INTER PLANT STANDARD – STEEL INDUSTRY		
IPSS	**SPECIFICATION FOR ac CRANE (Hoist and Winches) DUTY SQUIRREL CAGE INDUCTION MOTORS** *(Fourth Revision)*	**IPSS:1-03-004-14**
	BASED ON IS 325:1996	Formerly: IPSS:1-03-004-05

0. FOREWORD

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

0.2 Inter Plant 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 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.

0.4 The Fourth revision as well as previous third revision was carried out after a similar Workshop on electric motors at Bangalore on 23 December 1993. Apart from the results of discussions with manufacturers, there were other reasons as given below for the need to print third revision:

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

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

0.5 This Inter Plant Standard shall be read in conjunction with IPSS:1-03-016-14 `Standard Information for Enquiry and Order for Electric Motors (*second revision*)'.

0.6 In the preparation of this standard, considerable assistance has been derived from IEMA Standard 3-1978 `ac induction motors for cranes and hoists'.

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1. SCOPE

1.1 This Interplant Standard covers the requirements of 4, 6 and 8 pole ac crane duty squirrel cage three-phase induction motors for voltage of 415 V and having rated outputs varying from 1.7 to 37 kW for different cyclic duration factors and class of duty S5 for use in hoists and winches and is generally based on IS 325:1996 `Specification for three-phase induction motors (fifth revision)'. This is for DOL application only.

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:

2.2 **Ambient Temperature** - The ambient temperature or the cooling medium temperature not exceeding 40°C.

NOTE: For using the motors at a higher ambient temperature, the guidance given in clause 5.3 shall be followed.

2.3 **Relative Humidity** - The maximum relative humidity shall be 100%. However, maximum ambient temperature and 100% relative humidity may not occur simultaneously.

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

2.5 **Altitude** - The altitude shall not exceed 1000 m.

2.6 **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°C. Motors, when operated under the extreme conditions of voltage and frequency variation, may not necessarily have their performance in accordance with this standard.

2.7 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 clause 3.2 of 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 percent 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 percent of the positive-sequence component.

3. TYPE OF ENCLOSURE

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

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, DUTY AND RATING

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

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

5.3 **Duty and Rating** - The output rating for minimum Class F insulated ac crane duty squirrel cage induction motors at the ambient temperature of 40°C for different cyclic duration factors shall be as given in Table 1 corresponding to various frame sizes.

NOTE: For higher ambient temperatures, the following output correction factors shall be applied.

Ambient Temperature (^{o}C)	Output Correction factor (%)
45	93
50	85
55	80
60	75

6. TECHNICAL REQUIREMENTS

6.1 **Mounting** - The mounting arrangement shall conform to IMB3 or IMB5 of IS 2253:1974 `Designation for types of construction and mounting arrangement of rotating electrical machines (*first revision*)'.

6.2 **Dimensions** - The dimensions of foot-mounted and flange-mounted motors for preferred frame sizes shall be in accordance with IS 1231:1974 `Dimensions of three-phase foot-mounted induction motors (*third revision*)' and IS 2223:1983 `Dimensions of flange mounted ac induction motors (*first revision*)' respectively.

6.3 **Constructional Details**

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

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

6.3.3 Separately screwed eye bolts or lifting lugs of suitable size shall be provided on the motors of frame size 100 and above for the purpose of lifting. Eye bolts conforming to IS 4190:1984 `Specification for 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.

6.3.4 The material of the motor body shall be grey iron casting as per IS 210:2009 `Specification for grey iron casting. Fabricated steel body may be provided when agreed to between the user and the supplier.

6.3.5 **Fixing bolts for end shields and fan covers** - All fasteners used in the assembly of motors shall be only of metric size. Only hexagonal headed fasteners shall be used. For frame sizes 100 L and above, the minimum size of end shield fixing bolt shall be M8. The minimum size of fan cover fixing bolt shall be M6. Bolts shall be cadmium coated and of high tensile strength.

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

6.3.7 Winding overhang shall be adequately supported and secured for all sizes of motors.

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

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

6.3.10 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.

6.3.11 The rating plate/name plate shall be of non-rusting metal with all relevant information marked indelibly on it.

6.4 **Shaft Extension**

6.4.1 All motors shall have single cylindrical shaft extension unless otherwise specified and shall correspond to IS 1231:1974 `Dimensions of three-phase foot mounted induction motors (*third revision*)'.

6.5 **Bearings** - All bearings shall have an L10 life of at least 40,000 h or minimum medium duty (C3) bearing shall be provided [IS 3824 (Part 1 to 4) : 1983 has been withdrawn]. The bearings shall be selected so as to take care of the thrust to which the motors are likely to be subjected. The actual thrust value shall be indicated by the user.

6.6 **Lubrication of Bearings** - The bearing shall be of sealed type (see IS 4009:1981 “grease nipple” – *first revision*).

6.7 **Terminals and Terminal Box** - Terminal box and terminals shall be adequate to receive cables with aluminium conductors. Maximum cable size for different frame sizes shall be as shown in Table 1. The suggested terminal stud size and terminal box size for motor frame sizes 112 M to 200 L are given at Table 3.

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

6.8 **Rotation** - The motor shall be suitable for reversible duty.

6.9 **Balancing** - Rotor shall be dynamically balanced with half key.

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

a) Rotors/stators,
b) End shields,

c) Bearings/bearing capsules,
d) Cooling fans,
e) Terminal box,
f) Terminal covers, and
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 earthing terminals of proper size suitable to receive galvanized iron conductors 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. The size of earthing terminal shall conform to clause 12.2.2.2 of IS 3043:1987 `Code of practice for earthing (*first revision*)'.

