for tests are made by the purchaser at the specified place. The following shall constitute acceptance tests.

12.4.1 *Performance Test*

Measurements shall be made of the following when tested as per **9.10** and the performance parameters shall be compared with the unit which has already passed the type test:

a) Dry bulb temperature of return air;

b) Dry bulb temperature of the supply air;
c) ISEER;
d) Current consumption;
e) Total power consumption;
f) Voltage; and
g) Power factor.

12.4.2 *Pressure Test or Leakage Test*

No part of the assembly under test shall show signs of leakage when tested with a leak detector after the panel cover removed to access the tubing joints of the unit.

12.4.3 *Leakage Current Test*

The leakage current shall not exceed 3.5 mA when tested at 1.06 times the rated voltage as per **13.2** of IS 302 (Part 1).

13 MARKING

13.1 The unitary air conditioner shall have the following information marked on a nameplate in a location where it is accessible and visible:

a) Manufacturers name/brand/trademark /identification mark;
b) Country of manufacture/origin;
c) Model number and serial number of the unit;
d) Name and quantity of the refrigerant charge;
e) Rated voltage, frequency, and phase;
f) Rated cooling capacity;
g) Heating capacity, if provided;
h) Total power consumption at the rated conditions;
j) Nominal current at rated conditions; and
k) ISEER at rated conditions.

13.2 BIS Certification Marking

Each unitary air conditioner may also be marked with the Standard Mark.

13.2.1 The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

14 PRECAUTIONS

Precautions to install and to run the room air conditioner shall be written on the main body and/or in the instruction manual.

ANNEX A

(*Clause* 2)

LIST OF REFERRED STANDARDS

IS No./Other Standards	*Title*
IS 302 (Part 1) : 2008	Safety of household and similar electrical appliances: Part 1 General requirements
IS 694 : 2010	Polyvinyl chloride insulated unsheathed and sheathed cables/cords with rigid and flexible conductor for rated voltages up to and including 450/750 V (*fourth revision*)
IS 996 : 2009	Single phase a.c. induction motors for general purpose (*third revision*)
IS 3615 : 2020	Glossary of terms used in refrigeration and air conditioning (*second revision*)
IS 9968 (Part 1) : 1988	Specification for elastomer insulated cables: Part 1 For working voltages up to and including 1 100 V (*first revision*)
IS 10617 : 2018	Hermetic compressors — Specification (*second revision*)
IS 10773 : 1995	Wrought copper tubes for refrigeration and air-conditioning purposes — Specification (*first revision*)
IS 11329 : 2018	Finned type heat exchanger for room air conditioner (*first revision*)
IS 15575 (Part 1) : 2016/IEC 61672-1 : 2013	Electroacoustics — Sound level meters: Part 1 Specifications (*first revision*)
IS 16656 : 2017/ ISO 817 : 2014	Refrigerants — Designation and safety classification
IS 16753 (Part 1) : 2022/ISO 29463-1 : 2017	High-efficiency filters and filter media for removing particles in air: Part 1 Classification, performance testing and marking (*first revision*)
IS 17570 (Part 1) : 2021/ISO 16890-1 : 2016	Air filters for general ventilation: Part 1 Technical specifications, requirements and classification system based upon particulate matter efficiency (ePM)
IS 18154 (Part 1) : 2023	Air-cooled air conditioners and air-to-air heat pumps — Testing and calculating methods for seasonal performance factors — Part 1: Cooling seasonal performance factor (ISO 16358-1 : 2013, MOD)
IS/IEC 60730-2-9 : 2011	Automatic electrical controls for household and similar use: Part 2 Particular requirements: Section 9 Temperature sensing controls
ISO 3745 : 2012	Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for anechoic rooms and hemi-anechoic rooms
IEC 60335-2-40 : 2022	Household and similar electrical appliances — Safety Part 2-40 Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers

ANNEX B

(*Foreword*)

UNITS OF MEASUREMENT AND THEIR SYMBOLS

Sl No.	*Quantity*	*International System (SI)*		*Metric System*	
		Unit	Symbol	Unit	Symbol
(1)	(2)	(3)	(4)	(1)	(2)
i)	Acceleration	metre per square second	m/s^2	metre per square second	m/s^2
ii)	Air mass flow rate	kilogram per second	kg/s	kilogram per hour	kg/h
iii)	Air specific humidity	kilogram per kilogram	kg/kg	kilogram per kilogram	kg/kg
iv)	Air specific volume	cubic metre per kg	m^3/kg	cubic metre per kilogram	m^3/kg
v)	Air static volume pressure or dynamic pressure	newton per square metre	N/m^2	millimetre of water	mm H_2O
vi)	Air velocity	metre per second	m/s	metre per second	m/s
vii)	Air volume	cubic metre	m^3	cubic metre	m^3
viii)	Air volume flow rate	cubic metre per second	m^3/s	cubic metre per hour	m^3/h
ix)	Area	square metre	m^2	square metre	m^2
x)	Barometric pressure	newton per square metre	N/m^2	bar millibar millimetre of mercury (torr)	barmbar mm Hg
xi)	Cooling effect	watt	W	kilocalorie per hour	kcal/h
xii)	Dehumidifying effect	watt	W	kilocalorie per hour	kcal/h
xiii)	Electric current input	ampere	A	ampere	A
xiv)	Electric frequency	hertz	Hz	hertz	Hz
xv)	Electric power input	watt	W	watt	W
xvi)	Heat flow rate	watt	W	kilocalorie per hour	kcal/h
xvii)	Heat leakage rate	watt	W	kilocalorie per hour	kcal/h
xviii)	Linear measurements	metre millimetre	m mm	metre millimetre	m mm
xix)	Rotating speed	radian per second	rad/s	turn per second turn per minute	tr/str/min
xx)	Specific enthalpy	joule per kilogram	J/kg	kilocalorie per kilogram	kcal/kg
xxi)	Temperature interval of temperature	kelvin	K	degree Celsius	°C
xxii)	Water mass flow rate	kilogram per second	kg/s	kilogram per hour	kg/h

ANNEX C

(*Clause* 3.2)

SYMBOLS

Sl No.	*Symbol*	*Description*	*Unit*
(1)	(2)	(3)	(4)
i)	A_l	coefficient, heat leakage	J/(s·K)
ii)	A_n	nozzle area	m^2
iii)	c_{pa1}	specific heat of moist air entering indoor-side[b]	J/(kg[b]·K)
iv)	c_{pa2}	specific heat of moist air leaving indoor-side[b]	J/(kg[b]·K)
v)	c_{pa3}	specific heat of moist air entering outdoor-side[b]	J/(kg[b]·K)
vi)	c_{pa4}	specific heat of moist air leaving outdoor-side[b]	J/(kg[b]·K)
vii)	c_{pw}	specific heat of water	J/(kg[b]·K)
viii)	C	airflow coefficient	$Pa/(m^3/s)^2$
ix)	C_d	nozzle discharge coefficient	-[a]
x)	D_e	equivalent diameter	M
xi)	D_i	diameter of circular ducts, inlet	m
xii)	D_n	nozzle throat diameter	m
xiii)	D_o	diameter of circular ducts, outlet	m
xiv)	D_t	outside diameter of refrigerant tube	m
xv)	h_{a1}	specific enthalpy of air entering the indoor-side	J/kg[b]
xvi)	h_{a2}	specific enthalpy of air leaving the indoor-side	J/kg[b]
xvii)	h_{a3}	specific enthalpy of air entering the outdoor-side	J/kg[b]
xviii)	h_{a4}	specific enthalpy of air leaving the outdoor-side	J/kg[b]
xix)	h_{f1}	specific enthalpy of refrigerant liquid entering expansion device	J/kg
xx)	h_{f2}	specific enthalpy of refrigerant liquid leaving condenser	J/kg
xxi)	h_{g1}	specific enthalpy of refrigerant vapour entering compressor	J/kg
xxii)	h_{g2}	specific enthalpy of refrigerant vapour leaving compressor	J/kg
xxiii)	h_{r1}	specific enthalpy of refrigerant entering the indoor-side	J/kg
xxiv)	h_{r2}	specific enthalpy of refrigerant leaving the indoor-side	J/kg
xxv)	h_{w1}	specific enthalpy of water or steam supplied to the indoor side test chamber	J/kg
xxvi)	h_{w2}	specific enthalpy of condensed moisture leaving the indoor side test chamber	J/kg
xxvii)	h_{w3}	specific enthalpy of condensed moisture leaving outdoor-side test chamber	J/kg
xxviii)	h_{w4}	specific enthalpy of the water supplied to the outdoor side test chamber	J/kg
xxix)	h_{w5}	specific enthalpy of the condensed water (in the case of H1 test condition) and the frost, respectively (in the case of H2 or H3 test conditions) in the test unit	J/kg
xxx)	K_1	latent heat of vaporization of water (2 460 J/kg at 15 °C)	J/kg
xxxi)	L	length of refrigerant line	m
xxxii)	L_d	length of duct	m

Table (*Continued*)

Sl No. (1)	*Symbol* (2)	*Description* (3)	*Unit* (4)
xxxiii)	L_m	length to external static pressure measuring point	m
xxxiv)	p_a	barometric pressure	kPa
xxxv)	p_c	test chamber equalization pressure	Pa
xxxvi)	p_e	external static pressure (ESP)	Pa
xxxvii)	p_{isc}	internal static pressure drop of the indoor coil cabinet assembly measured from the cooling capacity test	Pa
xxxviii)	p_m	external static pressure (p_e during the blowing test)	Pa
xxxix)	p_n	absolute pressure at nozzle throat	Pa
xl)	p_v	velocity pressure at nozzle throat or static pressure difference across the nozzle	Pa
xli)	P_{fan}	estimated fan power to circulate indoor air	W
xlii)	P_i	power input, indoor-side data	W
xliii)	P_K	power input to the compressor	W
xliv)	P_t	total power input to the equipment	W
xlv)	q_m	air mass flow rate	kg/s
xlvi)	q_r	refrigerant flow rate	kg/s
xlvii)	q_{ro}	refrigerant and oil mixture flow rate	kg/s
xlviii)	q_v	air volume flow rate	m^3/s
xlix)	q_{vi}	air volume flow rate, indoor-side	m^3/s
l)	q_{vo}	air volume flow rate, outdoor-side	m^3/s
li)	q_w	condenser water flow rate	kg/s
lii)	q_{wc}	rate at which water vapour is condensed by the equipment	kg/s
liii)	q_{wo}	water mass flow supplied to the outside test chamber for maintaining the test conditions	kg/s
liv)	R_e	Reynolds number	-[a]
lv)	*SHR*	sensible heat ratio	-[a]
lvi)	T	thickness of tubing insulation	m
lvii)	t_a	temperature, ambient of compressor calorimeter	°C
lviii)	t_{a1}	temperature of air entering the indoor-side, dry bulb	°C
lix)	t_{a2}	temperature of air leaving the indoor-side, dry bulb	°C
lx)	t_{a3}	temperature of air entering the outdoor-side, dry bulb	°C
lxi)	t_{a4}	temperature of air leaving the outdoor-side, dry bulb	°C
lxii)	t_c	temperature of surface of condenser of the compressor calorimeter	°C
lxiii)	t_e	temperature of surface of evaporator of the compressor calorimeter	°C
lxiv)	t_{w1}	temperature of water entering condenser of the compressor calorimeter	°C
lxv)	t_{w2}	temperature of water leaving condenser of the compressor calorimeter	°C
lxvi)	v_a	velocity of air, at nozzle	m/s
lxvii)	v_n	specific volume of dry air portion of mixture at nozzle[b]	m^3/kg[b]
lxviii)	v'_n	specific volume of dry air portion of mixture at nozzle	m^3/kg
lxix)	W_1	mass of cylinder and bleeder assembly, empty	g

Table (*Continued*)

