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SPECIFICATION FOR

SELF - CONTAINED ROOM AIRCONDITIONERS

BUREAU OF CEYLON STANDARDS

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Sri Lank[redacted] subject to periodical revision in order to accommodate the progress made by industry. Suggestions for improvement will be recorded and brought to the notice of the Committees to which the revisions are entrusted.

This standard does not purport to include all the necessary provisions of a contract.

SRI LANKA STANDARD
SPECIFICATION FOR SELF-CONTAINED ROOM AIR CONDITIONERS

FOREWORD

This Sri Lanka Standard was authorized for adoption and publication by the Council of the Bureau of Ceylon Standards on 1981-07-28, after the draft, finalized by the Drafting Committee on Self-Contained Room Air Conditioners had been approved by the Electrical Engineering Divisional Committee.

All values in this standard have been given in SI Units. Accordingly the capacity is specified in watts instead of the conventional unit kcal/h hitherto used.

This specification covers the requirements for the self-contained room air conditioners. Some of the tests specified, can not be carried out in the country at present and efforts are being made to have these facilities available in the near future.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with CS 102*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

The assistance derived from the publications of the International Organization for Standardization and Indian Standards Institution in the preparation of this standard is gratefully acknowledged.

1 SCOPE

This standard specifies constructional and performance requirements and the standard conditions on which the ratings of room air conditioners employing air-cooled condensers are based and the test conditions

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***CS 102** *Presentation of numerical values* and the corresponding test procedures for determining various performance characteristics.

2 DEFINITIONS

For the purpose of this standard, the following definitions shall apply:

2.1 room air conditioner: An encased assembly designed as a self contained unit to be mounted in a window or through the wall or as a console. These units shall be designed for comfort cooling, dehumidification, filtering or cleaning and circulating room air. It may also provide ventilation by introducing outdoor air to room and or by exhausting room air to outside. When specified the conditioner may also be designed to provide heating by reverse cycle operation, steam or hot water coils or by electrical resistance elements.

2.2 standard barometric pressure: Barometric pressure of 101 kPa.

2.3 wet-bulb temperature: Temperature indicated when the temperature sensing element and wetted wick have reached a state of constant temperature (evaporative equilibrium) (see 6.1.4).

2.4 net total room codling effect of a unit: Total available capacity of the unit for removing sensible and latent heat from the space to be conditioned.

2.5 net room dehumidifying effect (latent cooling effect): Total available capacity of the unit for removing latent heat from the space to be conditioned.

2.6 net room sensible cooling effect: Available capacity of the unit for removing sensible heat from the space to be conditioned.

2.7 net room sensible heat ratio: Ratio of the net room sensible cooling effect to the net total room cooling effect.

2.8 room calorimeter: Apparatus consisting of two contiguous calorimeters with a common partition. One is designed 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 outdoorside humidifying and heating effect of the room air conditioner under test.

2.9 rated voltage: Voltage shown on the nameplate of the unit.

2.10 rated frequency: Frequency shown on the nameplate of the unit.

2.11 room discharge air-flow of a unit: Rate of flow of air from the room-side outlet of the unit.

2.12 room intake air-flow of a unit: Rate of flow of air into the unit from the conditioned space.

2.13 ventilation air-flow of a unit: Rate of flow of air introduced to the conditioned space through the unit from the outside.

2.14 outdoor discharge air-flow of a unit: Rate of flow of air from the outdoor side of the unit.

2.15 outdoor intake air-flow of a unit: Rate of flow of air into the unit from the outdoor side.

2.16 exhaust air-flow of a unit: Rate of flow of air from the room side through the unit to the outdoor side.

2.17 leakage air-flow: 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.

2.18 bypassed room air-flow of a unit: Flow of conditioned air directly from the room-side outlet to the room-side inlet of the unit.

2.19 bypassed outdoor air-flow of a unit: Flow of air directly from the outdoor-side outlet to the outdoor-side inlet of the unit.

2.20 equalizer opening air-flow: Rate of flow of air through the equalizer opening in the partition wall of a calorimeter.

NOTE – The definitions given in **2.11** to **2.20** (inclusive) relating to air flow are illustrated in Annex A.

3 CAPACITY

3.1 The nominal capacities of the room air conditioners shall be categorized as follows:

TYPE 1 Units upto 7000 W ; and

TYPE 2 Units above 7000 W.

NOTE – 1 W = 0.8598 kcal/h

4 CONSTRUCTIONAL REQUIREMENTS

4.1 The air conditioner and its components shall be constructed with strength and rigidity adequate for normal conditions of handling and usage. The unit shall be provided with the operating charge of refrigerant and shall be ready for operation when installed according to manufacturers' instructions.

4.2 There shall be no sharp edges or corners liable to cause injury under normal conditions of use and all moving components shall be adequately guarded. Components requiring periodic maintenance shall be readily accessible.

4.3 The air conditioning unit shall be equipped with a suitable heavy metallic saddle to facilitate, safe and installation on a window sill of either wood or masonry. The materials used for saddle shall be rust proof and corrosion resistant.

4.4 Materials

4.4.1 The materials used in the construction of units shall be of good commercial quality and shall be free from defects which are liable to cause undue deterioration or failure, under normal conditions of use and maintenance.

The materials shall not shrink, deteriorate, warp or cause moulds or odours and shall be resistant to vermin attack. The insulating and sealing materials shall not loose their essential properties such as heat and moisture resistance and adhesion.

4.4.2 All components subjected to corrosion shall be protected by approved methods of corrosion prevention. The exterior finish of metal components shall be suitable for local climatic conditions, cleaning and repainting when necessary.

4.5 Components

4.5.1 *Air filter*

The air filter elements shall be dry type or oil impegnated type. The filter shall be throw away type or washable and reuseable type. The filter shall be made from any suitable material which can provide adequate filtering of airborne dirt in the air conditioned room.

4.5.2 *Motor compressor unit*

The motor compressor unit shall consist of a compressor and motor enclosed in a welded shell and connected within a refrigerating circuit where all refrigerant liquid or gas containing parts shall be sealed to an extent that the circuit cannot be opened without cutting or melting. The motor unit shall be designed for operation on plus or minus 10 per cent of the rated voltage.

4.5.3 *Fans*

The motor driven fans shall be silent in operation and adequately secured to shafts. The fans shall be statically and dynamically balanced. The direction of rotation shall be clearly indicated on each fan and fan housing. The bearing shall be self-oiling with adequate oil or grease reservoirs or permanently life lubricated ball bearings.

The electric fan motor shall be shaded pole or split capacitor type, with tapping on the winding for multi-speed operation.

4.5.4 *Controls*

All controls of the air conditioner shall be easily accessible and mounted in front of the unit. Each control shall be clearly identified of its functions with indications or marking to indicate *ON* and *OFF* positions.

