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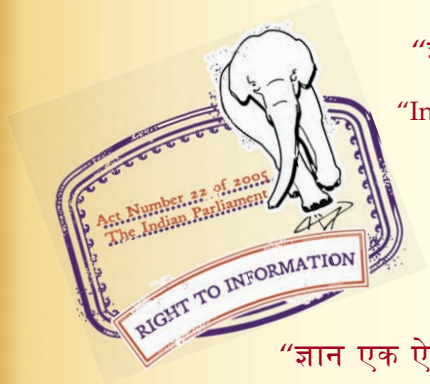
IS 1391-2 (1992): Room air conditioners, Part 2: Split air conditioners [MED 3: Refrigeration and Air Conditioning]



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Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS 1391 (Part 2) : 1992
(Reaffirmed 1999)

REAFFIRMED
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भारतीय मानक

कक्ष वातानुकूलक — विशिष्टि

भाग 2 विभक्त वातानुकूलक

(दूसरा पुनरीक्षण)

Indian Standard

ROOM AIR CONDITIONERS — SPECIFICATION

PART 2 SPLIT AIR CONDITIONERS

(Second Revision)

Second Reprint MAY 2002

UDC 697.94

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

December 1992

Price Group 9

FOREWORD

This Indian Standard (Second 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 Heavy Mechanical Engineering Division Council.

This Indian Standard was first published in 1960 and revised in 1971. The committee responsible to formulate this standard decided to cover the requirements of split air conditioners also in the standard. Accordingly, this standard has been splitted up in following two parts:

IS 1391 (Part 1) : 1992 Room air conditioners — Specification : Part 1 Unitary air conditioners

IS 1391 (Part 2) : 1992 Room air conditioners — Specification : Part 2 Split air conditioners

In the preparation of this standard assistance has been derived from ISO/DIS 5151 'Room air conditioners and heat pumps — Testing and rating', issued by the International Organization for Standardization.

In this standard split air conditioners from 3 000 kcal/h to 9 000 kcal/h capacities have been covered. While formulating this standard due importance has been given to energy conservation, noise pollution and safety.

The basic units of measurement together with their symbols for the various quantities used in the text have been listed in Annex A.

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 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

AMENDMENT NO. 1 OCTOBER 2000
TO
IS 1391 (PART 2) : 1992 ROOM AIR CONDITIONERS — SPECIFICATION
PART 2 SPLIT AIR CONDITIONERS

(Second Revision)

(*Page* 3, *clause* **5.3.5**, *second line*) — Substitute 'IS 694 : 1990' *for* 'IS 694 : 1977'.

(*Page* 3, *clause* **5.4.1**, *fourth line*) — Substitute 'IS 10773 : 1995' *for* 'IS 10773 : 1983'.

(*Page* 6, *clause* **9.5.3.1**, *second line*) — Substitute '4 hours' *for* '12 hours'.

(*Page* 6, *clause* **9.5.3.2**, *first line*) — Substitute '4 hours' *for* '12 hours'.

(*Page* 18, *clause* **15.3.7**) — Insert the following Note at the end of the clause:

'NOTE — The tests at 15.3.1 and 15.3.5 may be carried out separately on each indoor and condensing units without inter-connecting. These tests on the inter-connected units may be carried out as per sampling plan agreed between manufacturer and purchaser.'

(*Page* 6, *Table* 1) —Substitute the following table for the existing:

Table 1 Power Consumption Rating

Rated Cooling Capacity (kcal/h)	Maximum Power Consumption (kW)
3 000	1.65
4 500	2.3
6 000	3.1
7 500	3.6
9 000	4.4

Amend No. 1 to IS 1391 (Part 2) : 1992

(*Page* 20, *Annex* B) — Substitute the following IS No. and title for existing:

IS No.	*Title*
694 : 1990	PVC insulated cables for working voltages up to and including 1 100 volts (*third revision*)
10773 : 1995	Wrought copper tubes for refrigeration and air conditioning purposes (*first revision*)

(ME 3)

Printed at New India Printing Press, Khurja, India

AMENDMENT NO. 2 DECEMBER 2006
TO
IS 1391 (PART 2) : 1992 ROOM AIR CONDITIONERS — SPECIFICATION

PART 2 SPLIT AIR CONDITIONERS

(Second Revision)

(*Page* 2, *clause* 4.4) — Substitute following for the existing:

'Recommended classification of nominal cooling capacities of the split air conditioners shall be as under, kcal/h (kW):

3 000 (3.5), 4 500 (5.2), 6 000 (7), 7 500 (8.7) and 9 000 (10.5).'

(*Page* 3, *clause* 6.1, *second line*) — Substitute '6.1.7' *for* '6.1.8'.

(*Page* 3, *clause* 6.1.1) — Delete and renumber the subsequent clauses.

(*Page* 4, *clause* 8.1, *tenth line*) — Substitute 'Not specified' *for* '30°C'.

(*Page* 4, *clause* 8.3, *sixth line*) — Substitute '15°C' *for* '16°C'.

(*Page* 4, *clause* 8.3, *ninth line*) — Substitute 'Not specified' *for* '16°C'.

(*Page* 5, *clause* 8.5, *sixth line*) — Substitute '20°C' *for* '21°C'.

(*Page* 5, *clause* 8.5, *seventh line*) — Substitute '15°C' *for* 'Not specified'.

(*Page* 5, *clause* 8.6, *sixth line*) — Substitute '27°C' *for* '24°C'.

(*Page* 5, *clause* 8.6, *ninth line*) — Substitute '24°C' *for* '21°C'.

(*Page* 5, *clause* 8.6, *tenth line*) — Substitute '18°C' *for* '15.5°C'.

(*Page* 7, *clause* 9.9.3) — Insert the following Note at the end of the clause:

'NOTE — Measurement of wet bulb temperature surrounding the balanced ambient room calorimeter is not required if the calorimeter meets the requirement of 12.2.8.'

Amend No. 2 to IS 1391 (Part 2) : 1992

(*Pages* 8 *and* 10, *clauses* **10.1.1, 10.1.2, 10.1.4, 10.2.1** *and* **10.2.2**) — Cooling Effect/Heating Capacity shall be calculated in terms of Watts (W).

(ME 3.)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 3 JULY 2010
TO
IS 1391 (PART 2) : 1992 ROOM AIR CONDITIONERS — SPECIFICATION

PART 2 SPLIT AIR CONDITIONERS

(Second Revision)

(*Page* 8, *clause* **10.1.1**) **—** Substitute the following for the existing:

10.1.1 *Total Cooling Effect on Room Side*

The total cooling effect on the room side, as tested in either the calibrated or balanced ambient room type calorimeter (*see* Fig. 2A and 2B) is calculated as follows:

$$q_{tr} = \sum E_r + (h_{w1} - h_{w2})\, w_r + q_{lp} + q_{lr} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where

q_{tr} = total room cooling effect as determined on room side compartment, in watts;

$\sum E_r$ = sum of all power input to room side compartment, in watts;

h_{w1} = specific enthalpy of water or steam supplied to maintain humidity. If no water is introduced during the test, h_{w1}, is taken at the temperature of the water in the humidifier tank of reconditioning equipment, in kJ/kg;

h_{w2} = specific enthalpy of condensed moisture leaving the room side compartment. Since transfer of condensed moisture from room side to outdoor side compartment usually takes place within the air conditioner. Due to the practical difficulty in measuring its temperature, the temperature of the condensate may be assumed to be at the measured or estimated wet bulb temperature of the air leaving the air conditioner, in kJ/kg.

Price Group 2

w_r = water vapour (rate) condensed by air conditioner. This is measured by reconditioning equipment as the amount of water evaporated into room side compartment to maintain required humidity, in g/sec;

q_{lp} = heat leakage rate into room side compartment through separating partition between room side and outdoor side compartments, as determined from calibrating test (or may be based on calculation in case of balanced ambient room type calorimeter), in watts; and

q_{lr} = heat leakage rate into room side compartment through wall, floor and ceiling (but not including the separating partition) as determined from calibrating test, in watts.

(*Page* 8, *clause* **10.1.2**) **—** Substitute the following for the existing:

10.1.2 *Total Cooling Effect on Outdoor Side*

The total room cooling effect on the outdoor side, as tested in either the calibrated or balanced ambient room type calorimeter (*see* Fig. 2A and 2B) is calculated as follows:

$$q_{to} = q_o - \sum E_o - E + (h_{w3} - h_{w2})\ w_r + q_{lp} + q_{1o} \quad \text{.....(2)}$$

where

q_{to} = total room cooling effect as determined on outdoor side, in watts;

q_o = heat removed by cooling coil in outdoor side compartment, in watts;

$\sum E_o$ = sum of all power input to any equipment, such as reheaters, circulating fans, etc, in outdoor side compartment, in watts;

E = total power input to air conditioner, in watts;

h_{w2} = specific enthalpy of condensed moisture leaving the room side compartment, as defined in **10.1.1**;

h_{w3} = specific enthalpy of condensate removed by air-treating coil in outdoor side compartment reconditioning equipment taken at the temperature at which the condensate leaves the compartment, in kJ/kg;

w_r = water vapour condensed by air conditioner, as defined in **10.1.1**;

q_{lp} = heat leakage out of outdoor side compartment through separating partition between room side and outdoor side compartments, as determined from calibrating test (or may be based on calculation in case of balanced ambient room type calorimeter). This quantity will be numerically equal to q_{lp} used in equation (1) (*see* **10.1.1)** only if the area of separating partition exposed to outdoor side is equal to the area exposed to the room side compartment, in watts; and

q_{1o} = heat leakage out of outdoor side (but not including the separating partition), as determined from the calibrating test, in watts.

(*Page* 8, *clause* **10.1.3**) **—** Substitute the following for the existing:

10.1.3 *Net Room Dehumidifying Effect*

The net dehumidifying effect is calculated as follows:

$$q_d = K_2 w_r \quad \text{.....(3)}$$

where

q_d = net room dehumidifying effect in watts;

K_2 = 2 460 kJ/kg; and

w_r = water vapour condensed by air conditioner as defined in **10.1.1**.

