भारतीय मानक
Indian Standard

IS 3315 : 2024

डायरेक्ट वाष्पशील वायु शीतलन यंत्र — विशिष्टि

(चौथा पुनरीक्षण)

Direct Evaporative Air Cooler — Specification

(Fourth Revision)

ICS 91.140.30

© BIS 2024

May 2024   **Price Group 8**

Refrigeration and Air Conditioning Sectional Committee, MED 03

FOREWORD

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

A direct evaporative air cooler also known as desert cooler is a device that cools air through the evaporation of water. Evaporative cooling differs from other air conditioning systems, which use vapor-compression or absorption refrigeration cycles. Evaporative coolers are relatively simpler and require less energy than other forms of cooling.

This standard was first published in 1956 and subsequently revised in 1974, 1994, and 2019. This standard is being revised again to keep pace with the latest technological developments and international practices. Also, in this revision, the standard has been brought into the latest style and format of Indian Standards, and references of Indian Standards, wherever applicable have been updated. BIS certification marking clause has been modified to align with the revised *Bureau of Indian Standards Act*, 2016. The following major modifications have been incorporated in this revision of the standard:

a) The title and scope have been revised;
b) Sump tank capacity requirement has been modified;
c) Method of measurement of sump tank capacity has been added;
d) Blower/fan reliability tests have been added; and
e) Sound pressure levels for blower/fan type air cooler have been added.

A scheme of labelling environmentally friendly products with ECO logo known as ECO-Mark has been introduced by the Ministry of Environment, Forest and Climate Change of India (MoEFCC), Government of India. MoEFCC issued a notification dated 17 May 1996 [GSR 214(E)] for ECO labelling of desert coolers. These ECO labelling criteria relevant to desert coolers have been incorporated in this Indian Standard. The ECO-Mark would be administered by the Bureau of Indian Standards (BIS) as per the *Bureau of Indian Standards Act*, rules and the regulations framed thereunder.

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

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

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

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

DIRECT EVAPORATIVE AIR COOLER — SPECIFICATION

(Fourth Revision)

1 SCOPE

This Indian Standard specifies the construction, performance, safety, and method of testing ofdirect evaporative air cooler for household and similar applications for capacity up to and including 1.67 m^3/sec (6 000 CMH) suitable for rated voltage up to and including 250 V single-phase, 50 Hz a.c.

> NOTES
>
> **1** These coolers are not suitable if difference between dry bulb temperature (DBT) and wet bulb temperature (WBT) is less than 3 °C and humidity is over 75 percent.
> **2** cubic meter/second = 3 600 cubic meter/hour.

2 REFERENCES

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

3 DEFINITIONS

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

3.1 Cooling Efficiency — The extent to which the leaving air dry bulb temperature approaches the wet bulb temperature of entering air is expressed as cooling efficiency. It is expressed as:

$$= [(T_{a1} - T_{a2})/(T_{a1} - T_{w1})] \times 100 \text{ %}$$

where

T_{a1} = dry bulb temperature, °C, of inlet air;

T_{a2} = dry bulb temperature, °C, of outlet air; and

T_{w1} = wet bulb temperature, °C, of inlet air.

3.2 Direct Evaporative Air Cooling — It involves the process of evaporating water into air stream. Air is cooled by direct contact with water through a wetted surface. The heat and mass transfer process between the air and water lowers the air dry bulb temperature at constant wetbulb temperature.

3.3 Dry Bulb Temperature (DBT) — It is the temperature of air measured by a thermometer freely exposed to the air, but shielded from radiation and moisture.

3.4 Evaporative Air Cooler — A device which cools air by evaporation of water.

3.5 Wet Bulb Temperature (WBT*)* — The temperature indicated when a thermometer bulb is covered with a water saturated wick over which air is caused to flow at approximately 4.5 m/s (900 ft/min) to reach the equilibrium temperature of water evaporating into the air when the heat of vaporization is supplied by the sensible heat of the air.

3.6 Static Pressure — The actual pressure of the fluid, which is associated not with its motion but with its state. The pressure is exerted uniformly throughout the entire fluid. The portion of the fluid pressure which exists by virtue of the degree of compression only. If expressed as Gauge pressure, it may be negative or positive. In a dynamic system, static pressure is the difference between total and velocity pressures in H_2O (kPa).

4 CLASSIFICATION

According to airflow, the air coolers shall be classified as follows:

a) Blower type; and
b) Fan type.

5 CONSTRUCTION

5.1 Enclosure

5.1.1 Materials used in the construction shall comply with relevant Indian Standards wherever applicable, except where such requirements are modified by this standard. They shall be free from defects that are liable to cause undue deterioration or failure. Under normal conditions ofuse, the materials used shall not shrink, warp or cause odour and shall be resistant to attack by local vermin and destructive pests.

