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IS 2997 (B) (1964): Air circulator type electric fans and regulators (Bi-lingual) [ETD 5: Electric Fans]



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Indian Standard

**SPECIFICATION FOR
AIR CIRCULATOR TYPE ELECTRIC FANS
AND REGULATORS**

(Incorporating Amendment Nos. 1 to 8)

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

Price Group 6

Indian Standard

**SPECIFICATION FOR
AIR CIRCULATOR TYPE ELECTRIC FANS
AND REGULATORS**

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Indian Standard

SPECIFICATION FOR AIR CIRCULATOR TYPE ELECTRIC FANS AND REGULATORS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 25 November 1964, after the draft finalized by the Electric Fans Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 Like the pedestal type electric fans air circulator fans also are being increasingly used both indoor and outdoor. The main difference between the air circulator type fan and pedestal type fan is that the former has relatively higher air velocities in the axial direction.

0.3 In preparing this specification the general aspects accepted in the IEC publications on electric fans have been adopted.

0.4 This standard is one of a series of Indian Standard Specifications on electric fans. Other specifications published so far in the series are:

*IS : 374-1960 Electric ceiling fans and regulators (*revised*)

*IS : 555-1960 Electric table type fans and regulators (*revised*)

*IS : 1169-1957 Pedestal type electric fans

IS : 1709-1960 Fixed capacitors for fans

*IS : 2312-1963 Propeller type ac ventilating fans

0.5 This edition 1.8 incorporates Amendment No. 6 (February 1994), Amendment No. 7 (July 2000) and Amendment No. 8 (October 2002). Side bar indicates modification of the text as the result of incorporation of the amendments. Amendment Nos. 1 to 5 had been incorporated earlier.

0.6 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 IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard specifies the requirements and methods of test of air circulator fans, oscillating and non-oscillating, and their associated

*Since revised.

†Rules for rounding off numerical values (*revised*).

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regulators suitable for use on single phase ac circuits and dc circuits not exceeding 250 V, intended for normal domestic and similar uses.

2. TERMINOLOGY

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

2.1 Air Circulator Fan — A free air fan having two or more propeller type blades directly driven by an ac or dc electric motor and having relatively high air velocities in the axial direction. It may be mounted on a pedestal or a bracket.

2.2 Rating — A statement of the operating characteristics assigned to the fan by the manufacturer when tested in accordance with **19**.

2.3 Rated Voltage — The voltage assigned to the fan by the manufacturer and marked on it.

2.4 Rated Voltage Range — The voltage limits assigned to the fan by the manufacturer and marked on it.

2.5 Rated Frequency — The frequency assigned to the fan by the manufacturer and marked on it.

2.6 Rated Frequency Range — The limits of frequency assigned to the fan by the manufacturer and marked on it.

2.7 Rated Speed — The rotational speed specified by the manufacturer at which the fan develops the specified output at the rated frequency.

2.8 Cooling Air Temperature — The temperature of the surrounding atmosphere in which the fan operates.

2.9 Blade Sweep — The diameter of the circle traced out by the extreme tips of the fan blades.

2.10 Size of Fan — The blade sweep in millimetres.

2.11 Plane of Fan Blades — The middle plane of the solid of revolution traced out by the fan blades.

2.12 Plane of Anemometer Vanes — The middle plane of the solid of revolution traced out by the vanes of the anemometer.

2.13 Test Plane — The vertical plane containing the plane of the anemometer vanes.

2.14 Types of Enclosures of Motors and Regulators

2.14.1 Totally Enclosed Type — An enclosure which prevents circulation of air between the inside and outside of the case, but not necessarily air-tight.

2.14.2 Ventilated Type — An enclosure in which the ventilation is not materially obstructed while the live and internal rotating parts are protected mechanically against accidental or careless contact.

2.15 Mounting — The mounting of a fan is the means of attaching the fan system (motor and blades) to its base.

2.16 Insulation

2.16.1 Double Insulation — Denotes insulation comprising both functional insulation and supplementary insulation.

2.16.2 Functional Insulation — Denotes insulation necessary for the proper functioning of equipment and for basic protection against electric shock.

2.16.3 Supplementary Insulation (Protective Insulation) — Denotes an independent insulation provided in addition to the functional insulation in order to ensure protection against electric shock in case of failure of the functional insulation.

2.16.4 Reinforced Insulation — Denotes an improved functional insulation with such mechanical and electric qualities that it provides the same degree of protection against electric shock as double insulation.

2.16.5 Type Tests — Tests made on a fan submitted as a sample of that type to prove compliance with the tests which all fans of the type are designed to pass.