(*Page* 8, *clause* **10.1.4**) **—** Substitute the following for the existing:

10.1.4 *Net Room Sensible Cooling Effect*

The net room sensible cooling effect is calculated as follows:

$q_s = q_{tr} - q_d$.....(4)

where

q_s = net room sensible cooling effect, in watts,

q_{tr} = taken from equation (1), and

q_d = taken from equation (3).

(*Page* 10, *clause* **10.2.1**) **—** Substitute the following for the existing:

10.2.1 *The Heating Capacity by Heat Pump on Room Side*

The heating effect on the room side as tested in either the calibrated or balanced ambient room type calorimeter is calculated as follows:

$q_{hr} = q - \sum E_{hr} + q_{lp} + q_{lr}$.....(6)

where

q_{hr} = net heating capacity calculated on room side of the calorimeter, in watts;

q = heat quantity removed by the cooling coil of the room side of the calorimeter, in watts;

$\sum Her$= total power input to room side of the calorimeter, in watts,

q_{lp} = heat leakage through the partition between room side and outdoor side, in watts); and,

q_{lr} = heat leakage through the floor, the wall (exclusive of the partition) and the ceiling, in watts.

(*Page* 10, *clause* **10.2.2**) **—** Substitute the following for the existing:

10.2.2 *The Heating Capacity by Heat Pump on Outdoor Side*

The heating capacity by heat pump on the outdoor side as tested in either the calibrated or balanced ambient room type calorimeter is calculated as follows:

$$q_{ho} = \sum E_{ho} + E + (h_{w5} - h_{w6})\ w_r + q_{lp} + q_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

where

q_{ho} = net heating capacity calculated on the outdoor side of the calorimeter, in watts;

$\sum E_{ho}$ = total power input to the outdoor side of the calorimeter, in watts;

E = total power input to air conditioner, in watts;

h_w = specific enthalpy of water or vapour flowing into the outdoor side of the calorimeter, in kJ/kg;

h_{w6} = specific enthalpy of condensed water, in kJ/kg;

w_r = quantity of water condensed at the conditioner, in g/sec;

q_{lp} = heat leakage through the partition between room side and outdoor side, in watts; and

q_1 = heat leakage through the floor, the wall (exclusive of the partition) and the ceiling, in watts.

(ME 03)

Indian Standard
ROOM AIR CONDITIONERS — SPECIFICATION
PART 2 SPLIT AIR CONDITIONERS
(Second Revision)

1 SCOPE

1.1 This standard prescribes the constructional and performance requirements of split air conditioners.

1.2 This standard also prescribes the test conditions and the corresponding test procedures for determining various performance characteristics of split air conditioners which operate non-frosting when cooling and dehumidifying at standard rating conditions.

1.3 This standard specifies split air conditioners which may also serve as heaters by heat pump/electric heater application.

2 REFERENCES

The Indian Standards given in Annex B are necessary adjuncts to this standard.

3 TERMINOLOGY

3.1 For the purpose of this standard, the following definitions shall apply. Definitions relating to air flow (3.1.4 to 3.1.5) are illustrated in Fig. 1. Exhaust air or fresh air in room side may be indicated in Fig. 1, if provided.

3.1.1 *Split Air Conditioner*

It comprises of Indoor unit and Outdoor unit. The Indoor unit may be mounted on floor or wall or ceiling. The Indoor and Outdoor units consist of compressor, heat exchangers, fan motors and air handling system installed in two separate cabinets.

It is designed primarily to provide conditioned air to an enclosed space, room or zone (conditioned space). It includes a prime source of refrigeration for cooling and dehumidification and means for the circulation and filtering of air.

3.1.2 *Standard Barometric Pressure*

Barometric pressure of 1.013 25 bar (760 mm Hg).

3.1.3 *Wet-Bulb Temperature*

Temperature indicated when the temperature sensing element and wetted wick have reached a state of constant temperature (evaporative equilibrium) (*see* 11.1.5).

3.1.4 *Room Discharge Air Flow of a Unit*

Rate of flow of air from the room side outlet of the unit.

3.1.5 *Room Intake Air Flow of a Unit*

Rate of flow of air into the unit from the conditioned space.

3.1.6 *Net Total Room Cooling Effect of a Unit*

Total available capacity of the unit for removing sensible and latent heat from the space to be conditioned.

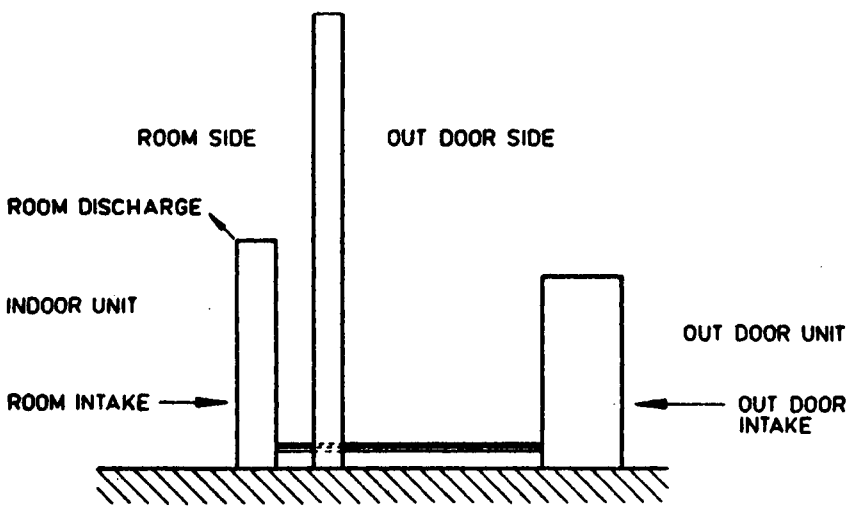


FIG. 1 DEFINITIONS RELATING TO AIR FLOW

3.1.7 *Net Room Dehumidifying Effect (Latent Cooling Effect)*

Total available capacity of the unit for removing latent heat from the space to be conditioned.

3.1.8 *Net Room Sensible Cooling Effect*

Available capacity of the unit for removing sensible heat from the space to be conditioned.

3.1.9 *Net Room Sensible Heat Ratio*

Ratio of the net room sensible cooling effect to the net total room cooling effect.

3.1.10 *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 counter balance the room side dehumidifying and cooling effect and the outdoor side humidifying and heating effect of the split air conditioner under test.

3.1.11 *Rated Voltage*

Voltage shown on the nameplate of the unit.

3.1.12 *Rated Frequency*

Frequency shown on the nameplate of the unit.

4 CLASSIFICATION

According to function and nominal cooling capacity, split air conditioners shall be classified as follows.

4.1 Classification by Function

4.1.1 *Cooling and Dehumidification*

4.1.2 *Cooling and Heating by Heat Pump*

4.1.3 *Cooling and Heating by Electric Heater*

4.2 Unit Type

4.2.1 *Single Split having Single Indoor and Outdoor Unit*

4.2.2 *Multi Split having Multiple Indoor and Single Outdoor Unit*

4.3 Unit Mounting Arrangement

4.3.1 *Floor Type*

4.3.2 *Ceiling Type*

4.3.3 *Wall Type*

4.4 Recommended classification of nominal cooling capacities of the split air conditioners shall be as under:

3 000, 4 500, 6 000, 7 500 and 9 000 kcal/h.

NOTE — 1 kcal/h = 1.162 78 W.

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.

5.2 Material

5.2.1 Materials used in the construction of cabinet, front panel, etc, shall comply with the corresponding Indian Standards wherever applicable except where such requirements are modified by this standard.

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

5.2.3 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.

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

5.2.5 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.

5.3 Electrically Charged Parts

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

5.3.2 Electric conductors shall be of electrically, thermally and mechanically stable and anti-corrosive materials such as copper and copper alloy.

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

5.3.4 Make and break operation or status of a manual switch shall be marked on prominent place by letters, symbols or colours.

5.3.5 Electrical cables used shall conform to IS 694 : 1977.

5.4 Refrigerant Circuit

5.4.1 The refrigerant pipes and fittings shall be of approved quality and shall withstand normal working pressures of air conditioners and should conform to IS 10773 : 1983 or equivalent national standard/ international standard.

5.4.2 The refrigerant used shall be chemically pure, free from moisture or any other chemical contamination.

5.5 Electrical Heater

5.5.1 The heating element and fittings shall be firmly installed. Also, the heating element shall be so built that its broken end has no possibility to make contact with non-live metallic parts.

5.5.2 Air conditioners which have electric heaters for heating shall be so constructed that electric heater circuit will not be completed when the recirculating air handling system remains switched off. Alternatively switches of air handling motor and electric heater shall work together simultaneously.

5.5.3 With electric heater which has the possibility of causing hazard by temperature rise, temperature-rise preventive device (inclusive of thermal fuse) shall be installed. In addition heating thermostat shall be used to control temperature.

5.5.4 The heat insulators shall be made of non-flammable material and shall withstand normal working temperature.

5.6 Grounding Terminal and Grounding Lead Wire

Grounding terminal or grounding lead wire shall be installed on a readily accessible place of the main body. Indication of grounding shall be marked on it or on the near spot. Grounding terminal shall be so constructed that grounding wire can be easily and firmly fastened.

5.6.1 Screw for grounding terminal shall conform to IS 302-1 (1979).

5.6.2 Grounding lead wire shall conform to IS 302-1(1979).

5.7 Air Filter

5.7.1 The air filter shall be of the dry air type. It may be of the throwaway type or washable replaceable type. The filter may be made from synthetic or coconut fibre, animal hair or any other suitable material with proper bonding and impregnation to prevent fraying or loosening of fibres under normal operation.

5.8 Thermostat

5.8.1 The thermostat shall conform to IS 11338 : 1985. Alternatively electronic thermostat may also be used.

5.9 Hermetic Compressors

Hermetically sealed compressors shall conform to IS 10617 (Part 1) : 1983.

5.10 Motors

Fan/blower motor shall conform to IS 996 : 1979.

6 RATING REQUIREMENTS

6.1 The declared ratings of the air conditioner shall be based on conditions specified in **6.1.1** to **6.1.8**.

6.1.1 *Run-in Period*

Before testing to determine ratings, the unit shall be run-in continuously for a period of about 15 hours.