5.1.2 The external parts of non-metallic material shall comply with **30** of IS 302 (Part 1). The external parts of metallic material shall withstand minimum 96 h of salt spray test as per IS 9844.

> NOTE — Based on the customer requirement as per different climatic condition across country, the min hrs may be extended as per mutual agreement.

5.1.3 The design and assembly of the equipment shall be such that vibration does not cause rattling and loosening of parts and create excessive noise.

5.1.4 Parts which require service and replacement shall be interchangeable and readily accessible.

5.1.5 The body should be so designed that during normal working water shall not blow off, leak, or drip from air cooler.

5.1.6 *Grill*

The front grill shall be made of non-corrosive material with an arrangement for adjusting horizontal and vertical directional flow of air.

5.1.7 *Water Feeding Arrangement*

Suitable water feeding arrangement shall be provided in such a way that water shall not fall out from the cooler.

5.2 Filter Pads

Filter pads shall be made of wood wool/honeycomb or any other environment friendly material placed in non-corrosive wire mesh or plastic parts and tightened at places with side panels to avoid sagging.

5.3 Sump Tank Capacities

5.3.1 For sump tanks of evaporative air coolers which does not need to be connected to continuous water supply, the capacity shall be as declared by the manufacturer.

5.3.2 Water is measured in a calibrated beaker (in litre) and poured in the sump tank until excess water escapes from the overflow hole (for the sump with overflow hole) or through the brim (for sump without overflow hole). The quantity of water thus measured, indicates the sump capacity of the air-cooler.

5.3.3 The declared sump capacity shall be within ± 5 percent of the rated capacity.

5.3.4 Each cooler shall be provided with an accessible drain hole. The drain cock and drain cock cap shall be of non-corrosive material.

5.4 Blower/Fan

5.4.1 The blower/fan blade shall be well balanced. Fan material can be either of sheet metal orsuitable plastic. The blade and blade carriers shall be securely fixed so that they do not get loose in operation. The metallic parts shall be powder coated or suitably protected against corrosion.

5.4.2 The bearing used shall be such as to ensure quiet running, and good service. The fan shall have resilient mounting so as to reduce noise and vibration.

5.4.3 The fan motor shall conform to IS 996.

5.5 Pump Set

The pump set used in air coolers shall conform to IS 11951.

5.6 Wiring

5.6.1 Electrical wiring and connection shall conform to the requirements of **23.1** of IS 302 (Part 1). All electrical joints shall be electrically and mechanically secure. Where any cable, passes through metal holes, the metal edges, shall be fitted with a grommet of suitable insulating material, so as to protect the cable from damage and possible earthing.

5.6.2 Suitable power cable conforming to IS 694 or IS 9968 (Part 1) of minimum 1.5 m length shall be provided with each unit from the outer body of the cooler to end. The length should be measured from the outer body of unit.

6 RATING REQUIREMENT

6.1 Rated Voltage

The rated voltage shall be 230 ~ 240 volts.

6.2 Rated Frequency

The rated frequency of air cooler shall be standard frequency of 50 Hz.

7 TEST CONDITIONS

7.1 Unless otherwise specified the tests shall be made on the air cooler installed as for normal use, with the accessories, grills, etc, if any, in their normal position in accordance with the manufacturer's instructions.

7.2 Air delivery test may be conducted at any ambient temperature prevailing at the time of test.

7.3 The evaporating medium shall be dry during the airflow test.

7.4 The appliance shall be complete with all components and accessories necessary for an actual installation in place.

7.5 The evaporation medium and components for determining cooling efficiency and airflow test will remain same.

7.6 The static pressure difference between the air delivered by the air cooler at the outlet of the air cooler in the mixing chamber and the ambient conditions of inlet air cooler in the test room shall

be adjusted to give zero static pressure with the help of exhaust fan and damper.

7.7 The air cooler shall be operated to give maximum:

a) Cooling efficiency; and
b) Air delivery.

7.8 Stable Operating Conditions

The air cooler shall be operated under conditions specified in **7.1** to **7.7** with airflow and temperature measuring apparatus (*see* **10**) attached to it, for a reasonable time to establish thermal equilibrium. Stable operating condition is deemed to be reached when during an interval of 15 min the temperature measured at the same position does not vary by more than 0.5 °C. Stable operating conditions are deemed maintained when the dry bulb temperature at the outlet of the mixing chamber remains within 1.5 °C of the average value adopted as given in **8.3.3** and **8.4.3**. The test shall be continued until at least five successive readings within the permissible range are obtained.

7.9 The voltage supply and frequency to the air cooler shall be adjusted within ± 2 percent of the motor rated voltage.

8 PERFORMANCE REQUIREMENTS

8.1 The air cooler shall satisfy the following requirements under the standard rating conditions specified in **7**:

a) The tested value of air delivery shall be within ± 10 percent of the value declared by the manufacturer;

b) The minimum energy efficiency ratio (EER) shall be as per the Table 1; and

c) Power factor — When operating under full load capacity under the specified test conditions with controls set for maximum fan speed, the air cooler shall have an overall power factor measured at rated voltage and frequency of not less than 0.85.

