भारतीय मानक

सामान्य प्रयोजन के लिए एक फेज़ी ए सी प्रे

(तीसरा पुनरीक्षण)

Indian Standard

SINGLE PHASE a.c. INDUCTION MOTOR GENERAL PURPOSE

(Third Revision)

ICS 29.160.30

Rotating Machinery Sectional Committee, ETD 15

FOREWORD

This Indian Standard (Third Revision) was adopted by the Bureau of Indian Standards, after t the Rotating Machinery Sectional Committee had been approved by the Electrotechnical Di

This standard was first published in 1959. The first revision was brought out in 1964 and the brought out in 1979. This revision has been undertaken to align it with the latest developm rotating machinery and also to include the following changes:

a) The universal motors are excluded as these motors have very little common appl phase ac induction motors covered under this standard;
b) Performance requirement of various types of motors including for fans, pumps etc, for shaded pole and split phase motors; and
c) Guidelines for selection of fan duty motors are included (*see* Annex F).

This standard recommended the important dimensions for frame of motors with foot or resili with sleeve or ball bearings which are necessary to ensure mechanical interchangeability.

This standard covers the requirements and tests for general purpose motors. The motors used in may have special requirements and these special requirements are subject to agreement betw manufacturer. The special requirements for single-phase electric motors for domestic laundry m in IS 9582 (Part 1) : 1980 'Single-phase electric motors for definite purposes: Part 1 Domest motors'. The special requirements and the guidelines for selection of fan duty motors are gi

Guidance for testing single-phase a.c. is given in IS 7572 : 1972 'Specification for guide for t a.c. and universal motors'.

To ensure satisfactory installation and maintenance of induction motors, it is urged that the contained in IS 900 : 1965 'Code of practice for installation and maintenance of induction mot be carefully followed.

If so desired, the thermistors may be used in the windings of the motors. The details and specifica would be as agreed between the purchaser and the manufacturer.

In the formulation of this standard, assistance has been derived from the following publicati

IEC 34-1 (1969) Rotating electrical machines — Part 1: Rating and performan International Electrotechnical Commission.

IEC 34-2 (1972) Rotating electrical machines — Part 2: Methods of determining loss rotating electrical machinery from tests (excluding machines for tracti by the International Electrotechnical Commission.

IEC 72 (1971) Dimensions and output ratings for rotating electrical machines — Fram

Indian Standard

SINGLE PHASE a.c. INDUCTION MOTORS GENERAL PURPOSE

(Third Revision)

1 SCOPE

1.1 This standard covers single phase ac induction motors of the capacitor types for voltages upto and including 250 V and having windings with Class A, Class E, Class B, Class F or Class H insulation (*see* IS 1271 : 1985 Thermal evaluation and classification of electrical insulation) and output upto and including 2 200 W).

1.2 Motors for use on systems complying to voltages and frequencies other than preferred (*see* **4**) shall be considered as complying with this standard provided they comply in all other respects. The voltages and frequency for which they are designed shall be stated on the rating plate.

2 REFERENCES

The list of standards given in Annex A are necessary adjunct to this standard.

3 TERMINOLOGY

3.1 For the purpose of this standard, the following definitions in addition to those covered in IS 1885 (Part 35) shall apply.

3.1.1 *Overload* — Any load in excess of the rated output expressed as a percentage of rated output.

3.1.2 *Momentary Overload* — Any overload the duration of which is so short as not to affect appreciably the temperature of the motor.

3.1.3 *Refrigeration Duty Motor* — A special purpose ventilated motor suitable for driving open type compressor in condensing unit refrigeration.

3.1.7 *Thermally Protected Motor* — with thermal protector.

3.1.8 *Thermal Protector* — A p assembly as an integral part of t when properly applied, protects dangerous overheating due to ov start.

3.1.9 *General Purpose Motor* — standard ratings with standard ope and mechanical construction for us conditions without restrictions to a or type of application.

3.1.10 *Breakaway (Starting) To* torque developed by the moto condition when the motor is su voltage and rated frequency.

3.1.11 *Pull-Up Torque* — Th developed by the motor between speed which corresponds to the p the motor is supplied at the rate frequency.

3.1.12 *Pull-Out Torque* — The hig motor can develop while running rated frequency.

3.1.13 *Wide Voltage Motor* — A voltage range of 190-240 V (specified on the nameplate). This performance specifications at the band. At the extreme voltage condi be capable of delivering the rated may not necessarily have their ot

4.2 Rated Frequency

The rated frequency shall be 50 Hz.

4.3 Rated Output

The preferred output ratings shall be 2.5, 4, 7, 12, 18, 25, 40, 60, 90, 120, 180, 250, 370, 550, 750, 1 100, 1 500 and 2 200 Watt.

4.4 Rated Speeds

Preferred rated speeds shall be corresponding to two poles, four poles and six poles.

5 SITE CONDITIONS

5.1 The following shall constitute the normal site conditions.

5.1.1 *Altitude and Temperature*

Motors shall be designed for the following site conditions unless otherwise agreed between the manufacturer and the purchaser.

5.1.2 *Altitude*

Altitude not exceeding 1 000 m.

5.1.3 *Temperature*

The cooling air temperature not exceeding 40°C.

5.1.4 *Voltage and Frequency Variation*

Motors covered by this standard shall be capable of delivering rated output with,

a) terminal voltage differing from its rated value by not more than ± 6 percent, or
b) frequency differing from its rated value by not more than ± 3 percent, or
c) any combination of (a) and (b).

In case of continuous operation at extreme voltage limits, the temperature rise specified in Table 1 of IS 12802 shall not exceed by more than 10°C. Motors when operated under the extreme conditions of voltage and frequency variations may not necessarily have their

motors shall be as in IS 1231 a
frame dimensions addition in thi
in view of its popularity).

NOTES

1 Whenever the motor construction
the recommended dimensions, the d
shall be a matter of agreement betwe
the user.

2 Dimensional requirements of mo
corresponding to frame 56 shall be
between the manufacturer and the us

3 Tolerance on centre height shall not
base mounted motors. Centre height f
not be as in IS1231 and the tolerance o
between the manufacturer and the use

4 Oblong holes may be used making
the motors. However, the width of t
equal to the diameter specified for the
slots are not permissible.