6.1.2 *Cooling Capacity Ratings*

6.1.2.1 *Domestic market*

Cooling capacity ratings shall be based on tests conducted under conditions specified in **8.1** and with apparatus described in **12**. Ratings shall include the total cooling capacity and the latent cooling capacity stated in kilocalories per hour.

6.1.2.2 *Export market*

Air conditioners manufactured for export shall be rated on the conditions given in Annex C or as specified by the purchaser.

6.1.3 *Heat Pump Heating Capacity Ratings*

Heating capacity ratings shall be based on tests conducted under the conditions specified in **8.5** and shall be stated in kilocalories per hour.

6.1.4 *Power Consumption Ratings for Heating by Heat Pump*

The rate of power consumption shall be based on tests conducted under the conditions specified in **8.5** and shall be stated in kilowatt.

6.1.5 *Room Discharge Air Flow Ratings*

Room discharge air flow ratings shall be stated in cubic metres per hour of standard air at 27°C dry bulb, 65 percent relative humidity and a pressure of 1.013 25 bar (or 760 mm Hg) as specified in IS 196 : 1966 with the controls set for maximum cooling and with the fresh air and exhaust dampers, if any, properly closed.

6.1.6 *Electrical Heating Capacity Ratings*

An air conditioner equipped with an electrical heating element or elements shall have its electrical heating

capacity ratings determined by measurement of the total electrical power consumed by the heating element or elements.

6.1.7 *Electrical Ratings*

Ratings in watts for split air conditioner shall be based on standard voltage which shall be 230 volts, single phase, 50 c/s, the units, however, shall be capable of working at any voltage within ±10 percent of the standard voltage. In case of three phase power supply the ratings in watts shall be based on standard 400 volts, 50 c/s, the units, however, shall be capable of working at any voltage within ±5 percent of the standard voltage.

In the case of dc machines, the standard voltage shall be 220 volts and the units shall be capable of working within a voltage variation of ±5 percent of the standard dc voltage.

6.1.8 *Noise Ratings*

This is recommendatory test. As and when testing facility would be available, it would be considered to make this test mandatory. Noise ratings of split air conditioner shall be conducted under the test conditions specified in 8.1.

7 BASIS OF RATINGS

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

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

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 size or type;
c) Net total cooling effect;
d) Net dehumidifying effect;
e) Net sensible cooling effect;
f) Total air capacity;
g) Name of refrigerant;
h) Weight of the refrigerant charged into the unit;
j) Power input of each motor separately;
k) Total power input;
m) Nameplate ratings of each motor;
n) Power input for heating in watts;
p) Heating capacity, if provided; and
q) Manufacturer's instructions and requirements which may affect performance.

8 RATING AND TEST CONDITIONS

8.1 Capacity Rating Test Conditions

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

Room air temperature:

a) Dry bulb	27°C
b) Wet bulb	19°C

Outside air temperature:

a) Dry bulb	35°C
b) Wet bulb	30°C

Test voltage	Rated voltage
Test frequency	Rated frequency

NOTES

1 If rated frequency is not available, the capacity measured shall be corrected by a correction factor depending upon frequency actually measured during the testing.

2 Percentage drop in frequency shall be applied as percentage drop in voltage for power consumption.

3 The pipe length between indoor unit and outdoor unit shall be 5 m when laid horizontally.

8.2 Maximum Operating Test Conditions

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

Room air temperature:

a) Dry bulb	35°C
b) Wet bulb	24°C

Outside air temperature:

a) Dry bulb	46°C
b) Wet bulb	27°C

Test frequency	Rated frequency
Test voltage	90 percent and 110 percent of nameplate rating

8.3 Freeze-Up Test Conditions

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

Room air temperature:

a) Dry bulb	21°C
b) Wet bulb	16°C

Outside air temperature:

a) Dry bulb	21°C
b) Wet bulb	16°C

Test frequency	Rated frequency
Test voltage	Rated voltage

8.4 Enclosure Sweat Test Conditions

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

Rated air temperature:

a) Dry bulb	27°C
b) Wet bulb	24°C

Outside air temperature:

a) Dry bulb	27°C
b) Wet bulb	24°C

Test frequency	Rated frequency
Test voltage	Rated voltage

8.5 Heating by Heat Pump Capacity Rating Test Conditions

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

Room air temperature:

a) Dry bulb	21°C
b) Wet bulb	Not specified

Outside air temperature:

a) Dry bulb	7°C
b) Wet bulb	6°C

Test voltage	Rated voltage
Test frequency	Rated frequency

8.6 Heating by Heat Pump Overload Rating Test Conditions

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

Room air temperature:

a) Dry bulb	24°C
b) Wet bulb	Not specified

Outside air temperature:

a) Dry bulb	21°C
b) Wet bulb	15.5°C

Test voltage	90 percent and 110 percent of nameplate rating
Test frequency	Rated frequency

9 PERFORMANCE REQUIREMENTS

9.1 Variations Allowed in Performance Test Readings

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

a) ±2 percent of the standard voltage and frequency, and

b) ±0.5°C for the specified temperatures.

9.2 Safety

Split air conditioners shall meet as far as applicable the requirements of IS 660 : 1963.

9.3 Power Factor Test

When operating under normal load under the conditions specified in **8.1** with controls set for maximum cooling the split air conditioner shall have overall power factor, measured at 230 volts, 50 c/s, not less than 0.85.

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 **8.2** for cooling and **8.6** for heating.

9.4.3 *Voltage Adjustment*

Test voltages should be as specified in **8.2**. These voltages should be maintained at the specified percentages under running conditions. The electrical service supplied to the unit service connection should be such that the voltage will not rise more than 3 percent when the unit is stopped. After the service has been adjusted to accomplish this result, no subsequent adjustment should be made during either test.

9.4.4 *Procedure*

The split air conditioner shall be operated continuously for two hours after the specified air temperatures and equilibrium condensate level have been established. All power to the split air conditioner shall then be cut off for 3 minutes and then restored for 1 hour. During this test no water should be sprinkled on to the condenser other than what is condensed in the evaporator.

9.4.5 *Requirements*

9.4.5.1 During one entire test, the split air conditioner should operate without visible or audible indication of damage.

9.4.5.2 The split air conditioner fan/blower motor should operate continuously for the first 2 hours of the test without tripping of the motor overload protective devices.

9.4.5.3 The motor overload protective device may trip only during the first 5 minutes after the shut down period of 3 minutes. During the remainder of that 1 hour test period, no motor overload protective device should trip.

9.4.5.4 For those models so designed that resumption of operation does not occur after initial trip within the first 5 minutes, the unit may remain out of operation for not longer than 60 minutes. It should then operate continuously for 1 hour.

9.5 Freeze-Up Tests

9.5.1 *Purpose*

The air blockage test and the drip test shall be conducted to determine the ability of the air conditioner to operate satisfactorily under conditions with the maximum tendency to frost or ice the evaporator.

9.5.2 *Test Conditions*

Freeze-up test shall be conducted under the conditions given in **8.3**. Temperature control and fan speed 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 manufacturers operating instructions.

9.5.3 *Air Blockage Test*

9.5.3.1 *Procedure*

The test should be continuous, with the unit on the cooling cycle for 12 hours after establishment of the specified temperature conditions.

9.5.3.2 *Requirement*

At the end of 12 hours the accumulation of ice or frost on the evaporator shall not obstruct the air passing through the evaporator coil.

9.5.4 *Drip Test*

9.5.4.1 *Procedure*

The unit should be operated for 6 hours 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 6 hours operating period, the unit should be stopped and the air inlet covering removed until the accumulation of ice or frost has melted. The unit should then be turned on again, with the fans operating at the highest speed, for 5 minutes.

9.5.4.3 *Requirements*

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

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 **8.4**. The unit controls, fans, dampers, and grilles shall be set to produce the maximum tendency to sweat provided such settings are not contrary to manufacturers' operating instructions.

9.6.3 *Procedure*

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

9.6.4 *Requirements*

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

9.7 Power Consumption Test for Cooling

9.7.1 *Purpose*

The purpose of the power consumption test is to determine the power in watts.

9.7.2 *Test Condition*

The power measurement shall be determined during the capacity rating test under the conditions given in **8.1**.

9.7.3 *Procedure*

The power measurement shall be the average power measurement in watts measured during the capacity rating test (*see* **9.9** and Annex D).

9.7.4 *Requirements*

The power consumption for air conditions tested under the conditions laid in **8.1** shall not exceed the values as given in Table 1.

Table 1 Power Consumption Rating

Rated Cooling Capacity (kcal/h)	Maximum Power Consumption (kW)
3 000	1.7
4 500	2.6
6 000	3.4
7 500	4.5
9 000	5.4

9.8 Power Consumption Test for Heating by Heat Pump

9.8.1 *Purpose*

The purpose of the power consumption test is to determine the power in watts.

9.8.2 *Test Conditions*

The power measurement shall be determined during the heat pump rating test under the condition given in **8.5**.

9.8.3 *Procedure*

The power measurement shall be the average power measurement in watts measured during the heating pump rating test (*see* **9.11** and Annex D).

9.8.4 *Requirements*

The rate of energy consumption for air conditioners tested under the conditions laid in **8.5** shall not exceed 115 percent of the rated energy for heating by heat pump.

9.9 Capacity Rating Test

9.9.1 *Purpose*

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

a) Net total cooling effect,

b) Net dehumidifying effect,

c) Net sensible cooling effect, and

d) Net total air capacity for cooling.

9.9.2 *Test Conditions*

Capacity rating test shall be conducted under the conditions specified in **8.1** and within the allowable variation given in Table 2. The air conditioner shall be in the condition as normally intended for use. Filters and grilles where supplied shall be in position.

9.9.2.1 The test should 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* **3.1.2**).

9.9.3 Variations allowed in capacity test readings shall be as given in Table 2.

Table 2 Variations Allowed in Capacity Test Readings

Reading	Variation of Arithmetical Average from Rating Conditions	Maximum Variation of Individual 10-Minute Readings from Rating Conditions
All entering air temperature:		
a) Dry-bulb	0.3°C	0.5°C
b) Wet-bulb	0.2°C	0.3°C
Air temperature surrounding balanced ambient calorimeter:		
a) Dry-bulb	0.5°C	1.0°C
b) Wet-bulb	0.3°C	0.5°C

9.9.4 *Procedure for Testing Air Conditioner in Calorimeter*

This procedure shall be applicable only when the air conditioner is tested in calorimeter. The air conditioner shall be tested in calorimeter complying with **12**. Two 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.)