Sl No.	*Symbol*	*Description*	*Unit*
(1)	(2)	(3)	(4)
lxx)	W_3	mass of cylinder and bleeder assembly, with sample	g
lxxi)	W_5	mass of cylinder and bleeder assembly, with oil from sample	g
lxxii)	W_{i1}	specific humidity of air entering the indoor-side[b]	kg/kg[b]
lxxiii)	W_{i2}	specific humidity of air leaving the indoor-side[b]	kg/kg[b]
lxxiv)	W_n	specific humidity at nozzle inlet[b]	kg/kg[b]
lxxv)	W_r	water vapour (rate) condensed	kg/s
lxxvi)	X_o	concentration of oil to refrigerant-oil mixture	-[a]
lxxvii)	X_r	mass ratio, refrigerant to refrigerant-oil mixture	-[a]
lxxviii)	Y	expansion factor	-[a]
lxxix)	α	pressure ratio	-[a]
lxxx)	α_a	interconnecting tubing heat transfer coefficient	$W/(m^2 \cdot K)$
lxxxi)	λ	thermal conductivity	$W/(m \cdot K)$
lxxxii)	v	kinematic viscosity of air	m^2/s
lxxxiii)	$\eta_{fan,i}$	estimated indoor fan static efficiency	-[a]
lxxxiv)	$\eta_{mot,i}$	estimated indoor motor efficiency	-[a]
lxxxv)	$\sum P_{ic}$	other power input to the indoor side test chamber (for example illumination, electrical and thermal power input to the compensating device, heat balance of the humidification device)	W
lxxxvi)	$\sum P_{oc}$	sum of all total power input to the outdoor side test chamber, not including power to the equipment under test	W
lxxxvii)	ϕ_c	heat removed by the cooling coil in the outdoor-side test chamber	W
lxxxviii)	ϕ_{ci}	heat removed by cooling coil in the indoor-side test chamber	W
lxxxix)	ϕ_d	latent cooling capacity (dehumidifying)	W
xc)	ϕ_e	heat input to evaporator of compressor calorimeter	W
xci)	ϕ_{hi}	heating capacity, indoor-side test chamber	W
xcii)	ϕ_{ho}	heating capacity, outdoor-side test chamber	W
xciii)	ϕ_{li}	heat leakage into the indoor side test chamber through walls, floor and ceiling	W
xciv)	ϕ_{lo}	heat leakage out of the outdoor side test chamber through walls, floor and ceiling	W
xcv)	ϕ_{lp}	heat leakage into the indoor-side test chamber through the partition separating the indoor-side from the outdoor-side	W
xcvi)	ϕ_L	line heat loss in interconnecting tubing	W
xcvii)	ϕ_{sci}	sensible cooling capacity, indoor-side	W
xcviii)	ϕ_{tc}	refrigerating capacity of a refrigerant compressor	W
xcix)	ϕ_{tci}	total cooling capacity, indoor-side	W
c)	ϕ_{tco}	total cooling capacity, outdoor-side	W
ci)	ϕ_{thi}	total heating capacity, indoor-side	W
cii)	ϕ_{tho}	total heating capacity, outdoor-side	W

Table (*Concluded*)

Sl No.	*Symbol*	*Description*	*Unit*
(1)	(2)	(3)	(4)
ciii)	$L_{p(ST)}$	sound pressure level measured with the noise source test (ST) in operation	dBA
civ)	K_{1A}	background noise	dBA
cv)	K_{2A}	environmental correction	dBA
cvi)	$Lp_{(B)}$	sound pressure level of background (B) noise	dBA

[a] dimensionless value
[b] it means the mass of dry air; the mass, kg of denominator in this unit is based on dry air (or da). For units practically used in the air conditioning field, 'kg (da)' is very often used for denominator.

Example; j/kg(da), m^3/kg(da), kg/kg(da)

NOTE — All parameters are in relation to the unit being tested unless specified otherwise.

ANNEX D

(*Clauses* 9.10.4 *and* 9.11.7.4)

DATA TO BE RECORDED FOR COOLING/HEATING CAPACITY TESTS

D-1 GENERAL TEST INFORMATION

The data to be recorded for the cooling capacity test are given in below Table 8 for the calorimeter test method and in Table 9 for the indoor air enthalpy test method.

Table 8 Data to be Recorded for Calorimeter Cooling and Heating Capacity Tests

(*Clause* D-1)

Sl No.	**Data**
(1)	(2)
i)	Date
ii)	Observers
iii)	Barometric pressure in kPa
iv)	Time of test
v)	Fan speed settings
vi)	Applied voltage in V
vii)	Frequency in Hz
viii)	Total current input to unit in A
ix)	Total power input to unit in W NOTE — Total power input to unit, except if more than one external power connection is provided on unit, record input to each connection separately.
x)	Setting of variable capacity compressor at full load
xi)	Dry bulb and wet bulb temperatures of air (in door room side calorimeter compartment) in °C
xii)	Dry bulb and wet bulb temperatures of air (outdoor room side calorimeter compartment) in °C
xiii)	Average air temperature outside the calorimeter (calibrated room type)
xiv)	Total power input to room side and outdoor side test chamber in kW
xv)	Quantity of water evaporated in humidifier in kg
xvi)	Temperature of humidifier water entering room side test chambers or in humidifier tank in °C
xvii)	Cooling water flow rate through outdoor side test chamber for heat rejection coil in l/s
xviii)	Temperature of cooling water entering outdoor side test chamber for heat rejection coil in °C

Table 8 (*Concluded*)

Sl No.	Data
(1)	(2)
xix)	Temperature of cooling water leaving outdoor side test chamber from heat coil in °C
xx)	Water condensed in outdoor side test chamber in °C
xxi)	Temperature of condensed water leaving outdoor side test chamber in °C
xxii)	Volume of air flow through measuring nozzle of separating partition flow metre in m^3/s
xxiii)	Air static pressure difference across separating partition calorimeter test chambers in Pa
xxiv)	Refrigerant charge added during the test in kg
xxv)	Factory charge in kg

Table 9 Data to be Recorded During the Indoor Air Enthalpy Capacity Test

(*Clause* D-1)

Sl No.	Data
(1)	(2)
i)	Date
ii)	Observers
iii)	Barometric pressure in kPa
iv)	Time of test
v)	Total power input to equipment[a] in W NOTE — Total power input to unit, except if more than one external power connection is provided on unit, record input to each connection separately.
vi)	Energy input to equipment[b] in Wh
vii)	Applied voltage in V
viii)	Current in A
ix)	Frequency in Hz
x)	External resistance to airflow in Pa
xi)	Fan speed settings
xii)	Setting of variable capacity compressor at full load
xiii)	Dry bulb temperatures of air entering equipment in indoor side in °C
xiv)	Wet bulb temperatures of air entering equipment in indoor side in °C
xv)	Dry bulb temperatures of air entering equipment in outdoor side in °C
xvi)	Wet bulb temperatures of air entering equipment in outdoor side in °C
xvii)	Volume flow rate of air in m^3/s
xviii)	Refrigerant charge added during the test in kg
xix)	Factory charge in kg

[a] Total power input and, where required, input to equipment components.
[b] Energy input to equipment is required only in defrost operations

D-2 PERFORMANCE TESTS

D-2.1 The test report shall indicate whether the test passed or failed based on recorded data.

For all performance tests relevant information shall be recorded to show the specific requirements for each test has been meet. Additional information to be recorded are as below.

D-2.2 For maximum operating conditions test, following shall be provided:

a) Current recorded at least once in every 10 min in ampere (A);
b) Time at which the power to the unit was interrupted; and
c) Time at which the unit automatically starts and/or stops operating.

D-2.3 For freeze-up drip performance test, following shall be provided:

a) Pictures or sketches of the unit at the end of the test that clearly depicts any area of moisture outside of the unit.

D-2.4 For condensate control and enclosure sweat performance test, following shall be provided:

a) Pictures or sketches of the unit at the end of the test that clearly depicts any area of moisture outside of the unit.

D-2.5 For maximum heating performance test, following shall be provided:

a) Current recorded at least once in every 1 min in ampere (A);
b) Time at which the power to the unit was interrupted; and
c) Time at which the unit automatically starts and/or stops operating.

D-2.6 For automatic defrost performance test, following shall be provided:

a) Temperature of the air leaving the indoor side of the equipment recorded at least once every 1 min in °C.

ANNEX E

(*Clause* 9.11.1.1)

TEST REQUIREMENTS

E-1 GENERAL TEST ROOM REQUIREMENTS

E-1.1 If an indoor condition test room is required, it shall be a room or space in which the desired test conditions can be maintained within the prescribed tolerances. It is recommended that air velocities in the vicinity of the equipment under test not exceed 2.5 m/s.

E-1.2 If an outdoor condition test room or space is required, it shall be of sufficient volume and shall circulate air in a manner such that it does not change the normal air circulating pattern of the equipment under test. It shall be of such dimensions that the distance from any room surface to any equipment surface from which air is discharged is not less than 1.8 m and the distance from any other room surface to any other equipment surface is not less than 1.0 m, except for floor or wall relationships required for normal equipment installation. The room conditioning apparatus should handle air at a rate not less than the outdoor airflow rate, and preferably should take this air from the direction of the equipment air discharge and return it at the desired conditions uniformly and at low velocities.

E-2 EQUIPMENT INSTALLATION

E-2.1 The equipment to be tested shall be installed in accordance with the manufacturer's installation instructions using recommended installation procedures and accessories. In all cases, the manufacturer's recommendations with respect to distances from adjacent walls, amount of extensions through walls, etc shall be followed.

E-2.2 No other alterations to the equipment shall be made except for the attachment of the required test apparatus and instruments in the prescribed manner.

E-2.3 If necessary, the equipment shall be evacuated and charged with the type and amount of refrigerant specified in the manufacturer's instructions.

E-2.4 Air Sampler

The air dry-bulb and wet-bulb temperature (as applicable) shall be measured at multiple locations entering the condenser (outdoor) and evaporator (indoor), based on the airflow nominal face area at the point of measurement. Multiple temperature measurements will be used to determine acceptable air distribution and the mean air temperature. The use of air sampling device as a measuring station reduces the time required to setup a test. The air sampling trees shall be placed within 15 cm to 30 cm from the inlet face of the unit to minimize the risk of damage to the unit while ensuring that the air sampling tubes are measuring the air going into the unit rather than the room air around the unit. For units that have air entering the sides and or bottom of the unit, additional air sampling device should be used. A minimum total of two air sampling device should be used in this case, to assess air temperature uniformity.

The air sampling device shall be located such that it is at geometric center of each rectangle condenser coil; either horizontal or vertical orientation of the branches is acceptable. The sampling device shall cover at least 80 percent of the height and 60 percent of the width of the air entrance to the unit (for long horizontal coils) or shall cover at least 80 percent of the width and 60 percent of the height of the air entrance (for tall vertical coils). The sampling device shall not extend beyond the face of the air entrance area. It is acceptable to block all branch inlet holes that extend beyond the face of the unit.

NOTE — Typical example for air sampling device given in **E-2.4** is for the information and guidance to the testing laboratory.

Fig. 6 gives examples of how an increasing number of air sampling devices are required for longer condenser coils.

E-2.5 Aspirating Psychrometer

The aspirating psychrometer consists of a flow section and utilizes a fan to draw air through the flow section and measures an average value of the sampled air stream. At a minimum, the flow section shall have a means for measuring the dry-bulb temperature (typically, a resistance temperature device (RTD) and a means for measuring the water vapor content (RTD with wetted sock, chilled mirror hygrometer, or relative water vapor content sensor). The aspirating psychrometer shall include a fan that either can be adjusted manually or automatically to maintain required velocity across the sensors. A typical configuration for the aspirating psychrometer is shown in Fig. 7. Psychrometer shall be made from suitable material which may be plastic (such as polycarbonate), aluminum or other metallic materials. All psychrometers for a given system being tested, shall be constructed of the same material. Psychrometers shall be designed such that radiant heat from the motor does not affect sensor measurements. For aspirating psychrometers, velocity across the wet-bulb sensor shall be (5 ± 1) m/s.