7.2 Non-standard Dimensions

Considering the wide variety of u
of motors covered by this stand
manufactured in frame sizes and di
those in **7.1**. Unless otherwi
dimensional tolerances (on the de
shall be corresponding to the near

8 DUTY AND RATING

8.1 Continuous Rating

For the purpose of this standard
specified, the general purpos
continuously rated.

8.2 Short Time Rating

If the motors are short time rated, t
shall be 5, 15, 30 or 60 min.

NOTE — For more details on selection
motors (*see* Annex E).

9 GENERAL CONSTRUCTIO

9.1 Mounting

9.1.4 *Resilient-Ring Mounted Motor*

A motor provided with resilient mounting so that it is supported between two resilient rings affixed to its end shields, the rings being used for mounting by the user.

9.1.5 *Resilient-Base Mounted Motor*

A resilient-ring mounted motor provided with mounting base, the base being used for fixing it in position.

9.1.6 *Stator-Pad Mounted Motor*

A motor provided with three or four pads on stator body, equispaced in angular position, duly tapped, the pads being used for fixing motor in position.

9.1.7 *End Shield Pad Mounting*

A motor provided with three or four pads on end shield equispaced in angular position in same plane, duly tapped, the pads being used for fixing motor in position.

9.1.8 *Foot-cum-End Shield-Pad Mounting*

An end shield pad mounted motor with feet, the feet being used for fixing motor in position.

9.1.9 *Extended Bolt Mounting*

A motor where extended threaded studs or motor bolts are provided to be used for fixing motor in position.

9.1.10 *Frame-Mounted Motor*

A motor without driving end shield, the frame or stator body being used for fixing it in position.

NOTE — Dimensions for fixing the motor in position of motors in **9.1.4**, **9.1.6**, **9.1.7**, **9.1.8**, **9.1.9**, and **9.1.10**, shall be a matter of agreement between the manufacturer and the user.

9.2 Terminal Box

The position of terminal box, when provided, shall be a matter of agreement between the manufacturer and the user.

9.3 Mounting Constructions

metallic, the material of such e
structure shall be non flame su
extinguishing.

9.4.2 *Thermal Protector*

When motors are provided with th
shall bear a warning label sta
PROTECTOR FITTED' or
PROTECTED' and shall be conspi

9.4.3 *Manual Resetting Protector*

When such protectors are of manua
resetting arrangement shall be rea
identifiable through clear marking

9.4.4 *Lubrication*

Readily accessible lubricating point
wherever necessary.

9.4.5 *Lubricant Temperature*

The lubricant of the motor bearing
for bearing temperatures which
operating conditions covered by th

9.4.6 *Centrifugal Switch*

To ensure satisfactory operation the
where fitted shall be so disposed
exposed to lubricating grease or
discharged from over lubricated be

9.4.6.1 Each motor shall be subject
of 5 cycles of switch operation at
fitted with centrifugal switch to
operation.

NOTE — As type test the number of cyc
shall be conducted for 1 in 250 numbers

9.4.7 *Resilient Mounting Material*

When resilient mountings are an i
motor the mounting shall be oil res
to heat which is produced by the m

supplied with the motor shall be suitable for the maximum temperature of the part of motor coming in contact with these leads.

9.4.11 *Capacitors*

Capacitors where used shall comply to IS 2993.

NOTES

1 For capacitor-start or capacitor-start capacitor-run motors, the voltage of the electrolytic capacitor during locked rotor at rated voltage shall not exceed 90 percent of the rms surge voltage of capacitor.

2 For two value capacitor/permanent split capacitor motor, during no load run at rated voltage of the motor the voltage of the paper dielectric capacitor shall not exceed the rated voltage of the paper dielectric capacitor excepting directly loaded appliances such as monobloc pumps, mono-compressors and fans which always are run at or near full load. In such uses the voltage of the capacitor shall not exceed 95 percent of its rated voltage when the appliance is run at rated load at rated voltage.

9.4.12 *Construction Material*

All materials and components used in the manufacture of the motor shall conform to the relevant Indian Standard, wherever they exist. In case of any difficulty in complying with this requirement, it shall be subject to agreement between the manufacturer and the purchaser.

9.4.13 *Finishing*

All surfaces exposed to atmosphere which are not adequately protected by metal deposition shall be protected against corrosion by painting, enamelling, oxidizing or phosphatizing.

9.5 Earthing

9.5.1 *Earthing Terminal*

At least one separate earthing terminal of adequate current carrying capacity conveniently located and visible shall be provided on the motor. The earthing terminal shall be of suitable material adequately protected against corrosion and shall have '⏚' or 'E' on or adjacent to it.

10.1.1 *Open Ventilated Motor*

A motor having no protective enclo

NOTE — In case of non-protected motor shall be provided by the user.

10.1.2 *Ventilated Motor*

A motor having an enclosure so con protection while ventilation is not m The protection provided by encl requirements of IP20 in accordance

10.1.3 *Drip Proof Motor*

A ventilated motor so construct vertically falling water or dirt. The p by enclosure shall meet requirer accordance with IS 4691.

10.1.4 *Water Protected Motor*

A drip proof motor so constructed t falling at an angle up to 15° from have no harmful effect, the protec enclosure shall meet requirem accordance with IS 4691.

10.1.5 *Totally Enclosed Motor*

A motor so constructed as to prevent of air between inside and outside The protection provided by encl requirements of IP44 in accordance

10.1.6 *Totally Enclosed Fan Coolea*

A totally enclosed motor with augm means of a fan driven by the motor over motor body or cooling passa protection provided by enclos requirements of IP44 in accordance

10.1.7 *Environment Proof Motor*

A motor so constructed that it can wo protection from the weather condit

incorporated in appliances may have enclosures not providing a specific degree of protection. Such motors also shall be considered conforming to this standard so long as they comply with all the requirements of this standard except that relating to enclosures.

10.1.11 Besides enclosures defined in **10.1** this standard also recognizes the enclosures arising out of various degrees of protection stated in IS 4691.