8.2 Sound Test

The overall design of the air cooler shall be such that reasonably silent performance is obtained. The maximum sound pressure levels shall be as per Table 2 when measured at a distance of 1 m from the air cooler under conditions as per **9.13.2** of IS 1391 (Part 2). An alternate method of sound test as per IS 1391 (Part 2) may be used.

Table 1 Minimum EER for Air Coolers

(*Clause* 8.1)

Sl No.	Air Delivery (Airflow) CMH	Blower Type	Fan Type
(1)	(2)	(3)	(4)
i)	Up to 1 000	5	6
ii)	1 001 to 2 000	7	8
iii)	2 001 to 3 000	10	15
iv)	3 001 to 4 000	12	17
v)	4 001 to 5 000	14	20
vi)	5 001 to 6 000	16	22

Table 2 Maximum Sound Pressure Levels for Fan/Blower Type Air Cooler

(*Clause* 8.2)

Sl No.	Capacity CMH	Fan Type	Blower Type
(1)	(2)	(3)	(4)
i)	Up to 1 000	70	72
ii)	1 001 to 2 000	70	72
iii)	2 001 to 3 000	75	77
iv)	3 001 to 4 000	75	77
v)	4 001 to 5 000	77	77
vi)	5 001 to 6 000	78	78

8.3 Air Delivery (Air Flow) Test

8.3.1 *Purpose*

Purpose of air delivery test is to evaluate the airflow in m^3/h for the calculation of EER.

8.3.2 *Test Condition*

See **7** for test condition.

8.3.3 *Test Procedure*

The air cooler shall be operated at maximum operating condition at maximum blower/fan speed and the evaporating medium shall be in dry condition (there shall not be any water inside the unit and pump shall not be operational).

Then air delivery rate is measured with airflow and temperature measuring apparatus (*see* **10**) at ambient temperature.

Once the stable operating condition as specified in **7.8** is reached, the readings are noted for five successive readings at the interval of 15 min.

The arithmetical averages of these readings shall be obtained as final values for air delivery rate and further used for cooling capacity calculation (refer step 0 and step 1 of **8.6.3**).

8.4 Cooling Efficiency Test

8.4.1 *Purpose*

Purpose of cooling efficiency test is to evaluate the efficiency of cooler in percentage for the calculation of EER.

8.4.2 *Test Condition*

See **7** for test condition.

8.4.3 *Test Procedure*

a) The air cooler shall be operated at maximum operating condition at maximum fan/blower speed;

b) The evaporating medium shall be in wet condition, that is, there shall be water in the sump tank and pump shall be operational;

c) Once the stable operating condition as mentioned in **7.8** is reached, the dry bulb and wet bulb temperature of the inlet and outlet air are noted for five successive readings at an interval of 15 min;

d) Temperature, airflow, power consumption, and other tolerances shall be as per IS 1391 (Part 2); and

e) The arithmetical averages of the readings shall be obtained as final values for cooling efficiency and further used for EER calculation (*see* **8.6**).

8.5 Power Consumption

8.5.1 *Purpose*

Purpose of power consumption test is to measure the input power consumed by cooler in watts for the calculation of EER.

8.5.2 *Test Condition*

See **7** for test condition.

8.5.3 *Test Procedure*

Under stable operating conditions laid down in **7.8**, at least five readings shall be taken at equal intervals of not less than 15 min. The arithmetical averages of these readings shall be adopted as final values to calculate the power consumption which shall be used for the calculation of EER as power input.

8.6 EER Calculation Method

8.6.1 *Purpose* — The purpose of EER calculation is to conform to the performance requirements as specified in **8.1**.

8.6.2 *Test Condition* — Refer to Step 1.

8.6.3 *Test Procedure*

a) Step 0: Airflow measurements

Airflow measurements shall be conducted in dry-mode (no water shall be filled inside the unit and water pump shall not be operational) under ambient conditions and at maximum fan flow speed using the setup specified in **10**.

Step 1: Measure cooling efficiency of evaporative coolers

1) Maximum fan speed and full open grilles (as measured in Step 0);
2) The conditions specified for the test shall be average values within the following variations:

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

4

3) Measurement time (60 min + 60 min) and water temperature (should match with WB after 30 min to 60 min) shall be defined;

4) The chamber shall have the minimum wet-bulb depression of 11 °C for testing with a minimum dry-bulb temperature of 35 °C; and

5) Design temperature for specification: 40 °C DBT, 24 °C WBT.