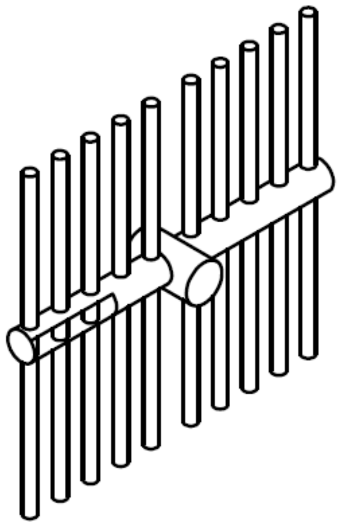


FIG. 6 DETERMINATION OF MEASUREMENT RECTANGLES AND REQUIRED NUMBER OF AIR SAMPLER TREES

E-3 STATIC PRESSURE MEASUREMENTS ACROSS INDOOR COIL

E-3.1 Equipment with a Fan and a Single Outlet

A short plenum shall be attached to the outlet of the equipment. This plenum shall have cross-sectional dimensions equal to the dimensions of the equipment outlets. A static pressure tap shall be added at the centre of each side of the discharge plenum, if rectangular, or at four evenly distributed locations along the circumference of an oval or round plenum. These four static pressure taps shall be manifolded together. The minimum length of the discharge plenum and the location of the static pressure taps relative to the equipment outlets shall be as shown in Fig. 8, if testing a single-package unit.

NOTE — For freeze up test (*see* **9.5**) and enclosure sweat test (*see* **9.6**) connecting duct is not required for testing.

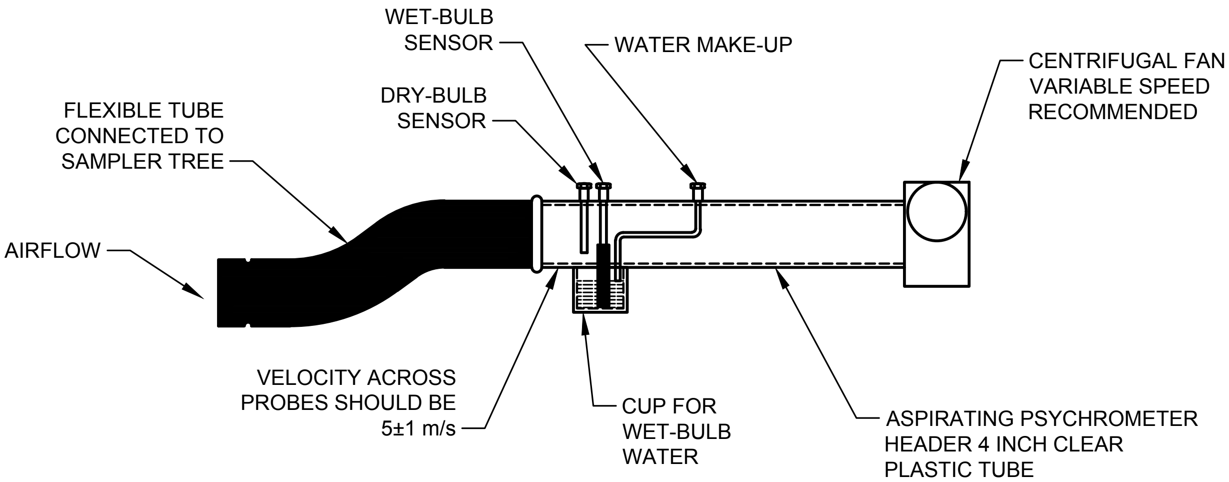
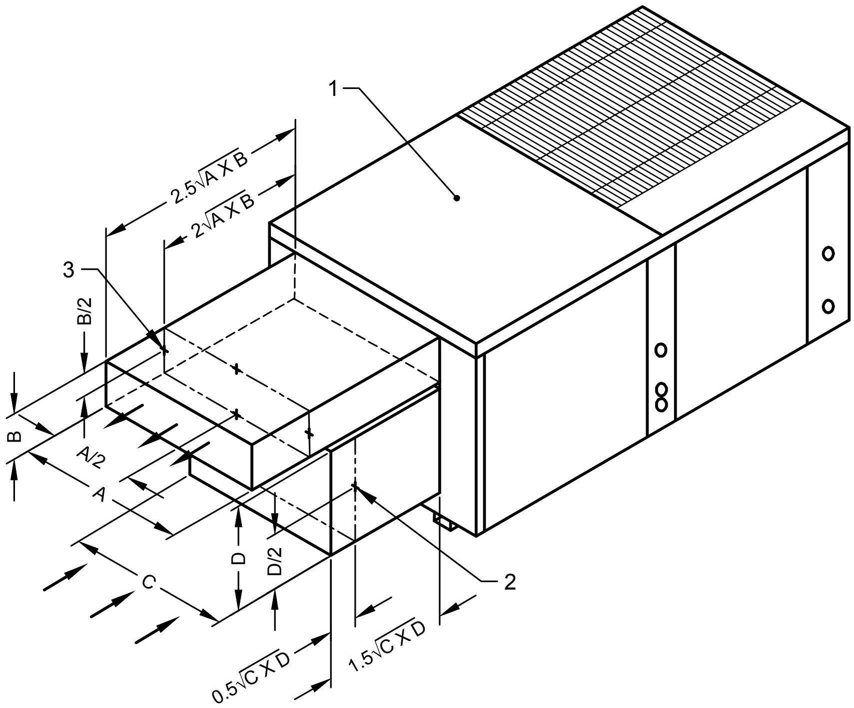


FIG. 7 TYPICAL ASPIRATING PSYCHROMETER



Key

1 Equipment under test — Single package unit
2 Static pressure top, inlet (4 nos.)
3 Static pressure tap, outlet (4 nos.)

NOTE — For circular ducts with diameter, d, substitute $\pi d^2/4$ for ($A \times B$) or ($C \times D$).

FIG. 8 ESP MEASUREMENTS — SINGLE PACKAGE

ANNEX F

[*Clauses* 9.10.4(b) *and* H-2.2]

AIRFLOW MEASUREMENT

F-1 AIRFLOW DETERMINATION

F-1.1 Airflow should be measured using the apparatus and testing procedures given in this annex.

F-1.2 Airflow quantities are determined as mass flow rates.

F-2 NOZZLE APPARATUS

F-2.1 Nozzle Apparatus

a) Option 1 — Consisting of a receiving chamber and a discharge chamber separated by a partition in which one or more nozzles are located (*see* Fig. 9); or
b) Option 2 — Receiving chamber and discharge chamber can be made as separate chambers where nozzles are part of discharge chamber.

Air from the equipment under test is conveyed via a duct to the receiving chamber, passes through the nozzle(s) in discharge chamber and is then exhausted to the test room or channelled back to the equipment's inlet.

F-2.2 Diffusers

a) Option 1 — Installed in the receiving chamber (at a distance at least 1.5 times the largest nozzle throat diameter, D_n) upstream of the partition wall and in the discharge chamber (at a distance at least 2.5 times the largest nozzle throat diameter, D_n) downstream of the exit plane of the largest nozzle; or
b) Option 2 — Installed in the discharge chamber (at a distance at least 1.5 times the largest nozzle throat diameter, D_n) upstream of the inlet plane of the largest nozzle and (at a distance at least 2.5 times the largest nozzle throat diameter, D_n) downstream of the exit plane of the largest nozzle.

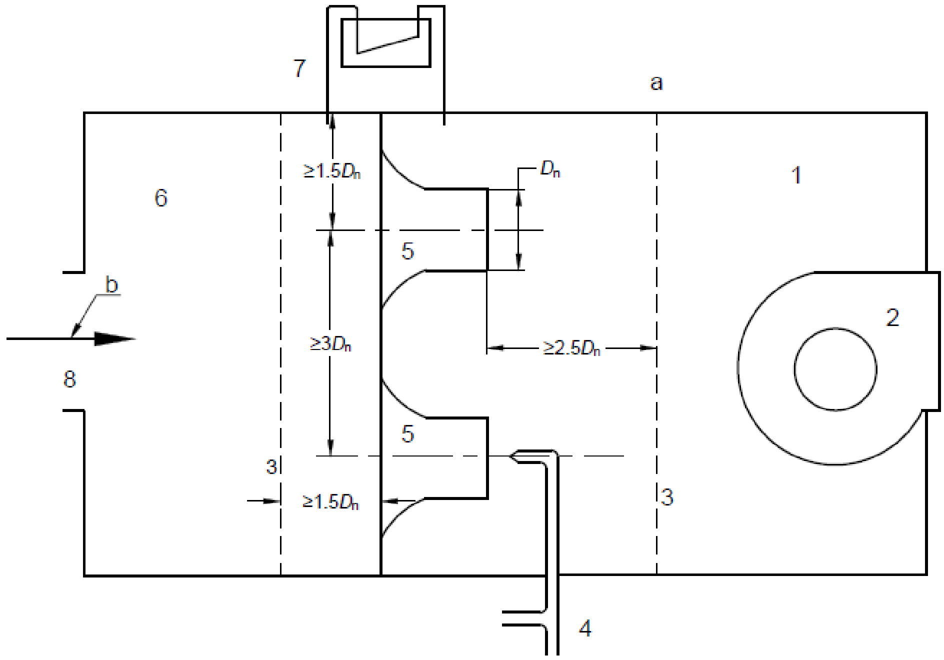
F-2.3 Exhaust Fan

It shall be capable of providing the desired static pressure at the equipment's outlet, installed in one wall of the discharge chamber and provided with a means of varying its capacity.

F-2.4 Manometers/Differential Pressure Gauge

It is used for measuring the static pressure drop across the nozzle(s).

a) Option 1 — One end of the manometer should be connected to a static pressure tap located flush with the inner wall of the receiving chamber and the other end to a static pressure tap located flush with the inner wall of the discharge chamber, or preferably, several taps in each chamber should be connected to several manometers in parallel or manifolded to a single manometer. Static pressure connections should be located so as not to be affected by airflow; or
b) Option 2 — One end of the manometer should be connected to a static pressure tap located flush with the inner wall of the discharge chamber (inlet plane of the nozzles) and the other end to a static pressure tap located flush with the inner wall of the discharge chamber (exit plane of the nozzles), or preferably, several taps in each chamber should be connected to several manometers in parallel or manifolded to a single manometer. Static pressure connections should be located so as not to be affected by airflow.



Key

1 Discharge chamber
2 Exhaust fan
3 Diffusion baffle
4 Pitot tube (optional)
5 Nozzle
6 Receiving chamber
7 Apparatus for differential pressure measurement
8 Adapter duct (*see* **F-4.1**)
a Diffusion baffles should have uniform perforations, with approximately 40 percent of free area
b Airflow

FIG. 9 AIR FLOW MEASURING APPARATUS

F-2.5 Means of Determining the Air Velocity at the Nozzle Throat

F-2.5.1 The throat velocity of any nozzle in use should be not less than 15 m/s or more than 35 m/s.

F-2.5.2 Nozzles should be constructed in accordance with Fig. 9 and applied in accordance with the provisions of **F-2.5.3** and **F-2.5.4.**

F-2.5.3 The nozzle discharge coefficient, C_d, for the construction shown in Fig. 9, which has a throat length to throat diameter ratio of 0.6, may be determined using equation (1).

$$C_d = 0.998\,6 - \frac{7.006}{\sqrt{R_e}} + \frac{134.6}{R_e} \qquad \ldots(1)$$

For Reynolds numbers, R_e, of 12 000 and above.