11 METHODS OF COOLING

11.1 The method of cooling of motors and their designations shall be as given in IS 6362. Cooling methods shall be any one of the following types:

a) *According to origin of cooling*:

1) *Natural cooling* — The motor is cooled without the use of a fan by the movement of air and radiation.
2) *Self cooling* — The motor is cooled by cooling air driven by a fan mounted on the rotor or one driven by it.
3) *Separate cooling* — The motor is cooled by a fan not driven by its shaft.

b) *According to manner of cooling*:

1) *Open circuit ventilation* — The heat is given up directly to the cooling air flowing through the motor which is being replaced continuously.
2) *Surface ventilation* — The heat is given up to the cooling air from the external surface of a totally enclosed motor.

12 GENERAL CHARACTERISTICS

12.1 Torques

12.1.1 With rated voltage and frequency applied to terminals, the breakaway (starting), pull-up and pull-out torques shall comply with the requirements given in Table 1.

12.1.2 Motors conforming to this
expected to carry sustained overloads.
agreed to between the manufactur
motors rated in accordance with this
capable of withstanding on test (unde
of torque) without injury, the overlo
15 s is given in Table 2, after having

All the torque values shall be measur
with IS 7572.

Table 2 Momentary Overload
(*Clauses* 3.1.13, 5.1.4 *and*

Sl No.	Type of Motor	F
(1)	(2)	
i)	Capacitor-start Induction-run	
ii)	Capacitor start-and-run	
iii)	Capacitor-start Capacitor-run	

12.2 Temperature Rise

Temperature rise of motors for all typ
when tested under the rated cor
accordance with the requirements of t
not exceed the limits given in Table
Motors shall, however, be capable of c
injurious heating at extreme volta
in **5.1.4** (that is ± 6 percent of rated
extremes of the voltage range specif
plate. The temperature rise of motors t
in appliances shall be tested when the
in the appliance.

12.3 Short Time Rating

For motors having short time rating, th
in Table 1 of IS 12802 may by agreem
by 10°C. Where such an agreement is
the limits, the increased limits shall
the rating plate.

12.4 Method of Testing

maximum full load current, nominal efficiency and maximum breakaway starting current for 2 pole, 4 pole and 6 pole general purpose ac single phase motors at rated voltage of 230 V, 50 Hz shall be in accordance with Tables 1 to 11.

NOTES

1 For specific applications such as fans, blowers, domestic applications, air conditioners, room coolers, refrigerators, data processing equipments, and compressors etc, the performance values specified in Tables 1 to 11 may not be applicable as the motor design is based on the overall requirements of the application.

2 For motors having rated voltage or me range other than 230 V, values given in Ta applicable except for maximum value of maximum breakaway starting current wh inverse proportion of the voltage.

3 In case the manufacturer declares performance characteristics than specifie the declared values shall be subject to v values of the performance characteristics sl declared by the manufacturer within the in Table 12 and shall in no case be in specified in Tables 1 to 11.

Table 3 Values of Performance Characteristics of 2-Pole Capacitor-Start Induction-R

(*Clauses* 3.1.13, 5.1.4 *and* 12.5.1)

Sl No.	Rated Output	Minimum Full Load Speed	Nominal Full Load Efficiency	Maximum Full Load Current	Maxi Sta
	W	rev/min	Percent	A	
(1)	(2)	(3)	(4)	(5)	
i)	180	2 630	50	2.7	
ii)	250	2 650	55	3.6	
iii)	370	2 680	58	4.9	
vi)	550	2 720	60	7.2	
v)	750	2 740	65	8.9	
vi)	1 100	2 760	67	12.3	
vii)	1 500	2 780	69	15.9	
viii)	2 200	2 800	70	20.3	

Table 4 Values of Performance Characteristics of 2-Pole Capacitor-Start-and Run

(*Clauses* 3.1.13, 5.1.4 *and* 12.5.1)

Sl No.	Rated Output	Minimum Full Load Speed	Nominal Full Load Efficiency	Maximum Full Load Current	Maximu Starti
	W	rev/min	Percent	A	
(1)	(2)	(3)	(4)	(5)	
i)	180	2 630	52	2.1	
ii)	250	2 650	57	2.8	
iii)	370	2 680	60	3.8	
iv)	550	2 720	66	5.0	
v)	750	2 740	68	6.3	
vi)	1 100	2 760	70	8.9	
vii)	1 500	2 780	71	11.9	
viii)	2 200	2 800	72	15.7	

Table 5 Values of Performance Characteristics of 2-Pole Capacitor-Start Capacitor-R

Table 6 Values of Performance Characteristics of 4-Pole Capacitor-Start Induction-

(*Clauses* 3.1.13, 5.1.4 *and* 12.5.1)

Sl No.	Rated Output	Minimum Full Load Speed	Nominal Full Load Efficiency	Maximum Full Load Current	Max S
	W	rev/min	Percent	A	
(1)	(2)	(3)	(4)	(5)	
i)	180	1 340	50	3.0	
ii)	250	1 340	55	3.6	
iii)	370	1 360	58	5.0	
iv)	550	1 375	60	6.5	
v)	750	1 375	65	8.5	
vi)	1 100	1 380	67	12.5	
vii)	1 500	1 380	69	16.2	
viii)	2 200	1 390	70	20.9	

Table 7 Values of Performance Characteristics of 4-Pole Capacitor-Start-and Ru

(*Clauses* 3.1.13, 5.1.4 *and* 12.5.1)

Sl No.	Rated Output	Minimum Full Load Speed	Nominal Full Load Efficiency	Maximum Full Load Current	Maxi St
	W	rev/min	Percent	A	
(1)	(2)	(3)	(4)	(5)	
i)	180	1 340	52	2.2	
ii)	250	1 340	57	2.9	
iii)	370	1 360	60	4.0	
iv)	550	1 375	66	5.4	
v)	750	1 380	68	6.8	
vi)	1 100	1 380	70	9.4	
vii)	1 500	1 380	71	12.5	
viii)	2 200	1 390	72	16.5	

Table 8 Values of Performance Characteristics of 4-Pole Capacitor-Start Capacitor-

(*Clauses* 3.1.13, 5.1.4 *and* 12.5.1)