The evaporation efficiency is calculated as follows:

$$\eta = \frac{(t_{a1} - t_{a2})}{(t_{a1} - t_{w1})} \times 100 \ \%$$

where

t_{a1}	=	air inlet dry bulb (as measured from test), °C;
t_{a2}	=	air outlet dry bulb (as measured from test), °C; and
t_{w1}	=	air inlet wet bulb (as measured from test), °C.

Step 2: Calculate sensible capacity

Cooling capacity (kW)

$$= \frac{\text{Airflow} \times \text{density} \times \text{air heat capacity} \times (T_{a1} - T_{a2})}{3\ 600}$$

where

airflow	=	m³/h;
density of air at ambient condition	=	kg/m³; and
air heat capacity at ambient condition	=	kJ/kg°C

Step 3: Calculate sensible capacity (simplified equation)

Cooling capacity (kW) =

$$\frac{\text{Airflow} \times \text{density} \times \text{air heat capacity} \times \text{cooling efficiency} \times 16}{3\ 600}$$

where

airflow	=	m³/h;
density of air at ambient condition	=	kg/m³; and
air heat capacity at ambient condition	=	kJ/kg°C
cooling efficiency	=	Derived from Step 1; and
wet-bulb temperature depression at standard conditions	=	DBT – WBT = 40 – 24 = 16 °C.

Step 4: Calculate EER

$$\text{EER} = \frac{\text{Cooling capacity (kW)}}{\text{Power input (kW)}}$$

8.7 Drop Test

The appliance, with non-metallic enclosure, shall withstand the effects of dropping during transport and normal use without damage. Compliance is checked by the following:

The appliance is tested in its final packaging for transport and shall withstand the following number of drops on a horizontal hardwood board 20 mm thick placed on a concrete or similar hard surface:

a) one with the appliance held upright; and

b) one for each of the four edges of the bottom side, with the bottom side forming an angle of about 30° to the horizontal.

The drop height depends on the weight of the appliance according to the following Table.

Sl No.	Appliance Weight kg	Drop Height cm
(1)	(2)	(3)
i)	< 10	80
ii)	≥ 10 and < 20	60
iii)	≥ 20 and < 30	50
iv)	≥ 30 and < 40	40
v)	≥ 40 and < 50	30
vi)	≥ 50	20

8.8 Air Cooler Blower/Fan Reliability Test

Following tests are applicable on components (blower/fan) used in air coolers:

a) High revolution per minute (RPM) test — Blower/fan shall run at 1.5 × speed of rated RPM for 1 h and no abnormality shall be observed;

b) Endurance test — Blower/fan shall run for ON/OFF cycle test at rated RPM for 10 000 cycle of 1 min ON and 1 min OFF and no abnormality shall be observed; and

c) Creep test — Blower/fan shall run at rated RPM at 55 °C for min 3 h and no deflection shall be there in blade.

9 ACCURACY OF INSTRUMENTS

9.1 The accuracy of the manometers shall be within ± 0.5 mm of water Gauge.

9.2 The accuracy of the temperature measuring instruments shall be within ± 0.1 °C.

9.3 Electrical measurements shall be made with

instruments having accuracy within ± 0.5 percent of the quantity measured.

9.4 The smallest division on the scale of any instrument shall not exceed twice the specified accuracy for it.

10 TEST CHABMER

### 10.1 Test Chamber Layout

Temperature and flow rate of air delivered by the air cooler are determined as per Fig. 1 and Fig. 2. The air cooler takes in air at ambient conditions specified in 7.2. The air leaving cooler first passes through a mixing device to eliminate non-uniformity. The dry bulb temperature shall be measured at the outlet of the mixing device for calculating cooling efficiency of the cooler. Flow rate is determined by measuring the pressure drop across one or more nozzles of the type shown in Fig. 3.

10.2 The inlet air dry bulb temperatures shall be measured at the approximate geometrical centre of the intake surface area of the air cooler at a distance of not less than 25 cm from the cooler. The temperature measurements shall be taken on all sides of the air intake to the air cooler. The air intake surfaces of the air cooler shall not be exposed to radiant heat or direct air draught. The distance from air intake surface to the next obstruction shall not be less than 1 m. The air cooler shall be placed on a stand at least 50 cm from ground level or on the trolley stand supplied, if any, by the manufacturer.

10.3 Outlet or outlets of the air cooler shall be connected to a mixing chamber. The mixing chamber shall contain deflectors or vanes to mix air stream. The mixing chamber shall be well insulated so that heat leakage shall be reduced to a minimum. The mixing chamber shall be connected to one wall of the receiving chamber. The temperature measurements are made at the outlet of mixing chambers. The thermometers are so placed so as to ensure the flow of well mixed air over them to measure average temperature. To establish zero static pressure, at the outlet of the air cooler in mixing chamber, with respect to inlet air to the air cooler in the test room, a manometer shall have one side connected to one or more static pressure connections located flush with the inner surface of the mixing chamber. The other side of the manometer is open to inlet air ambient conditions. The static pressure connections shall be located so as not to be affected by airflow.