The controls of the air conditioner shall permit the operation either of fan only or fan and cooling system simultaneousely when heating equipment is specified, the control shall incorporate provision for heating and ventilation simultaneously.

The thermostatic control of the air conditioners shall be adjustable in the range 22 $^{\circ}$C to 28 $^{\circ}$C.

The thermostat on Type 1 air conditioners shall be mounted on the control pannel with sensing element clipped on to the cooling coil.

In Type 2 air conditioners the thermostat shall be provided for remote mounting, to obtain a better control of temperature in the conditioned space.

4.5.5 *Electrical wiring*

The internal electrical wiring of the air conditioner shall be factory-completed. All wiring shall be indented with numerals or colour coded and adequately sized to carry the normal operating currents without any heating or deformation of the insulating materials.

The terminating of all Power wiring shall be clipped or screw typed terminal connections and shall have protected covers to prevent any exposed connections. The wiring shall be arranged to prevent exposure to any condensate or sweating inside the air conditioner.

For the connection of power, Type 1 air conditioners shall be provided with a sheathed flexible cord of appropriate rating and complying with CS 40*. The power connection to Type 2 air conditioners shall be provided on a suitable terminal block inside the unit.

**CS 40 PVC insulated electric cables and flexible cord with copper conductors (for voltages upto 1100 volts).*

4.5.6 *Electrical protection*

The hermetic motor compressor unit shall be provided with a surface/ internal mounted thermal overload which shall disconnect the electricity supply to the motor in the event of a sustained overload.

Type 2 air conditioners shall be provided with a low and high pressure operated switch which shall disconnect the electricity supply to the motor compressor.

4.5.7 *Refrigerating system*

All pipes connecting the refrigerating system shall be seamless copper or aluminium pipes. The pipe connections shall be arranged in a manner that does not impair the vibration-isolation properties of absorption type mounts. The pipes shall be securely supported to minimise strain and vibrations. The pipe fittings used shall be forged bronze or copper. All brazed connections shall be made with an alloy having a melting point greater than 500 ^{o}C.

4.5.8 *Refrigerent*

Chlorodifluoromethane (R 22) formulae $CHClF_2$

Dichlorodifluoromethane (R 12) formulae CCl_2F_2

4.5.9 *Cooling and condensing coils*

The cooling and condensing coils shall be constructed from seamless copper tubes not less than 6 mm outside diameter. The copper tubes shall be finned for better heat transfer.

4.5.10 *Filter driers*

A filter drier shall be installed in the refrigerating circuit. The drier shall be marked to show the direction of the refrigerent flow.

4.5.11 *Restrictor*

The restrictor shall be a pressure reducing device, namely a capillary copper tube for Type 1 air conditioners.

4.5.12 *Condensate disposal pan*

The air conditioner shall be provided with a condensate disposal pan under the cooling coil. A suitable drain plug connection shall be provided where the design of the system does not permit the condensate disposal to air stream passing through the condensing coil.

The drain pan shall be constructed with corrosion resistant material or provided with a coating of an approval water proofing compound.

4.5.13 *Mounting and installation*

Each air conditioner shall be provided with an instruction folder indicating with diagrams the installation and maintenance procedure of the unit.

5 RATINGS

5.1 Basis of ratings

Information shall be provided regarding functions namely:

a) cooling ;

b) dehumidfying ;

c) heating, if provided ;

d) air circulating ;

e) ventilating ; and

f) filtering.

5.2 Rating and test conditions

5.2.1 *Cooling capacity ratings*

The cooling capacity range covered by these units shall be in two categories as indicated in 3.1.

The cooling capacity ratings of air conditioners shall be determined by tests conducted at the standard rating conditions specified below.

5.2.1.1 Test conditions

Room air temperature a) dry bulb 24.5 ± 1 $^{\circ}C$

b) wet bulb 19° ± 1 $^{\circ}C$

Outside air temperature a) dry bulb 32 $^{\circ}C$

b) wet bulb 30 $^{\circ}C$

Test frequency - Rated frequency
Test voltage - - Rated voltage.

Any capacity rating should be followed by the corresponding voltage and frequency ratings.

5.2.2 *Electrical rating*

All room air conditioners in Type 1 shall be rated for 230 V single phased 50 Hz each units shall be equipped with a flexible line cord and plug for operation from a standard 15 A socket outlet. The conductors in the line cord shall be colour coded for easy identification.

The Type 2 air conditioner shall be rated for 400 V 3-phased 50 Hz. The power connection to these air conditioners shall be provided on a suitable terminal block inside the unit.

5.2.2.1 Test conditions

Electrical input values used for rating purposes shall be measured during the cooling-capacity test specified in **7**.

5.2.3 *Maximum operating conditions test*

5.2.3.1 Test conditions

Room air temperature	a) dry bulb	28 °C
	b) wet bulb	23 °C
Outside air temperature	a) dry bulb	32 °C
	b) wet bulb	26 °C

Test frequency - Rated frequency

Test voltage - ± 6 per cent of the rated voltage.

5.2.4 *Condensate disposal test*

5.2.4.1 Test conditions

Room air temperature	a) dry bulb	25 °C
	b) wet bulb	22 °C
Outside air temperature	a) dry bulb	25 °C
	b) wet bulb	22 °C

Test frequency - Rated frequency

Test voltage - Rated voltage

5.2.5 *Enclosure sweat test*

5.2.5.1 Test conditions

Enclosure sweat test should be conducted at the same conditions as those specified for condensate disposal test (see **5.2.4**).

5.2.6 *Air flow measuring conditions*

Tests for determining air flow quantities for rating purposes should be conducted at standard rating conditions (Test conditions given for cooling capacity ratings), with the refrigeration means in operation and after condensate equilibrium has been obtained.

6 INSTRUMENTATION

6.1 Temperature measuring instruments

6.1.1 Temperature measurements should be carried out with one or more of the following instruments :

a) mercury-in-glass thermometers ;

b) thermocouples ;

c) electric resistance thermometers ;

6.1.2 Instrument accuracy should be within the following limits ;

a) wet-and dry-bulb temperatures of reconditioned air in room-side calorimeter compartment, ± 0.05 °C

b) water temperatures, outdoor-side compartment conditioning coil, ± 0.05 °C

c) all other temperatures, 1 ± 0.3 °C

6.1.3 The temperature measuring instruments should be calibrated by comparison with a thermometer certified by a recognized authority.

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

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

For any other instrument, a sufficient air velocity should be provided to give the same equilibrium conditions as those defined above.

6.1.5 Wherever 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.

6.1.6 Temperature of fluids within conduits should be measured by inserting the temperature measuring instrument 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 should be calibrated for the effect of pressure.