Sl No.	Rated Output	Minimum Full Load Speed	Nominal Full Load Efficiency	Maximum Full Load Current	Max St
	W	rev/min	Percent	A	
(1)	(2)	(3)	(4)	(5)	
i)	180	1 340	52	2.2	
ii)	250	1 340	57	2.9	
iii)	370	1 360	60	4.0	
iv)	550	1 375	66	5.4	
v)	750	1 380	68	6.8	
vi)	1 100	1 380	70	9.4	
vii)	1 500	1 380	71	12.5	
viii)	2 200	1 390	72	16.5	

Table 9 Values of Performance Characteristics of 6-Pole Capacitor-Start Induction-

Table 10 Values of Performance Characteristics of 6-Pole Capacitor-Start-and I
(*Clauses* 3.1.13, 5.1.4 *and* 12.5.1)

Sl No.	Rated Output	Minimum Full Load Speed	Nominal Full Load Efficiency	Maximum Full Load Current	Max St
	W	rev/min	Percent	A	
(1)	(2)	(3)	(4)	(5)	
i)	180	750	52	3.0	
ii)	250	750	57	3.8	
iii)	370	770	60	4.8	
iv)	550	780	66	6.4	
v)	750	780	68	8.5	
vi)	1 100	800	70	11.0	
vii)	1 500	800	71	14.0	
viii)	2 200	800	72	20.0	

Table 11 Values of Performance Characteristics of 6-Pole Capacitor-Start Capacito
(*Clauses* 3.1.13, 5.1.4 *and* 12.5.1)

Sl No.	Rated Output	Minimum Full Load Speed	Nominal Full Load Efficiency	Maximum Full Load Current	M
	W	rev/min	Percent	A	
(1)	(2)	(3)	(4)	(5)	
i)	180	750	52	3.0	
ii)	250	750	57	3.8	
iii)	370	770	60	4.8	
iv)	550	780	66	6.4	
v)	750	780	68	8.5	
vi)	1 100	800	70	11.0	
vii)	1 500	800	71	14.0	
viii)	2 200	800	72	20.0	

NOTES
1 Comprehensive values of performance characteristics are invited for all ratings of split-phase and shade 2-pole, 4-pole and 6-pole all ratings not given in Tables 1 to 11.
2 For ratings not specified above performance values shall be declared by the manufacturer which shall be s Table 12.

12.5.2 *Tolerances*

Unless otherwise specified, tolerances on performance shall be in accordance with Table 12. Where a tolerance is stated in only one direction, the tolerance in the other direction is considered unimportant.

12.6 Limits of Vibration Severity

Unless otherwise specified the maximum rms-

13.1.1 *High Voltage Test Method*

High voltage test shall be made in of IS 7572.

13.2 Moisture Proofness

The testing chamber shall be so c conditions given in **13.2.1** to **13.2.** [*see also* IS 9000 (Part 3) : 1977]

Table 12 Tolerances
(*Clauses* 5.2 *and* 12.5.2)

Sl No. (1)	Performance Parameter (2)	Tolerance (3)
i)	Efficiency	–15 percent of $(100 - \eta)$
ii)	Power factor	–1/5 $(1-\cos\phi)$, *Min* –0.02, *Max* –0.1
iii)	Speed of motor at rated full load	±50 percent of rated slip at full load
iv)	Breakaway (starting) torque	–20 percent of the stated breakaway
v)	Pull out torque	–10 percent of the stated pull out tor
vi)	Pull up torque	–20 percent of the stated pull up torq
viii)	Breakaway (starting) current (locked rotor)	+20 percent of the stated breakaway

NOTE — η-Declared efficiency expressed as percentage and $\cos\phi$ = Declared power factor.

humidity shall have a resistivity of not less than 500 Ω m.

13.2.5 Condensed water from the walls and roof of the chamber shall not fall on the items.

13.2.6 The items under test shall not be subjected to radiant heat from the chamber conditioning processes.

13.2.7 The items shall be introduced into the chamber in the unpacked, switched off, ready for use state.

13.2.8 The chamber temperature shall be raised from laboratory temperature 25 ± 10°C to 40 ± 2°C within a period of 2 h ± 30 min; the relative humidity during this period shall be not less than 80 percent and condensation on the item may occur.

13.2.9 The chamber temperature shall be maintained at 40 ± 2°C for a period of 16 h. During this period the relative humidity shall be not less than 95 percent.

13.2.10 The temperature within the chamber shall then be allowed to cool to laboratory temperature in not less than 1 h. The relative humidity during this cooling period shall be not less then 80 percent. The chamber temperature shall be maintained at the laboratory temperature and at relative humidity not less than 80 percent for the remainder period of the 24 h from the start of the test. However, this period shall be at least 3 h.

13.2.11 The graphical description of the test cycle is

NOTE — Relevant test procedure from has been incorporated above.

Table 13 Values of Test
(*Clauses* 13.1 *and* 13.

Sl No. (1)	Rated Voltage of Motor Volts (V_{rms}) (2)
i)	50 V or less
ii)	Above 50 V up to and including 2

13.3 Leakage Current

Leakage current shall not exceed 3. a voltage equal to 1.1 times the rate to the motor and is measured betwe of the system and the accessible r and a metal foil covering the o insulating material. The resistance shall be 2 000 ± 50 Ω. In case of m use in domestic appliances, the current shall be in accordance with

NOTE — The test is to be conducted in with the motor placed on an insulating p

14 TERMINAL MARKING

14.1 Terminal markings shall be i IS 4728.

14.1.1 Where no terminal board/be

1974, *Water (PCP) Cess Act*, 1977 and *Air (PCP) Act*, 1981 along with the authorization required under *Environment (Protection) Act*, 1986 and rules made there under by the Bureau of Indian Standards while applying for the ECO-Mark.

15.1.3 The motor packaging may display in brief the criteria based on which the product has been labelled environment friendly.

15.1.4 The motor shall be sold along with instructions for proper use so as to maximize product performance and minimize wastage.

15.1.5 The motor shall conform to the noise levels as notified under the *Environment (Protection) Act*, 1986 from time-to-time.

15.2 Specific Requirements

15.2.1 *Efficiency*

The motor shall have at least 3 percent improvement in efficiency over and above that prescribed in this standard.

16 MARKING AND DIAGRAM OF CONNECTIONS

16.1 A rating plate stating the following shall be supplied with each motor:

a) Reference to this Indian Standard, that is, *see* IS 996;
b) Type of motor (*see* Annex B);
c) Name of the manufacturer;
d) Manufacturer's number and frame reference;
e) Type of duty rating;
f) Rated voltage and frequency, in Hz;
g) Rated output, in watts;
h) Approximate current, in amperes at rated output;
j) Approximate full-load speed, in revolutions per minute, at rated output;
k) Class of insulation;

special grade paper, metal/plastic and s
using adhesives/fasteners at conspicuo
shall be taken that information provid
have reasonable life and is protecte
heat, oil and/or moisture.

16.2 A diagram of connection, incl
for changing direction of rotation,
shall be supplied preferably mo
terminal cover.

16.3 BIS Certification Marking

The motor may also be marked wit
Mark.

16.3.1 The use of the Standard Ma
the provisions of the *Bureau of Ind*
1986 and the Rules and Regulation
The details of conditions under wh
the use of the Standard Mark m
manufacturers or producers may be
Bureau of Indian Standards.

17 TESTS

17.1 Tests specified shall normall
manufacturer's premises.

NOTES

1 For the purpose of this standard, t
performance characteristics shall be ma
methods specified in IS 7572.

2 If normal test arrangements are inap
tests are required, the tests to be made a
application shall be agreed to between
the user before order is placed.

17.2 The presence of user or his rep
the tests shall be as agreed to betwee
and the user.

17.3 Type Tests

Type tests for single phase induc
consist of the following:

a) Test for no-load current,
speed at rated voltage and
b) Test for torques at rated volt

n) Dimensions (*see* **7**).

NOTES

1 Also capacitor voltage where applicable.

2 This test may be conducted at reduced voltage.

17.4 Routine Tests

Routine tests for induction motors shall comprise **17.3** (a), (c), (g) and (h) and also test for switching operation of centrifugal switch at no load.

17.5 Acceptance Tests

17.5.1 For carrying out the acceptance tests specified in this standard, the sampling procedure if not otherwise specified shall be according to Annex G.

17.5.2 Acceptance tests for induction motors shall comprise **17.3** (a), (b), (c), (e), (f), (g) and (h).

17.6 Type Test Certificates

17.6.1 The performance characteristics of motor may include efficiency, power factor, breakaway starting torque, breakaway starting current and pull out torque. Temperature rise test is made on motor when required.

NOTE — For specific application motors, *see* relevant clauses of this standard.

17.6.2 It is recommended that type test certificate may be made in the form given in Annex C.

17.6.3 Unless otherwise spec
tenders, the user, if so desired by
accept as evidence of complianc
requirements of this standard, cer
on a motor identical in essentia
purchased and of routine tests on

17.6.4 Certificate of routine test
motor purchased has been run a
be electrically and mechanically
order in all particulars.

17.6.5 If user demands, then type
this standard shall be carried out
provided the executive order qua
or more, in one single lot.

18 GENERAL INFORMATIO
WITH ENQUIRY AND ORDE

The general information to
enquiring for and ordering a moto

19 SELECTION AND APPLIC

The information on selection
different types of motors is give
special requirements and the gui
of fan duty motors, as defined
Annex F.)

ANNEX A
(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
3315 : 1994	Evaporative air coolers (desert coolers) (*first revision*)
4691 : 1985	Degrees of protection provided by enclosure for rotating electrical machinery (*first revision*)
4728 : 1975	Terminal marking and direction of rotation for rotating electrical machinery (*first revision*)
4905 : 1968	Methods for random sampling
6362 : 1995	Designation of methods of cooling of rotating electrical machines
7572 : 1984	Guide for testing single phase ac and universal motors
8148 : 2003	Packaged air conditioners

IS No.	*Ti*
9000 (Part 5/ Sec 1 and 2) : 1981	Basic environmenta for electronic and Part 5: Damp hea
9572 (Part 1) : 1980	Single phase electri purposes: Part 1 machines motors
12075 : 1987	Mechanical vibr electrical machine mm and higher evaluationandlimits
12060 : 1987	Specification f frequency for ac distribution syste
12802 : 1989	Temperature rise rotating electrical

ANNEX B

(*Clause* 16.1)

TYPES OF MOTORS AND THEIR TORQUE CHARACTERISTICS

B-1 TYPES OF MOTORS

B-1.1 Capacitor — Start Induction — Run

These motors having higher starting torques and lower starting currents than split –phase motors are generally more suitable for loads of higher inertia and more frequent starting.

B-1.2 Capacitor — Start Capacitor — Run

are acceptable. They are also gene split-phase or capacitor-start inducti

Unless otherwise specified these mo with some means of switching out auxiliary or starting winding for ex switches or electromagnetic relays.

NOTE — Starting, pull-up and pull-out t as the square of the voltage at the motor

ANNEX C
(*Clause* 17.6.2)

TEST REPORT

C-1 FORM FOR TEST REPORT OF SINGLE-PHASE INDUCTION MOTOR

Name and address of manufacturer as per IS 996: .....

Certificate No.: .....

Order Acceptance No.: .....

Purchaser: .....

Purchaser's Order No.: .....

C-2 RATING PLATE DATA

Enclosure	Output	W	Voltage	V
Frame	Speed	rev/min	Current	A
Insulation Class	Rating		Efficiency	Percent
			Starting capacitor	.....V.
			Running capacitor	 V

C-3 TEST CHARACTERISTICS

Loading Condition	Volts	Amperes	Watts	Speed rev/min	Power Factor
No load test					

C-4 FULL LOAD TEST

Breakaway Torque and Starting (Locked Rotor) Current

Breakaway Torque (Locked rotor), in kgm	Breakaway Starting (Locked Rotor) Current	Input watt

C-5 TEMPERATURE — RUN TEST

Condition of Test				Temperature of Cooling Air °C		Temperature Ris	
Hours	Voltage	Current	Watts			Winding	C

Insulation resistance test .....MΩ

High voltage test .....V/min for 1 min

Leakage current .....mA (rms)

Tests conducted on motor No.. .....

Tested by: .....

Approved by: .....

Date: .....

ANNEX D
(*Clause* 18)

INFORMATION TO BE GIVEN WITH ENQUIRY OR ORI

1. Type of motor (*see* Annex B).
2. Reference to this Indian Standard that is IS 996.
3. Rated output in watts (at each speed multi-speed motors) (*see* **4.3**).
4. Approximate speed in rev/min at rated output (*see* **4.4**).
5. Voltage and frequency, in Hz (*see* **4.1** and **4.2**).
6. Class of rating (*see* **8**).
7. Type of enclosure (*see* **10**).
13. Installation positi horizontal or verti
14. Direction of rotati
15. Type of bearings (s
16. Method of starting line, resistance, etc
17. Any restriction on
18. Any restriction on
19. Nature of load or a driven equipment, w

ANNEX E

(*Clauses* 8.2 *and* 19)

INFORMATION ON SELECTION AND APPLICATION

E-1 NUMBER OF STARTS

These shall be subject to an agreement between the manufacturer and the user. However, the following may be taken as a guide to the number of starts:

Sl No.	*Type of Motor*	*No. of Starts/ Hour Max*	*Duration of Each Start Max*
(1)	(2)	(3)	(4)
i)	Capacitor-start induction-run	20	3
ii)	Capacitor-start and capacitor-run	20	3
iii)	Capacitor-start-and-run	60	3

E-2 SELECTION OF MOTORS

Motors should be properly selected to ensure their satisfactory service. Motors conforming to this standard are suitable for operation in accordance with their ratings under usual service conditions.

Usual service conditions in addition to those stated in **5** shall be as follows:

a) Installation on a rigid mounting base;

b) Installation in areas or supplementary enclosures which do not seriously interfere with the ventilation of the motor;

c) Voltages and frequency in accordance with **4**; and

d) Motors and driven equipment is direct-coupled with flexible couplings.

E-3 SHORT TIME RATED MOTORS

Unless otherwise agreed upon between the manufacturer and the user, the short time rated motors should not be used on any application where driven machine may be left running continuously.

E-4 EFFECTS OF VARIATION IN VOLTAGE AND FREQUENCY UPON THE PERFORMANCE OF INDUCTION MOTORS

Induction motors are at times operated on circuits of voltage and frequency other than those for which they are rated. Following would be a brief statement of some operating results caused by variation in voltage and frequency:

a) With increase or decrease in voltage from that permitted by tolerances on rated voltage; the heating at rated output, in watts, may increase. Such operation for longer periods of time may deteriorate or accelerate deterioration of insulation system;

b) Increase in voltage than rated voltage would usually result in lowering of power factor and *vice-versa*;

c) Starting and pull out torques will be proportional to the square of voltage;

d) Increase in voltage will result in decrease of slip the while decrease in voltage will result in increase of slip, for example, for 10 percent decrease in rated voltage, slip will increase from 5 to 6.05 percent;

e) Frequency greater than rated frequency usually improves power factor but decreases starting torque and increases speed friction and winding loss. At frequency lower than rated frequency reverse can be expected;

f) If frequency and voltage are both varying. Then cumulative affects shall be observed, for example if voltage is high and frequency is low, the starting torque would be greatly increased while power factor will be decreased and the temperature rise increased with normal load. Therefore highest permissible voltage and lowest permissible frequency should not occur simultaneously; and

g) The information given in (a) to (f) applies particularly to general-purpose motors. This may not be always applicable in connection with definite purpose motors (for example for fan duty motors) being built for particular purpose.

ANNEX F

(*Clause* 19)

GUIDELINES FOR SELECTION OF FAN DUTY MOTORS

F-1 The information given in **F-1** to **F-8** may be useful in selection and application of fan duty motors as defined in **3.1.4**.

F-2 TYPE OF MOTORS

Fan duty motors shall preferably be of shaded pole or capacitor start and run type (*see* **B-1.3**).

F-3 GENERAL MACHANICAL FEATURES

F-3.1 Motors shall be constructed with the following mechanical features:

a) Unless otherwise specified the motors shall be totally enclosed (*see* **10.1.5**).

b) Unless otherwise specified, the horizontal motors rated up to 250 W shall have sleeve bearings. The motor shall be provided with means to withstand axial thrust imposed by the impeller fan. Horizontal motors rated above 250 W shall have ball bearings unless otherwise agreed between the manufacturer and the user, and easily accessible re-lubrication points shall be provided for sleeve bearings.

F-4 DIMENSIONS

As these motors are meant for specific applications, dimensions including those of mounting and shaft extension should be as per the agreement between the user and the manufacturer.

F-5 SITE CONDITIONS

F-5.1 The site conditions shall be in accordance with **5**.

F-5.2 Ambient Temperature

When the fan motors are supplied for use in packaged air conditioners (*see* IS 8148) room air conditioners (*see* IS 1391) and drinking water coolers (*see* IS 1475) the ambient temperature for motor shall be taken as not exceeding 45°C.

F-5.2.1 This standard also covers motors used in evaporative air coolers (*see* IS 3315). The fan motors used in evaporative air coolers may have ambient temperature conditions as agreed to between the manufacturer and the user.

F-6 CHARACTERISTICS OF FAN MOTORS

F-6.1 The fan duty motors shall meet the requirements of **12** and as modified by **F-5.1**.

NOTE — The values of performance (*see* **12.5**) for motors other than 4 pole construction shall be as agreed between the manufacturer and the user, subject to tolerances specified in Table 12.

F-6.2 Torque

F-6.2.1 *Pull-Out Torques*

Lower torque than specified in Table 1 may be acceptable provided motor meets other performance requirement for satisfactory operation of appliance in which it is used.

F-6.2.2 *Pull-Up and Breakaway Torque*

These should be sufficient to accelerate the fan satisfactorily under worst operating conditions of voltage and frequency (*see* Annex E) for which the appliance has been designed.

F-6.2.3 *Momentary Overload Test*

The requirement shall not be applicable to fan motors.