10.4 One or more nozzles shall be fitted into the wall at the outlet side of receiving chamber, discharging air into discharge chamber. The size and arrangement of the receiving chamber shall be sufficient to provide uniform approach velocity to the nozzle(s). To accomplish this purpose, suitable diffusion baffles may be installed in the receiving chamber, at a distance of not less than 1.5 throat diameter of nozzle from the nozzle inlet.
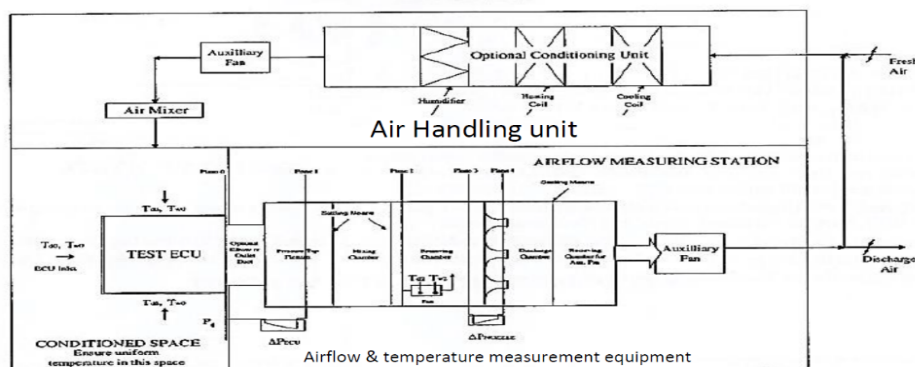
Plane 0   ECU inlet surfaces
Plane 1   Pressure tap station
Plane 2   Temperature measurement station
Plane 3   Nozzle inlet station
Plane 4   Nozzle discharge station

NOTE — Lab dimensions are as per the manufacturer's requirement where the test unit room temperatures shall be maintained.

FIG. 1 SUGGESTED SETUP FOR TESTING DIRECT EVAPORATIVE COOLERS
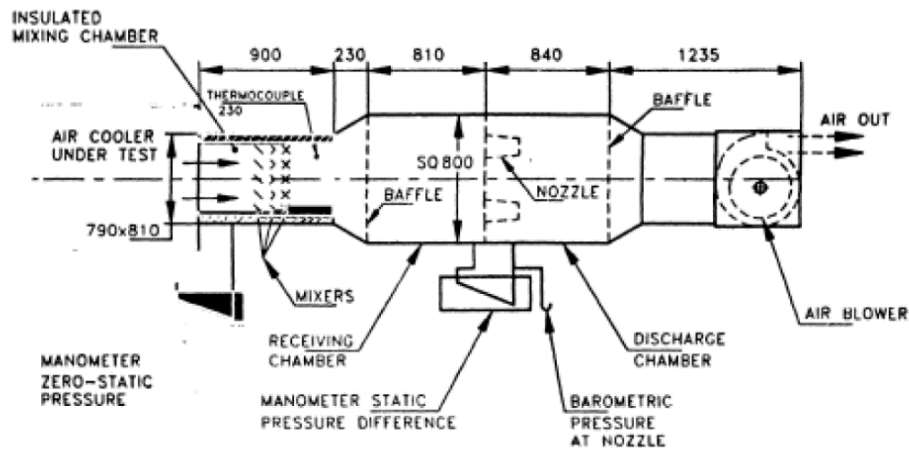
All dimensions in millimetres.

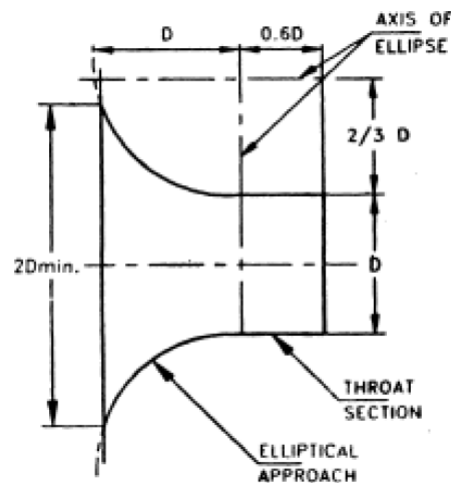FIG. 2 TYPICAL AIRFLOW AND TEMPERATURE MEASURING APPARATUS

FIG. 3 AIRFLOW MEASUREMENT NOZZLE

10.5 Nozzles shall be constructed in accordance with Fig. 3 and fitted into the wall separating receiving chamber from discharge chamber. The throat diameter of the nozzle(s) shall be such that the throat velocity is between 5 m/s and 35 m/s and the total nozzle area is less than 10 percent of the approach duct area. The distance from the centre of any nozzle to any of the four adjacent side walls, either in receiving chamber or in discharge chamber, shall be not less than 1.5 throat diameter of nozzles. The centre to centre distances between the nozzles shall be not less than three throat diameters. If diameters. If nozzles of different diameters are in use, the distance between axes shall be based upon the average diameter. The dry bulb temperature and wet bulb temperature shall be measured at each nozzle separately. These temperature readings shall be used only for determining the density and specific volume of the air.