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

9.9.4.2 The data to be recorded for this test are given in Annex D. This Annex shows general information required, but is not intended to limit the data to be obtained.

As an interim measure till the date by which the testing facilities as per calorimeter are available in the country, the capacity rating test shall be conducted adopting the psychrometric method on the evaporator side as described in **4.1**(a) and calculations as given in **5.1.1** of IS 8148 : 1976 employing nozzle method of measuring velocity. This method shall, however, be followed without having any ducting arrangement shown in Fig. 1 of IS 8148 : 1976, during temperature measurements. The room discharge air flow shall be measured separately in accordance with **13** of IS 1391 (Part 2) : 1992.

9.9.5 *Requirements*

The capacity of the production unit as determined on the room side shall be not less than 90 percent of the nameplate rating.

9.10 Noise Test

For noise test, the air conditioner shall be installed in a noise measuring room shown in Fig. 7. The split air conditioner shall be operated in the cooling condition with rated voltage and rated frequency. The noise level in the indoor side shall be measured in accordance with the method described in **14** and shall not exceed the value given in Table 3.

Table 3 Noise Level

Rated Cooling Capacity (kcal/h)	Maximum Noise Level in DBA	
	Indoor Side	Outdoor Side
4 500 or less	58	68
5 000 or more	62	70

NOTE — During starting and stopping, there should not be any touching noise.

9.11 Heat Pump Heating Capacity Test

After installation of the air conditioner in the calorimeter specified in **12**, the operation switches and others shall be put in operation under the condition of heating by heat pump shall be worked out with the measuring method and calculating formula defined in **10**. The heating capacity shall include those of

auxiliary electric heater and humidifying heater, if these are provided.

The measured heating capacity shall not be less than 90 percent of the rated heat pump capacity.

10 CALCULATIONS

10.1 Capacity Rating

10.1.1 *Net Total Cooling Effect on Room Side*

The net total cooling effect on the room side, as tested in either the calibrated or balanced ambient room type calorimeter (Fig. 2A and 2B) is calculated as follows:

$$q_{tr} = K_1 \Sigma E_r + (h_{\omega 1} - h_{\omega 2}) W_r + q_{1p} + q_{1r} \quad ....(1)$$

where

q_{tr} = net total room cooling effect as determined on room side compartment (kcal/h);

K_1 = 1 (= 0.860 kcal/Wh);

ΣE_r = sum of all power input to room side compartment;

$h_{\omega 1}$ = enthalpy of water of steam supplied to maintain humidity. If no water is introduced during the test, hw_1 is taken at the temperature of the water in the humidifier tank of reconditioning equipment;

$h_{\omega 2}$ = enthalpy of condensed moisture leaving the room side compartment. Since transfer of condensed moisture from room side to outdoor side compartment usually takes place within the air conditioner, with consequent difficulty in measuring its temperature, the temperature of the condensate may be assumed to be at the measured or estimated, wet bulb temperature of the air leaving the air conditioner;

W_r = water vapour (rate) condensed by air conditioner. This is measured by reconditioning equipment as the amount of water evaporated into room side compartment to maintain required humidity;

q_{1p} = heat leakage rate into room side compartment through separating partition between room side and outdoor side compartments, as determined from calibrating test (or may be based on calculation in case of balanced ambient room type calorimeter); and

q_{1r} = heat leakage rate into room side compartment through wall, floor and ceiling (but not including the separating partition) as determined from calibrating test.

10.1.2 *Net Total Cooling Effect on Outdoor Side*

The net total room cooling effect on the outdoor side, as tested in either the calibrated or balanced ambient room type calorimeter (*see* Fig. 2A and 2B) is calculated as follows :

$$q_{to} = q_o - K_1 \Sigma E_o - K_1 E + (h_{\omega 3} - h_{\omega 2}) W_r + q_{1p} + q_{1o} \quad ....(2)$$

where

q_{to} = net total room cooling effect as determined on outdoor side;

q_o = heat removed by cooling coil in outdoor side compartment;

K_1 = 1 (= 0.860 kcal/Wh);

ΣE_o = sum of all power input to any equipment, such as heaters, circulating fans, etc, in outdoor side compartment;

$h_{\omega 2}$ = enthalpy of condensed moisture leaving the room side compartment, as defined in **10.1.1**;

E = total power input to air conditioner,

$h_{\omega 3}$ = enthalpy of condensate removed by air-treating coil in outdoor side compartment reconditioning equipment taken at the temperature at which the condensate leaves the compartment;

W_r = water vapour condensed by air conditioner, as defined in **10.1.1**;

q_{1p} = heat leakage out of outdoor side compartment through separating partition between room side and outdoor side compartments, as determined from calibrating test (or may be based on calculation in case of balanced ambient room type calorimeter). This quantity will be numerically equal to q_{1p} used in equation (1) (*see* **10.1.1**) only if the area of separating partition exposed to outdoor side is equal to the area exposed to the room side compartment; and

q_{1o} = heat leakage out of outdoor side (but not including the separating partition), as determined from the calibrating test.

10.1.3 *Net Room Dehumidifying Effect*

The net dehumidifying effect is calculated as follows:

$$q_d = K_2 W_r \quad ....(3)$$

where

q_d = net room dehumidifying effect;

K_2 = 2 460 kJ/kg (= 588 kcal/kg); and

W_r = water vapour condensed by air conditioner as defined in **10.1.1**.

10.1.4 *Net Room Sensible Cooling Effect*

The net room sensible cooling effect is calculated as follows:

$$q_s = q_{tr} - q_d \quad ....(4)$$

where

q_s = net room sensible cooling effect,

q_{tr} = *see* equation (1), and

q_d = *see* equation (3).

10.1.5 *Net Room Sensible Heat Ratio*

The net room sensible heat ratio is calculated as follows:

$$SHR = \frac{q_s}{q_{tr}} \quad \text{....(5)}$$

where

SHR = net room sensible heat ratio,
q_s = *see* equation (4), and
q_{tr} = *see* equation (1).

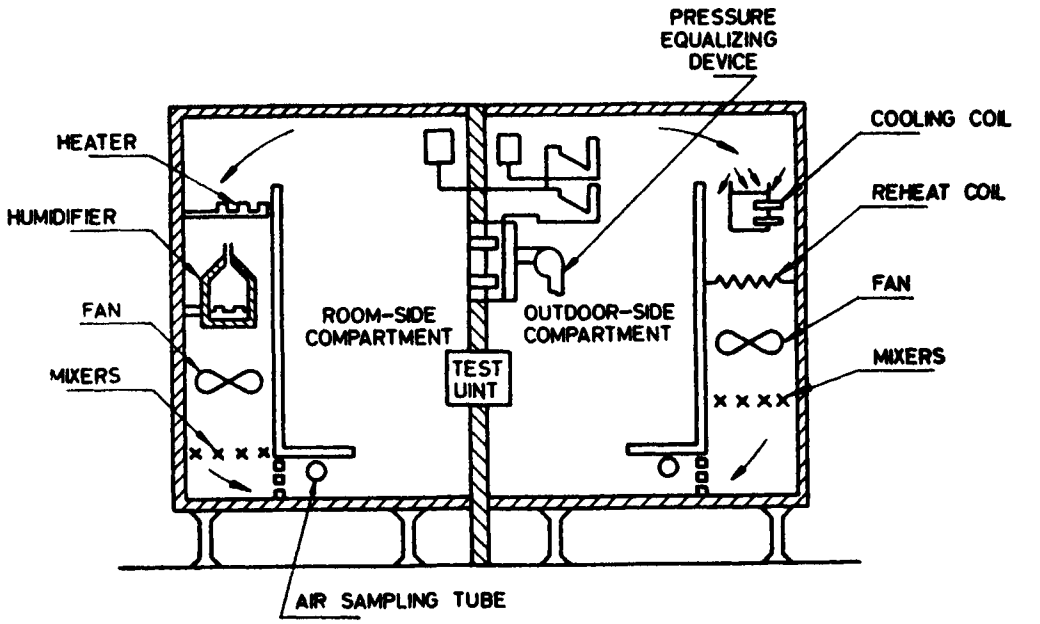


FIG. 2A CALIBRATED ROOM TYPE CALORIMETER

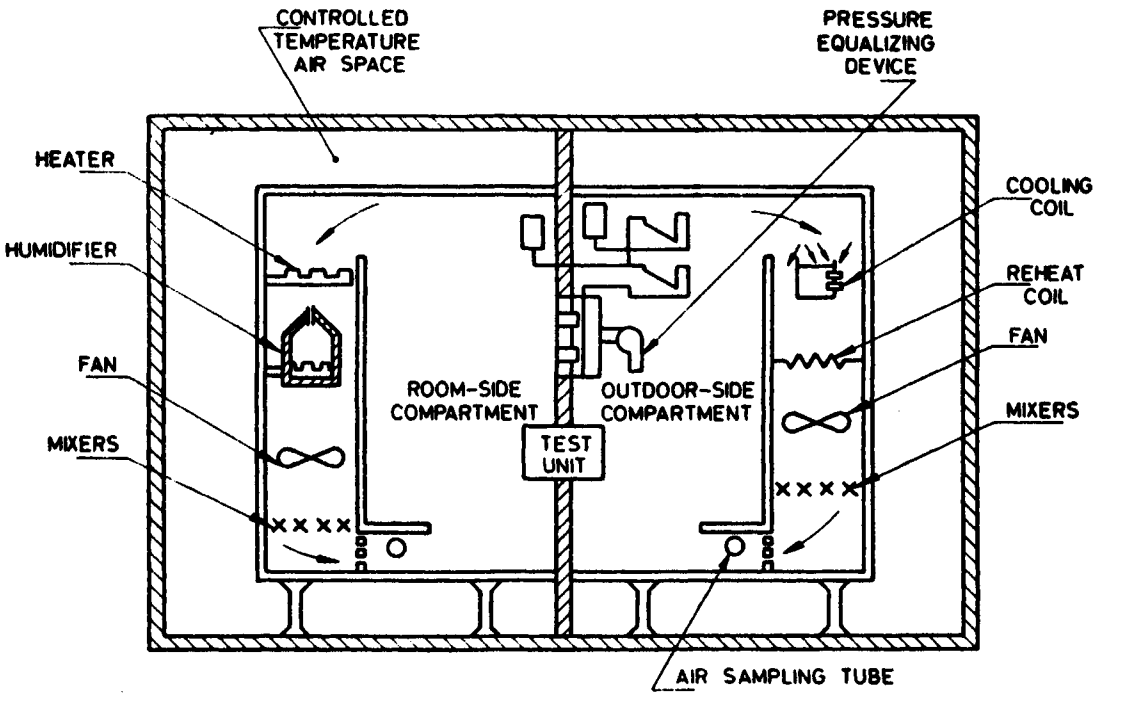


FIG. 2B BALANCED AMBIENT ROOM TYPE CALORIMETER

10.2 Calculation of Heating Capacity by Heat Pump

10.2.1 *The Heating Capacity by Heat Pump on Room Side*

The net heating effect on the room side as tested in either the calibrated or balanced ambient room type calorimeter is calculated as follows:

$$qh_r = q - 860\ \Sigma Eh_r - (h_{\omega 4} - h_{\omega 5})W_r + q_{1p} + q_{1r} \quad \text{....(6)}$$

where

qh_r = net heating capacity calculated on room side of the calorimeter (kcal/h);

q = heat quantity removed by the cooling coil of the room side of the calorimeter (kcal/h);

ΣEh_r = total input to room side of the calorimeter (kW);

$h_{\omega 4}$ = enthalpy of water or vapour flowing into the room side of the calorimeter (kcal/kg);

$h_{\omega 5}$ = enthalpy of condensed water flowing out of the room side of the calorimeter (kcal/kg);

W_r = quantity of condensed water at cooling coil (quantity of vapour from humidifier -- kg/h);

q_{1p} = heat leakage through the partition between room side and outdoor side (kcal/h); and

q_{1r} = heat leakage through the floor, the wall (exclusive of the partition) and the ceiling (kcal/h).

10.2.2 *The Heating Capacity by Heat Pump on Outdoor Side*

The heating capacity by heat pump on the outdoor side as tested in either the calibrated or balanced ambient room type calorimeter is calculated as follows:

$$qh_o = 860\ \Sigma Eh_o + 860\ E\ (h_{\omega 5} - h_{\omega 6})W_r + q_{1p} + q_1 \quad \text{....(7)}$$

where

qh_o = net heating capacity calculated on the outdoor side of the calorimeter (kcal/h);

ΣEh_o = total input to the outdoor side of the calorimeter;

E = total power input to air conditioner;

$h_{\omega 5}$ = enthalpy of water or vapour flowing into the outdoor side of the calorimeter (kcal/kg);

$h_{\omega 6}$ = enthaply of condensed water flowing out of the outdoor side of the calorimeter (kcal/kg);

W_r = quantity of water condensed at the conditioner (kg/h);

q_{1p} = heat leakage through the partition between room side and outdoor side (kcal/h); and

q_1 = heat leakage through the floor, the wall (exclusive of the partition) and the ceiling (kcal/h).

11 INSTRUMENTS

11.1 Temperature Measuring Instruments

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

a) Mercury-in-glass thermometers,

b) Thermocouples,

c) Electric resistance thermometers, and

d) Electronic temperature indicator.

11.1.2 Instrument accuracy shall be within the following limits:

a) Wet bulb and dry bulb temperatures of reconditioned air in room side calorimeter compartment, ±0.1°C;

b) Water temperatures, outdoor side compartment conditioning coil, ±0.1°C; and

c) All other temperatures, ±0.3°C.

11.1.3 In no case smallest scale division of the temperature measuring instrument shall exceed the specified accuracy.

11.1.4 Where an instrument accuracy ± 0.1°C is specified, the instrument shall be calibrated by comparison with a thermometer certified by a recognized authority.

11.1.5 In all measurements of wet bulb temperature, sufficient setting shall be provided and sufficient time shall be allowed for the state of evaporative equilibrium to be attained.

For mercury-in-glass thermometers (not over 6.5 mm bulb diameter) temperatures shall be read under conditions which ensure a minimum air velocity of 3 m/s.

11.1.6 Whenever possible, temperature measuring instruments used to measure the change in temperature should be arranged so that they can be readily interchanged between inlet and outlet positions to improve accuracy.

11.1.7 Temperature of fluids within conduits should be measured by inserting temperature instruments directly within the fluid or within a well inserted into the fluid. If a glass thermometer is to be inserted directly into the fluid, it shall be calibrated for the effect of pressure.

11.1.8 Temperature measuring instruments should be adequately shielded from radiation from any adjacent heat sources.

11.2 Pressure Measuring Instruments

11.2.1 Accuracy of pressure measuring instruments, not including barometers should permit measurements within ±1 N/m^2 (0.01 m bar) (0.1 mm H_2O).

11.2.2 In no case the smallest scale division of the pressure measuring instrument shall exceed the specified accuracy.

11.2.3 Barometric pressure shall be measured by a barometer having scale markings permitting readings with an accuracy within ±0.1 percent.

11.3 Electrical Instruments

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

11.3.2 Instruments used for measuring all electrical inputs to the calorimeter compartments shall be accurate to ±0.5 percent of the quantity measured.

11.4 Water Flow Measuring Instruments

11.4.1 Volume measurements shall be made with either of the following instruments having an accuracy of ±1.0 percent of the quantity measured:

a) Liquid-quantity meter, measuring either mass or volume; and

b) Liquid flow rate meter.

11.4.2 Liquid quantity meter shall employ a tank having sufficient capacity to accumulate the flow for at least two minutes.

11.5 Noise Measuring Instrument

Noise measurement shall be made with a sound level meter whose accuracy is ±1.0 percent of the quantity measured. The instrument shall be able to measure a weighted sound pressure level.

11.6 Other Instruments

11.6.1 Time interval measurements should be made with instruments whose accuracy is ±0.2 percent of the quantity measured.

11.6.2 Mass measurements should be made with apparatus whose accuracy is ±1.0 percent of the quantity measured.

12 CALORIMETERS

12.1 Calorimeter Required for Testing Split Air Conditioners

Air conditioners shall be tested for cooling capacity in a room calorimeter of either the calibrated or balanced ambient type as prescribed in **12.3** and **12.4**.

12.2 Calorimeters — General

12.2.1 The calorimeter provides a method for determining cooling capacity simultaneously on both the room side and the outdoor side. The room side capacity determination is made by balancing the cooling and dehumidifying effects with measured heat and water inputs. The outdoor side capacity provides a conforming test of the cooling and dehumidifying effect by balancing the heat and water rejection on the condenser side with a measured amount of cooling medium.

12.2.2 The two calorimeters compartments, room side and outdoor side, are separated by an insulated partition having an opening into which the split air conditioner is mounted. The air conditioner shall be installed using supporting members and filler pieces in a manner similar to a normal installation. No effort shall be made to seal the internal construction of the air conditioner to prevent air leakage from the condenser side to the evaporator side or vice versa. No connections or alterations shall be made to the air conditioner which might in any way alter its normal operation.

12.2.3 A pressure equalizing device shall be provided in the partition wall between the room side and the outdoor side compartments to maintain a balanced pressure between these compartments 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. 3, a discharge chamber equipped with an exhaust fan and manometers for measuring compartment and air flow pressures. A suggested arrangement of components is shown in Fig. 4. Since the air flow from one compartment to the other may be in either direction, two such devices mounted in opposite direction, or a reversing device shall be used.

The manometer pressure pick-up tubes shall be so located as to be affected by air discharged from the air conditioner on test or by the exhaust from the pressure equalizing device. The fan or blower which exhaust air from the discharge chamber shall permit variation of its air flow by suitable means, such as a variable speed drive, or a damper as shown in Fig. 4. The exhaust from this fan or blower shall be such that it will not effect the inlet air to the air conditioner on test.

The equalizing device shall be adjusted during calorimeter tests or air flow measurements, so that

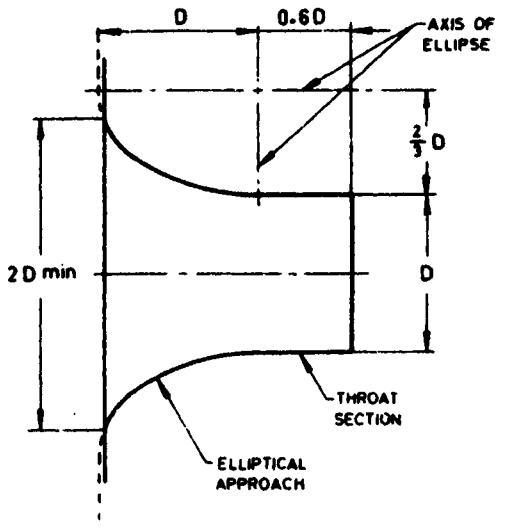


FIG. 3 AIR FLOW MEASUREMENT NOZZLE

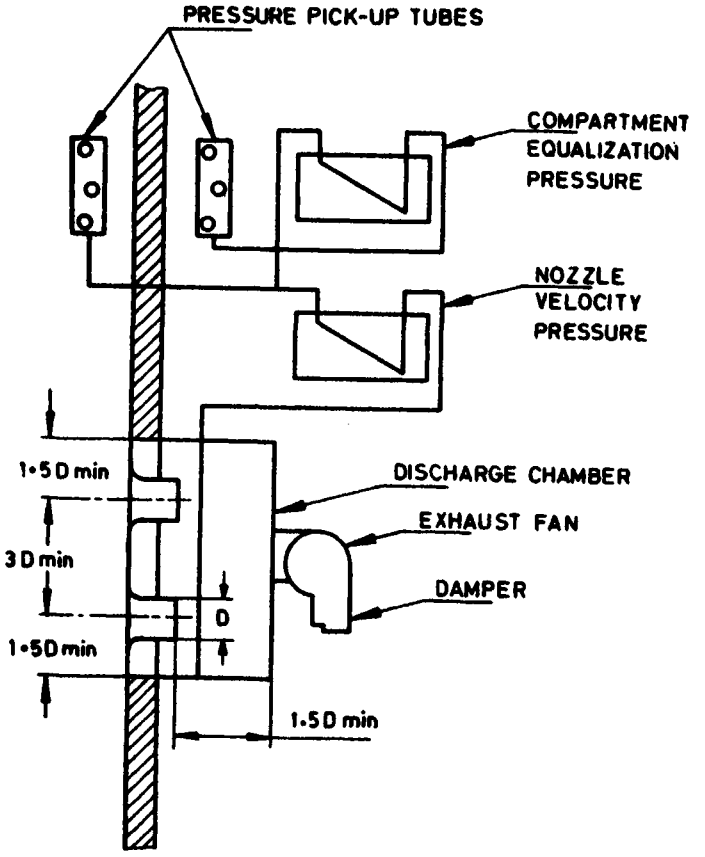


FIG. 4 PRESSURE EQUALIZING NOZZLE

the static pressure difference between the roomside and outdoor side compartments is not greater than 1.5 N/m² or 0.015 mbar or 0.153 mm H_2O. The construction details and calculations are specified in 13.