2.16.6 Acceptance Tests — Tests made, if required, on all samples selected from a batch of fans for acceptance.

2.16.7 Routine Tests — Tests made on all fans during manufacture.

3. SIZES, SPEEDS AND TYPES

3.1 The sizes, number of speeds and types of fans shall be as given in Table 1.

TABLE 1 SIZES, NUMBER OF SPEEDS AND TYPES

SIZE OF FAN mm	MINIMUM NUMBER OF SPEEDS	TYPE
450	2 } 2 } 2 }	Oscillating or Non-oscilla- ting
600		
750		

NOTE — Sizes of fans specified above are subject to a tolerance of ± 5 mm.

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4. PREFERRED VOLTAGES

4.1 The preferred voltages for the rating of air circulator type fans shall be 240 and 230 volts.

5. FREQUENCY

5.1 The standard frequency for air circulator fans shall be 50 Hz.

6. NUMBER OF PHASES

6.1 Single phase motors shall be used for ac fans. They may, however, have three phase motors, if required when the preferred voltages will be 400 and 415 volts.

7. TYPE OF MOTORS

7.1 Induction motors (ac) of 450 mm fans shall either be of the shaded pole or capacitor type, but in the case of 600 mm and 750 mm fans they shall be of the capacitor type.

8. DESIGN AND GENERAL CONSTRUCTION

8.1 Stampings — Stampings of ac fans shall be made from electrical steel sheets conforming to IS : 648-1962*.

8.2 Enclosures

8.2.1 Motors and regulators of fans shall be either of the ventilated or totally enclosed type.

8.2.2 The enclosures of all insulated fans may form part or whole of the supplementary or reinforced insulation.

8.3 Blades — Fans shall be fitted with two or more well-balanced blades made from suitable material. The blades and blade carriers shall be securely fixed so that they do not loosen in operation.

8.4 Guard — Each fan shall have a suitable robust guard either of the open or close mesh type to provide, in normal use, adequate protection against personal injury. When the guards are in two pieces, positive locking arrangement to keep the two pieces together should be made.

8.5 Heat Resistance — No readily flammable material shall be used in the construction of fan and regulator. Moulded parts, if used, shall be of such materials as will withstand the maximum temperature attained in the adjacent component parts.

*Specification for steel sheets for magnetic circuits of power electrical apparatus (non-oriented steel) (*revised*). (Since revised).

8.6 Moisture Resistance — Only suitable material which is resistant to moisture shall be used and the fan shall be capable of withstanding the moisture-proofness test specified in **19.4**.

8.7 Bearings — Instructions for the proper lubrication of bearings shall be furnished by the manufacturer.

8.8 Commutator Segments — Commutator segments shall be made from hard-drawn high-conductivity copper and shall have an adequate contact surface for duty involved.

8.9 Carbon Brushes — Carbon brushes for dc air circulator fans shall be of rectangular cross-section. The grade of the brushes used shall be such as would not cause undue wear of commutator or excessive wear of the carbon. Brushes shall be provided with suitable flexible pigtailed or tags. Contact between brushes and brush holders shall not be relied upon for electrical connection.

8.10 Brush Holder Springs — Springs used on carbon brushes shall be of high quality hard-drawn phosphor-bronze or any other suitable high quality non-rusting metal which will retain its temper in service.

8.11 Supply Cord — Unless specifically agreed otherwise between the supplier and the user, a minimum length of 5 metres of flexible cord of the tough rubber sheathed type or equivalent type [see IS : 434 (Parts I & II)-1964* or IS : 694 (Parts I & II)-1964†] suitably connected to the terminals or contacts, shall be supplied with each fan. For fans intended to be earthed, a three-core cable shall be supplied with the earthed core. For fans with double or reinforced insulation, a two-core cord shall be used.

8.11.1 The arrangements of the flexible leads to the fan motor should be such that they will not be damaged as a result of movement in the course of adjustment of the fan height.

8.12 Cord-Grip

8.12.1 Fans shall be provided with a cord-grip capable of passing the test specified in **19.5.1** so that the conductors are protected from strain including twisting and abrasion.

8.12.2 The cord-grip shall preferably be of insulating material or, if of metal, be adequately insulated.

8.12.3 On fans with double or reinforced insulation, the cord-grip shall be so designed that the flexible cord does not come into contact with the fixing screws if they are accessible, or in contact with accessible

*Specification for rubber insulated cables:

Part I With copper conductors (*revised*).

Part II With aluminium conductors (*revised*).

†Specification for pvc insulated cables (for voltages up to 1 100 V):

Part I With copper conductors (*revised*).

Part II With aluminium conductors (*revised*).

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metal parts. The cord-grip shall be suitable for the different types of cords which may be attached to the fan.

8.13 Protective Measures — From the point of view of protection against electric shock, electric fans shall be of either of the following two types:

- a) With functional insulation only, with the accessible metal parts designed to be connected to an earthing terminal or contact; and
- b) With double or reinforced insulation with the accessible metal parts not designed to be connected to an earthing terminal or contact.