The Reynolds number is defined as equation (2).

$$R_e = \frac{V_a D_n}{V} \qquad \ldots(2)$$

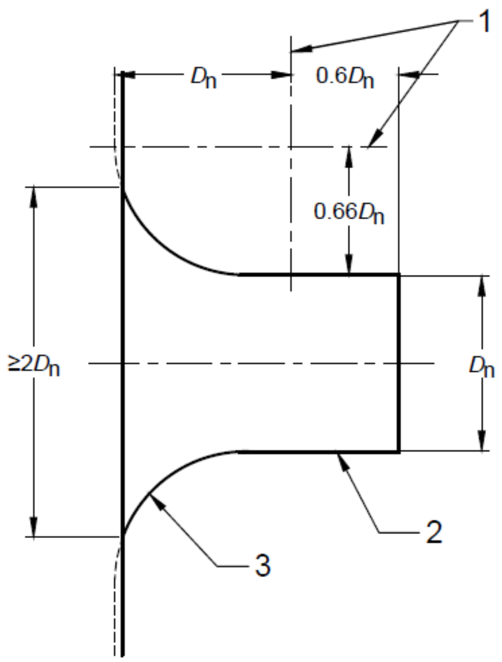
where

va = mean airflow velocity at the throat of the nozzle;

D_n = diameter of the throat of the nozzle; and

v = kinematic viscosity of air.

F-2.5.4 Nozzles may also be constructed in accordance with appropriate national standards, provided they can be used in the apparatus described in Fig. 9 and result in equivalent accuracy.



Key

1 Axes of ellipse
2 Throat section
3 Elliptical approach
d_n Diameter of nozzle throat in metres

FIG. 10 AIR FLOW MEASURING NOZZLES

F-3 STATIC PRESSURE MEASUREMENTS

F-3.1 The pressure taps should consist of (6.25 ± 0.25) mm diameter nipples soldered to the outer plenum surfaces and centred over 1 mm diameter holes through the plenum. The edges of these holes should be free of burrs and other surface irregularities.

F-3.2 The plenum and duct section should be sealed to prevent air leakage, particularly at the connections to the equipment and the air measuring device, and should be insulated to prevent heat leakage between the equipment outlet and the temperature measuring instruments.

F-4 DISCHARGE AIRFLOW MEASUREMENTS

F-4.1 The outlet or outlets of the equipment under test should be connected to the receiving chamber by adaptor ducting of negligible air resistance, as shown in Fig. 9.

F-4.2 To establish zero static pressure with respect to the test room at the discharge of the air conditioner or heat pump in the receiving chamber, a manometer should have one side connected to one or more static pressure connections located flush with the inner wall of the receiving chamber.

F-5 INDOOR-SIDE AIRFLOW MEASUREMENTS

F-5.1 The following readings shall be taken:

a) Barometric pressure;
b) Nozzle dry-bulb temperature; and
c) Static pressure difference at the nozzle(s) or optionally, nozzle velocity pressure.

F-5.2 Air mass flow rate, q_m, through a single nozzle is determined using equation (3).

$$q_m = Y \times C_d \times A_n \sqrt{\frac{2P_v}{v'_n}} \qquad \ldots(3)$$

where

A_n is the area of the nozzle throat, in square metres (m^2).

The expansion factor, Y, is obtained from equation (4).

$$Y = 0.452 + 0.548\,\alpha \qquad \ldots(4)$$

The pressure ratio, α is obtained from equation (5).

$$\alpha = 1 - \frac{p_v}{p_n} \qquad \text{...(5)}$$

Air volume flow rate, q_v, through a single nozzle is determined using equation (6).

$$q_v = Y \times C_d \times A_n \sqrt{2 p_v v'_n} \qquad \text{...(6)}$$

where

v'_n is calculated using equation (7).

$$v'_n = \frac{v_n}{1 + W_n} \qquad \text{...(7)}$$

where

W_n is the specific humidity at the nozzle inlet.

Air volume flow rate expressed in terms of standard air q_s is calculated by equation (8).

$$q_s = \frac{q_v}{1.204\, v'_n} \qquad \text{...(8)}$$

F-5.3 Airflow through multiple nozzles may be calculated in accordance with **F-5.2**, except that the total flow rate is then the sum of the q_m or q_v values for each nozzle used.

ANNEX G

(*Clauses* 9.10.4, 9.11.1.1, 9.11.1.3, 9.11.7.2, 10.1 *and* 10.2)

CALORIMETER TEST METHOD

G-1 GENERAL

G-1.1 The calorimeter provides a method for determining capacity simultaneously on both the indoor-side and the outdoor-side. In the cooling mode, the indoor-side capacity determination should be made by balancing the cooling and dehumidifying effects with measured heat and water inputs. The outdoor-side capacity provides a confirmative test of the cooling and dehumidifying effects by balancing the heat and water rejection on the condenser side with a measured amount of cooling.

G-1.2 The two calorimeter test chambers, indoor-side and outdoor-side, are separated by an insulated partition having an opening into which the non-ducted, single-packaged unitary equipment is mounted.

The equipment should be installed in a manner similar to a normal installation. No effort should be made to seal the internal construction of the equipment to prevent air leakage from the condenser side to the evaporator side or vice versa. No connections or alterations should be made to the equipment which might in any way alter its normal operation.

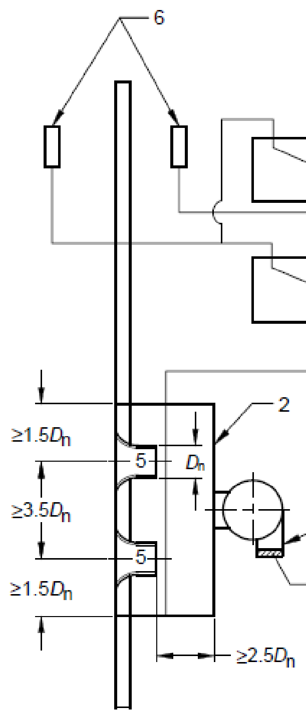
G-1.3 A pressure-equalizing device, as illustrated in Fig.11, should be provided in the partition wall between the indoor-side and the outdoor-side test chambers to maintain a balanced pressure between these test chambers and also to permit measurement of leakage, exhaust and ventilation air. This device consists of one or more nozzles of the type shown in Fig. 10, a discharge chamber equipped with an exhaust fan and manometers for measuring test chamber and airflow pressures.

Since the airflow from one test chamber to the other may be in either direction, two such devices mounted in opposite directions or a reversible device should be used. The manometer pressure pickup tubes should be located so as to be unaffected by air discharged from the equipment or by the exhaust from the pressure-equalizing device. The fan or blower, which exhausts air from the discharge chamber, should permit variation of its airflow by any suitable means, such as a variable speed drive or a damper as shown in Fig. 11. The exhaust from this fan or blower should be such that it does not affect the inlet air to the equipment.

The pressure equalizing device should be adjusted during calorimeter tests or airflow measurements so that the static pressure difference between the indoor-side and outdoor-side test chambers is not greater than 1.25 Pa.

G-1.4 The size of the calorimeter should be sufficient to avoid any restriction to the intake or discharge openings of the equipment. Perforated plates or other suitable grilles should be provided at the discharge opening from the reconditioning equipment to avoid face velocities exceeding 0.5 m/s. Sufficient space should be allowed in front of any inlet or discharge grilles of the equipment to avoid interference with the airflow. Minimum distance from the equipment to side walls or ceiling of the test chamber(s) should be 1 m, except for the back of console-type equipment, which should be in normal relation to the wall. Ceiling-mounted equipment should be installed at a minimum distance of 1.8 m from the floor.

Table 10 gives the suggested dimensions for the calorimeter. To accommodate peculiar sizes of equipment, it may be necessary to alter the suggested dimensions to comply with the space requirements.



Key

1 Pressure manometers
2 Discharge chamber
3 Exhaust fan
4 Damper
5 Nozzle
6 Pick-up tube
p_c Test chamber equalization pressure
p_v Nozzle velocity pressure

FIG. 11 PRESSURE-EQUALIZING DEVICE

Table 10 Size of Calorimeter

(*Clause* G-1.4)

Sl No.	Rated Cooling Capacity of Equipment[1] (W)	Suggested Minimum Inside Dimensions of Each Room of the Calorimeter (m)		
		Width	Height	Length
(1)	(2)	(3)	(4)	(5)
i)	3 000	2.4	2.1	1.8
ii)	6 000	2.4	2.1	2.4
iii)	9 000	2.7	2.4	3.0
iv)	12 000[2]	3.0	2.4	3.7

[1] All figures are round numbers.

[2] Larger capacity equipment requires larger calorimeters.

G-1.5 Each test chamber should be provided with reconditioning equipment to maintain specified airflow and prescribed conditions. Reconditioning apparatus for the indoor-side test chamber should consist of heaters to supply sensible heat and a humidifier to supply moisture. Reconditioning apparatus for the outdoor-side test chamber should provide cooling, dehumidification and humidification. The energy supply should be controlled and measured.

G-1.6 When calorimeters are used for heat pumps, they should have heating, humidifying and cooling capabilities for both rooms (*see* Fig. 12 and Fig. 13) or other means, such as rotating the equipment, may be used as long as the rating conditions are maintained.

G-1.7 Reconditioning apparatus for both test chambers should be provided with fans of sufficient capacity to ensure airflows of not less than twice the quantity of air discharged by the equipment under test in the calorimeter. The calorimeter should be equipped with means of measuring or determining specified wet-bulb and dry-bulb temperatures in both calorimeter test chambers.

G-1.8 It is recognized that in both the indoor-side and outdoor-side test chambers, temperature gradients and airflow patterns result from the interaction of the reconditioning apparatus and test equipment. Therefore, the resultant conditions are peculiar to and dependent on a given combination of test chamber size, arrangement and size of reconditioning apparatus and the air discharge characteristics of the equipment under test.

The point of measurement of specified test temperatures, both wet-bulb and dry-bulb, should be such that the following conditions are fulfilled:

a) The measured temperatures should be representative of the temperature surrounding the equipment and should simulate the conditions encountered in an actual application for both indoor and outdoor-sides, as indicated above;
b) At the point of measurement, the temperature of air should not be affected by air discharged from any piece of the equipment. This makes it mandatory that the temperatures are measured upstream of any re-circulation produced by the equipment; and
c) Air sampling tubes should be positioned on the intake side of the equipment under test.

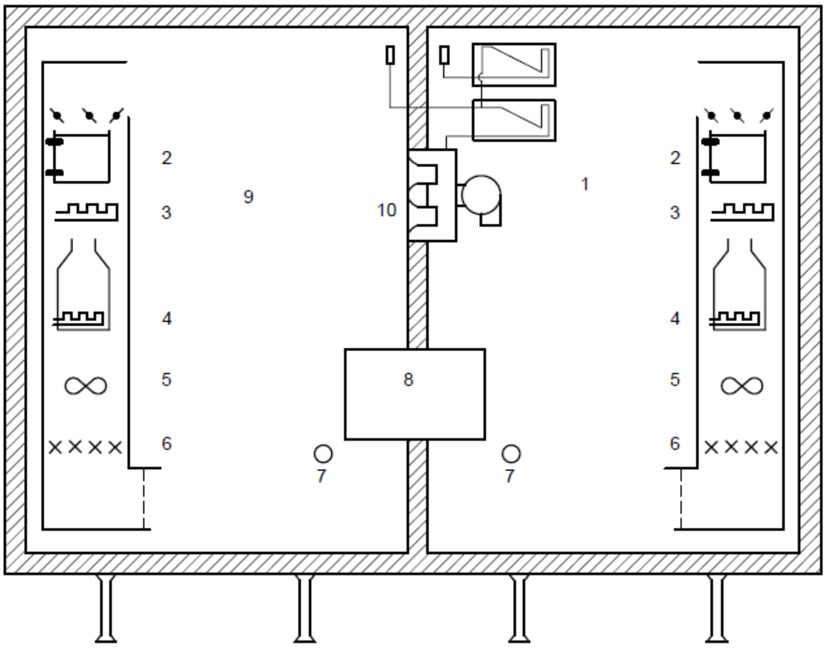
G-1.9 During a heating capacity test, the temperature of the air leaving the indoor-side of the heat pump shall be monitored to determine if its heating performance is being affected by a build-up of ice on the outdoor-side heat exchanger. A single temperature measuring device, placed at the centre of the indoor air outlet, is sufficient to indicate any change in the indoor air discharge temperature caused by a build-up of ice on the outdoor-side heat exchanger.