6.1.7 Temperature-measuring instruments should be adequately shielded from radiation and from any adjacent heat sources.

6.2 Pressure measuring instruments

6.2.1 Accuracy of pressure-measuring instruments, not including barometers, should permit measurements within ± 1 Pa.

6.2.2 In no case should the smallest scale division of the pressure-measuring instrument exceed twice the specified accuracy.

6.2.3 Barometric pressure should be measured by a barometer having scale markings permitting readings with an accuracy within ± 0. 1 per cent.

6.3 Electrical instruments

6.3.1 Electrical measurements should be made with either of the following instruments:

a) indicating ; and

b) integrating.

6.3.2 Accuracy should be within the following limits :

Instruments used for measuring all electrical inputs to the calorimeter compartments should be accurate to ± 0.5 per cent of the quantity measured.

6.4 Water-flow measuring instruments

6.4.1 Volume measurements should be made with either of the following instruments having an accuracy of ± 1 per cent of the quantity measured :

a) liquid quantity meter, measuring either mass or volume ;

b) liquid flow rate meter.

6.4.2 The liquid quantity meter should employ a tank having a capacity sufficient to accumulate the flow for at least two minutes.

6.5 Other instruments

6.5.1 Time interval measurements should be made with instruments whose accuracy is ± 0.2 per cent of the quantity measured.

6.5.2 Mass measurement should be made with apparatus whose accuracy is ± 1 per cent of the quantity measured.

6.6 Calorimeters

6.6.1 *Calorimeters required for testing room air conditioners*

Room air conditioners should be tested for cooling-capacity in a room calorimeter of either calibrated or balanced-ambient type (see **6.7** and **6.8**).

6.6.2 *Calorimeters-general*

6.6.2.1 The calorimeter provides a method for determining cooling-capacity simultaneously on both 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 confirming 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.

6.6.2.2 The two calorimeter compartments, room-side and outdoor-side, are separated by an insulated partition having an opening into which the room air conditioner is mounted. The air conditioner should be installed using supporting members and filler pieces in a manner similar to a normal installation. No effort should 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 should be made to the conditioner which might in any way alter its normal operation.

6.6.2.3 A pressure-equalizing device should 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 the permit measurement of leakage, exhaust, and ventilation air. This device consists of one or more nozzles of the type shown in Figure 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 Figure 2.

Since the air flow from one compartment 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 pick-up tubes should be so located as to be unaffected by air discharged from the air conditioner on test 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 air flow by any suitable means, such as a variable-speed drive, or a damper as shown in Figure 2. The exhaust from this fan or blower should be such that it will not affect the inlet air to the air-conditioner test.

The equalizing device should be adjusted during calorimeter tests or air-flow measurements so that the static pressure difference between the room-side and outdoor-side compartments is not greater than 1.5 Pa.

6.6.2.4 The size of the calorimeter should be sufficient to avoid any restrictions to intake or discharge openings of the airconditioner. Perforated plates or other suitable grills should be provided at the discharge openings 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 grills of the air-conditioner to avoid interference with the air-flow. Minimum distance from the air-conditioner to side walls or ceiling of the compartment (s) should be one metre except for the back of a console-type room air-conditioner, which should be in normal relation to the wall. Table 1 gives the suggested dimensions for the calorimeter.

TABLE 1 - Sizes of calorimeter

Maximum rated cooling capacity of unit	Suggested minimum inside dimensions of each room of calorimeter		
	Width	Height	Depth
3 000 W	2.4 m	2.1 m	1.8 m
6 000 W	2.4 m	2.1 m	2.4 m
9 000 W	2.7 m	2.4 m	3.0 m
12 000 W	3.0 m	2.4 m	3.7 m

NOTE - 1 W = 0.8598 kcal/h.

6.6.2.5 Each compartment should be provided with reconditioning equipment to maintain specified air-flow and prescribed conditions, reconditioning equipment for the room-side compartment should consist of heaters to supply sensible heat and a humidifier to supply moisture. The energy supply may be electric, steam, or any other that can be controlled and measured. Reconditioning equipment for the outdoor-side compartment should provide cooling and dehumidification. A cooling coil equipped with by-pass dampers, to control the dry-bulb temperature and supplied with 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 should be provided with fans of sufficient capacity to overcome the resistance of the reconditioning equipment and to circulate not less than twice the quantity of air dischanged by the air-conditioner to the room side or to the outdoor-side as the case may be. In no case should the reconditioning equipment discharge less than one compartment air change per minute.

6.6.2.6 Remote reading thermometers, instruments, or air-sampling tubes should be used to measure the specified wet and dry bulb temperatures in both calorimeter compartments. Air sampling should comply with **6.1.4.** 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 should be installed completely within the calorimeter compartments and their electrical input included in the load measurement. The fan motor should 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.

6.6.2.7 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 room air-conditioner being tested. Therefore, the resultant conditions are peculiar to, and dependent upon a given combination of compartment size, arrangements and size of reconditioning equipment, and the air-conditioners air-discharge characteristics. Accordingly, no single location for the measurement of dry and wet bulb temperatures can be specified which will be acceptable for all combinations of calorimeter facilities and room air-conditioners which may be tested.

It is intended that the specified test temperatures surrounding the unit being tested should 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 and dry bulb should be such that the following conditions are fulfilled:

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

b) At the point of measurement, the temperature of air should 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.

6.6.2.8 Interior surfaces of the calorimeter compartments should be of nonporous material with all joints sealed against air and moisture leakage. Access doors should be tightly sealed against air and moisture leakage use of gaskets or other suitable means.

6.7 Calibrated room-type calorimeter

6.7.1 The calibrated room-type calorimeter is shown in Figure 1 A. Each calorimeter, including the separating partition, should be insulated to prevent heat leakage (including radiation) in excess of 5 per cent of the air-conditioner capacity. It is recommended that an air space permitting free circulation be provided under the calorimeter floor.

6.7.2 Heat leakage may be determined in either the room-side or outdoor-side compartment by the following method :

All openings should 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 temperature should be maintained constant within ± 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.

6.7.3 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 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 second test will permit determination of the leakage through the partition alone.

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

6.8 Balanced ambient room-type calorimeter

6.8.1 The balanced ambient room-type calorimeter is shown in Figure 1 B and 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 6.6.2.8 are not required.

6.8.2 The floor, ceiling and walls of the calorimeter compartments should be spaced 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 0.3 m. Means should be provided to circulate the air within the surrounding space to prevent stratification.

6.8.3 Heat leakage through the separating partition should be introduced into the heat balance calculation and may be calibrated in accordance with 6.7. or may be calculated.

6.8.4 It is recommended that the floor, ceiling and walls of the calorimeter compartments be insulated so as to limit heat leakage (including radiation) not more than 10 per cent of the air-conditioner capacity, with a 11 °C temperature difference, or 300 W for the same temperature difference, whichever is greater, as tested using the procedure given in 6.7.2.