8.13.1 In the case of a fan provided with an earthing terminal or contact, it shall be indelibly marked with the symbol “ \perp ”. The earthing terminal or contact shall not be used for any other purpose.

8.14 Protection Against Direct Contact — In the assembled fan and regulator, live parts shall not be accessible to the standard test finger (see IS : 1401-1959*). In the case of a double insulated fan, both functionally insulated parts and live parts shall not be accessible to the standard test finger.

8.15 Method of Mounting — The mounting may be of one of the following types:

- a) *Rigid* — The direction of draught is changed only by changing the position of the fan.
- b) *Semi-rigid* — A trunnion and/or swivel arrangement incorporated in the mounting so that the direction of the draught may be altered to suit the requirements. The minimum angle through which it is possible to rotate the fan horizontally as well as vertically without changing the position of the fan shall be 7° vertically and 45° horizontally.
- c) *Oscillating* — Some device is provided by which the direction of the axis of the draught is changed automatically and continuously in one plane.
- d) *Double Oscillating or Gyrostatic* — Some device is provided by which the direction of the axis of the draught is changed automatically and continuously in more than one plane.

8.15.1 Clamping Devices — All clamping devices, where provided shall be of strong and simple design. They shall be so arranged that it is possible to positively adjust the mechanism without there being undue risk of its working loose.

*Specification for accessibility test probes. (Since revised).

8.16 Capacitors — Capacitors (*see* IS : 1709-1960*), if any, shall be easily replaceable and placed at sufficient distance from the windings, so that its maximum working temperature is not exceeded. Capacitors shall be clearly marked with the maximum safe working temperature and the corresponding voltage and capacitance.

8.17 Stability — The construction and overall dimensions of the base shall be such as to ensure that the fan is stable with an angle of tilt up to 10° in any direction with fan fully extended.

8.18 Finish — All the surfaces of the assembly and mechanism of both fan and regulator, if any, shall be of corrosion resisting material or shall be suitably and durably protected against corrosion.

8.19 Insulating Material — With the exception of resistance wires in regulators, windings of fans and regulators shall be insulated either with Class A or with Class E insulating materials which comply with limits of temperature-rise specified in **19.3** and moisture-proofness test specified in **19.4** (for classification of insulating materials, *see* IS : 1271-1958†).

9. HEIGHT OF FAN

9.1 Pedestal mounted fans may either be of fixed height type or adjustable height type.

9.2 Adjustable height type fans shall conform to the heights given in Table 2.

TABLE 2 HEIGHT OF FAN

(*Clauses 9.2 and 16.1*)

SIZE OF FAN	HEIGHT	
	<i>Min</i>	<i>Max</i>
(1)	(2)	(3)
mm	mm	mm
450	1 100	1 400
600	1 400	1 650
750	1 500	1 950

9.3 Fixed height type fans shall conform to the minimum heights specified above for the respective sizes.

*Specification for fixed capacitors for fans.

†Classification of insulating materials for electrical machinery and apparatus in relation to their thermal stability in service.

10. SPEED REGULATORS

10.1 Regulators shall be capable of reducing the speed of the fan by at least 30 percent of the full speed at the voltage and frequency specified for the test, except in the case of fans of the shaded pole type where the speed reduction shall be not less than 20 percent. Fans shall be capable of running continuously on any one of the contacts of the regulator at the rated voltage or voltages (*see 2.3*) or within the whole rated voltage range (*see 2.4*) whichever is applicable.

10.2 Speed regulators shall be provided with an 'OFF' position preferably next to the lowest speed contact and shall be provided with running positions as specified in **3.1**. It is desirable that speed steps are equal.

10.3 Where a regulator is provided with a capacitor not permanently connected across the motor terminals, provision shall be made so that the capacitor is discharged when the regulator is in the 'OFF' position.

10.4 The regulator handle or knob, if of metal, shall be adequately insulated electrically and thermally.

10.5 The regulator handle or knob shall be so placed that it can be safely and conveniently manipulated, and unless variable, shall only rest in one of the regulating positions. The handle or knob shall be so designed that it does not become loose in use. The running and 'OFF' positions of the regulator shall be distinctly and clearly marked and the indicator on the operating handle or knob shall correctly indicate the position of the regulator.

10.6 The mechanism of the regulator shall be so designed as to ensure positive contact at each running position. In the case of induction type regulator, it is essential that no portion of the induction winding should remain permanently short-circuited in any of the running positions.

10.7 The regulator shall have mechanical stops for the regulator moving contact to prevent accidental contact with the metallic body of the regulator in the event of forced overtravel of the knob.

11. STARTING

11.1 The fan shall be capable of starting up from rest with the regulator, if any, at the lowest speed step when 85 percent of the rated voltage or 85 percent of the lowest voltage in the voltage range is applied, with the oscillating mechanism in the case of fans of oscillating and double oscillating types in action and in the worst position.