G-1.10 Interior surfaces of the calorimeter test chambers should be of non-porous material with all joints sealed against air and moisture leakage. The access door should be tightly sealed against air and moisture leakage by use of gaskets or other suitable means.

G-1.11 If defrost controls on the heat pump provide for stopping the indoor airflow, provisions shall be made to stop the test apparatus airflow to the equipment on both the indoor and outdoor-sides during such a defrost period. If it is desirable to maintain operation of the reconditioning apparatus during the defrost period, provisions may be made to bypass the conditioned air around the equipment as long as assurance is provided that the conditioned air does not aid in the defrosting. A watt-hour meter shall be used for obtaining the integrated electrical input to the equipment under test.

G-2 CALIBRATED ROOM-TYPE CALORIMETER

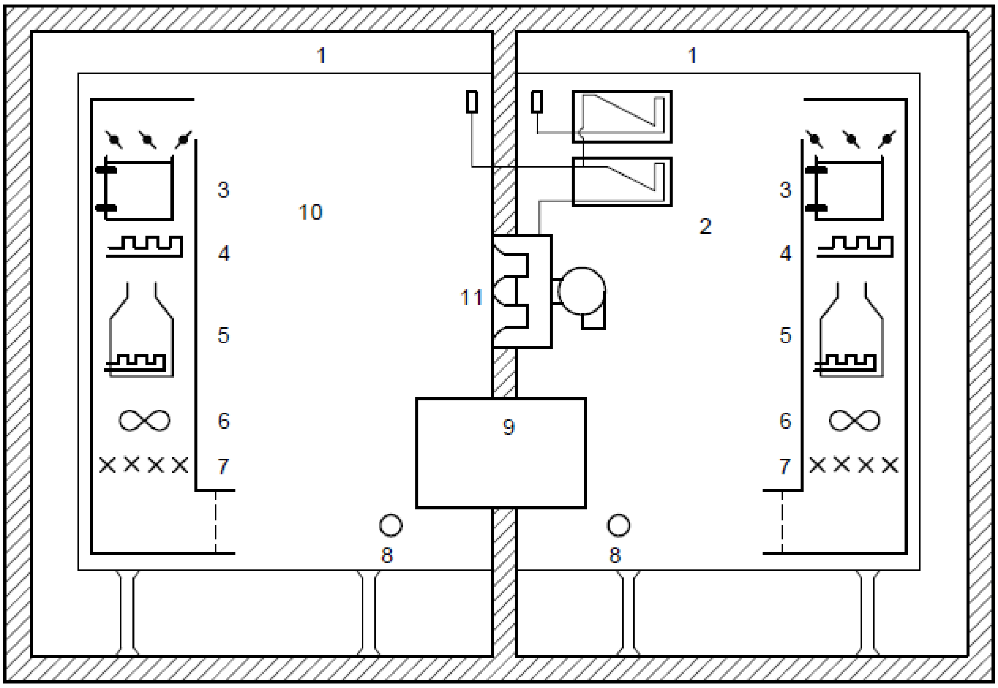
G-2.1 Heat leakage may be determined in either the indoor-side or outdoor-side test chamber by the following method: All openings should be closed. Either test chamber may be heated by electric heaters to a temperature of at least 11 °C above the surrounding ambient temperature. The ambient temperature should be maintained constant within ± 1 K outside all six enveloping surfaces of the test chamber, including the separating partition. If the construction of the partition is identical to that of the other walls, the heat leakage through the partition may be determined on a proportional area basis.



Key

1	Outdoor-side test chamber
2	Cooling coil
3	Heating coil
4	Dehumidifier
5	Fan
6	Mixer
7	Air sampling tube
8	Equipment under test
9	Indoor side test chamber
10	Pressure equalization device

FIG. 12 TYPICAL CALIBRATED ROOM-TYPE CALORIMETER



Key

1 Controlled-temperature air space
2 Outdoor-side test chamber
3 Cooling coil
4 Heating coil
5 Humidifier
6 Fan
7 Mixer
8 Air sampling tube
9 Equipment under test
10 Indoor-side test chamber
11 Pressure equalization device

FIG. 13 TYPICAL BALANCED AMBIENT ROOM-TYPE CALORIMETER

G-2.2 For calibrating the heat leakage through the separating partition alone, the following procedure may be used: a test is carried out as described above. Then the temperature of the adjoining area on the other side of the separating partition is raised to equal the temperature in the heated test chamber, thus eliminating heat leakage through the partition, while the 11 °C differential is maintained between the heated test chamber and the ambient surrounding the other five enveloping surfaces.

The difference in heat input between the first test and the second test permits determination of the leakage through the partition alone.

G-2.3 For the outdoor-side test chamber equipped with means of cooling, an alternative means of calibration may be to cool the test chamber to a temperature of at least 11 °C below the ambient temperature (on six sides) and carry out a similar analysis.

G-2.4 The indoor-side calorimeter including the central partition and the outdoor-side calorimeter shall be insulated so that heat leakage (including radiation) does not exceed 5 percent of the equipment capacity. Space where enough air circulation is available shall be secured under the floor of the room-type calorimeter.

G-3 BALANCED AMBIENT ROOM-TYPE CALORIMETER

G-3.1 The balanced ambient room-type calorimeter is shown in Fig. 13 and is based on the principle of maintaining the dry-bulb temperatures surrounding the particular test chamber equal to the dry-bulb temperatures maintained within that test chamber. If the ambient wet-bulb temperature is also maintained equal to that within the test chamber, the vapour-proofing provisions of **G-1.10** are not required.

G-3.2 The floor, ceiling and walls of the calorimeter test chambers shall be spaced a sufficient distance away from the floor, ceiling and walls of the controlled areas in which the test chambers are located in order to provide a uniform air temperature in the intervening space. It is recommended that this distance be at least 0.3 m. Means shall be provided to circulate the air within the surrounding space to prevent stratification.

G-3.3 Heat leakage through the separating partition shall be introduced into the heat balance calculation and may be calibrated in accordance with **G-3.4** or may be calculated.

G-3.4 It is recommended that the floor, ceiling, and walls of the calorimeter test chambers be insulated so as to limit heat leakage (including radiation) to no more than 10 percent of the test equipment's capacity, with an 11 °C temperature difference, or 300 W for the same temperature difference, whichever is the greater, as tested using the procedure given in **G-2.2**.

G-4 CALCULATION OF COOLING CAPACITY

G-4.1 The energy flow quantities used to calculate the total cooling capacity, based on indoor-side and outdoor-side measurements, are shown in Fig. 14.

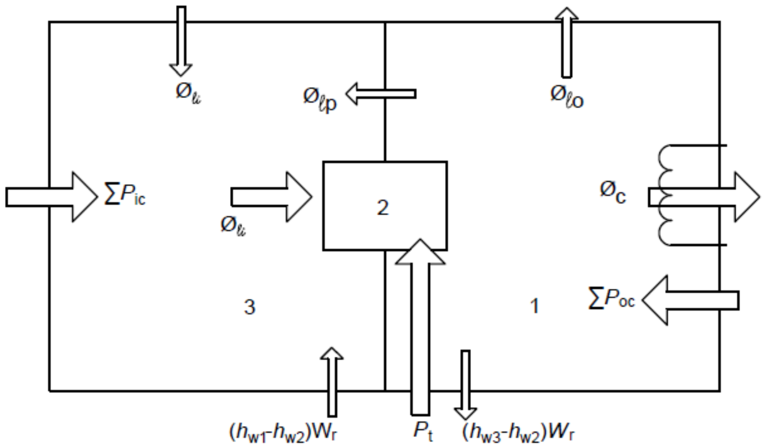
G-4.2 The total cooling capacity on the indoor-side, ϕ_{tci}, as tested in either the calibrated or balanced ambient, room-type calorimeter, is calculated using equation (9).

$$\emptyset_{tci} = \sum P_{ic} + (h_{w1} - h_{w2})W_r + \emptyset_{lp} + \emptyset_{li} \quad \ldots(9)$$

NOTE — If no water is introduced during the test, h_{w1} is taken at the temperature of the water in the humidifier tank of the conditioning apparatus.

When a cooling coil of the indoor-side calorimeter is used for testing of small capacity units, in order to stabilize the test condition, equation 10 shall be used. Φ_{ci} in equation (10) is the amount of heat exchanged in the cooling coil of the indoor-side calorimeter.

$$\emptyset_{tci} = \sum P_{ic} + (h_{w1} - h_{w2})W_r + \emptyset_{lp} + \emptyset_{li} - \emptyset_{ci} \quad \ldots(10)$$



Key

1 Outdoor-side test chamber
2 Equipment under test
3 Indoor-side test chamber

FIG. 14 CALORIMETER ENERGY FLOWS DURING COOLING CAPACITY TESTS

G-4.3 When it is not practical to measure the temperature of the air leaving the indoor-side test chamber to the outdoor-side test chamber, the temperature of the condensate may be assumed to be at the measured or estimated wet-bulb temperature of the air leaving the test equipment.

G-4.4 The water vapour condensed by the equipment under test, W_r, may be determined by the amount of water evaporated into the indoor-side test chamber by the reconditioning equipment to maintain the required humidity.

G-4.5 Heat leakage, ϕ_{lp}, into the indoor-side test chamber through the separating partition between the indoor-side and outdoor-side test chambers may be determined from the calibrating test or, in the case of the balanced-ambient room-type test chamber, may be based on calculations.

G-4.6 The total cooling capacity on the outdoor-side, ϕ_{tco}, as tested in either the calibrated or balanced-ambient, room-type calorimeter is calculated using equation (11).

$$\emptyset_{tco} = \emptyset_c - \sum P_{oc} - P_t + (h_{w1} - h_{w2})W_r + \emptyset_{lp} + \emptyset_{lo} \quad \ldots(11)$$

NOTE — The h_{w3} enthalpy is taken at the temperature at which the condensate leaves the outdoor-side test chamber of the reconditioning apparatus.

G-4.7 The heat leakage rate into the indoor-side test chamber through the separating partition between the indoor-side and outdoor-side test chambers, ϕ_{lp}, may be determined from the calibrating test or, in the case of the balanced-ambient room-type test chamber, may be based on calculations.

NOTE — This quantity is numerically equal to that used in equation (9) if, and only if, the area of the separating partition exposed to the outdoor-side is equal to the area exposed to the indoor-side test chamber.

G-4.8 The latent cooling capacity (room dehumidifying capacity), ϕ_d, is calculated using equation (12).

$$\emptyset_d = K_1 W_r \quad \ldots(12)$$

G-4.9 The sensible cooling capacity, ϕ_{sci}, is calculated using equation (13).

$$\emptyset_{sci} = \emptyset_{tci} - \emptyset_d \quad \ldots(13)$$

G-4.10 Sensible heat ratio (SHR) is calculated using equation (14).

$$SHR = {\emptyset_{sci}}/{\emptyset_{tci}} \quad \ldots(14)$$

G-5 CALCULATION OF HEATING CAPACITY

G-5.1 The energy flow quantities used to calculate the total heating capacity, based on indoor-side and outdoor-side measurements, are shown in Fig. 15.