12.2.4 The size of the calorimeter shall be sufficient to avoid any restriction to intake or discharge openings of the air conditioner. Perforated plates or other suitable grilles shall be provided at the discharge opening from the reconditioning equipment to avoid face velocities exceeding 0.5 m/s. Sufficient space shall be allowed in front of any inlet or discharge grilles of the air conditioner to avoid interference with air flow. Minimum distance from the air conditioner to side walls or ceiling of the compartments should be 1 m except for the back of a console type room air conditioner which should be in normal relation to the wall. The suggested dimensions for the calorimeter are given below:

12.2.5 Each compartment shall be provided with reconditioning equipment to maintain specified air flow and prescribed conditions. Reconditioning equipment for the room side compartment shall consist of heaters to supply sensible heat and a humidifier to supply moisture. The energy supply may be electric, steam or any other source that can be controlled and measured. Reconditioning equipment for the outdoor side compartment shall provide cooling and dehumidification. A cooling coil equipped with by-pass dampers to control the dry bulb temperature and supplied with a variable temperature water or variable water quantity to control the wet bulb temperature may be used. If desired, dehumidifying apparatus or reheating apparatus or both may be used in combination with the cooling coil. Reconditioning equipment for both compartments shall be provided with fans of sufficient capacity to overcome the resistance of the reconditioning equipment and circulate not less than two times the quantity of air

*Maximum Rated Cooling Capacity of Unit**	*Suggested Minimum Inside Dimensions of Each Room of Calorimeter*		
	Width	Height	Depth
kcal/h (W*)	m	m	m
2 500 (3 000)	2.4	2.1	1.8
5 000 (6 000)	2.4	2.1	2.4
7 500 (9 000)	2.7	2.4	3.0

*Figures given in bracket are rounded off values.

discharged by the air conditioner to the room side or to the outdoor side as the case may be. In no case shall the reconditioning equipment discharge less than one compartment air change per minute.

12.2.6 Remote reading thermometers, instruments, or air sampling tubes shall be used to measure the specified wet bulb and dry bulb temperature in both calorimeter compartments. Air sampling shall comply with **11.1.5**. The air sampling tube may be brought outside of the calorimeter walls for ease in reading the thermometers, but should be sealed and insulated to avoid air leakage and heat leakage. The sampling tube fans and fan motors shall be installed completely within the calorimeter compartments and their electrical input included in the load measurement. The fan motor shall be located so that its heat will not cause stratification of the air passing into the air conditioner. The fan should draw the air over the thermometers and return the air to the same compartment in a manner that will not affect air temperature measurements or inlet or discharge air flow of the air conditioner.

12.2.7 It is recognized that in both the room side and outdoor side compartments, temperature gradients and air flow patterns result from the interaction of the reconditioning equipment and the split air conditioner being tested. Therefore, the resultant conditions are peculiar to and depend upon a given combination of compartment size, arrangement and size of reconditioning equipment, and the air conditioners air discharge characteristics.

Accordingly, no single location for the measurement of dry bulb and wet bulb temperatures may be specified which will be acceptable for all combinations of calorimeter facilities and split air conditioners which may be tested.

It is intended that the specified test temperatures surrounding the unit being tested shall simulate as nearly as possible a normal installation of such a unit operating at ambient air conditions identical with these specified test temperatures.

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

a) The measured temperatures shall be the representative of the temperature surrounding the unit, and simulate the conditions encountered in an actual application for both room and outdoor sides as indicated above; and

b) At the point of measurement, the temperature of air shall not be affected by air discharged from the test unit. This makes it mandatory that the temperatures are measured upstream of any recirculation produced by the test unit.

NOTES

1 If the conditions of air movement and air flow patterns in the calorimeter compartment are favourable, the temperature may be measured at the outlet of the reconditioning equipment.

2 It has been established that the unit being tested does not produce any by-passed air from discharge to intake opening, the specified temperatures may be measured immediately upstream of such intake opening. In this case, care shall be taken to ensure that the temperature measuring equipment does not help or penalize the conditioner in any way.

12.2.8 Interior surfaces of the calorimeter compartments shall be of non-porous material with all joints sealed against air and moisture leakage. Access doors shall be tightly sealed against air and moisture leakage by use of gaskets or other suitable means.

12.3 Calibrated Room Type Calorimeter

12.3.1 Calibrated room type calorimeter is shown in Fig. 2A. Each calorimeter, including the separating partition, shall be insulated to prevent heat leakage (including radiation) in excess of 5 percent of the air conditioner capacity. It is recommended that an air space permitting free circulation may be provided under the calorimeter floor.

12.3.2 Heat leakage may be determined in either the room side or outdoor side compartments by the following method:

"All openings shall be closed. Either compartment may be heated by electric heaters to a temperature of at least 11°C above the surrounding ambient temperature. The ambient should be maintained at a constant temperature ± 1°C outside all six enveloping surfaces of the compartment including the separating partition. If the construction of the partition is identical with that of the other walls, the heat leakage through the partition may be determined on a proportional area basis."

12.3.3 For calibrating the heat leakage through the separating partition, the following procedure may be used:

"A test is carried as described in **12.3.2**. Then the temperature of the adjoining area on the other side of the separating partition may be raised to equal the temperature in the heated compartment thus eliminating heat leakage through the partition, while the 11°C differential is maintained between the heated compartment and the ambient surrounding the other five enveloping surfaces. The difference in heat between the first test and the second test will permit determination of the leakage through the partition alone."

12.3.4 For the outdoor side compartment equipped with means for cooling, an alternate means of calibration may be to cool the compartment to temperature at least 11°C below the ambient temperature (on six sides) and carry out a similar analysis.

12.4 Balanced Ambient Room Type Calorimeter

12.4.1 The balanced ambient room type calorimeter similar to that shown in Fig. 3B is based on the principle of maintaining the dry bulb temperatures surrounding the particular compartment equal to the dry-bulb temperatures maintained within that compartment.

If the ambient wet bulb temperature is also maintained equal to that within the compartment, the vapour-proofing provisions of **12.2.8** are not required.

12.4.2 The floor, ceiling and walls of the calorimeter compartments shall be spaced at a sufficient distance away from the floor, ceiling and walls of the controlled areas in which the compartments are located in order to provide uniform air temperature in the intervening space. It is recommended that this distance be at least 300 mm. Means shall be provided to circulate the air within the surrounding space to prevent stratification.

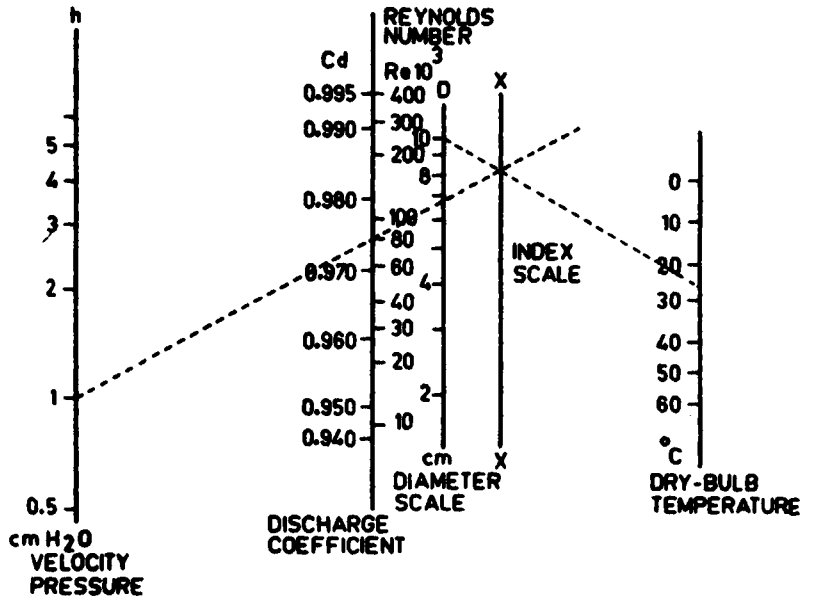
12.4.3 Heat leakage through the separating partition shall be introduced into the heat balance calculation and may be calibrated in accordance with **12.3** or may be calculated.

12.4.4 It is recommended that the floor, ceiling and walls of the calorimeter compartments be insulated so as to limit heat leakage (including radiation) to not more than 10 percent of the air conditioner capacity, with a 11°C temperature difference or 300 W (250 kcal/h) for the same temperature difference, whichever is greater, as tested using the procedure given in **12.3.2**.

13 AIR FLOW MEASUREMENT

13.1 Air Flow Determination

13.1.1 The following air quantities may be measured



This nomograph is the solution of the following equations:

$$C_d = f(R_e) : R_e = \frac{VD\sigma}{\mu}$$

where

C_d = discharge coefficient,
R_e = Reynolds number,
V = ϕ (h),
$\frac{\sigma}{\mu}$ = ψ (t),
D = nozzle diameter,
v = velocity,
t = dry bulb temperature,
σ = density,
h = velocity pressure, and
μ = viscosity.