12. INTERCHANGEABILITY

12.1 Components of a particular model and size of fan, its associated regulator and set of blades shall be interchangeable.

13. SILENT OPERATION

13.1 Precautions shall be taken in the manufacture of fans and regulators to ensure a reasonable degree of silence at all speeds.

NOTE — The need for specifying limits of noise levels (acoustical) of the fans is recognised. However, it has not been found possible to specify these limits at present on account of:

- a) dependency of these limits on the actual location of the fans,
- b) lack of data on the acceptable noise levels for different applications, and
- c) lack of agreed definition of noise level and method of evaluating the same.

The criterion of noise level may, therefore, be subject to an agreement between the manufacturer and the purchaser.

14. COMMUTATION

14.1 The brush gear of dc fan motor shall be of the fixed-brush type and shall work practically sparklessly and without injury to the surface of the commutator or brushes, within the range of specified speeds.

15. OSCILLATING MECHANISM

15.1 The number of oscillations (that is, complete to- and fro-cycles) per minute at full speed shall be not less than four.

15.2 Whether or not the angular movement of the mechanism is variable, an angular movement of not less than 85° shall be available (see Fig. 1).

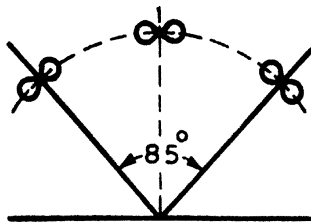


FIG. 1 ANGULAR MOVEMENT OF OSCILLATION

15.3 A device shall be provided to render the oscillating mechanism inoperative when desired. The method of operating the device should preferably be indicated. Means shall be provided to ensure that when properly installed, the fan is not stalled or overturned if the oscillating mechanism is impeded.

16. STANDARD OF PERFORMANCE

16.1 All fans shall be tested by running them at full speed and at rated voltage with the centre of the blades at a height from ground corresponding to the minimum height for each size of fan as given in Table 2.

16.2 For compliance with requirements of this standard, the values of total air delivery shall not be less than those specified in Table 3. In case higher value of total air delivery is declared by the manufacturer, the observed results, expressed as the percentage of the values declared by the manufacturer shall not be less than 90 percent of the declared value. The actual input when measured shall not exceed the declared value by more than 10 percent subject to the condition that the observed value shall in no case exceed the specified value given in Table 3.

TABLE 3 MINIMUM STANDARD OF PERFORMANCE

SIZE OF FAN	DISTANCE FROM THE PLANE OF FAN BLADES TO THE PLANE OF ANEMOMETER VANES	MINIMUM TOTAL AIR DELIVERY	MAXIMUM POWER INPUT	MINIMUM PEAK VELOCITY
(1)	(2)	(3)	(4)	(5)
mm	mm	m ³ /min	W	m/min
450	2 700	125	100	245
600	3 600	250	200	245
750	4 500	370	250	245

17. TOLERANCES ON RATINGS

17.1 For an air circulator fan covered by this standard, in no case shall the measured performance be inferior to that given in this standard.

17.2 In addition, the observed results expressed as a percentage of the rating assigned by the manufacturer (*see 2.2*) shall be within the following limits:

<i>Characteristic</i>	<i>Tolerance</i>
Electrical input power in watts (with oscillating mechanism, if provided, in operation)	+ 10 percent
Total air delivery	- 10 percent
Fan speed	- 10 percent

18. MARKING

18.1 Each fan shall be indelibly marked with at least the following information:

- a) Manufacturer's name, trade name of fan (if any), and number;
- b) Country of manufacture;
- c) Rated voltage(s) or voltage range and number of phases;
- d) Input in watts;
- e) Size of fan;
- f) Rated speed in rev/min; and
- g) Rated frequency.

NOTE — It is recommended that the information mentioned above should also be marked on the associated regulator if it is separate from the fan.

18.1.1 In the case of a fan provided with an earthing terminal or contact, it shall be indelibly marked with the symbol “ $\underline{\underline{\perp}}$ ”.

18.1.2 For additional information that the manufacturer may be requested to supply is listed in Appendix A.

18.2 BIS Certification Marking

The product may also be marked with Standard Mark.

18.2.1 The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

19. TESTS

19.1 General — Tests shall be classified as type, acceptance and routine tests. Type tests shall be carried out on three samples. The following are the different tests:

Type Tests

- a) Starting (*see 11*),
- b) Air Delivery (*see 19.2*),
- c) Temperature-Rise (*see 19.3*),
- d) Moisture-Proofness (*see 19.4*),
- e) Cord-Grip (*see 19.5*),

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- f) Mechanical Endurance (for Regulators Only) (*see* **19.6**),
- g) Power Factor (*see* **19.7**),
- h) ac Leakage (*see* **19.8**),
- j) Oscillating Mechanism (under consideration),
- k) High Voltage (*see* **19.9**),
- m) Insulation Resistance (*see* **19.10**),
- n) Earthing Continuity (*see* **19.11**),
- p) Electrical Input (*see* **19.12**), and
- q) Fan Speed (*see* **19.13**).