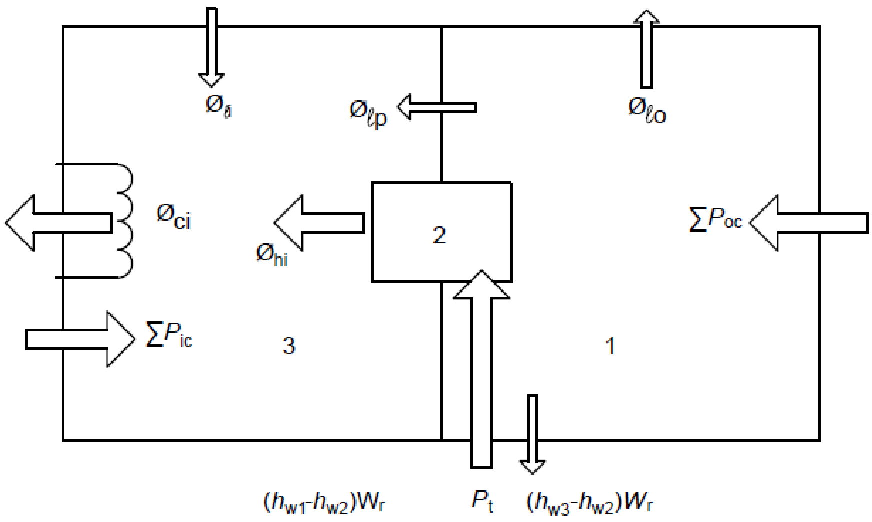
G-5.2 Determination of the heating capacity by measurement in the indoor-side test chamber of the calorimeter, ϕ_{hi}, is calculated using equation (15).

$$\emptyset_{hi} = \emptyset_{ci} - \sum P_{ic} - \emptyset_{lp} - \emptyset_{li} \quad \ldots(15)$$

NOTE — ΣP_{ic} is the other power input to the indoor-side test chamber (for example illumination, electrical and thermal power input to the compensating device, heat balance of the humidification device) in watts.

G-5.3 Determination of the heating capacity by measurement of the heat absorbing side, ϕ_{ho}, is calculated for equipment where the evaporator takes the heat from an airflow using equation (16).

$$\emptyset_{ho} = \sum P_{oc} + P_t + (h_{w4} - h_{w5})q_{wo} - q_{lp} - \emptyset_{lo} \quad \ldots(16)$$



Key

1 Outdoor-side test chamber
2 Equipment under test
3 Indoor-side test chamber

FIG. 15 CALORIMETER ENERGY FLOWS DURING HEATING CAPACITY TESTS

ANNEX H

(*Clauses* 9.10.4, 9.11.1.1, 9.11.2.2, 9.11.7.2, 10.1 *and* 10.2)

INDOOR AIR ENTHALPY TEST METHOD

H-1 GENERAL

In the air enthalpy test method, capacities are determined from measurements of entering and leaving wet-bulb and dry-bulb temperatures and the associated airflow rate.

H-2 APPLICATION

H-2.1 Air leaving the equipment under the test shall lead directly to the discharge chamber. If a direct connection cannot be made between the equipment and the discharge chamber, a short plenum shall be attached to the equipment. In this case, the short plenum shall have the same size as the discharge opening of the equipment or shall be constructed so as not to prevent the leaving air from expanding. The cross-section area of the airflow channel through the discharge chamber shall be such that the average air velocity is less than 1.25 m/s against the airflow rate of the equipment under test. The static pressure difference between the discharge chamber and intake opening of the equipment under test shall be zero.

H-2.2 Airflow measurements shall be made in accordance with the provisions specified in Annex F.

H-3 CALCULATION OF COOLING CAPACITY

The total cooling capacity based on the indoor-side test data, ϕ_{tci}, shall be calculated using equation (17).

$$\emptyset_{tci} = \frac{q_{vi}(h_{a1}-h_{a2})}{v_n} = \frac{q_{vi}(h_{a1}-h_{a2})}{v'_n(1+W_n)} \quad \ldots(17)$$

The sensible cooling capacity based on the indoor-side test data, ϕ_{sci}, shall be calculated using equation (18).

$$\emptyset_{sci} = \frac{q_{vi}(c_{pa1}t_{a1}-c_{pa2}t_{a2})}{v_n} = \frac{q_{vi}(c_{pa1}t_{a1}-c_{pa2}t_{a2})}{v'_n(1+W_n)} \quad \ldots(18)$$

The latent cooling capacity based on the indoor-side test data, ϕ_d, shall be calculated using equation (19) and (20).

$$\emptyset_d = \frac{K_1 q_{vi}(W_{i1} - W_{i2})}{v_n} = \frac{K_1 q_{vi}(W_{i1} - W_{i2})}{v'_n(1 + W_n)} \quad \ldots(19)$$

$$\emptyset_d = \emptyset_{tci} - \emptyset_{sci} \quad \ldots(20)$$

H-4 CALCULATION OF HEATING CAPACITY

Total heating capacity based on indoor-side data, ϕ_{thi}, shall be calculated using equation (21).

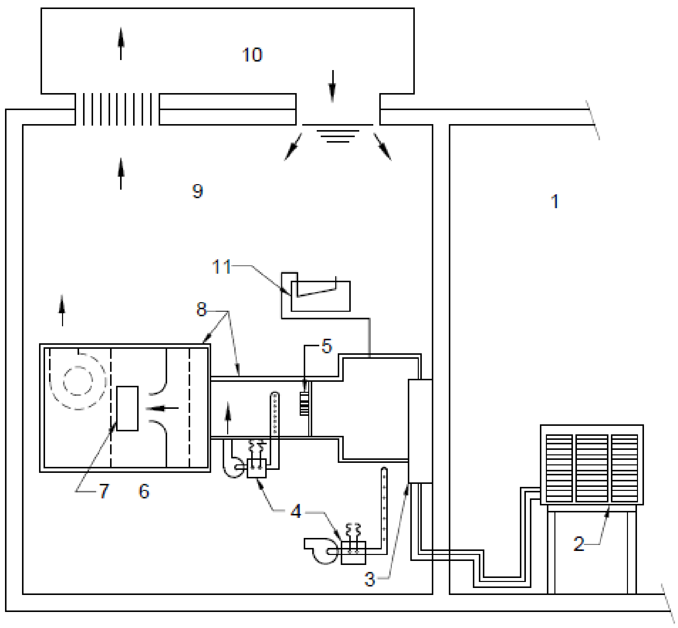
$$\emptyset_{thi} = \frac{q_{vi}\left(c_{pa2}t_{a2} - c_{pa1}t_{a1}\right)}{v_n} = \frac{q_{vi}(c_{pa2}t_{a2} - c_{pa1}t_{a1})}{v'_n(1 + W_n)} \quad \ldots(21)$$

NOTE — C_{pa1} can be equal to C_{pa2}.

H-5 AIRFLOW ENTHALPY MEASUREMENTS

H-5.1 Tunnel Air Enthalpy Method

The equipment to be tested is typically located in a test room or rooms. An air measuring device is attached to the equipment air discharge (indoor). This device discharges directly into the test room or space, which is provided with suitable means for maintaining the air entering the equipment at the desired wet-bulb and dry-bulb temperatures (*see* Fig. 16). Suitable means for measuring the wet-bulb and dry-bulb temperatures of the air entering and leaving the equipment and the external resistance shall be provided.



Key

1	Outdoor-side test room
2	Outdoor unit of equipment under test
3	Indoor-side coil section of equipment under test
4	Air temperature and humidity measuring instruments
5	Mixer
6	Airflow measuring apparatus
7	Door/Window
8	Insulation
9	Indoor-side test room
10	Room conditioning apparatus
11	Apparatus for differential pressure measurement

FIG. 16 TUNNEL AIR ENTHALPY TEST METHOD ARRANGEMENT

ANNEX J

(*Clause* 9.11)

(*Informative*)

PICTORIAL EXAMPLES OF THE HEATING CAPACITY TEST PROCEDURES

J-1 GENERAL

The six schematic diagrams given in the examples shown in Fig. 17 to Fig. 23 show several cases which could occur while conducting a heating capacity test as specified in **9.11**. All examples show cases where a defrost cycle ends the preconditioning period Fig. 17 to Fig. 23 represent cases where the indoor air enthalpy method is used and, as a result, the data collection period for the transient test lasts 3 h or three complete cycles (as opposed to 6 h or six complete cycles if using the calorimeter test method).

J-2 PROCEDURE FLOW CHART FOR HEATING CAPACITY TEST

The following flow chart gives the procedures to be adopted and the clauses in the main text to be used when conducting the heating capacity test.

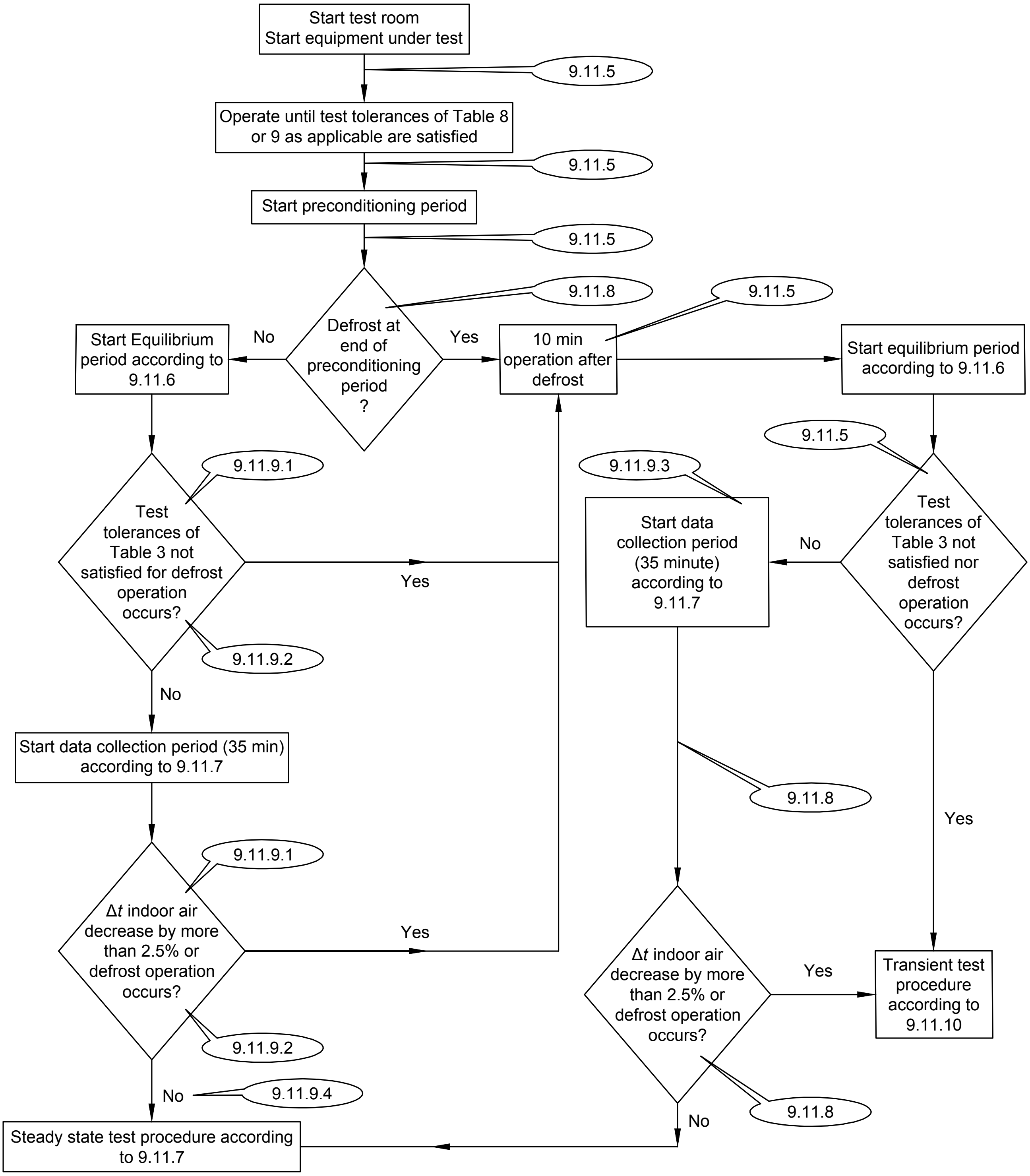
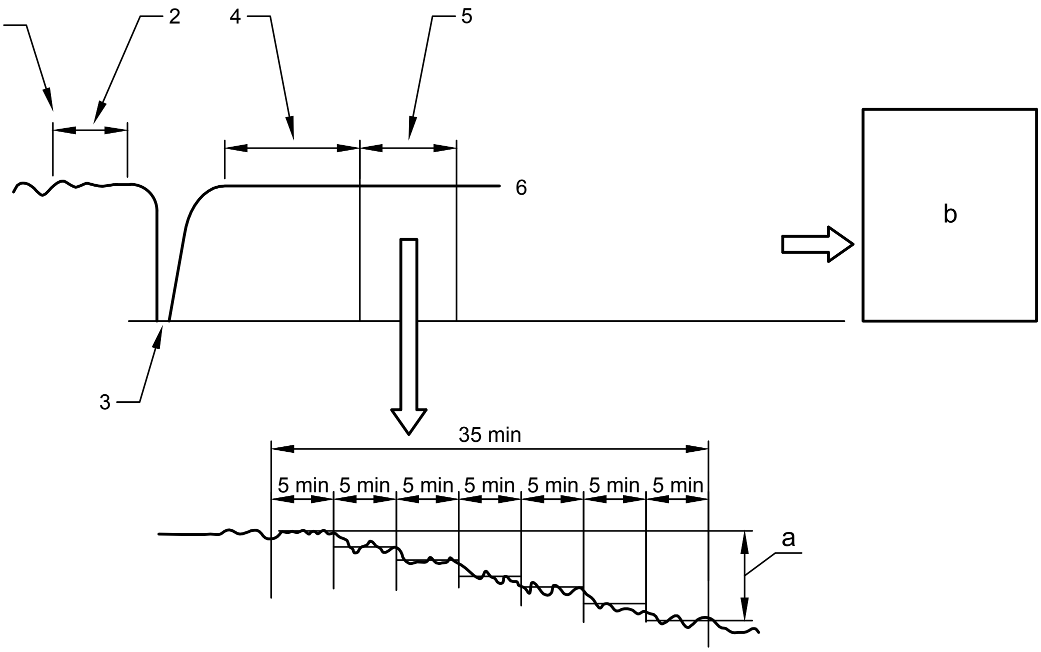