8. INSULATION AND TEMPERATURE-RISE

8.1 The class of insulation of the motor shall be F unless otherwise specified.

8.2 The permissible temperature-rise of the windings of Class F insulated motors above the ambient temperature of 40°C shall not be greater than 80°C when measured by resistance method.

NOTE: The temperature-rise test shall be conducted at S2, 60 minutes duty corresponding to the rated output of the motor at S3, 40% duty.

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 levels shall not exceed the limits specified in IS 12065:1987 `Permissible limits of noise level for rotating electrical machines', if specified by the user.

11. PERFORMANCE CHARACTERISTICS

11.1 **Overspeed** - Motors with 6 and 8 poles shall be designed for a maximum working speed of 2.5 times rated speed or 2000 rpm whichever is less for a duration of 2 minutes.

NOTE: For 4 pole motors, the maximum working speed may be agreed to between the manufacturer and the user.

11.2 **Breakaway Torque** - The value of breakaway torque shall be 250% or higher of the rated torque with a permissible tolerance of -10% on the guaranteed value.

11.3 **Breakaway Starting Current** - The maximum breakaway starting current shall not be greater than 6 times the full load current corresponding to S3, 40% duty at the ambient temperature of 40°C subject to relevant tolerance.

11.4 **Slip** - The motors shall have a slip up to 10% at S3, 40% duty.

NOTE: If a specific value of slip is required by the purchaser, the same shall be specified.

11.5 Pull out torque shall be $\geq$ 275% of rated torque for all motor ratings.

12. TOLERANCES

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 both on the leads and the terminal blocks.

14. RATING PLATE

14.1 A rating plate stating the relevant particulars given in clause 19.1 of IS 325:1996 shall be fixed on the body of the motor. An additional name plate shall be provided to carry the following information:

a) Reference to this Interplant Standard, that is, IPSS:1-03-004-14

b) Designation of the motor (see clause 15),

c) Manufacturer's name and serial number of the machine

d) Output kW and current rating at type of duty S3, and CDF 40%,

e) No load current at rated voltage,

f) Rated voltage (V),

g) Bearing designation,

h) Lubrication details,

j) Moment of inertia (GD^2 value),

k) The mass of motor in kg, and

l) Year of manufacture.

m) Efficiency

n) Power Factor

o) Duty class

p) Enclosure protection class

q) Rated RPM

r) B-Value (GD^2 x No. of starts / h)

15. DESIGNATION OF MOTORS

15.1 The motor designation shall consist of four parts. The first part identifies the application, i.e., ac crane duty squirrel cage induction motors in steel plant and is denoted by MMSC;(Full form to be provided) the second part indicates frame size; the third part indicates the number of poles of the machine and the fourth part indicates the type of mounting.

Example - Crane duty 6-pole squirrel cage induction motor with IMB3 type mounting arrangement and with a frame size of 180 L shall be designated as follows:

MMSC 180 L 6 B3

16. TESTS

16.1 The tests specified in clause 21 of IS 325:1996 shall be applicable to these types of motors. In addition, the following test shall also be carried out:

16.1.1 **Over speed Test** - The over speed test shall be carried out as a type test (see clause 11.1).

17. MANUFACTURER'S RESPONSIBILITY

17.1 **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 motor whenever asked for.

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

TABLE 1
RATINGS OF ac CRANE DUTY SQUIRREL CAGE INDUCTION MOTORS
(Clauses 5.3 and 6.7)

Frame Size	S_4/S_5 (150 starts)				S_4/S_5 (300 starts)		
	25%	40%	60%	100%	40%	60%	100%
4 POLE (1500 rpm)							
112 M	4.3	4.0	3.3		3.3	3.0	
132 S	6.0	5.5	5.0		5.0	4.5	
132 M	8.0	7.5	6.7		6.7	6.0	
6 POLE (1000 rpm)							
112 M	2.2	1.9	1.8		1.8	1.7	
132 S	3.0	2.7	2.5		2.5	2.2	
132 M	6.4	5.5	5.0		5.0	4.5	
160 M	8.5	7.5	6.7		8.0	7.0	
180 L	17.5	15.0	13.0		13.0	11.0	
200 L	26.0	22.0	19.0		19.0	17.0	
225 M	37.0	30.0	27.0		19.0	17.0	
8 POLE (1000 rpm)							
160 M	6.4	5.5	5.0	5.0	3.7		
160 L	8.8	8.0	7.5	7.5	6.0		
180 L	13.0	11.0	10.0	10.0	8.5		
200 L	18.0	150.0	13.0	13.5	11.0		
225 M	26.0	22.0	19.0	19.0	17.0		
250 M	37.0	30.0	26.0	26.0	22.0		

Ref: Formulae given in IS 13555:1993

$$\text{kWrms } (S_1 \text{ duty}) = \frac{(kW1)^2 \times t1}{kto + t1}$$

Where t1 = one time
t = off time
kW1 = S_3 output at the duty specific

kWrms = 0.9252 x kW (S_3 60%)
0.8528 x kW (S_3 40%)
0.7559 x kW (S_3 25%)

TABLE 2

FEET THICKNESS RANGE
(Clause 6.3.2)

(All dimensions are in mm)

Frame Size	Leg Thickness Range
160	25 - 26
180	25 - 30
200	34 - 35
225	34 - 40
250	42 - 45
280	42 - 50
315	50 - 52
355	50 - 55
400	60 - 62
450	60 - 62

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

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 17.2)

PROFORMA FOR TECHNICAL PARTICULARS OF ac CRANE DUTY 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) Break away torque:
8. Cyclic duration factor, (%)
9. Duty type:
10. Type of enclosure:
11. Type of cooling:
12. Class of insulation:
13. Frame size:
14. Mass in kg:
15. Efficiency
16. Power factor
17. Type and quantity of grease to be used and frequency of regreasing:
18. 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.