Acceptance Tests

- a) High Voltage,
- b) Insulation Resistance,
- c) Earthing Continuity,
- d) Electrical Input, and
- e) Fan speed.

Routine Tests

- a) Flash Test (*see* **19.14**), and
- b) A simple running test to determine that the fan and oscillating mechanism are in working order; this includes oscillating mechanism, if fitted.

19.1.1 Acceptance tests, if requested, shall be made on samples selected according to a method of sampling agreed between the purchaser and the manufacturer.

19.1.2 *Limits of Error of Electrical Instruments*— The error in the indicated value of ammeters, voltmeters and wattmeters shall not exceed 0.5 percent of full scale value for instruments used for type tests. For routine and acceptance tests, industrial class instruments (*see* IS : 1248-1958*) may be used.

19.1.3 *Test Voltage*— The voltage at which the tests are conducted shall be as follows.

19.1.3.1 When a rated voltage is indicated on the nameplate, the test shall be conducted at the rated voltage. If the fan is specified for two or more distinct rated voltages with three or more supply terminals, the tests shall be carried out at all voltages.

*Specification for electrical indicating instruments. (Since revised).

19.1.3.2 When a voltage range is indicated on the nameplate, the test voltage shall be as follows:

Sl No.	Test	Test Voltage	
		When the voltage range is in excess of 10 percent of the lowest voltage	When the voltage range is less than 10 percent of the lowest voltage
1.	Temperature-rise	Highest value of range	Mean of the upper and lower limits
2.	Starting	85 percent of the lowest value of range (see 11.1)	
3.	Air delivery and service value	Highest and lowest values of range	
4.	Power factor and rated speed	Highest and lowest values of range	

For a fan with a range of frequency, the test shall be made at the frequency which gives the most unfavourable result.

19.1.3.3 Limits of voltage variation — The variation in the voltage shall not exceed ± 1 percent of the test voltage during air delivery tests. While taking the current and watt readings during these tests, however, the voltage shall be the test voltage.

19.2 Air Delivery Test — The following method for determining the air delivery of the fan shall be followed.

19.2.1 Test Chamber — The fan shall be tested in a test chamber 10 m long, 4.5 m wide and 3 m high; this chamber shall be reasonably free from extraneous draughts while the test is being carried out.

19.2.1.1 The test chamber shall be free from obstructions. Any table or shelf for electrical instruments shall be on the intake side of the fan, beyond a distance of 0.90 m from the plane of the fan blades. No heating or cooling apparatus shall be used in the test room while the test is in progress.

19.2.1.2 The fan shall be so situated that the front of the blades is at least 1.20 m from the back wall and 1.80 m from the side walls.

19.2.2 Testing Instrument — The air movement shall be measured by means of a rotating vane anemometer having an internal diameter of 70 mm suitable for the range of velocities to be measured. It is recommended that the anemometer be calibrated frequently.

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19.2.3 Arrangement of Apparatus

19.2.3.1 The arrangement of the apparatus (*see* Fig. 2) shall be such as to permit the anemometer being moved in a horizontal plane containing the axis of the fan, the movement being at right angles to the axis and extendable in both directions. The anemometer shall be supported in such a manner as to offer as little obstruction as possible to the air flow. The axis of anemometer vane shall always be parallel to the axis of the fan blades.

19.2.3.2 The distance between the test plane and the plane of the fan blades shall be in accordance with col 2 of Table 3.

19.2.4 Procedure for Test

19.2.4.1 Before taking any steps towards testing a fan against this standard, it is essential that it should have been 'run-in' for at least one hour at the highest voltage of the voltage range.

19.2.4.2 The measurements shall be carried out with the fan running at full speed at the test voltage and with the guard in position.

19.2.4.3 Air velocity — Readings shall be commenced at a point 20 mm from the axis of the fan blades, and shall progress along the horizontal line in each direction by increments of 40 mm. Readings shall be continued in each direction until the true air velocity falls below 24 metres per minute.

19.2.4.4 Each reading shall consist of the time taken by an air-movement of 300 m measured by the anemometer, except when such air-movement takes more than two minutes; the reading shall then consist of the time taken by a movement of some convenient and readable quantity of air. In no case should the duration of the reading be less than one minute.

19.2.4.5 The average air velocity over any annulus shall be the mean of the readings on either side of the axis of the fan blades at each mean radius of annulus.

19.2.4.6 The average velocity so obtained, multiplied by the area of the corresponding annulus shall be taken as the total air delivery through that annulus.