7 COOLING CAPACITY TEST

7.1 Test conditions

7.1.1 Cooling capacity test should be conducted under the conditions specified in 5.2.1.1 and within the allowable variation given in Table 2.

7.1.2 The test capacity should be the sensible latent or total heat capacity determined on the room-side compartment.

7.1.3 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.

TABLE 2 - Variations allowed in capacity test readings

Readings	Variations of arithmetical average from rating conditions	Maximum variation of individual from rating conditions
All entering air temp:		
dry bulb	0.3 °C	0.5 °C
wet bulb	0.2 °C	0.3 °C
Air temperature surrounding balanced ambient calorimeter		
dry bulb	0.5 °C	1.0 °C
wet bulb	0.3 °C	0.5 °C
Voltage (at unit connection)	1%	2%

7.2 Procedure

7.2.1 Two simultaneous methods of determining capacities should be used. One method determines the capacity on the room side, the other measures the capacity on the outdoor side. These two simultaneous determinations should agree within 4 per cent of the value obtained on the room-side for the test to be valid.

7.2.2 Test conditions should be maintained until equilibrium has been reached; and maintained for not less than one hour, before recording data for the capacity test. The test should then be run for one hour recording data every ten minutes, giving seven sets of readings.

7.2.3 Data to be recorded for this test are given in Table 3. This table shows the general information, but is not intended to limit the data to be collected.

7.3 Requirements

The capacity of the production unit as determined on the room side shall be not less than 90 per cent of the name plate rating.

7.4 Calculations

7.4.1 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. 1 A and 1 B) is calculated as follows :

$$q_{t_r} = K_1 \sum E_r + (h_{w_1} - h_{w_2})\, w_r + q_{1_p} + q_{1_r} \quad \ldots\ldots\ldots \quad (1)$$

where

q_{t_r} = the net total room-cooling effect as determined on room-side compartment ;

K_1 = unity ;

E_r = sum of all power input to room-side compartment ;

h_{w_1} = the enthalpy of water or steam supplied to maintain humidity. If no water is introduced during the test h_{w_1} is taken at the temperature of the water in the humidifier tank of the reconditioning equipment ;

h_{w_2} = the enthalpy of condensed moisture leaving the room-side compartment since transfer of condensed moisture from the room-side to the 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 = the water vapour (rate) condensed by air-conditioner. This is measured by reconditioning equipment as the amount of water evaporated into the room-side compartment to maintain required humidity;

q_{1_p} = the 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);

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

7.4.2 *Net total room-cooling effect on the 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. 1 A and 1 B) is calculated as follows :

$$q_{t_o} = q_c - K_1 \sum E_o - K_1 E + (h_{w_3} - h_{w_2}) w_r + q_{1_p} + q_{1_o} \quad \text{.......(2)}$$

where

q_{t_o} = the net total room-cooling effect as determined on outdoor side ;

q_c = the heat removed by cooling coil in outdoor-side compartment ;

K_1 = unity ;

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

E = the total power input to air conditioner;

h_{w_2} = the enthalpy of condensed moisture leaving the room-side compartment, as defined in 7.4.1.

h_{w_3} = the 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 = the water vapour condensed by air-conditioner, as defined in 7.4.1.

q_{1_p} = the 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);

NOTE - This quantity will be numerically equal to q_1 used in equation (1) (see 7.4.1) *but only if, the area of separating partition exposed to outdoor-side is equal to the area exposed to the room-side compartment.*

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

7.4.3 *Net room dehumidifying effect*

The net room dehumidifying effect is calculated as follows:

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

where

K_2 = 2460 kj/kg

q_d = the net room dehumidifying effect;

w_r = the water vapour condensed by air-conditioner, as defined in 7.4.1.

7.4.4 *Net room sensible cooling effect*

The net room sensible cooling effect is calculated as follows :

$$q_s = q_{t_r} - q_d \; .... (4)$$

where

q_s = the net room sensible cooling effect;

q_{t_r} (see equation (1), 7.4.1);

q_d (see equation (3), 7.4.3);

7.4.5 *Net room sensible heat ratio*

The net room sensible heat ratio is calculated as follows :

$$SHR = \frac{q_s}{q_{t_r}} \quad \ldots\ldots\ldots \quad (5)$$

where

SHR = the net room sensible heat ratio.

q_s (see equation (4) 7.4.4)

q_{t_r} (see equation (1) 7.4.1)

TABLE 3 - Data to be recorded for cooling-capacity tests

No.	Data
01	Date
02	Observers
03	Barometric pressure
04	Speed of test unit cooling fan (s), where such speed is adjustable for variable
05	Applied voltage for each test unit motor
06	Frequency of applied voltage for each test unit motor
07	Total power input to unit*
08	Total current input to unit
09	Control dry-bulb and wet-bulb temperature of air (room-side calorimeter compartment)**
10	Control dry-bulb and wet-bulb temperature of air (outdoor-side calorimeter compartment)**
11	Average air temperature outside the calorimeter (calibrated room-type – see Fig 1 A)
12	Total power input to room-side and outdoor-side compartments
13	Water quantity evaporated in humidifier
14	Temperature of humidifier water entering room-side compartment, or in humidifier tank
15	Cooling water-flow rate through outdoor-side compartment, for heat-rejection coil
16	Temperature of cooling water entering outdoor-side compartment, for heat rejection coil
17	Temperature of cooling water leaving outdoor-side compartment, from heat rejection coil
18	Water condensed in outdoor-side compartment
19	Temperature of condensed water leaving outdoor-side compartment
20	Volume of air flow through measuring nozzle of separating partition flow meter
21	Air-static pressure difference across separating partition of calorimeter compartments.

* *Total power input to unit, except if more than one external power connection is provided on unit; record input to each connection separately.*
** *See* 6.6.2.7

8 AIR FLOW MEASUREMENT

8.1 Air flow determination

8.1.1 The follwing air quantities may be measured using the apparatus and testing procedures given in this standard (see **5.2.6** for test conditions).

a) room discharge air flow ;

b) ventilation air flow if room air-conditioner is equipped to provide same ;

c) exhaust air flow if room air-conditioner is equipped to provide same ;

d) leakage air flow.

8.1.2 Airflow quantities are determined as mass flow rates. If airflow 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.

8.2 Nozzles

8.2.1 Nozzles should be constructed in accordance with Fig. 3, and installed in accordance with the provisions of succeeding clauses.

8.2.2 Nozzles discharge coefficients for the construction shown in Fig. 3 may be determined by use of the alignment chart (see Annex B).

8.2.3 Nozzles may also be constructed in accordance with appropriate national standards, provided they can be used in the apparatus described in Figures 2 and 4 and result in equivalent accuracy.