The nozzle coefficient of discharge may be determined with the help of Table 3 and Table 4 or preferably, the nozzle(s) may be calibrated.

7

Table 3 Flow Coefficients for Nozzles (C$_d$)

(Clauses 10.5 and B-1)

Sl No.	Reynolds Number Re	Discharge Coefficient Cd
(1)	(2)	(3)
i)	40 000	0.973
ii)	50 000	0.977
iii)	60 000	0.979
iv)	70 000	0.981
v)	80 000	0.983
vi)	100 000	0.985
vii)	150 000	0.988
viii)	200 000	0.991
ix)	250 000	0.993
x)	300 000	0.994

Table 4 Factor (*f*) to Determine the Reynolds Number

(Clauses 10.5 and B-1)

Sl No.	Temperature °C	Factor, *f*
(1)	(2)	(3)
i)	10	19.4
ii)	15	18.7
iii)	20	18.1
iv)	25	17.5
v)	30	16.9
vi)	35	16.4
vii)	40	15.9
viii)	45	15.5
ix)	50	15.2

Reynolds number (R_e) for air may be determined from empirical equation:

$$R_e = f \times V \times D$$

where

f = factor depending on temperature as given in Table 4;
V = velocity, in m², of air through nozzle in m/h declared nominal capacity divided by total area of nozzles; and
D = throat diameter, in m, of nozzle.

10.6 The air is discharge through nozzle(s) into the discharge chamber. The distance from nozzle to next obstruction in the discharge chamber shall not be less than five throat diameters unless suitable diffusion baffles are used. The distance from nozzle outlet to diffusion baffles in discharge chamber shall be not less than 2.6 throat diameters. If desired, the discharge chamber may be provided with an access door.

10.7 Diffusion baffles, used both in receiving chamber and discharge chamber shall have staggered pattern holes of diameter not more than 6 mm and free area between 45 percent to 55 percent of the duct area.

10.8 To measure the pressure drop across the nozzle(s) one or more manometers in parallel shall have one side connected to one or more static pressure connections located flush with the inner surface of the receiving chamber. The other side of the manometer(s) shall be connected in a similar manner to one or more static pressure connections in the wall of the discharge chamber. Static pressure connections shall be located so as not to be affected by airflow.

10.9 An exhaust fan/blower with speed regulator shall be connected to the discharge chamber with adjustable damper, to overcome the resistance of chambers, nozzle(s), and diffusion baffles. It shall be able to provide a zero static pressure at the outlet of the air cooler under test.

10.10 The temperature and airflow measuring apparatus shall be sealed reasonably air-tight to ensure that the air delivered by the air cooler is discharged into discharge chamber through nozzle(s) without leakage as far as possible.

11 CALCULATION OF AIRFLOW

11.1 Air volume flow rate through a single nozzle shall be determined as follows:

$$Q = K \times C_d \times A \times \sqrt{\frac{(p.v)}{(1+w)}} \times \frac{P_0}{P}$$

where

Q	=	volume, in m³/h, flow of air;
K	=	1.6×10^4 (a constant);
C_d	=	nozzle coefficient;
A	=	nozzle coefficient;
p	=	static pressure difference, in mm, across the nozzle(s) of water (velocity pressure in mm of water if pitot tube is used);
v	=	specific volume, in m³/kg, of air and water vapour mixture of dry air;
w	=	specific humidity, in kg/kg, of dry air;
P_0	=	standard barometric pressure – 760 mm of mercury; and
P	=	barometric pressure at nozzle in mm of mercury.

11.2 Where the barometric pressure (P) deviates from the standard barometric pressure by not more than 25 mm of mercury, the factor P_0/P may be considered equal to 1.0.

11.3 When more than one nozzle is in use, the total volume flow rate will be the sum of the volume flow rate (Q) of each nozzle calculated as directed in **11.1**.

11.4 An example for calculating air delivery of a cooler is given in Annex B for guidance.

12 TEST

12.1 Classification of Tests

Tests shall be classified as follows:

a) Routine tests; and
b) Type tests.

12.1.1 *Routine Tests*

These shall consist of routine tests that would be conducted on every assembled unit by the manufacturer.

12.1.2 *Type Tests*

The type tests shall consist of the tests that would be necessary to check up the performance and characteristics of the units and components. Once a cooler has undergone type tests, any major or minor alterations, which the manufacturer intends to make, shall further be type tested and shall be carried out in accordance with the procedure laid down in this standard.