19.2.4.7 The sum of the air deliveries through all such annuli up to the limit of readings (*see* 19.2.4.4) shall be taken as the measured air delivery of the fan for the purpose of this standard.

19.2.5 Air conditions (temperature, relative humidity and pressure) obtained at the test chamber during tests shall be recorded with the test result.

NOTE — No correction is to be made until an agreement is available on correction factor.

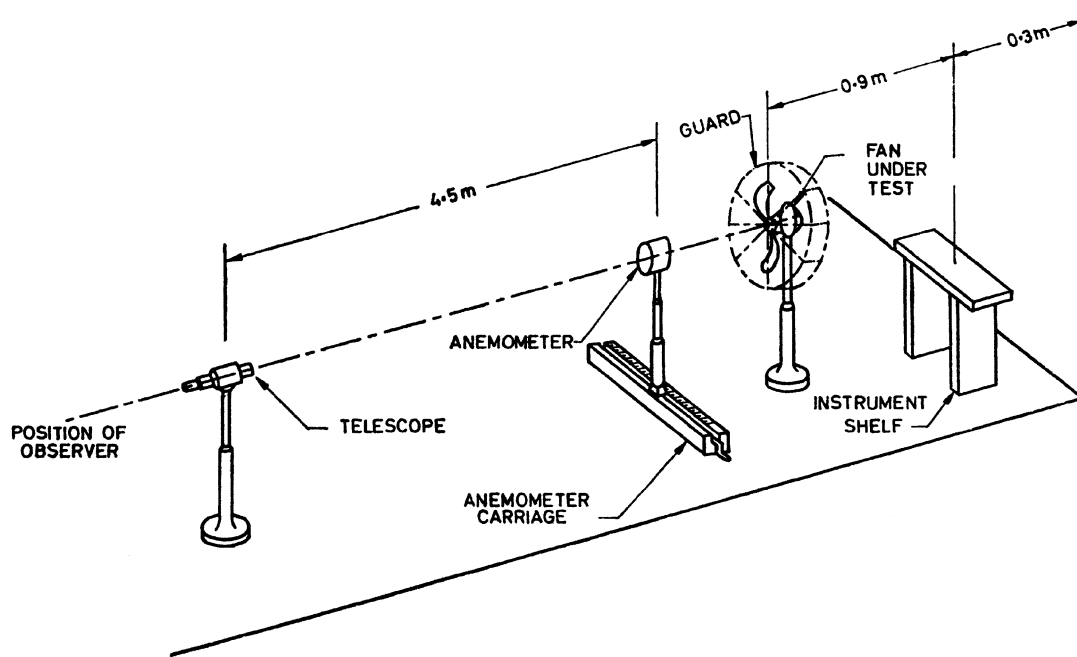


FIG. 2 ARRANGEMENT FOR AIR DELIVERY TEST

19.3 Temperature-Rise of Fan Motor and Regulator

19.3.1 Permissible Temperature-Rise — The fan motor and regulator shall be tested at any cooling air temperature not exceeding 40°C, but whatever be the value of this temperature, the permissible temperature-rise, when measured as described in **19.3.3**, shall not exceed the limits given in Table 4.

TABLE 4 PERMISSIBLE LIMITS OF TEMPERATURE-RISE

(Clauses 19.3.1 and 19.3.3)

SL NO.	PART OF MOTOR OR REGULATOR	TEMPERATURE-RISE		METHOD OF MEASUREMENT
		Class A Insulation	Class E Insulation	
(1)	(2)	(3)	(4)	(5)
i)	Insulated windings of motors	60°C	75°C	Change in resistance
ii)	Uninsulated parts of motors	The temperature-rise shall in no case reach such a value that there is a risk of injury to any insulating material on adjacent parts		Thermometer
iii)	Insulated windings, if any, of regulator (with continuous running on contact)	60°C	75°C	Change in resistance
iv)	Regulator resistance unit (with continuous running on any contact)	The temperature-rise shall not reach such a value that there is a risk of injury to any insulating material on adjacent parts of the regulator		Thermometer
v)	External surfaces other than metallic handles, likely to be touched momentarily during normal usage	40°C		Thermometer
vi)	External surface of capacitors	40°C		Thermometer

NOTE 1 — Thermocouples, if used, should be applied only to external surfaces which can be reached by an ordinary thermometer.

NOTE 2 — The temperature-rise values given above are for fans normally made to this specification to work in cooling air temperatures not exceeding 40°C. Nevertheless, fans made to work in higher cooling air temperatures can be regarded as complying with this specification, provided the temperature-rise values are reduced corresponding to the increase in cooling air temperature. Such fans shall be specially marked.