8.3 Apparatus for room discharge airflow measurements

8.3.1 Room discharge airflow measurements should be made with apparatus similar to that shown in Figures 2, 3 and 4.

8.3.2 One or more nozzles constructed in accordance with Fig. 3 should 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 distances 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 should be based upon the average diameter. Size and arrangements of the receiving chamber should be sufficient to provide uniform approach velocity to the nozzle(s) or have suitable diffusion baffles to accomplish this purpose. Nozzles so installed may be considered to have a negligible correction for approach velocity.

8.3.3 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.

8.3.4 Size and arrangement of the discharge chamber should 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 obstruction, unless suitable diffusion baffles are used.

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

8.3.6 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 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 airflow. 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 is in use, the Pitot tube reading is determined for each nozzle. Temperature readings at the nozzle(s) should be used only for determining air density.

8.4 Room discharge airflow measurement

8.4.1 Room discharge airflow should be measured with apparatus similar to that illustrated in Fig. 4.

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

8.4.3 The exhaust fan should be adjusted to give zero static pressure at the discharge of the room air-conditioner in the receiving chamber.

8.4.4 The following readings should be taken ;

a) barometric pressure ;

b) nozzle dry and wet-bulb temperatures ; and

c) nozzle velocity pressure.

8.4.5 Air mass flow rate through a single nozzle is determined as follows :

$$Q_m = K_3 C_d A \sqrt{\frac{h_p}{v'_n}} \quad \text{.......... (6)}$$

Air volume flow rate through a single nozzle is determined as follows :

$$Q_v = K_3 C_d A \sqrt{h_p v'_n} \quad \text{.......... (7)}$$

$$v'_n = \frac{P_o}{P} = \frac{v_n}{1 + x} \quad \text{........... (8)}$$

where

K_3 = 1.41

C_d = the nozzle coefficient (see **8.2**) ;

A = the nozzle area ;

h_p = the static pressure difference across nozzle, or velocity pressure of nozzle throat, the approach velocity being considered negligible ;

v'_n = the specific volume of humid air at nozzle inlet ;

P_o = the standard barometric pressure = 101 kPa ;

P = the barometric pressure at nozzle inlet ;

x = the specific humidity at nozzle inlet ; and

v_n = the specific volume of humid air at dry 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 3 kPa, v'n may, for simplicity, be considered equal to v_n.

8.4.6 Airflow through multiple nozzles should be calculated in accordance with **8.4.5** except that total flow rate will be the sum of the Q_m for each nozzle used.

8.5 Ventilation, exhaust and leakage airflow measurements

8.5.1 Ventilation, exhaust and leakage airflows should be measured by apparatus simialr to that illustrated in Fig. 2 with the refrigeration system in operation and after condensate equilibrium has been obtained.

8.5.2 With the equalizing device adjusted for a maximum static pressure differential between room-side and outdoor-side compartments of one pascal the following readings should be taken:

a) barometric pressure ;

b) nozzle dry and wet-bulb temperatures ; and

c) nozzle velocity pressure.

8.5.3 Airflow values should be calculated in accordance with 8.4.5.

9 PERFORMANCE TESTS

9.1 Maximum operating conditions test

9.1.1 *Test conditions*

9.1.1.1 The maximum operating conditions test should be conducted under the conditions specified in 5.2.3.

The units controls should be set for maximum cooling and all ventilating air dampers and exhaust air dampers should be closed.

9.1.1.2 Voltage adjustments

Test voltage should be as specified in 5.2.3. 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 per cent when the unit is stopped. After the service has been adjusted to accomplish this result, no subsequent adjustments should be made during either test.

9.1.2 *Procedure*

The room air-conditioner should be operated continuously for two hours after the specified air temperatures and equilibrium condensate level have been established. All power to the room air-coditioner should then be cut off for three minutes and then restored for one hour.

For variations allowed in test readings (see Table 4).

9.1.3 *Requirements*

9.1.3.1 During one entire test, the room air-conditioner should operate without visible or audible indication of damage.

9.1.3.2 The room air-conditioner motors should operate continuously for the first two hours of the test without tripping of the motor overload protective devices.

9.1.3.3 The motor overload protectives device may trip only during the first five minutes after the shut-down period of three minutes. During the remainders of that one hour test period, no motor overload protective device should trip.

9.1.3.4 For those models so designed that resumption of operation does not occur after initial trip within the first five minutes, the unit may remain out of operation for not longer than 30 min. It should then operate continuously for one hour.

9.2 Condensate disposal test

9.2.1 *Test conditions*

Condensate disposal test should be conducted under the conditions specified in 5.2.4. The unit's controls, fans dampers and grilles should be set to produce the maximum tendency to sweat, provided such settings are not contrary to the manufacturer's operating instructions.

9.2.2 *Procedure*

After establishment of the specified temperature conditions, the room air-conditioner should be started with its condensate collection pan filled to the overflowing point, and should be operated continuously for four hours after the condensate level has reached equilibrium.

For variations allowed in test readings see Table 4.

9.2.3 *Requirements*

During this test, the room air-conditioner should have the ability to dispose of all condensate and there should be no dripping or blowing-off of water from the unit such that the building or surroundings may become wet.

9.3 Enclosure sweat test

9.3.1 *Test conditions*

Enclosure sweat test should be conducted under the conditions specified in 5.2.5.

The unit's controls fans, dampers and grilles should be set to produce maximum tendency to sweat provided such settings are not contrary to the manufacturer's operating instructions.

NOTE - This test may be conducted concurrently with the condensate disposal test (see 9.2).

9.3.2 *Procedure*

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

For variations allowed in test readings see Table 4.

9.3.3 *Requirements*

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

9.4 Power consumption test

9.4.1 *Test conditions*

The power consumption should be determined during the cooling capacity test specified in **7** under the conditions given in **5.2.1**.

9.4.2 *Procedure*

The power consumption should be the average power consumption in watts measured during the cooling capacity test. (see **7** and Table 3).

9.4.3 *Requirements*

The power consumption should not exceed by more than five percent of that stated on the name plate.

TABLE 4 - Variations allowed in performance test readings

Quantity measured	Allowable variations in individual reading from stated test conditions
Air temperatures	± 0.5 °C
Water temperatures	± 0.3 °C
Voltage	± 1.0%

10 QUALITY CONTROL TEST

10.1 Production routine test

10.1.1 *General running test*

Each unit should be given a run to ensure vibration free and through running of mechanical parts.

10.1.2 *Pressure test or leakage test*

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

10.1.3 *Insulation resistance test*

The insulation resistance between all electric units and the metal parts when measured at normal room temperature with a voltage of not less than 500V dc, the measurement being made one minute after application of the voltage should be not less than two megachm.