12.2 Routine Tests

12.2.1 *General Running Tests*

The air cooler shall be given a run to ensure vibration free and smooth running of all the parts.

12.2.2 *Protection against Electric Shock*

The air cooler shall be tested for protection against electric shock as per **8** of IS 302 (Part 1).

12.2.3 *High Voltage Tests*

The air cooler shall be tested for high voltage test as per **13.3** of IS 302 (Part 1).

12.2.4 *Leakage Current*

The air cooler shall be tested for leakage current as per **13** of IS 302 (Part 1).

12.2.5 *Earthing Connections Tests*

The air cooler shall be tested for earthing connection as per **27** of IS 302 (Part 1).

12.2.6 *Finish*

All surface assembly of the air cooler shall be of corrosion resisting material or shall be suitablyand durably protected against corrosion and free from surface crack.

12.3 Type Tests

Besides all the routine tests specified in **12.2**, the type test shall comprise of the following:

a) Verification of marking as specified in **7** of IS 302 (Part 1);
b) Air delivery test (*see* **8.3**);
c) Cooling efficiency (*see* **8.4**);
d) Power consumption test (*see* **8.5**);
e) Energy efficiency ratio (*see* **8.6**); and

13 ADDITIONAL REQUIREMENTS FOR ECO-MARK

13.1 The evaporative air cooler (desert cooler) shall conform to the requirements for quality, safety, and performance prescribed in **5** to **8**.

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

13.3 Noise Level

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

13.4 Instructions

The evaporative air cooler shall be sold along with instructions for proper use so as to maximizeproduct performance, minimize wastage, and method of safe disposal of used product.

13.5 Energy Consumption

The power consumption shall be at least 5 percent less than those specified in **8.5**.

13.6 Packing

The evaporative air cooler shall be packed in such packages, which are made of recyclable or biodegradable materials.

14 STORAGE

There shall not be any dimension change if the cooler is stored at temperature ranging from 20 °C to 55 °C.

15 MARKING AND INFORMATION

15.1 Each unit shall have the following information on the name plate in a permanent and legible manner in a location where it is accessible and visible:

a) Manufacturers name/brand/trademark/ identification mark;
b) Type or model number, serial number and year of manufacturing;
c) Sump tank capacity;
d) Air delivery (airflow);
e) Normal total current and voltage;
f) Power input;
g) Cooling efficiency of the unit; and
h) EER.

15.2 The manufacturer shall provide a manual containing necessary information for proper installation, operation, and maintenance of the evaporative air cooler. In this manual suitabilityof coolers of different capacities for different sizes of rooms shall be indicated for the guidanceof the users.

15.3 BIS Certification Marking

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

ANNEX A

(*Clause 2*)

LIST OF REFERRED STANDARDS

IS No.	Title	IS No.	Title
IS 302 (Part 1) : 2008	Safety of household and similar electrical appliances: Part 1 General requirements (*sixth revision*)	IS 9844 : 1981	Methods of testing corrosion resistance of electroplated and anodized aluminium coatings by neutral salt spray test
IS 694 : 2010	Polyvinyl chloride insulated unsheathed and sheathed cables/cords with rigid and flexible conductor for rated voltages up to and including 450/750V (*fourth revision*)	IS 9968 (Part 1) : 1988	Specification for elastomer insulated cables: Part 1 For working voltages up to and including 1 100 volts (*first revision*)
IS 996 : 2009	Single phase a.c. industrial motors for general purpose (*third revision*)	IS 11951 : 2009	Pump set for desert coolers — Specification (*first revision*)
IS 1391 (Part 2) : 2023	Room air conditioners — Specification: Part 2 Split air conditioner (*fourth revision*)		

To access Indian Standards click on the link below:

https://www.services.bis.gov.in/php/BIS_2.0/bisconnect/knowyourstandards/Indian_standards/isdetails/

ANNEX B

EXAMPLE FOR METHOD OF CALCULATION

B-1 An example for method of calculation for air delivery of an air cooler has been illustrated for clear understanding. Suppose during a test on an air cooler, following readings were recorded.

Condition of the supply of air to the air cooler:

$$T_{a1} = 39.8 \text{ °C}$$
$$T_{w1} = 25 \text{ °C}$$

Condition of the outlet air from the air cooler:

$$T_{a2} = 29 \text{ °C}$$
$$T_{w1} = 25 \text{ °C}$$

Differential pressure across nozzles	=	10 mm water column;
Number of nozzle	=	5;
Diameter of each nozzle	=	0.013 685 m²;
Area of each nozzle	=	0.132 m;
Total area of 5 nozzles	=	0.068 5 m²; and
The declared capacity of the air cooler	=	3 000 m³/h.
From psychrometric tables at T_{a2}	=	29 °C
T_{w1}	=	25 °C
Specific volume of dry air at 29 °C (v_a)	=	0.855 7 m³/kg;
Specific volume of air mixture per kg of dry air at 29 °C (v_{s*})	=	0.890 8 m³/kg;
Specific humidity of air per kg of dry air at 25 °C (w_{s*})	=	0.020 09 kg/kg; and
Specific humidity of air per kg of dry air at 29 °C (w_{i2})	=	0.025 65.