19.3.2 Measurement of Cooling-Air Temperature During Tests — The cooling-air temperature shall be measured by means of several thermometers placed at different points around the fan motor at a distance of one or two metres, and protected from all heat radiations and extraneous draughts. The thermometers used for this test shall be accurate to $\pm 0.5^{\circ}\text{C}$.

The value to be adopted for the temperature of the cooling-air during a test shall be the mean of the readings of the thermometers taken at equal intervals of time during the last quarter of the duration of the test.

19.3.3 Measurement of Temperature-Rise — The temperature-rise measurements shall be carried out by the method indicated in Table 4 immediately after the air delivery test or after the fan has been run long enough to ensure that temperature-rise has reached a constant value, using the following procedure.

19.3.3.1 All temperature-rises to be measured by thermometer method [Items (ii), (iv), (v) and (vi) of Table 4] shall be taken at the hottest accessible surface of the part, as also on the parts which are likely to cause injury to any adjacent insulating material.

19.3.3.2 The method of measurement of temperature-rise by change in resistance for copper conductors is given below:

The temperature-rise $t_2 - t_1$ may be obtained from the ratio of the resistance by the formula:

$$\frac{t_2 + 235}{t_1 + 235} = \frac{R_2}{R_1}$$

where

R_2 = resistance of the winding at temperature t_2 ($^{\circ}\text{C}$) at the end of the test, and

R_1 = initial resistance of the winding at temperature t_1 ($^{\circ}\text{C}$) (cold).

From the above, the hot temperature (t_2) may be expressed as:

$$t_2 = \frac{R_2}{R_1} (t_1 + 235) - 235$$

19.4 Moisture-Proofness Test

19.4.1 The regulator shall be subjected to and shall satisfy the tests specified in **19.9** and **19.10** immediately after having been placed for a period of 24 hours, without passing current through the motor and regulator, in a closed receptacle in which relative humidity is

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maintained at 90-95 percent at any temperature chosen in the range of 40-50°C. Whatever temperature is chosen for this test, it shall be maintained constant to within $\pm 1^\circ\text{C}$.

19.5 Cord-Grip Test

19.5.1 The flexible cord shall be connected to the fan with the cordgrip in the normal position. The conductors shall be introduced into the terminal and screws, if any, shall be slightly tightened so that the conductors cannot easily change their position. After this it shall not be possible to push the cord further into the fan.

The flexible cord shall then be subjected 100 times to a pull of 10 kg for one second. Immediately afterwards, the cord shall be subjected to a torque of 3.5 kg/cm, for a period of one minute. The test shall be made with the flexible cord suitable for the fan and conforming to IS : 434 (Parts I & II)-1964* or IS : 694 (Parts I & II)-1964†. During the test no damage shall be caused to the flexible cord.

At the end of the test, the cord shall not have been displaced by more than 2 mm and the ends of the conductors shall not have been noticeably displaced in the terminals.

19.6 Mechanical Endurance Test for Regulator

19.6.1 The regulator shall continue to function satisfactorily after being subjected to a test of 2 500 operations when connected to a fan with locked rotor or an electrical load of equivalent impedance supplied at the maximum rated voltage. One operation includes a full cycle of movement from the 'OFF' position to the 'FULL SPEED' position (or to the other extreme position) and back to 'OFF'. The test shall be made at the rate of approximately 6 operations per minute.

19.7 Power Factor Test

19.7.1 The power factor of fan with its associated capacitor, if any, in circuit when tested at the test voltage and the highest speed of the fan shall be not less than 0.90 for capacitor type and 0.50 for non-capacitor type fans.

19.8 ac Leakage Test

19.8.1 The appliance shall be made to rest on a base well insulated from earth and a single-pole changeover shall be arranged as shown in

*Specification for rubber insulated cables:

Part I With copper conductors (*revised*).

Part II With aluminium conductors (*revised*).

†Specification for pvc insulated cables (for voltages up to 1 100 V):

Part I With copper conductors (*revised*).

Part II With aluminium conductors (*revised*).

Fig. 3 to connect a multirange milliammeter between frame and each live part of the appliance in turn.

NOTE 1 — To avoid risk to the milliammeter a suitable high resistance with a shunting switch may be used in series with the meter. The shunting switch should be kept open to start with and when it is ensured that the meter is safe in both the positions of the changeover switch, the shunting switch shall be closed and readings taken.

NOTE 2 — If interference suppression devices are fitted to the appliance they shall be disconnected during the test.

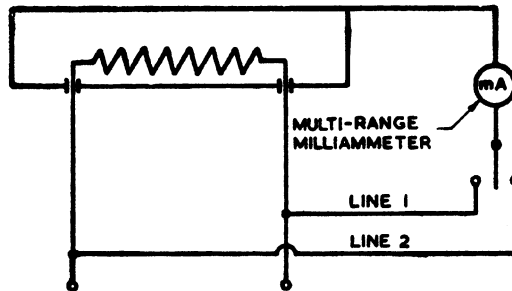


FIG. 3 CONNECTIONS FOR THE MEASUREMENT OF LEAKAGE CURRENT

19.8.1.1 The resistance of the measuring circuit shall be $2\,000 \pm 100$ ohms.

19.8.1.2 Care shall be taken that normal earthing connections are not made. It is recommended that the appliance should be supplied through an isolating transformer; otherwise the appliance must be insulated from earth.