10.1.4 *High voltage test*

The electrical insulation of all circuits should be such as to withstand a test pressure of $1000V_{rms}$ applied for not less than two 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 Hz to 100 Hz.

10.1.5 *Power factor*

When operating under normal load under the conditions specified in 5.2.1, with controls set for maximum cooling and with the ventilating air damper and exhaust damper, if any, closed room air-conditioner should have overall power factor, measured at 230 volts 50 Hz, not less than 80 per cent.

11 ENVIRONMENTAL

11.1 *Noise level*

During the operation of the air-conditioner the noise level shall be as low as possible.

12 INFORMATION FURNISHED BY MANUFACTURER

12.1 The follwing details should be stamped on all air-conditioners in legible manner in a location accessible for reading :

a) Manufacturer's name or trade mark ;

b) Manufacturer's address ;

c) Type or model ;

d) Serial number ;

e) Net total room-cooling capacity ;

f) Heating capacity (if provided) ;

g) Ventilation capacity ;

h) Test pressure of refrigerating system ;

j) Type and quantity of refrigerant charge ; and

k) Electrical ratings including voltage, current, frequency and power requirements.

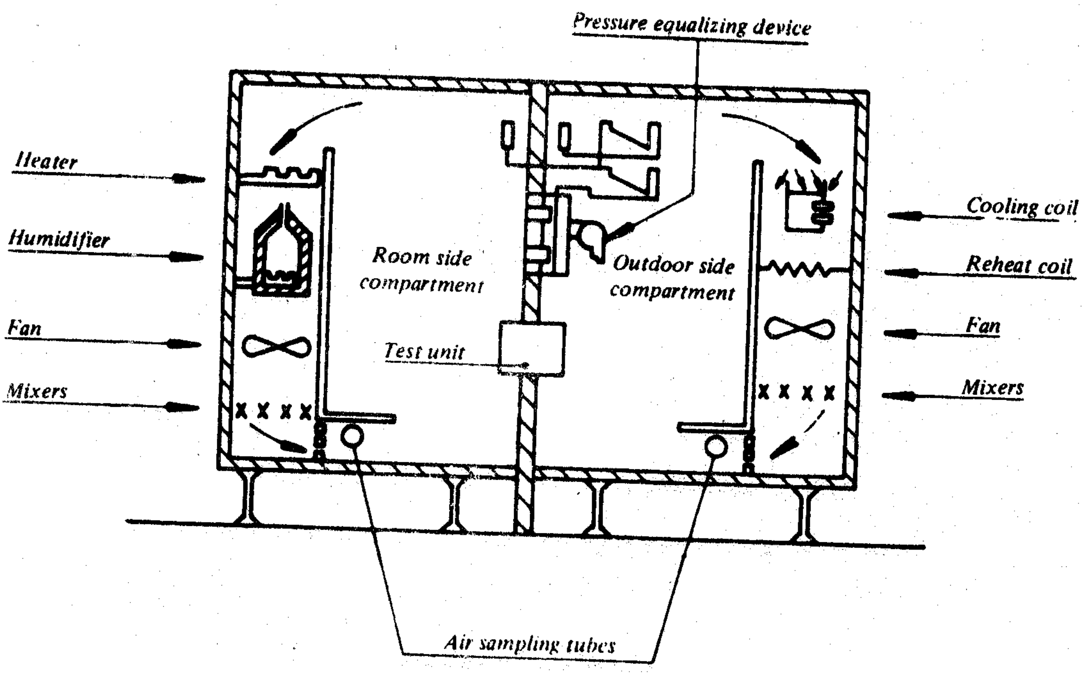


FIG. 1A Calibrated room-type calorimeter

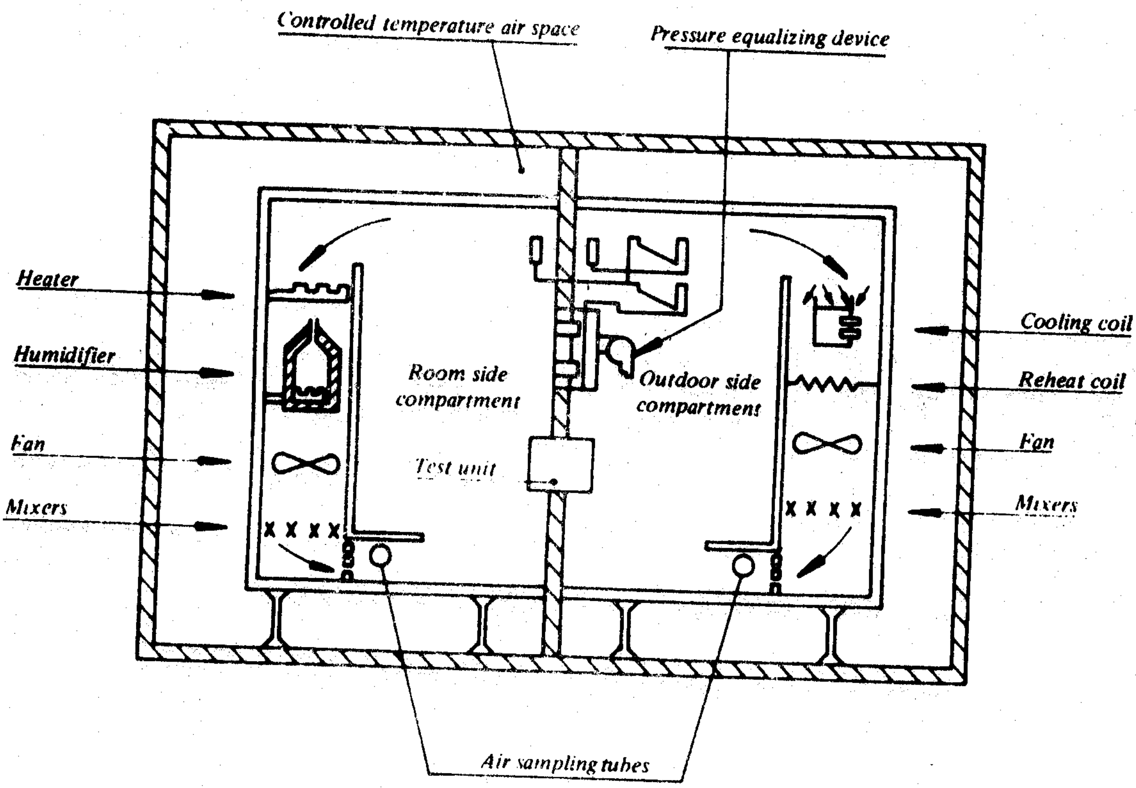


FIG. 1B Balanced ambient room-type calorimeter

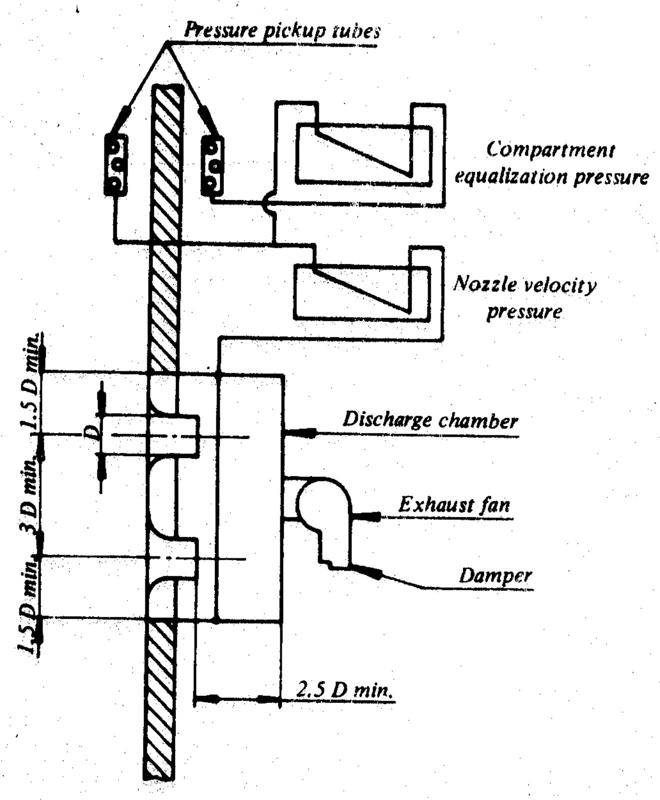


FIG. 2 Pressure equalizing device

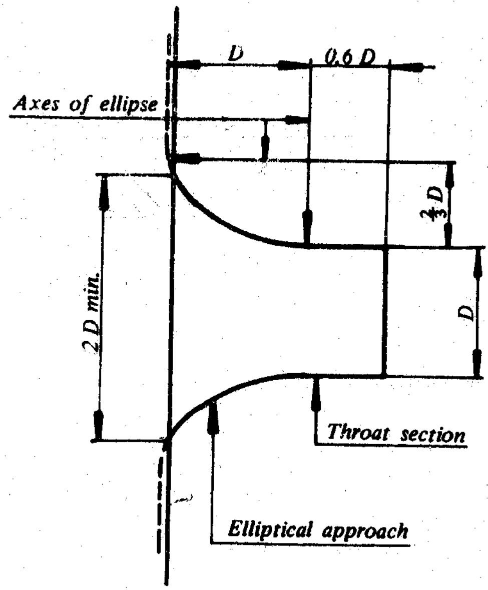


FIG. 3 – Air-flow measuring nozzle

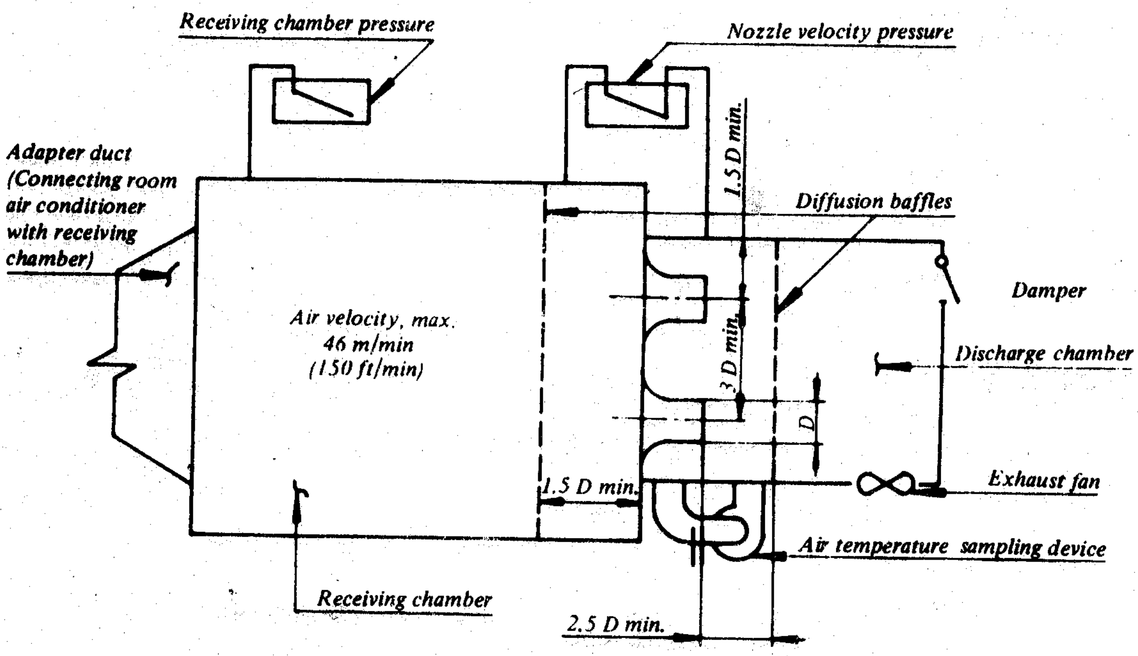
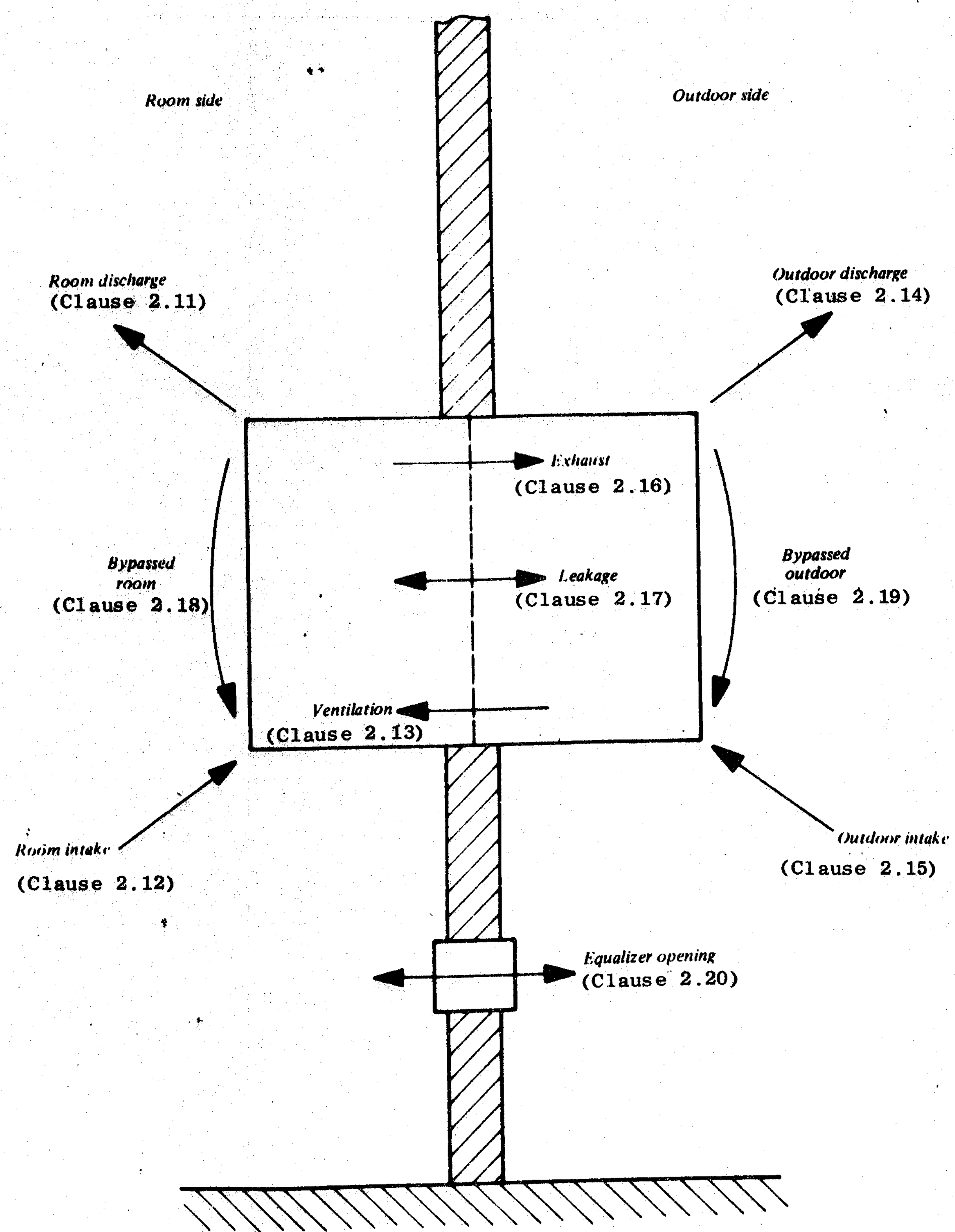