* Indicates at saturation condition.

The humidity ratio:

$$= \frac{(597.30 - 0.56T_{w1})\, w_{s*} - 0.24\,(T_{a2} - T_{w1})}{597.30 + 0.44\, T_{a2} - T_{w1}}$$

$$= \frac{(597.30 - 0.56 \times 25)\, 0.020\,09 - 0.24\,(29 - 25)}{597.30 + (0.44 \times 29) - 25}$$

$$= \frac{(597.30 - 14)\, 0.020\,09 - 0.24 \times 4}{597.30 + 12.876 - 25}$$

$$w = 0.018\,4$$

The saturation ratio:

$$\mu = \frac{w}{w_{i2}}$$

$$= \frac{0.018\,4}{0.025\,65}$$

$$= 0.717\,348\,9$$

$$= 0.717\,35$$

Specific volume, in m³/kg, of air and water vapour mixture of dry air,

$$v = v_a + \mu\,(v_{s*} - v_a)$$

$$= 08\,557 + 071\,735 \qquad (08\,908 - 08\,557)$$

$$= 0.880\,88 \text{ m}^3/\text{kg of dry air.}$$

NOTE — * Indicates at saturation condition.

At $t_{a2} = 29$ °C (from Table 4) and $f = 17$: Reynolds number R_e for air is given by:

$$R_e = f \times V \times D$$

$$R_e = 17 \times \frac{3\,000}{0.068\,5} \times 0.132$$

$$= 98\,277.372$$

From Table 3 for $R_e = 98\,277.372$:

$$C_d = 0.985$$

Airflow,

$$Q = K \times C_d \times A \times \sqrt{\frac{(p \times v)}{(1 + w)}} \times \frac{P_0}{P}$$

$$= 1.6 \times 10^4 \times 0.985 \times 0.068\,5$$

$$\times \sqrt{\frac{10 \times 0.880\,88}{(1 + 0.018\,4)}} \times 1$$

$$= 3\,175 \text{ m}^3/\text{h}$$

ANNEX C

(*Foreword*)

COMMITTEE COMPOSITION

Refrigeration and Air Conditioning Sectional Committee, MED 03

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

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

Member Secretary
MS NEHA THAKUR
SCIENTIST 'B'/ASSISTANT DIRECTOR
(MECHANICAL ENGINEERING), BIS

Panel for Revision of IS 3315, MED 03 : P15

Organization	*Representative (s)*
Voltas Limited, Mumbai	SHRI SRINIVASU (*Convener*)
Bajaj Electricals, Mumbai	SHRI SOCRATEES CHANDRASEKARAN SHRI ABHINANDAN D. E. SHRI RAUNAK PATEL
Blue Star Limited, Mumbai	SHRI SUNIL KUMAR JAIN SHRI SHUSHIL KUMAR
Bureau of Energy Efficiency, New Delhi	MS PRAVATANALINI SAMAL SHRI DHEERAJ PANDEY
CEPT University, Ahmedabad	DR YASH SHUKLA
Crompton, Mumbai	SHRI SARANG KUSALE SHRI SENTHIL ARUL SHRI ANKIT GUPTA
Godrej, Mumbai	SHRI YOGESH
Havells India, Noida	SHRI JUJHAR SINGH SHRI ANIRUDH KUMAR SHRI DEBTOSH GANGULY
Indian Society of Heating, Refrigerating and Air Conditioning Engineers, New Delhi	SHRI NISHANT GUPTA
Intertek India Private Limited, Gurugram	SHRI C. M. PATHAK
Kenstar, Gurugram	SHRI YOGESH PARGAONKAR
Orient Electric, Bhubaneshwar	MS AMITA JAIN SHRI BHARAT SATIJA SHRI AJIT SINGH
Panasonic, New Delhi	SHRI ANIL MEHTA
UL India Private Limited, Bengaluru	SHRI SATISH KUMAR
Usha International Limited, Gurugram	SHRI PRAMOD TRIVEDI SHRI VIKAS DUA
Symphony Ltd, Ahmedabad	SHRI FALGUN SHAH
V-Guard Industries Limited, Kochi	SHRI SIRISH BAKSHI SHRI SHEKHAR BHALEKAR
In Personal Capacity (*506/2, Kirti Apartments, Mayur Vihar, Phase-1 Extension, Delhi*)	SHRI P. K. MUKHERJEE

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected