INTER PLANT STANDARD – STEEL INDUSTRY		
IPSS	**SPECIFICATION FOR GENERAL PURPOSE SQUIRREL CAGE INDUCTION MOTORS** (*Fifth Revision*)	**IPSS: 1-03-001-14**
	BASED ON IS 325:1996	Formerly: IPSS:1-03-001-05

0. FOREWORD

0.1 This Interplant Standard (*fourth revision*) has been prepared by the Standards Committee on Rotating Electrical Machinery, IPSS 1:3 with the active participation of the representatives of steel plants, other concerned organizations and established manufacturers of electric motors; and was adopted in July, 2014.

0.2 Interplant standards for steel industry primarily aim at achieving rationalization and unification of parts and assemblies used in steel plant equipment and accessories, and provide guidance in indenting stores or equipment (or while placing orders for additional requirements) by individual steel plants. For exercising effective control on inventories, it is advisable to select a fewer number of sizes (or types) from among those mentioned in this standard, for the purpose of company standards of individual steel plants. It is not desirable to make deviations in technical requirements.

0.3 This interplant standard was first published in 1978 and was revised in 1981. The first revision incorporated rated output values at 40°C reference ambient temperature and de-rating factors for temperatures up to 60°C.

0.4 With a view to sort out the problems faced by the steel plants in repairs, maintenance and operation of ac and dc electric motors of Indian make, a Seminar-cum-Workshop was organized during December 1987 at Calcutta, where panel discussions were held with the manufacturers of these motors. It was decided to incorporate modifications in the existing Interplant Standards on Electric Motors. Second revision incorporated the salient points emerging out from the discussions with the manufacturers in the above workshop and subsequent modifications as decided by the steel plant representatives and other associated organizations.

0.5 The third revision was carried out after a similar Workshop on electric motors at Bangalore on 23 December 1993.

0.6 This revision as well as earlier fourth revision was carried out due to the reasons as given below :

i) Over the years, experience of users in steel plants demanded some modifications in standards.

ii) Due to technological upgradation over the years it was felt necessary to review the standards clause by clause and make changes wherever necessary.

0.7 This Interplant Standard shall be read in conjunction with IPSS:1-03-016-014 `Standard Information for Enquiry and Order for Electric Motors (*second revision*) .

0.8 This revision has been carried out to update the standard from the latest technology point of view and based on the users' experience.

1. SCOPE

1.1 This Interplant Standard covers the requirements of 2, 4, 6 and 8-pole squirrel cage three-phase induction motors for a voltage of 415 V and having windings with at least Class F insulation and rated outputs up to 200 kW (in general and above capacity under specific cases) for general purpose application in steel industry (like motors for pumps, fans and blowers, motor-generator sets, etc), and is generally based on IS 325:1996 `Specification for three-phase induction motors (*fifth revision*)'. The requirements of this Indian Standard regarding terminology, tests, earthing, overload, tolerances and terminal marking are applicable as such.

1.2 Other technical aspects required for meeting the special needs of the steel industry are given in this standard.

2. SITE CONDITIONS

2.1 The following shall constitute the normal site conditions for the purpose of this standard:

2.1.1 *Ambient Temperature* - The ambient temperature not exceeding 50^{o}C.

NOTE: 1 For using the motors at a higher ambient temperature, the guidance given in clause 5.3.1 shall be followed.

2.1.2 *Relative Humidity* - The relative humidity can be up to the maximum of 100%. Maximum ambient temperature and 100% relative humidity may not occur simultaneously.

Note : For operation of motors at 100% relative humidity, space heaters shall be provided by the motor manufacturers whenever specified.

2.1.3 *Ambient Air* - The ambient air may contain fair amount of conductive dust.

2.1.4 *Altitude* - Altitude not exceeding 1000 m above mean sea level.

2.2 **Form and Symmetry of Currents and Voltages** - Motors shall be designed assuming the supply voltage to be virtually sinusoidal. The supply voltages shall also form a virtually balanced system (Ref IS 325:1996).

NOTE: The voltage is considered to be virtually sinusoidal if none of the instantaneous values of the wave differ from the instantaneous values of the same phase of the fundamental wave by more than 5% of the amplitude of the latter.