FIG. 4 – Air-flow measuring apparatus

ANNEX A

AIR-FLOW DIAGRAM ILLUSTRATING DEFINITIONS GIVEN IN CLAUSES 2.11 TO 2.20



ANNEX B

DETERMINATION OF NOZZLE DISCHARGE COEFFICIENT

This nomograph is the solution of the following equations :

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

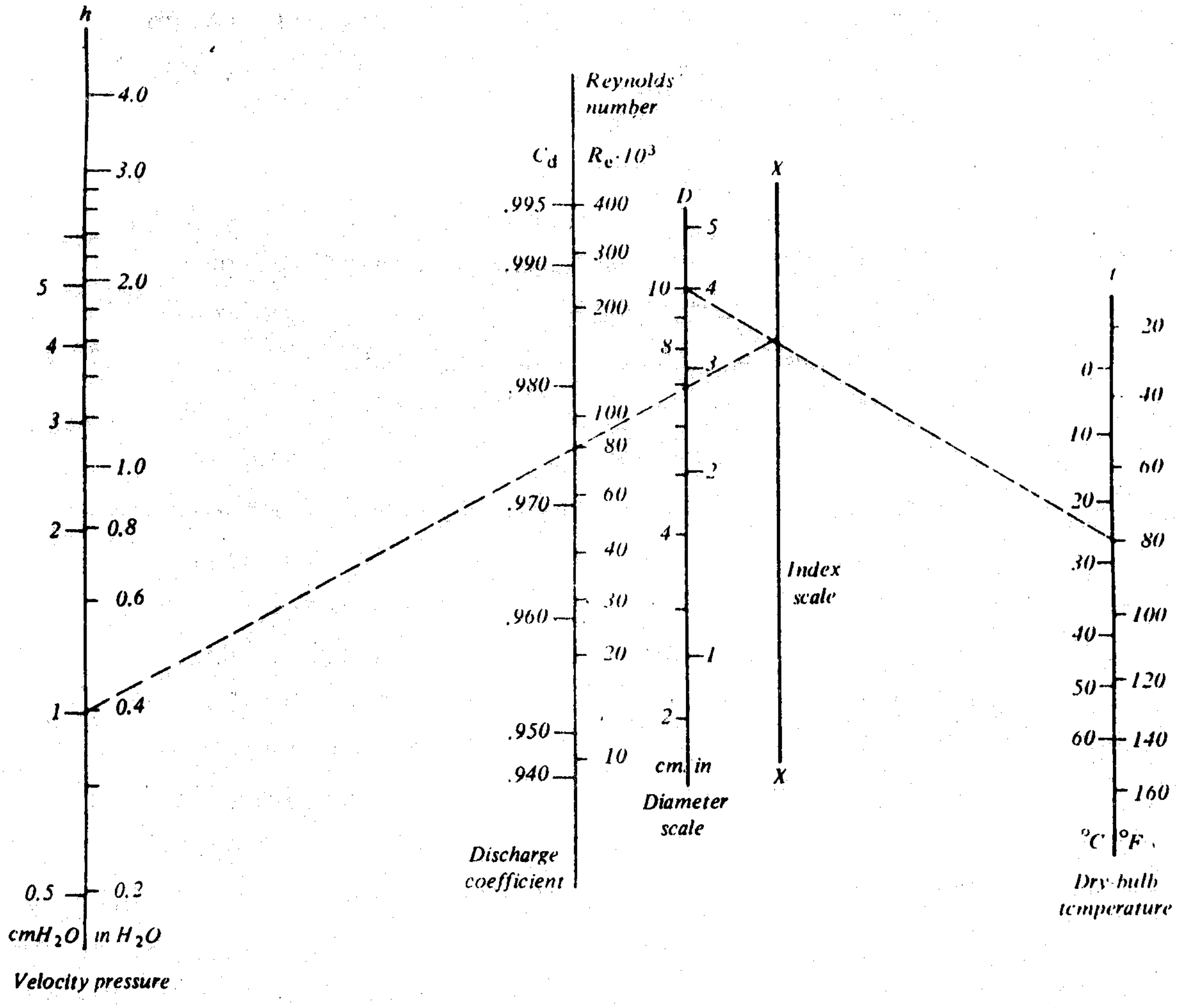
C_d is the discharge coefficient

R_e is the Reynolds number

where

$$V = \varphi \quad (h)$$

$$\frac{\rho}{\mu} = \psi \quad (t)$$



D is the nozzle diameter

t is the dry-bulb temperature

h is the velocity pressure

V is the velocity

ρ is the density

μ is the viscosity

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

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