FIG. 17 PROCEDURE FLOW CHART



Key

1 Compliance with test tolerances first achieved

2 Preconditioning period (10 min minimum)

3 Defrost at end of preconditioning period

4 equilibrium period (60 min)

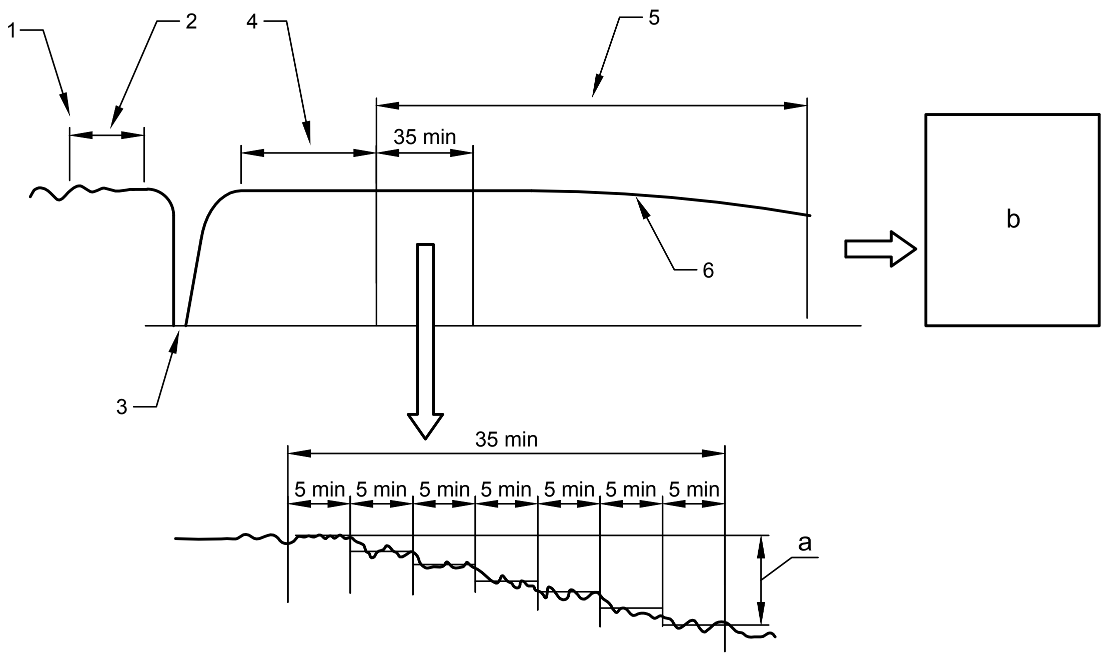
5 Data collection period (35 min)

6 Difference in indoor air temperature $\Delta t_{\text{indoor air}}$

a $\Delta t_{\text{indoor air}}$ decrease by 2.5 percent or less during the first 35 min of data collection period

b Steady-state test. Terminate test when data collection period equals 35 min

FIG. 18 STEADY STATE HEATING CAPACITY TEST



Key

1 Compliance with test tolerances first achieved

2 Preconditioning period (10 min minimum)

3 Defrost at end of preconditioning period

4 Equilibrium period (60 min)

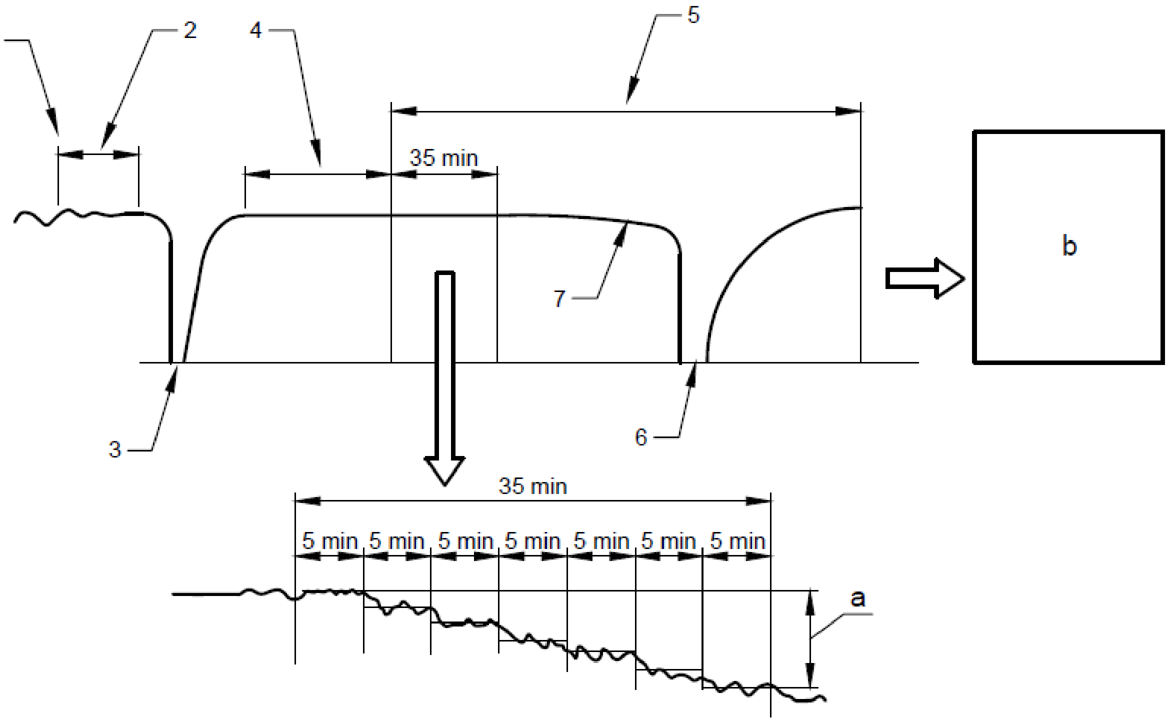
5 Data collection period (3 h)

6 Difference in indoor air temperature $\Delta t_{\text{indoor air}}$

a $\Delta t_{\text{indoor air}}$ decrease by 2.5 percent or less during the first 35 min of data collection period

b Transient test. Terminate test when data collection period equals 3 h

FIG. 19 TRANSIENT HEATING CAPACITY TEST WITH NO DEFROST CYCLES



Key

1 Compliance with test tolerances first achieved

2 Preconditioning period (10 min minimum)

3 Defrost at end of preconditioning period

4 Equilibrium period (60 min)

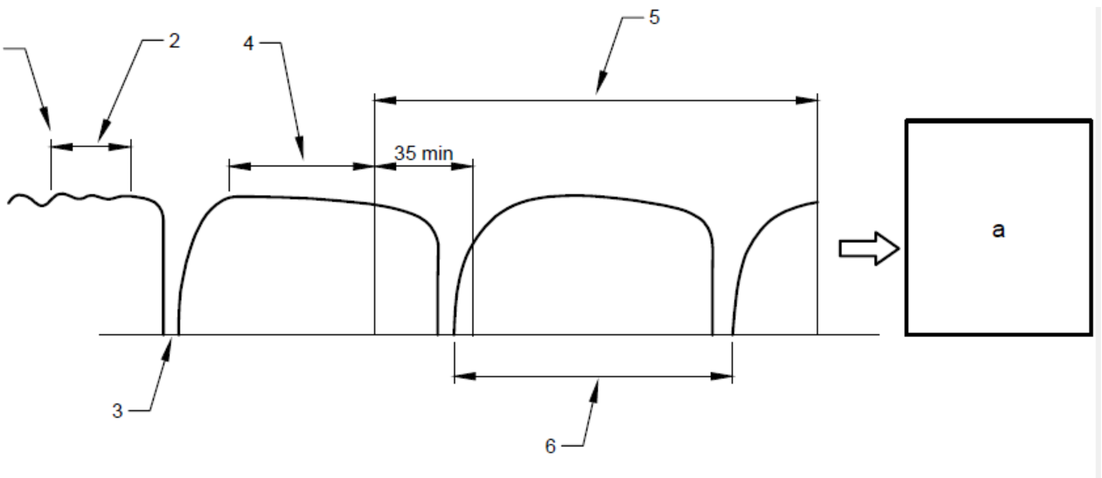
5 Data collection period (3 h)

6 Difference in indoor air temperature $\Delta t_{indoor\ air}$

a $\Delta t_{indoor\ air}$ decrease by 2.5 percent or less during the first 35 min of data collection period

b Transient test. Terminate test when data collection period equals 3 h

FIG. 20 TRANSIENT HEATING CAPACITY TEST WITH ONE DEFROST CYCLE DURING THE DATA COLLECTION PERIOD



Key

1 Compliance with test tolerances first achieved

2 Preconditioning period (10 min minimum)

3 Defrost at end of preconditioning period

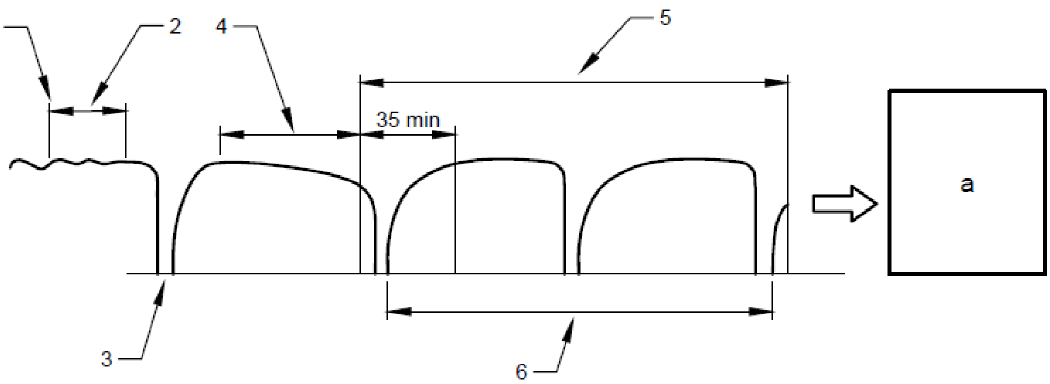
4 Equilibrium period (60 min)

5 Data collection period (3 h)

6 One complete defrost cycle

a Transient test. Terminate test when data collection period equals 3 h

FIG. 21 TRANSIENT HEATING CAPACITY TEST WITH ONE COMPLETE CYCLE DURING THE DATA COLLECTION PERIOD



Key

1 Compliance with tolerances first achieved

2 Preconditioning period (10 min minimum)

3 Defrost at end of preconditioning period

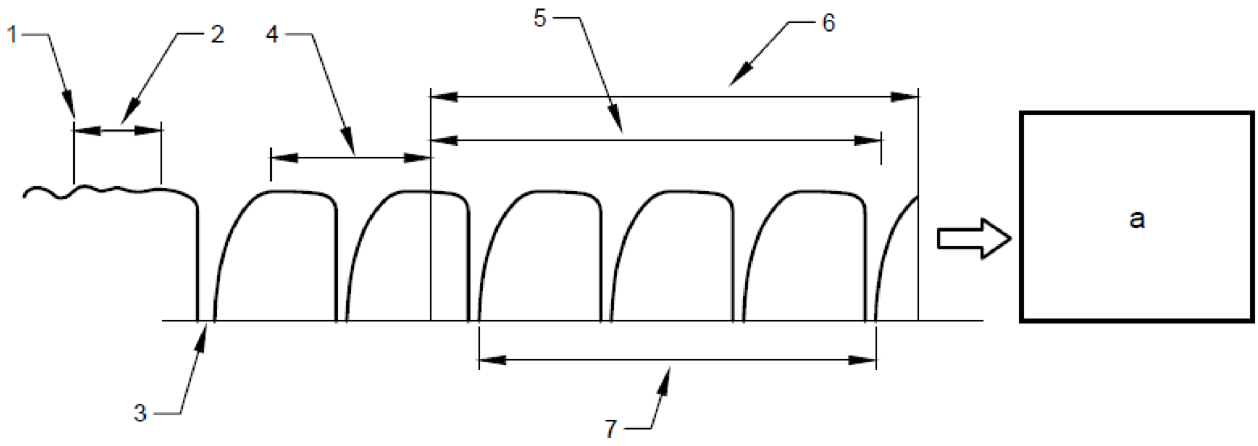
4 Equilibrium period (60 min)

5 Data collection period (3 h)

6 Two complete defrost cycles

a Transient test. Terminate test when data collection period equals 3 h

FIG. 22 TRANSIENT HEATING CAPACITY TEST WITH TWO COMPLETE CYCLES DURING THE DATA COLLECTION PERIOD



Key

1 Compliance with test tolerances first achieved
2 Preconditioning period (10 min minimum)
3 Defrost at end of preconditioning period
4 Equilibrium period (60 min)
5 Data collection period
6 Three hours
7 Three complete defrost cycles
a Transient test. Terminate test at the end of three complete cycles within the data collection period

FIG. 23 TRANSIENT HEATING CAPACITY TEST WITH THREE COMPLETE CYCLES DURING THE DATA COLLECTION PERIOD

ANNEX K

(*Foreword*)

COMMITTEE COMPOSITION

Refrigeration and Air Conditioning Sectional Committee, MED 03

Organization	*Representative (s)*
Indian Institute of Technology Roorkee	PROF RAVI KUMAR **(*Chairperson*)**
Annapurna Electronics and Services Private Limited, Hyderabad	SHRI G. K. PRASAD SHRI J. S. SASTRY (*Alternate*)
BSH Household Appliances Manufacturing Private Limited, Chennai	SHRI LOGANATHAN VIJAY KUMAR SHRI BALASUBRAMANIAN ANAND (*Alternate*)
Blue Star Limited, Mumbai	SHRI JITENDRA BHAMBURE SHRI SUNIL KUMAR JAIN (*Alternate*)
Bureau of Energy Efficiency, New Delhi	SHRIMATI P. SAMAL MS DEEPSHIKHA WADHWA (*Alternate* I) SHRI KAMRAN SHAIK (*Alternate* II) MS ANJU R. SINGH (*Alternate* III)
Carrier Air Conditioning and Refrigeration Limited, Gurugram	SHRI BIMAL TANDON SHRI MANMOHAN KULASHRI (*Alternate* I) SHRI JATINDER SHARMA (*Alternate* II)
Central Power Research Institute, Bengaluru	DR P. CHANDRA SEKHAR SHRI GUJJALA B. BALARAJA (*Alternate*)
Daikin Air Conditioning India Private Limited, Gurugram	SHRI GAURAV MEHTANI
Danfoss Industries Private Limited, Gurugram	SHRI MADHUR SEHGAL SHRI K. L. NAGAHARI (*Alternate* I) SHRI M. N. S. V. KIRAN KUMAR (*Alternate* II)
Directorate General of Quality Assurance, Ministry of Defence, New Delhi	LT COL DEEPAK SHARMA SHRI S. S. NIKAM (*Alternate*)
Electrical Research and Development Association, Vadodara	SHRI GUATAM BRAHMBHATT SHRI RAKESH PATEL SINGH (*Alternate*)
Emerson Climate Technologies (India) Private Limited, New Delhi	SHRI CHETHAN THOLPADY SHRI D. P. DESPANDE (*Alternate*)
Godrej & Boyce Manufacturing Company Limited, Mumbai	SHRI BURZIN WADIA SHRI JASVIR SINGH (*Alternate* I) SHRI NARENDRA SHEDGE (*Alternate* II)
Honeywell International India Private Limited, Gurugram	SHRI AADITYA PEGALLAPATI SHRI AVINASH KUMAR (*Alternate*)
Indian Institute of Chemical Engineering, Kolkata	DR D. SATHIYAMOORTHY DR SUDIP K. DAS (*Alternate*)
Indian Institute of Technology Madras, Chennai	DR. G. VENKATARATHNAM

Organization	*Representative (s)*
Indian Society of Heating, Refrigerating and Air Conditioning Engineers, New Delhi	DR JYOTIRMAY MATHUR SHRI ASHISH RAKHEJA (*Alternate* I) SHRI V. MANJUNATH (*Alternate* II)
Ingersoll Rand India Limited, Bengaluru	SHRI M. VENKANNA SHRI J. GURUSAMY (*Alternate*)
International Copper Association India, Mumbai	SHRI MAYUR KARMAKAR SHRI SHANKAR SAPALIGA (*Alternate*)
Intertek India Private Limited, Gurugram	SHRI C. M. PATHAK
Johnson Controls-Hitachi Air Conditioning India Limited, Mehsana	SHRI RAHUL RAMTEKKAR
LG Electronics India Private Limited, New Delhi	SHRI ADITYA ANIL
NTPC Limited, New Delhi	SHRI D. K. SURYANARAYAN SHRI S. K. JHA (*Alternate*)
Refrigeration and Air Conditioning Manufacturers Association, New Delhi	SHRI KANWALJEET JAWA SHRI HARSH VARDHAN PANT (*Alternate*)
Samsung India Electronics Private Limited, New Delhi	SHRI KALICHARAN SAHU
Sierra Aircon Private Limited, Gurugram	SHRI D. K. MUDGAL SHRI S. DHIMAN (*Alternate*)
The Chemours India Private Limited, Gurugram	SHRI VIKAS MEHTA SHRI NISHIT SHAH (*Alternate*)
UL India Private Limited, Bengaluru	SHRI V. MANJUNATH SHRI SATISH KUMAR (*Alternate*)
Voltas Limited, Mumbai	SHRI SRINIVASAN MOTURI SHRI A. D. KUMBHAR (*Alternate*)
Voluntary Organisation in Interest of Consumer Education (VOICE), New Delhi	SHRI B. K. MUKHOPADHYAY SHRI H. S. WADHWA (*Alternate*)
In Personal Capacity (*H.No. 03, Savita Vihar, Delhi*)	SHRI J. K. AGRAWAL
In Personal Capacity (*506/2, Kirti Apartments, Mayur Vihar, Phase-1 Extension, Delhi*)	SHRI P. K. MUKHERJEE
BIS Directorate General	SHRI NAVINDRA GAUTAM, SCIENTIST 'E'/DIRECTOR AND HEAD (MECHANICAL ENGINEERING) [REPRESENTING DIRECTOR GENERAL (*Ex-officio*)]

Member Secretary
SHRIMATI KHUSHBU JYOTSNA KINDO
SCIENTIST 'C'/DEPUTY DIRECTOR
(MECHANICAL ENGINEERING), BIS

Panel on Room Air Conditioners

Organization	*Representative (s)*
In Personal Capacity (*506/2, Kirti Apartments, Mayur Vihar, Phase-1 Extension, Delhi*)	SHRI P. K. MUKHERJEE ***(Convener)***
Bureau of Energy Efficiency, New Delhi	SHRIMATI DEEPSHIKHA WADHWA
Blue Star Limited, Mumbai	SHRI SUNIL KUMAR JAIN
Carrier Air Conditioning and Refrigeration Limited, Gurugram	SHRI BIMAL TANDON SHRI MANMOHAN KULASHRI (*Alternate*)
CEPT University, Ahmedabad	SHRI YASH SHUKLA
Daikin Air Conditioning India Private Limited, Gurugram	SHRI GAURAV MEHTANI
Emerson Climate Technologies (India) Private Limited, New Delhi	SHRI CHETHAN THOLPADY
Godrej & Boyce Manufacturing Company Limited, Mumbai	SHRI NARENDRA SHEDGE
International Copper Association India, Mumbai	SHRI SHANKAR SAPALIGA
Intertek India Private Limited, Gurugram	SHRI C. M. PATHAK
Johnson Controls-Hitachi Air Conditioning India Limited, Mehsana	SHRI RAHUL RAMTEKKAR
LG Electronics India Private Limited, New Delhi	SHRI ADITYA ANIL
Refrigeration and Air Conditioning Manufacturers Association, New Delhi	SHRI HARSH VARDHAN PANT
Sierra Aircon Private Limited, Gurugram	SHRI D. K. MUDGAL
Trane Technologies, Bengaluru	SHRI J. GURUSAMY
UL India Private Limited, Bengaluru	SHRI V. MANJUNATH
Voltas Limited, Mumbai	SHRI SRINIVASAN MOTURI
Whirlpool India Limited	SHRI MOHINDER SINGH

This Page has been Intentionally left blank

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 2016 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Review of Indian Standards

Amendments are issued to standards as the need arises on 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 website-www.bis.gov.in or www.standardsbis.in.

This Indian Standard has been developed from Doc No.: MED 03 (20225).

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: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices:		*Telephones*
Central	: 601/A, Konnectus Tower -1, 6th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	2323 7617
Eastern	: 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	2367 0012 2320 9474
Northern	: Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019	265 9930
Southern	: C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113	2254 1442 2254 1216
Western	: Plot No. E-9, Road No.-8, MIDC, Andheri (East), Mumbai 400093	2821 8093

Branches : AHMEDABAD. BENGALURU. BHOPAL. BHUBANESHWAR. CHANDIGARH. CHENNAI. COIMBATORE. DEHRADUN. DELHI. FARIDABAD. GHAZIABAD. GUWAHATI. HIMACHAL PRADESH. HUBLI. HYDERABAD. JAIPUR. JAMMU & KASHMIR. JAMSHEDPUR. KOCHI. KOLKATA. LUCKNOW. MADURAI. MUMBAI. NAGPUR. NOIDA. PANIPAT. PATNA. PUNE. RAIPUR. RAJKOT. SURAT. VISAKHAPATNAM.

Published by BIS, New Delhi