0. FOREWORD

0.1 This Interplant Standard (*second revision*) has been prepared by the Standards Committee on Rotating Electrical Machinery, IPSS 1:3 with the active participation of representatives of steel plants, reputed consulting organizations and established manufacturers of Electric Motors; and was adopted in June 2008.

0.2 This Interplant Standard was originally published in 1983.

0.3 In the preparation of this standard, considerable assistance has been derived from IEMA Standard 3-1996 `ac induction motors for cranes and hoists'.

0.4 This Interplant Standard should be read in conjunction with IPSS:1-03-016-03 `Standard information for enquiry and order for electric motors (*second revision*).

0.5 This IPSS has been published after updating the relevant things.

1. SCOPE

1.1 This Interplant Standard covers the requirements of 6, 8 and 10 pole ac mill/crane duty slipring three-phase induction motors for a voltage of 415 V and having rated outputs varying from 2.5 to 230 kW for different cyclic duration factors and classes of duty for use on EOT cranes, hoists, winders and auxiliary steel mill drives, such as transfer cars, tilters, pushers, coilers, etc and is generally based on IS 325:1996 `Specification for three-phase induction motors (*fifth revision*)'. For convenience of reference, the clause numbers of the above Indian Standard for each requirement are given in **Appendix A** along with the numbers of the matching clauses of this standard.

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 of the cooling medium shall not exceed 40°C.

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

2.1.2 *Relative Humidity* - The maximum relative humidity shall be 100%. However, 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, for motors beyond frame size 225.

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

2.1.4 *Altitude* - The altitude shall not exceed 1000 m above mean sea level.

2.1.5 *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% of the positive-sequence component.

2.1.6 *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 ±6% in general cases but in special cases if desired by the purchaser, voltage fluctuation of ±10% shall have to be provided; or as agreed between purchaser & supplier.

ii) The frequency differing from its rated value by not more than ±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.

3. TYPE OF ENCLOSURE

3.1 The degree of protection to be provided by the enclosure shall be IP54 in accordance with IS 4691:1985 `Degrees of protection provided by enclosures for rotating electrical machinery (*first revision*)' except for terminal box and slipring cover which will be as per IP55.

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 ratings of ac crane/mill duty slipring induction motors at the ambient temperature of 40°C for different cyclic duration factors shall be as given in Tables-1 to 3 corresponding to various frame sizes and classes of duty, S3 (6 cycles per hour), S4 and S5 (150 and 300 cycles per hour respectively).

NOTE: For higher ambient temperature, the following output correction factors shall be applied to correct the rated output:

Ambient Temperature (°C)	*Output Correction Factor* (%)
45	95
50	88
55	83
60	75

5.4 **Rotor Voltage and Current** - The preferred rotor voltages and currents shall be as indicated in Tables-1 to 3.

6. TECHNICAL REQUIREMENTS

6.1 **Mounting** - The mounting arrangements shall conform to IMB3 or IMB5 of IS 2253:1974 `Designations for types of construction and mounting arrangements of rotating electrical machines (*first revision*)', or as specified by the purchaser.

6.2 **Dimensions** - The mounting dimensions and tolerances of foot mounted and flange mounted ac crane/mill duty slipring induction motors shall be as given in Tables-4 and 5.

6.3 Constructional Details

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

6.3.2 Separately screwed eye bolts or lifting lugs of suitable size shall be provided on the motor frame 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.

6.3.3 Range of thickness of foundation legs should be as given in Table-6.

6.3.4 The material of the motor body shall be grey iron casting as per IS 210:1993 `Specification for Grey iron casting (*fourth revision*)', for crane duty application. For mill duty application, the motor bodies may be of SG iron or fabricated steel if so specified by the purchaser. For fabricated construction, the legs may be of welded type.

6.3.5 All fasteners used in the assembly of motors shall be only of metric size. Hexagonal headed fasteners shall be used. However, cheese head screws can be allowed wherever space restriction exists in motors up to frame size 200. Hexagonal socket head screws and screw heads requiring the use of allen keys are forbidden.

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

6.3.7 To avoid flaring, end stampings of the core on the stator and rotor shall be thicker than the rest. This may be achieved by spot welded or thick end stamping.

6.3.8 Coils shall be preferably made from rectangular conductors for winding of stators of motors of 355 frame size and above and for rotors of motors 250 and above frame size.

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

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

6.3.11 For motors of frame size 280 and above, the rotor strip-leads shall be connected to the slipring by brazing/bolting.