A system of three-phase voltages is considered to be virtually balanced if none of the negative-sequence and zero-sequence components exceed 2% of the positive-sequence component.

2.3 **Voltage and Frequency Variation** - The motors shall be capable of delivering the rated output with:

i) The terminal voltage differing from its rated value by not more than $\pm$6% in general cases but in special cases if desired by the purchaser, voltage fluctuation of +10, -15% shall have to be provided; or

ii) The frequency differing from its rated value by not more than $\pm$3% in general cases but in special cases if desired by the purchaser, frequency fluctuation of +3/-6% shall have to be provided; or

iii) Any combination of (i) and (ii).

In the case of continuous operation at extreme voltage limits, the temperature-rise limits specified in Table 1 of IS 325:1996 shall not exceed by more than 10^{o}C. Motors, when operated under the extreme conditions of voltage and frequency variation, may not necessarily have their performance in accordance with this standard.

3. TYPE OF ENCLOSURE

3.1 The degree of protection to be provided by the enclosure shall be IP 55 or superior where specified in accordance with IS/IEC 60034-5(2000) [IS 4691:1985 is withdrawn].

4. METHOD OF COOLING

4.1 The method of cooling shall be IC 0141 in accordance with IS 6362:1995 `Designation of methods of cooling for rotating electrical machines (*first revision)*'.

5. RATED VOLTAGE, FREQUENCY AND OUTPUT

5.1 **Rated Voltage** - The rated voltage shall be 415 V unless otherwise specified by the purchaser.

5.2 **Rated Frequency** - The rated frequency shall be 50 Hz.

5.3 **Duty & Ratings** - All motors shall be rated for duty type S1 unless otherwise specified. The preferred output ratings at an ambient temperature of 40°C and the corresponding frame sizes are given in **Table-1A and Table-1B**.

5.3.1 For higher ambient temperature, the output correction factors as given below shall apply:

Ambient Temperature (°C)	*Output Correction Factor* (%)
45	93
50	85
55	80
60	75

6. TECHNICAL REQUIREMENTS

6.1 **Mounting** - The construction and mounting arrangement shall conform to IM B3, IM B35, IM B5, IM B6, IM B14, IM V1 or IM V3 of IS 2253:1974 `Designations for types of construction and mounting arrangements of rotating electrical machines (*first revision*)'.

6.2 **Dimensions** - The dimensions of foot-mounted induction motors, flange-mounted induction motors and vertical shaft motors for pumps shall be in accordance with IS 1231:1974 `Dimensions of three-phase foot-mounted induction motors (*third revision*)', IS 2223:1983 `Dimensions of flange mounted ac induction motors (*second revision*)' and IS 2254:1985 `Dimensions of vertical shaft motors for pumps (*second revision*)', respectively.

NOTE: If motors with shaft extension as given in IS 2254:1985 are required, the same shall be specifically mentioned by the purchaser.

6.3 **Frame Sizes** - The standard outputs and corresponding frame sizes shall be as given in **Table-1A and Table-1B** for motors of frame sizes up to and including 355. Beyond this, the frame size shall be as agreed to between the manufacturer and the purchaser.

NOTE: In this and in the foregoing clauses, wherever frame size is mentioned, it shall be deemed to be in accordance with IS 1231:1974, unless otherwise specified.

6.4 **Constructional Details**

6.4.1 The motor feet shall be an integral part of the stator body.

6.4.2 Range of thickness of foundation legs shall be as given in **Table 2**.

6.4.3 Separately screwed eye bolts or lifting lugs of suitable size shall be provided on the motors of frame size 90 and above for the purpose of lifting. Eye bolts conforming to IS 4190:1984 `Eye bolts with collars (*first revision*)' may be used. The threaded hole for the hook shall be blind and not through. For frame sizes 280 and above, two lifting hooks shall be provided.

6.4.4 The material of the motor body shall be grey iron castings as per IS 210:2009 `Specification for grey iron castings. Fabricated steel body may be provided when agreed to between the user and the supplier. For fabricated construction, the legs may be of welded type.

6.4.5 *Fixing Bolts for End Shields and Fan Cover* - All fasteners used in the assembly of motors shall be only of metric size. Only hexagonal headed fasteners shall be used. For frame sizes 100L and above, the minimum size of end shield fixing bolts shall be M6 and the minimum size for fan cover fixing bolts M5. Bolts should be cadmium coated and of high tensile strength.

6.4.6 The end shield shall be provided with jacking arrangement for ease of dismantling for frame sizes 280 and above.

6.4.7 To avoid flaring, end stampings of the core on stator and rotor shall be thicker than the rest.

6.4.8 Winding overhang shall be adequately supported and secured for all sizes of motors. The minimum clearance of overhang with the end cover shall be 10 mm.

6.4.9 Slot filling factor shall be in the range of 45-55% both for wire wound and strip wound motors.

6.4.10 The cooling fans shall be constructed either from cast iron or from aluminium alloy and integrally cast on a steel/cast iron hub. A positive locking system shall be adopted to lock the fan both radially and axially. Four drilled and tapped holes shall be provided on the fan hub for easy removal of the fan.

6.4.11 Space heaters shall be provided by the motor manufacturers for the motors rated 37 kW & above until and unless not specified.

6.4.12 In case of die-cast rotors, balancing weights shall be positively locked and in case of brazed rotors suitable arrangements for balancing weights shall be provided.

6.4.13 The rating plate/name plate shall be of non-rusting metal with all relevant information marked indelibly on it. Stainless steel rating plates are preferred.

6.5 **Shaft Extension** - All motors shall have a single cylindrical shaft extension unless otherwise specified.

6.6 **Bearings** - All bearings shall have an L10 life of at least 40,000 h according to IS 3824:1983 `Methods of evaluating dynamic load ratings of rolling bearings' or minimum medium duty (3) bearing/P63 as the case may be shall be provided. The bearings shall be selected so as to take care of the thrust to which the motors are likely to be subjected.

6.7 **Lubrication of Bearings** - Motors of frame sizes below 250 shall be provided either with sealed type bearings on both sides or with regreasing facility. For motors of frame sizes of 250 and above, regreasing facility shall be provided. The regreasing facility shall be provided through a grease nipple {see IS 4009:1981 `Grease Nipples (*first revision*) along with facility for excess grease removal either by a collection chamber of adequate capacity, or through a plugged hole. In no case, the grease shall penetrate to the winding under normal greasing conditions.

6.8 **Terminals and Terminal Box** - Motors shall have three or six terminals as specified by the purchaser. Terminal box and terminals shall be adequate to receive cables with aluminium conductors. The suggested terminal stud size and terminal box size for various frame sizes are shown at **Table-3**. In deciding the sizes of cables, a derating factor of 0.6 shall be taken into consideration for covering effects of both the higher ambient temperature and the grouping of cables. In case, the motor warrants the use of cables above 185 mm^2, provision shall be made for using more than one cable per terminal. The size of the cables shall be indicated at the time of enquiry.

6.8.1 The minimum cross-sectional area of aluminium cable for the smallest motor is 6 mm^2.

6.8.2 The position of the terminal box shall be in accordance with clause 5 of IS 1231:1974.

6.8.3 Terminal box shall be possible to rotate by 90/180 degree at site to make it suitable for side and top entry, if required. It should be CPRI / accredited for enclosure protection class.

6.9 **Rotation** - the motors shall be suitable for reversible duty.

6.10 **Interchangeability of Parts** - In the motors with identical specifications and design supplied by one particular manufacturer, the following parts shall be interchangeable:

a) Rotors/Stators
b) End shields
c) Bearing/bearing capsules
d) Cooling fans
e) Terminal box
f) Terminal covers
g) Grease cups

6.11 The motor shall be so built that it shall function normally even if the rotor is reversed end to end, without causing any dimensional anomaly.

7. EARTHING

7.1 Two separate earthing terminals of proper size suitable to receive galvanized iron conductor shall be provided on the bottom half of the motor body. In addition to the two outside earthing terminals, provision for one more earthing terminal inside the terminal box is to be kept. Size of earthing terminal shall conform to IS 3043:1987 `Code of practice for earthing (*first revision*)'.

8. INSULATION AND TEMPERATURE-RISE

8.1 The class of insulation shall be minimum `F'.

8.2 The permissible temperature-rise of the stator windings of the motor above the ambient temperature of 40°C shall not be greater than 80°C. The temperature-rise shall be measured by resistance method only.

8.3 The temperature of other parts may attain such values that will not affect either operational performance or life expectancy in any respect.

8.4 Separate auxiliary terminal box shall be provided for thermistor / RTD as well as space heater on the motor.

9. LIMITS OF VIBRATION

9.1 Limits of vibration intensity shall be in accordance with normal class of Table 1 of IS 12075:2008 `Mechanical vibration of rotating electrical machines with shaft heights 56 mm and higher - measurement, evaluation and limits of vibration severity (*superseding IS 4729:1968*) '.

NOTE: The manufacturer shall indicate in the test certificate whether the rotor is balanced, with or without the coupling fixing key in the shaft.

10. LIMITS OF NOISE LEVEL

10.1 The noise level shall not exceed the limits specified in IS 12065:1987 `Permissible limits of noise level for rotating electrical machines'.

11. PERFORMANCE CHARACTERISTICS

11.1 All motors shall be suitable for direct-on-line starting. The performance values of motors up to 37 kW rating shall be as given in IS 8789:1996 `Values of performance characteristics for three-phase induction motors (*first revision*)'.

NOTE: Performance values for motors beyond 37 kW rating (up to 250 kW) to be considered with exact details.

12. TOLERANCE

12.1 Tolerances as specified in IS 325:1996 shall apply wherever relevant.

13. TERMINAL MARKING

13.1 Terminals shall be marked in accordance with IS/IEC 60034-8(2002) [IS 4728:1975 is withdrawn]. Marking shall be provided on both, the leads & the terminal blocks.

14. SELECTION OF FRAME SIZES AND MOUNTING

14.1 The Frame Sizes and mounting shall be restricted as per the needs of individual steel plants as may be given by the individual steel plant. Wherever such requirement is not enclosed by a plant details given in clauses 6.1, 6.2 and 6.3 shall apply.

15. RATING PLATE

15.1 A rating plate stating the relevant particulars as given in IS 325:1996 shall be fixed on the body of the motor. In addition, the rating plate shall carry the following information also:

a) Reference to this Interplant Standard, that is, IPSS:1-03-001-14 ;

b) Designation of the motor (see clause 16);

c) Manufacturer's Name and Serial Number of the machine

d) Power outputs at 40^{o}C;

e) Current in amps at rated output;

f) No load current at rated voltage

g) Bearing designations;

h) Lubrication details (type, quantity, frequency);

j) The mass of motor in kg; and

k) Year of manufacture

l) Efficiency

m) Power factor

n) No. of stator slots and no. of rotor bars (for $\geq$ 100 kW). An additional name plate to be provided, if required.

o) Winding connection Y / delta

p) Duty clause

q) Rated RPM

r) Enclosure protection clause

An additional name plate may be used, if required, to accommodate the above data.

15.2 Manufacturer's serial number shall be punched on the rotor shaft also, for motors of frame size 315 and above.

16. DESIGNATION OF MOTORS

16.1 The motor designation shall consist of four parts. The first part identifies the application, i.e. general purpose squirrel cage induction motor in steel plant and is denoted by Motor General Squirrel Cage (MGSC), the second part indicates frame size conforming to IS 1231:1974, the third part indicates the number of poles of the machine and the fourth part indicates the type of mounting.

Example: A general purpose 4-pole squirrel cage induction motor with B3 type mounting arrangement and with a frame size of 90 L shall be designated as follows:

MGSC 90 L 4 B3

17. TESTS

17.1 The tests specified in IS 325:1996 shall be applicable to these types of motors.

18. MANUFACTURER'S RESPONSIBILITY

18.1 **Test Certificates** - The manufacturer shall furnish certificates of routine tests along with each motor. The type test certificates in accordance with Appendix B of IS 325:1996 shall be furnished for each order, whenever asked for.

18.2 **Technical Particulars** - The manufacturer shall furnish technical particulars for each motor as specified in **Appendix B**.

TABLE 1A

FRAME SIZES AND OUTPUTS AT 40°C FOR GENERAL PURPOSE SQUIRREL CAGE INDUCTION MOTORS

(Clauses 5.3 and 6.3)
(First Preference)

Rated Output(kW) at 40°C	Frame Size			
	2-Pole	4-Pole	6-Pole	8-Pole
1.5	90 L	90 L	100 L	112 M
2.2	100 L	112 M	112 M	132 S
3.7	112 M	112 M	132 M	160 M
5.5	132 S	132 S	132 M	160 M
11	160 M	160 M	160 L	180 L
15	160 L	160 L	180 L	200 L
18.5	180 M	180 M	200 L	225 S
22	180 L	180 L	200 L	225 M
30	200 L	200 L	225 M	250 M
37	225 S	225 S	250 M	280 S
45	225 M	225 M	280 S	280 M
55	250 M	250 M	280 M	315 S
75	280 S	280 S	315 S	315 M
90	280 M	280 M	315 M	315 L
110	315 S	315 S	315 M	315 L
125	315 M	315 M	315 L	355
160	315 L	315 L	355	355
200*	355	355	355	355
250*	355	355	355	355

CRITICAL DIMENSIONS FOR MOTORS IN FRAME SIZES 315 L & 355

Frame Size		A	B	C	D	E	H
315 L	2 Pole	508	508	216	65	140	315
	4,6,8 Pole	508	508	216	80	170	315
355	2 Pole	610	630	254	75	140	355
	4,6,8 Pole	610	630	254	100	210	355

NOTE: All dimensions are in mm.

TABLE 1B

FRAME SIZES AND OUTPUTS AT 40°C FOR GENERAL PURPOSE SQUIRREL CAGE INDUCTION MOTORS

(Clauses 5.3 and 6.3)
(Second Preference)

Rated Output(kW) at 40°C	Frame Size			
	2-Pole	4-Pole	6-Pole	8-Pole
3	--	--	--	132 M
7.5	--	--	132 M	--
125	--	--	--	355 S
160	--	--	355 S	355 M
200*	355 S	355 S	355 M	--
250*	355 M	355 M	--	--

CRITICAL DIMENSIONS FOR MOTORS IN FRAME SIZES 315 L & 355

Frame Size		A	B	C	D	E	H
315 L	2 Pole	508	508	216	65	140	315
	4,6,8 Pole	508	508	216	85	170	315
355 S	2 Pole	610	500	254	75	140	355
	4,6,8 Pole	610	500	254	100	210	355
355 M	2 Pole	610	560	254	75	140	355
	4,6,8 Pole	610	560	254	100	210	355

NOTE: All dimensions are in mm.

TABLE 2

FEET THICKNESS RANGE
(Clause 6.4.2)
(All dimensions are in mm)

Frame Size	Leg Thickness Range (in mm)
90	13 (min)
100	14 (min)
112	15 (min)
132	17 (min)
160	25 - 26
180	25 - 30
200	34 - 35
225	34 - 40
250	42 - 45
280	42 - 50
315	50 - 52
355	50 - 55

TABLE 3

TERMINAL BOX SIZES

Frame size	Stud size	Terminal box size
90L - 160L	M6	100 x 100 x 60
180M - 200L	M10	250 x 250 x 100
225S - 250M	M12	400 x 400 x 125
280S - 355	M20	500 x 500 x 200

NOTE: 1. All dimensions in mm.
2. Stud sizes specified are for 3 lead connections.
3. Stud sizes are suitable for compression type tubular terminal ends for Aluminium cables with enlarged hole dimension conforming to Compression Type Terminal Ends and In-line Connectors for Conductors of Insulated Cables, IPSS:1-10-033-11

A P P E N D I X B

(Clause 18.2)

PROFORMA FOR TECHNICAL PARTICULARS OF GENERAL PURPOSE SQUIRREL CAGE INDUCTION MOTORS

1. Manufacturer's name
2. Serial number and year of manufacture of the motor
3. Rated output in kW (see Table 1)
4. Rated voltage:
5. Speed in rev/min
6. Stator current in A at
   a) Rated output, and
   b) No load
7. Torque in Nm
   a) Full load torque
   b) Pull out torque
8. Motor inertia in kgm^2
9. Cyclic duration factor: %
10. Duty type:
11. Type of enclosure:
12. Type of cooling:
13. Class of insulation:
14. Frame size
15. Mass in kg
16. Details of bearings:

	DE	NDE
a) Type		
b) Make		
c) Maker's number		

NOTE: Alternative makes of bearings which may be used, may also be given with the above details.

17. Efficiency
18. Power factor
19. Type and quantity of grease for regreasing and frequency of regreasing