F-6.2.4 *Full Load Test*

The power input and speed should be measured when motor is fitted with the fan and mounted in the appliance so that the actual condition under which it is loaded are simulated.

F-6.2.5 *Temperature Rise Test*

This shall be carried out, when motor is fitted with the fan as used in the appliance. As in most of the cases, the motor is cooled by the air drawn over its surface by the driven fan. In all such motors the rating on name plate should appear as AOM (Air oven motors). Motors with AOM ratings shall not be run without fan other than necessary for routine testing of motors as it may result in overheating of motor.

F-7 MULTISPEED MOTORS

F-7.1 In a single speed induction motor, the speed may be changed by virtue of fan load and motor characteristics by effective change of voltage. This change in voltage can either be achieved by tapped winding in the motor itself or by external means (for example, speed regulator). Close co-operation between the motor manufacturer and fan manufacturer is recommended in order to obtain satisfactory speed regulation.

F-7.1.1 The operational speeds shall be subject to agreement between the manufacturer and the user. The tolerances on speed shall be as per Table 12.

F-8 EFFECT OF VARIATION OF RATED VOLTAGE UPON OPERATING SPEED

F-8.1 The effect of variation from rated voltage upon the operation speed of typical designs of shaded pole and capacitor start and run motors used for fan drives are shown by speed-torque curves in Fig. 1 and Fig. 2 respectively. In each set of curves the solid curve intersecting the 0 torque axis near 100 percent of synchronous speed illustrates the speed torque characteristics of an average motor of a typical design. The dashed curves enveloping the solid curve illustrate the variation in speed-torque characteristics of the typical motor design when tested at rated voltage and frequency. The dot dash curve illustrates the variation in speed torque characteristics within ± 10 percent variations in line voltage for the motor of the typical design when operated at rated frequency.

In order to illustrate the variation in motor speed when driving a specified fan, a family of typical fan speed-torque curves are shown intersecting the typical average motor speed-torque curve at operating speeds of 95, 90, 85, 80, 75 and 70 percent of synchronous speed.

F-8.1.1 A study of these curves show that when the operating speed is lower than 50 percent of synchronous speed extremely wide variations in operating speed of motor of a particular design may be expected within the ±10 percent variation from rated voltage that may be encountered in service. The variation in air flow characteristics of the fan of a particular design are not included.

F-8.1.2 Care must be exercised in applying the motor to fan application particularly where two or three speed operation is desired so that the operating speed is kept within the range where tolerable starting characteristics and variations in operating speed may be obtained

F-9 TERMINAL MARKING

F-9.1 The terminal marking shall be in accordance with **14**. However, if terminal plate is not used and flexible

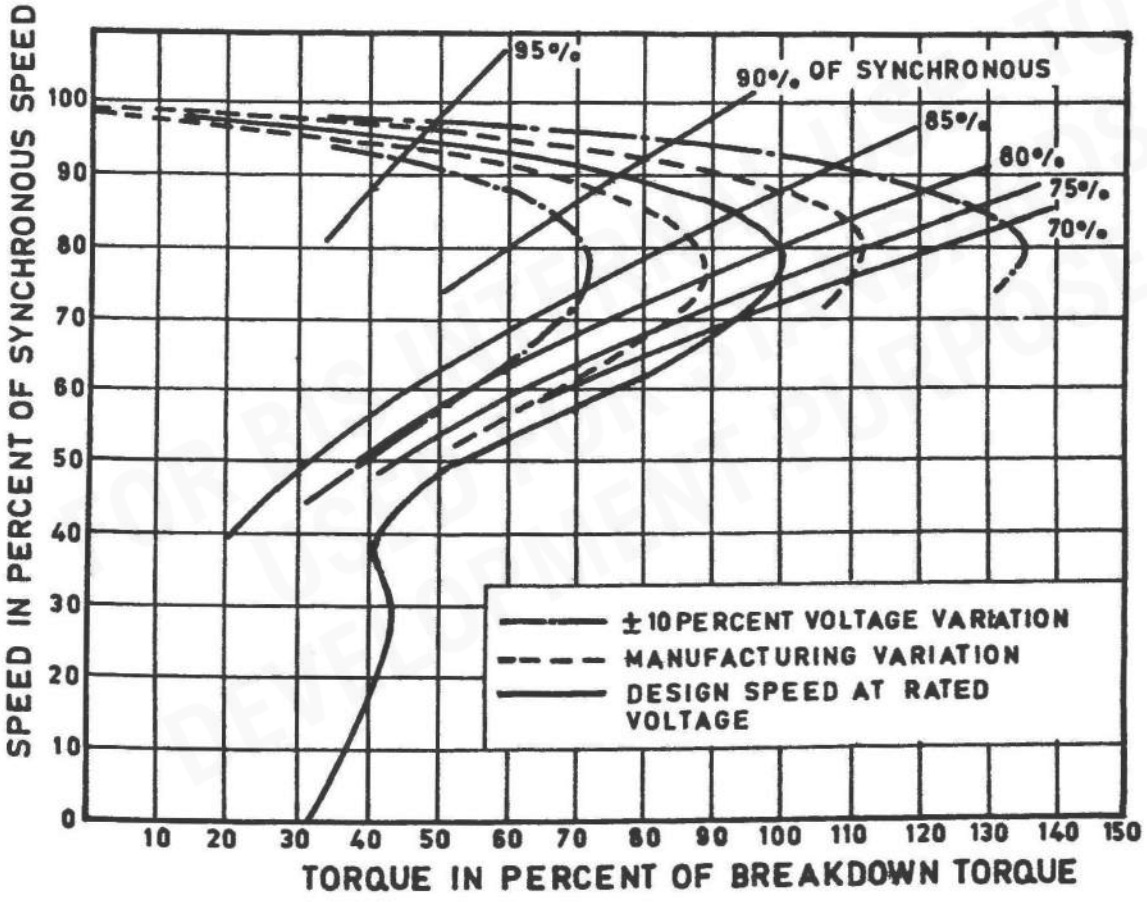

FIG. 1 TYPICAL SHADED POLE SPEED TORQUE CURVE SHOWING EXPECTED SPEED VARIATION DUE TO MANUFACTURING AND VOLTAGE VARIATIONS