19.8.1.3 The test shall be made with ac except in the case of appliances for dc only, when dc is used.

19.8.1.4 The milliammeter used to measure the leakage current should have an impedance small in comparison with that of the circuit under test and be of a type not appreciably affected by current wave-forms.

19.8.2 The appliances shall be connected to 1.1 times the rated voltage or to 1.1 times the upper limit of the rated voltage range, and operated as in normal use for a period of at least 10 minutes. The leakage current which may flow from any pole of the supply mains to the accessible metal parts and metal foil on external parts of insulating material, connected together, shall be measured under operating conditions.

19.8.2.1 The leakage current shall be measured with the milliammeter connected alternatively to line 1 and line 2.

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19.8.3 The leakage current for either of the positions (see **19.8.2.1**) shall not exceed 300 μ A (peak).

19.9 High Voltage Test

19.9.1 The source of supply for high voltage test shall be not less than 500 VA.

19.9.2 The high voltage test shall be applied to new and completed fan motors and regulators in normal working conditions with all parts in place except the capacitor which should be disconnected.

19.9.3 An ac test voltage at a frequency of 50 or 60 Hz of approximately sine-wave form shall be applied and maintained for one minute without showing any kind of breakdown or flashover.

The test voltage shall be applied as follows:

a) *For fan motors:*

- 1) Between live parts and body in the case of motors intended to be earthed 1 500 volts
- 2) Between live parts and other inaccessible metal parts (that is, over the functional insulation) in the case of double insulated motors 1 500 volts
- 3) Between the inaccessible metal parts and the body (that is, over the supplementary insulation) in the case of double insulated motors 2 500 volts
- 4) Between live parts and body (that is, over the reinforced insulation) for reinforced insulated motors 4 000 volts

b) *For regulators:*

- 1) Between any terminal and the body 1 500 volts
- 2) Between the terminals with the regulator in the 'OFF' position 1 500 volts

19.9.4 At the end of one minute, the test voltage shall be removed and the insulation resistance test conducted as in **19.10**.

19.10 Insulation Resistance Test

19.10.1 The insulation resistance test shall be carried out on fans and regulators immediately after conducting the high voltage test (see **19.9**).

NOTE — When conducted as a type test for fans and regulators, this test shall follow the moisture-proofness test (see **19.4**).

19.10.2 The insulation resistance of the fan motor and its regulator shall be not less than two megohms when tested after the completion of the high voltage test, with a dc voltage of approximately 500 volts applied between points used for the high voltage test.

19.11 Earthing Continuity Test

19.11.1 For fans intended to be earthed, the resistance shall not exceed 0.1 ohm between any exposed metal parts except the rotating parts supported by metal bearings, and

- a) the free end if the earthing conductor of the fan is fitted with a flexible cord, due allowance being made for the resistance of the earthing conductor of the flexible cord, or
- b) the earthing terminal or contact when the fan is supplied without a flexible cord.

The resistance measurement shall be made with a current of 10 A with a dc voltage not exceeding 6 volts.

19.12 Electrical Input Test — The electric power input in watts to the fan shall be determined by running the fan with axis of the blades horizontal at the test voltage specified with the regulator in the highest speed position and with the oscillating mechanism, if any, connected. The oscillating mechanism, shall then be disconnected and the position of the fan fixed so that the direction of the axis of the draught (that is, the axis of the rotation of the fan blades) is perpendicular to the test plane. The fan shall then be restarted with the test voltage applied to the terminals and the electrical input in watts again measured. The difference between this and the first reading shall be taken as the power absorbed by the oscillating mechanism.

19.13 Measurement of Fan Speed — The speed of rotation of the fan shall be determined by running the fan at the test voltage and at its rated frequency. The method of measurement shall be such that the speed of the fan is not appreciably affected.

19.14 Flash Test — Every fan and regulator shall withstand the voltage specified in **19.9** for one second, when it is applied instantaneously.

A P P E N D I X A

(*Clause 18.1.2*)

**ADDITIONAL INFORMATION TO BE SUPPLIED BY
THE MANUFACTURER**

A-1. The following additional information in respect of an air circulator type electric fan shall be supplied by the manufacturer on request:

- a) Power factor,
- b) Air delivery,
- c) Service value,
- d) Number of blades,
- e) Type of regulator and number of running positions,
- f) Class of insulation,
- g) Type of bearings, and
- h) Instructions for lubrication of bearings.

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