Instructions :

Enter graph using diameter and temperature scales to obtain point on index (*X*) scale. Use index and pressure scale to obtain Reynolds number and discharge coefficient.

FIG. 5 DETERMINATION OF NOZZLE DISCHARGE COEFFICIENT

using the apparatus described in 13.2 and 13.3 and testing procedure specified in 13.4 and 13.5:

a) Room discharge air flow;

b) Exhaust air flow; and

c) Fresh air flow, if room air conditioner is equipped to provide same.

13.1.2 Air flow quantities are determined as mass flow rate. If air flow quantities are to be expressed for rating purposes in volume flow rates, such ratings should state the conditions (pressure, temperature and humidity) at which the specific volume is determined.

13.2 Nozzles

13.2.1 Nozzles shall be constructed in accordance with Fig. 3 and installed in accordance with the provisions of 13.3, 13.4 and 13.5.

13.2.2 Nozzle discharge coefficients for the construction shown in Fig. 3 may be determined by use of alignment chart (*see* Fig. 5).

13.2.3 Nozzles may also be constructed in accordance with appropriate Indian Standards provided they can be used in the apparatus shown in Fig. 4 and 6, and result in equivalent accuracy.

13.3 Apparatus for Room Discharge Air Flow Measurements

13.3.1 Recirculated air flow measurements shall be made with apparatus similar to that shown in Fig. 3, 4 and 6.

13.3.2 One or more nozzles constructed in accordance with Fig. 4 shall be fitted into one wall of the receiving chamber, discharging into the discharge chamber, and should be of such a size that the throat velocity is not less than 15 m/s. Centre distance between nozzles in use should not be less than three throat diameters, and the distance from the centre of any nozzle to any of the four adjacent side walls should be not less than 1.5 throat diameters. If the nozzles are of different diameters, the distance between axes shall be based upon the average diameter. Size and arrangement of the receiving chamber shall be sufficient to provide uniform approach velocity to the nozzle(s) or have suitable diffusion baffle to accomplish this purpose. Nozzles so installed may be considered to have a negligible correction for approach velocity.

13.3.3 To establish a zero static pressure, with respect to the test room, at the discharge of the room air conditioner 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.

13.3.4 Size and arrangement of the discharge chamber shall be such that the distance from the centre of any nozzle to the adjacent side wall is not less than 1.5 throat diameters and not less than five throat diameters to the next construction unless suitable diffusion baffles are used.

13.3.5 An exhaust fan shall be connected to the discharge chamber to overcome the resistance of chamber, nozzle(s) and diffusion baffles.

13.3.6 The manometer(s) used to measure the pressure drop across the nozzle(s) should have one side connected to one or more static pressure connections located flush with the inner wall of the receiving chamber. The other side of the manometer(s) is connected in a similar manner to

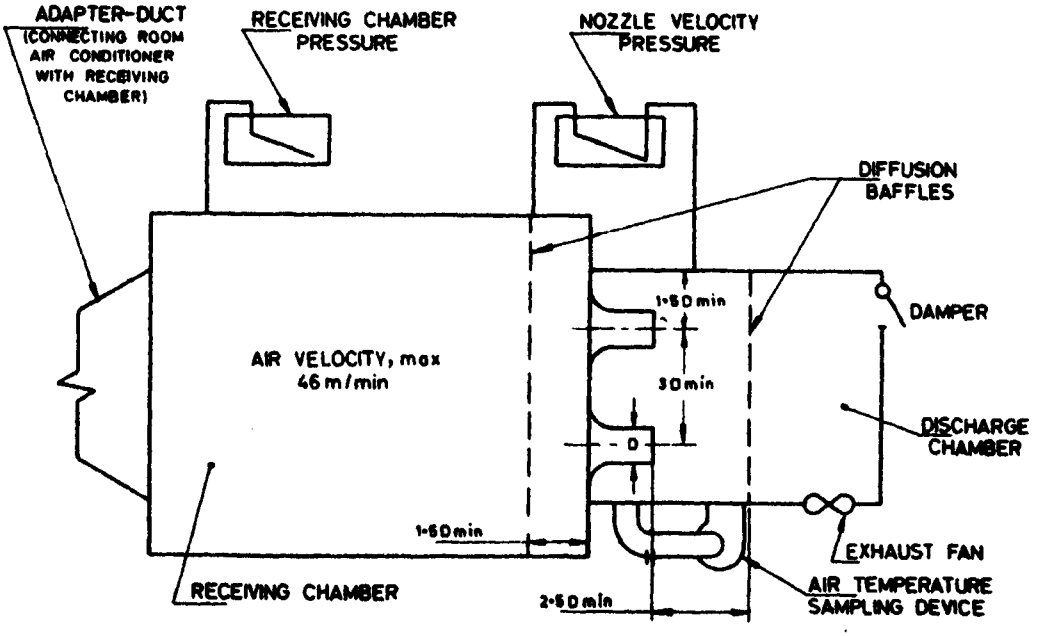


FIG. 6 AIR FLOW MEASURING APPARATUS

one or more static pressure connections in the wall of the discharge chamber. Static pressure connections should be located so as not to be affected by air flow.

If desired, the velocity head of the air stream leaving the nozzle(s) may be measured by a pitot tube, but, when more than one nozzle(s) are in use, the pitot tube reading shall be determined for each nozzle. Temperature readings at the nozzle(s) should be used only for determining air density.

13.4 Room Discharge Air Flow Measurement

13.4.1 Room discharge air flow shall be measured with apparatus similar to that illustrated in Fig. 6.

13.4.2 The outlet or outlets of the room air conditioner shall be connected to the receiving chamber by adapter ducting of negligible air resistance.

13.4.3 The exhaust fan shall be adjusted to give zero static pressure at the discharge of the unitary air conditioner in the receiving chamber.

13.4.4 The following readings shall be taken:

a) Barometric pressure,
b) Nozzle dry bulb and wet bulb temperatures, and
c) Nozzle velocity pressure.

13.4.5 Air mass flow rate and air volume flow rate through a single nozzle shall be determined as follows:

$$Q_m = K_3 \; C_d \; A \sqrt{\frac{h_p}{V_a}} \qquad \text{.....(8)}$$

$$Q_v = K_3 \; C_d \; A \sqrt{h_p \; V'_a} \qquad \text{.....(9)}$$

$$V'_a = \frac{P_o}{P} \left(\frac{V_a}{1+K} \right)$$

where

Q_m = mass flow rate;
Q_v = volume flow rate;
K_3 = 1.41 for international system (SI) units and 15 950 for metric technical units;
C_d = nozzle coefficient (*see* **13.2**);
A = nozzle area (m^2);
h_p = static pressure difference across nozzle or velocity pressure of nozzle throat, the approach velocity being considered negligible;
V'_a = specific volume of humid air at nozzle inlet;
P_o = standard barometric pressure = 1.013 25 bar (760 mm Hg);
P = barometric pressure at nozzle inlet;
K = specific humidity at nozzle inlet; and
V_a = specific volume of humid air at dry bulb and wet bulb temperature conditions existing at nozzle inlet but at standard barometric pressure.

NOTE — Where the barometric pressure deviates from the standard barometric pressure by not more than 0.03 bar (22.5 mm Hg), V_a' may, for simplicity, be considered equal to V_a.

13.4.6 Air flow through multiple nozzle shall be calculated in accordance with **13.4.5** except the total flow rate will be the sum of the Q_m for each nozzle used.

13.5 Ventilation, Exhaust and Leakage Air Flow Measurements

13.5.1 Ventilation, exhaust and leakage air flow shall be measured by apparatus similar to that illustrated in Fig. 4 with the cooling means and the heating means, if any, inoperative.

13.5.2 With the equalizing device adjusted for a maximum static pressure differential between room side and outdoor side compartment of 1 N/m^2 ; 0.01 m bar (0.1 mm H_2O) the following readings should be taken:

a) Barometric pressure,
b) Nozzle dry bulb and wet bulb temperatures, and
c) Nozzle velocity pressure.

13.5.3 Air flow values shall be calculated in accordance with **13.4.5.**

14 NOISE TEST

14.1 Noise Measuring Room

The noise measuring room shall be anechoic room complying with the following:

a) Background noise should be less than the measured value by at least 11 dBA.
b) Distance between the wall and microphone to be such that the effect of sound reflected from the wall can be negligible.

14.2 Noise Measuring Method

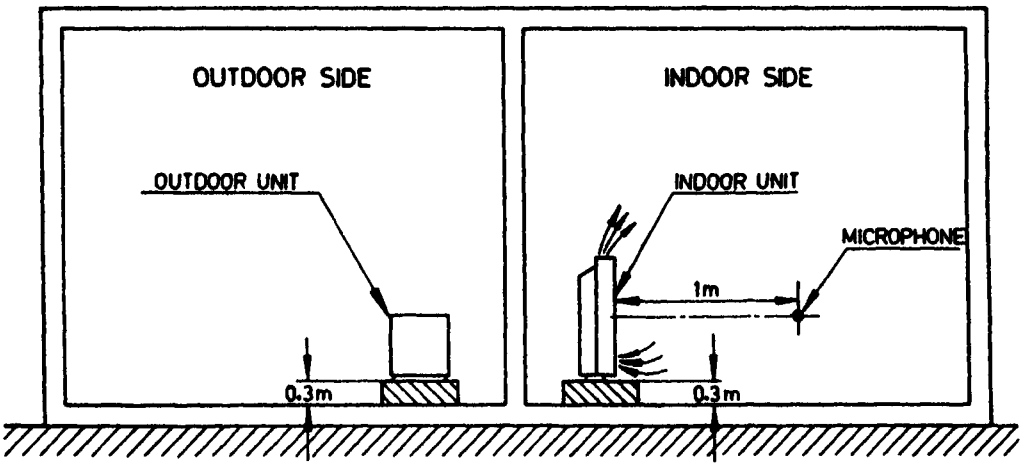
The room air conditioner should be mounted firmly and the microphone should be located indoor side at the position shown in Fig. 7. The sound level in A-scale should be measured using sound level meter.

15 TESTS

15.1 Classification of Tests

Tests shall be classified into the following three groups:

a) Production routine tests,
b) Type test, and
c) Acceptance tests.



NOTES

1 For noise test room, the figure indicates for floor model split air conditioners.

2 For other split airconditioner models like ceiling, wall or ceiling concealed mounted types, the microphone of the noise level measuring instrument should be kept at one meter distance from the supply air grill while taking readings.

FIG. 7 NOISE TEST ROOM

15.1.1 *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 (*see* 15.3).

15.1.2 *Type Tests*

These 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 who may be the manufacturer if approved by the purchaser. Once a split air conditioner has undergone type tests, any minor or essential alterations which the manufacturer intends to make shall be reported to the testing authority laid down in this standard (*see* 15.4).

15.1.3 *Acceptance Tests*

If the purchaser desired 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.

15.2 Samples for Tests

15.2.1 *Type Tests*

Two split air conditioners of each size be sent along with manufacturer's detailed specifications to the recognized testing authority for purposes of type tests. The samples shall be picked up at random from stock or routine factory production.

15.2.2 *Acceptance Tests*

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

15.3 Production Routine Tests

15.3.1 *General Running Test*

Each indoor unit shall be given a separate run to ensure vibration free and thorough running of mechanical parts. The running of outdoor unit shall be with a test rig patterned to a standard indoor unit.

15.3.2 *Pressure Test or Leakage Test*

No part of the assembly under test shall show signs of refrigerant leakage under normal working pressure when tested with a leak detector. This shall be in addition to the manufacturer's production test on each unit at the appropriate pressure corresponding to the refrigerant used.

15.3.3 *Insulation Resistance Test*

The insulation resistance between all electric circuits and the metal parts when measured at normal room temperature with a voltage of not less than 500 V dc shall not be less than 1 MΩ.

15.3.4 High Voltage Test

The electrical insulation of all circuits shall be such as to withstand a test pressure of 1 000 V_{rms} applied for not less than 2 seconds between circuits and accessible metal parts at normal room temperature.

The test voltage shall be alternating approximately sine wave form and of any convenient frequency between 25 to 100 c/s.

15.3.5 Performance Test

Measurements shall be made of the following under the prevailing ambient conditions and the performance figures from (a) to (d) 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) Voltage,

d) Current consumption, and

e) Total power consumption.

15.3.5.1 Permissible variations from the type tested unit

Temperature	±1°C
Electrical equipments	±5 percent

NOTE — Instruments accuracy shall be as follows:

Temperature	±0.2°C
Electrical meters	Class 1

15.3.6 Leakage Current Test

The leakage current shall not exceed 3.5 mA when tested as per IS 302-1(1979).

15.3.7 Earthing Resistance Test

The earthing resistance test of an air conditioner shall not exceed 0.1 Ω when tested as per IS 302-1(1979).

15.4 Type Tests

Besides all the production routine tests outlined in **15.3**, the type tests shall comprise the following:

a) Capacity rating test specified in **9.9**,

b) Room discharge air flow rating test in accordance with the procedure given in **13.4** and under conditions in **6.1.5**,

c) Power factor test specified in **9.3**,

d) Maximum operating conditions test specified in **9.4**,

e) Freeze-up test specified in **9.5**,

f) Enclosure sweat test as specified in **9.6**, and

g) Power consumption test as specified in **9.7** and **9.8**.

15.4.1 The type test report shall also contain the nameplate particulars of the split air conditioners for purposes of identification.

16 MANUFACTURER'S GUARANTEE

16.1 The manufacturer shall give a guarantee for the soundness of construction and performance of the air conditioner, and shall be responsible for putting right any manufacturing defects free of charge for a period of 12 months right from the date of sale to the original purchaser or date of inspection of approval in the case of Government or Semi-Government Institutions. Such repairs or replacements of defective parts shall be carried out at manufacturer's works, or his authorized agent at site or at service shop.

17 MARKING

17.1 The split air conditioner shall have the following information marked on a nameplate in a permanent and legible manner in a location where it is accessible and visible:

a) Name and address of the manufacturer;

b) Type or model number and serial number of the unit;

c) Name and quantity of refrigerant charge;

d) Rated voltage, phase and rated frequency;

e) Nominal cooling capacity at rated condition;

f) Power consumption at rated conditions; and

g) Nominal current at rated conditions.

17.2 Standard Marking

Details available with the Bureau of Indian Standards.

18 PRECAUTIONS

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

ANNEX A

(*Foreword*)

BASIC UNITS OF MEASUREMENT AND THEIR SYMBOLS

Sl No.	Quantity	International System (SI) Units		Metric Units	
		Name of unit	Symbol	Name of unit	Symbol
1	Air mass flow rate Air volume flow rate	kilogram per second cubic metre per second	kg/s m^3/s	kilogram per hour cubic metre per hour	kg/h m^3/h
2	Air specific humidity	kilogram per kilogram	kg/kg	kilogram per kilogram	kg/kg
3	Air specific volume	cubic metre per kilogram	m^3/kg	cubic metre per kilogram	m^3/kg
4	Air static pressure or dynamic pressure	newton per square metre	N/m^2	millimetre of water	mm H_2O
5	Air velocity	metre per second	m/s	metre per second	m/s
6	Air volume	cubic metre	m^3	cubic metre	m^3
7	Area	square metre	m^2	square metre	m^2
8	Barometric pressure	newton per square metre	N/m^2	bar millibar millimetre of mercury (torr)	bar mbar mm Hg
9	Cooling effect	watt	W	*kilocalorie per hour	kcal/h
10	Dehumidifying effect	watt	W	*kilocalorie per hour	kcal/h
11	Electric current input	ampere	A	ampere	A
12	Electric frequency	hertz	Hz	hertz	Hz
13	Electric power input	watt	W	watt	W
14	Specific enthalpy	joule per kilogram	J/kg	kilocalorie per kilogram	kcal/kg
15	Rotating speed	radian per second	rad/s	turn per second turn per minute	tr/s tr/min
16	Heat flow rate	watt	W	*kilocalorie per hour	kcal/h
17	Heat leakage rate	watt	W	*kilocalorie per hour	kcal/h
18	Linear measurements	metre millimetre	m mm	metre millimetre	m mm
19	Temperature	kelvin	K	degree Celsius	°C
	Interval of temperature	kelvin	K	degree Celsius	°C
20	Water mass flow rate	kilogram per second	kg/s	kilogram per hour	kg/h
21	Acceleration	metre per square second	m/s^2	metre per square second	m/s^2

*1 kilocalorie 15°C = 4.185 5 kJ.

ANNEX B
(*Clause* 2)

LIST OF THE REFERRED INDIAN STANDARDS

IS No.	*Title*	*IS No.*	*Title*
196 : 1966	Atmospheric conditions for testing	996 : 1979	Single-phase small ac and universal electric motors (*second revision*)
302-1(1979)	Safety of household and similar electrical appliances : Part 1 General requirements (*fifth revision*)	8148 : 1976	Packaged air conditioners
660 : 1963	Safety code for mechanical refrigeration	10617 (Part 1) : 1983	Hermetic compressors : Part 1 High temperature application group
694 : 1977	PVC insulated cables for working voltages up to and including 1 100 volts (*second revision*)	10773 : 1983	Copper tubes for refrigeration purposes
		11338 : 1985	Thermostats for use in refrigerators, air conditioners, water coolers and beverage coolers

ANNEX C
(*Clause* 6.1.2.2)

RATING CONDITIONS FOR UNITS INTENDED FOR EXPORT

C-1 COOLING CAPACITY RATING TEST CONDITIONS

C.1.1 The test conditions for the cooling capacity shall be as follows:

	Test Condition A	B
a) Room air temperature		
1. Dry bulb	27°C	29°C
2. Wet bulb	19°C	19°C
b) Outside air temperature		
1. Dry bulb	35°C	46°C
2. Wet bulb	24°C	24°C
c) Test frequency	Rated frequency*	
d) Test voltage	Rated voltage†	

C-2 MAXIMUM OPERATING CONDITIONS

C-2.1 The maximum operating test conditions shall be as follows:

	Test Condition A	B
a) Room air temperature		
1. Dry bulb	32°C	32°C
2. Wet bulb	23°C	23°C
b) Outside air temperature		
1. Dry bulb	43°C	52°C
2. Wet bulb	26°C	31°C
c) Test frequency	Rated frequency*	
d) Test voltage	1. 90 percent and 110 percent for units with single nameplate rating	
	2. 95 percent of minimum voltage and 110 percent of voltage for units with dual nameplate	

*Units with dual rated frequencies should be tested at each frequency.

†Units having dual rated voltages should be tested at the higher voltage.

ANNEX D

(*Clauses* 9.7.3, 9.8.3 *and* 9.9.4.2)

DATA TO BE RECORDED FOR COOLING CAPACITY TESTS

D-1 The following data shall be recorded for cooling capacity tests:

1. Date;
2. Observers;
3. Barometric pressure;
4. Applied voltage for each test unit motor;
5. Frequency of applied voltage for each test unit motor;
6. Total power input to unit, except if more than one external power connection is provided on unit, record input to each connection separately;
7. Total current input to unit;
8. Control dry bulb and wet bulb temperatures of air (room side calorimeter compartment) (*see* **12.2.7**);
9. Control dry bulb and wet bulb temperatures of air (outdoor side calorimeter compartment) (*see* **12.2.7**);
10. Average air temperature outside the calorimeter (calibrated room type) (*see* Fig. 2A);
11. Total power input to room side and outdoor side compartments;
12. Water quantity evaporated in humidifier;
13. Temperature of humidifier water entering room side compartment or in humidifier tank;
14. Cooling water-flow rate through outdoor side compartment heat rejection coil;
15. Temperature of cooling water entering outdoor side compartment for heat rejection coil;
16. Temperature of cooling water leaving outdoor side compartment from heat rejection coil;
17. Water condensed in outdoor side compartment;
18. Temperature of condensed water leaving outdoor side compartment;
19. Volume of air flow through measuring nozzle of separating partition flow meter; and
20. Static air pressure difference across separating partition calorimeter compartments.

Bureau of Indian Standards

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

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 latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

This Indian Standard has been developed from Doc : No. HMD 3 (0057).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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