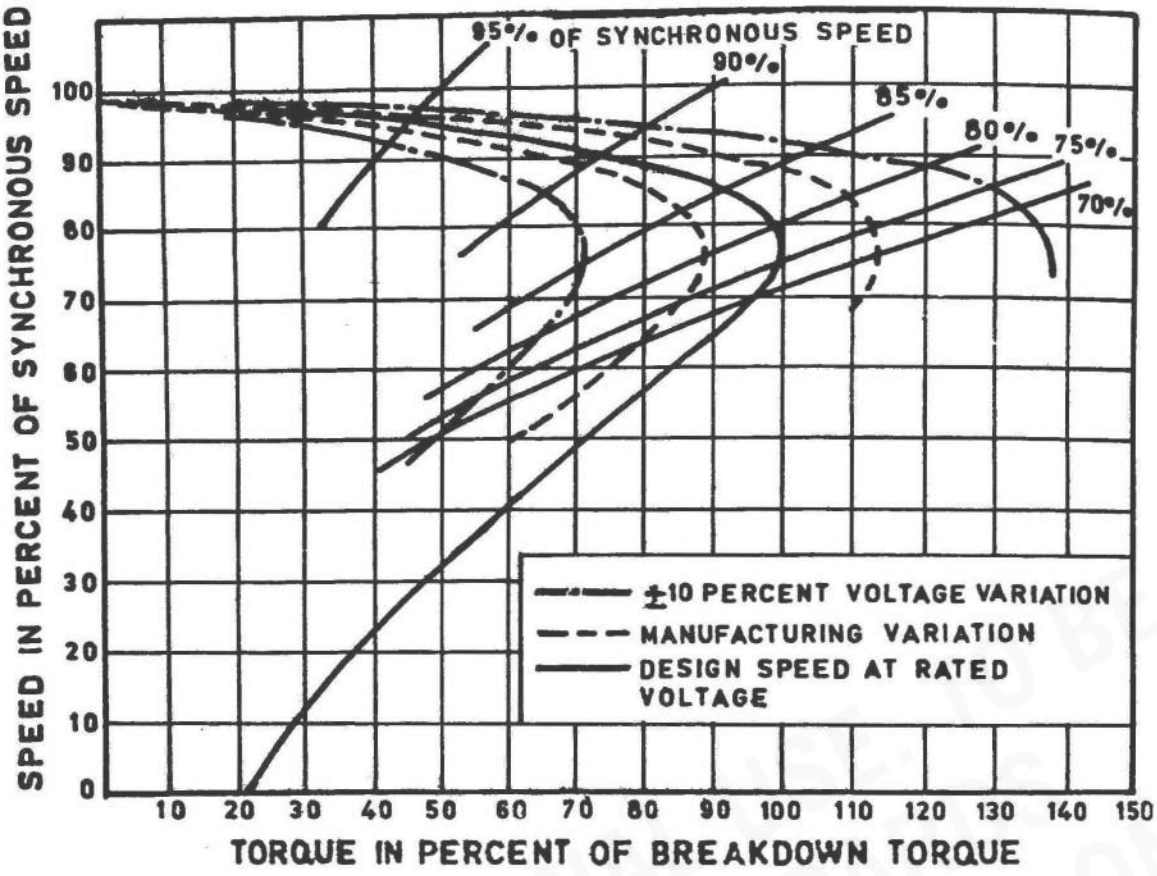

FIG. 2 TYPICAL PERMANENT-SPLIT CAPACITOR SPEED TORQUE CURVE SHOWING EXPECTED SPEED VARIATION DUE TO MANUFACTURING AND VOLTAGE VARIATIONS

cables are brought out of motor for connection the following colour code shall be used to identify the terminals:

Single speed motor:	Supply terminals	Red-Black
	Capacitor terminals	Yellow-Yellow
Two speed motor:	High speed	Blue-Black
	Low speed	Blue-Red
	Capacitor	Yellow-Yellow
Three speed motor:	High speed	Blue-Black
	Medium speed	Blue-White
	Low speed	Blue-Red
	Capacitor	Yellow-Yellow

ANNEX G
(*Clause* 17.5.1)

SAMPLING OF ELECTRIC MOTORS

G-1 SCALE OF SAMPLING

G-1.1 Lot

In any consignment, all the electric motors of the same type and rating from the same batch of manufacture shall be grouped together to constitute a lot.

G-1.2 The conformity of the lots to the requirements of this specification shall be ascertained for each lot separately. The number of electric motors to be selected for this purpose shall depend upon the size of lot and shall be in accordance with **2** and **4** of Table 14.

G-1.2.1 These electric motors shall be selected from the lot at random. In order to ensure the randomness of selection, procedures given in IS 4905 may be followed.

G-2 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

The electric motors at the first stage selected at random according to **2** and **4** of Table 14 shall be subjected to each of the acceptance tests. If an electric motor fails in any of the acceptance tests it shall be termed as defective. The lot shall be considered as conforming to the requirements if the number of defectives found in the sample is less than or equal to the acceptance number (*see* **6**) and shall be rejected if it is greater than or equal to rejection number (*see* **7**). If the numbers of defectives lie between the acceptance number and the rejection number the second sample of the same size shall be chosen at random and tested. If the number of defectives found in the combined samples is greater than or equal to the rejection number, the lot shall be rejected: otherwise the lot shall be accepted.

Table 14 Scale of Sampling and Permissible Number of Defectives
(*Clauses* G-1.2 *and* G-2.1)

Sl No.	Lot Size	Stage	Sample Size	Cumulative Sample Size	Acceptance Number	Rejection Number
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Up to 50	First	5	5	0	1
ii)	51 to 100	First	8	8	0	1
iii)	101 to 300	First	8	8	0	2
		Second	8	16	1	2
iv)	301 to 500	First	13	13	0	2
		Second	13	26	1	2
v)	501 to 1000	First	20	20	0	3
		Second	20	40	3	4
vi)	1001 and above	First	32	32	1	4
		Second	32	64	4	5

NOTE — For lot size up to 100, decision regarding acceptance or rejection of the lot shall be taken at the first stage only.

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