6.3.12 For the rotors of the motors of frame sizes 280 and above preferably resiglass bandaging shall be used.

6.3.13 The slipring shall be of built-up construction (fabricated) in case of motors of frame size 225 and above. In case of lower frame sizes also, the built-up construction shall be preferred.

6.3.13.1 The separator (insulating partition with rounded heads) between sliprings and at the ends, shall be at least 10 mm more in diameter than the diameter of the rings.

6.3.14 The brush arm fixing arrangement shall be such as to prevent the rotation of the brush arm. An insulating partition shall be provided between the brush holder clamps/brush holders. Brush holder arm shall be of square cross section or should be of two stud design. Brush holders shall be of constant pressure type.

6.3.15 To avoid entry of carbon dust from brushes to winding, there shall be a partition between the winding and the slipring for frame sizes 250 and above.

6.3.16 If required, the slipring chamber shall have a knock out entry of adequate size on two sides for entry of external connection cables. Alternatively, the arrangements given in clause 6.9.1 may be provided.

6.3.17 The cooling fans shall be either of cast iron or aluminium alloy integrally cast on steel/cast iron hub. A positive locking system shall be adopted to lock the fan both radially and axially.

6.3.18 Slipring inspection covers shall be of hinged design and shall be provided with gaskets so as to conform to the requirement of degree of protection IP55.

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

6.4 Shaft Extension

6.4.1 Foot mounted motors as shown in Table-4 shall have identical double tapered shaft extension along with key, lock, washer and nut unless otherwise specified and shall conform to IS 3688:1990 `Power Transmission-shafts-dimensions of cylindrical and 1/10 conical shaft ends (*second revision*)'. Protective covers shall be provided on the non-driving end if specified.

6.4.2 Flange mounted motors as shown in Table-5 shall have a single cylindrical shaft extension unless otherwise specified and shall correspond to IS 2223:1983 `Dimensions of flange mounted ac induction motors (*first revision*)'.

6.5 **Bearings** - All bearings shall have an L10 life of at least 40,000h according to IS 3824:1983 `Methods of evaluating dynamic load ratings of rolling bearings (*first revision*)' or minimum medium duty (C3) bearing should be provided. 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** - For motors of frame sizes 250 and above, re-greasing facility through a grease nipple [see IS 4009:1981 `Grease nipples (*first revision*)'] along with facility for excess grease removal through a plugged hole, shall be provided. In no case, the grease shall penetrate to the winding under normal greasing conditions.

6.7 **Provision for Easy Removal of Fan** - For motors of frame sizes 225 and above, four nos. drilled and tapped holes shall be provided on the fan hub for easy removal of the fan. Motors of frame sizes up to 225 shall be provided with two nos. drilled and tapped holes.

6.8 **Fixing Bolts for End Shield and Fan Cover** - The minimum size of end shield fixing bolts shall be M8. The minimum size of fan cover fixing bolts shall be M6. All the bolts shall have hexagonal heads (see clause 6.3.5 also).

6.9 **Terminals and Terminal Box** - Terminal box and terminals shall be adequate to receive cables with aluminium conductors. Maximum cable sizes for different frame sizes shall be as shown in Table-1 to 3.

6.9.1 Separate terminal boxes shall be provided for stator and rotor in frame sizes 315 and above. In frame sizes 280 and below single terminal box is also acceptable with properly segregated terminals and an insulating partition between stator and rotor terminals. The stator and rotor terminals shall be clearly marked. For any particular frame size, the size of terminals and terminals box shall be in accordance with Table-7.

6.9.2 Only three leads (with lugs), each from the stator and the rotor shall be brought out to the terminal box. Stator/rotor leads even with parallel lead cables shall be terminated on a single lug. Single hole standard lugs are to be used. Double check nuts should invariably be provided to all the terminals.

6.9.3 The terminal box position shall be in accordance with IS 1231:1974 `Dimensions of three-phase foot-mounted induction motors (*third revision*)', unless otherwise specified.

6.10 **Brush Gear** - Brushes of standard dimensions as specified in IS 13466:1992 `Specification for brushes of electrical machines (superseding IS 3003 Pt 3 & 4) and IS 9919:1999 `Guide for selection and use of carbon brushes for applications in rotating electrical machines (*first revision*)', shall be used.

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

6.12 **Balancing** - Rotors shall be dynamically balanced with half key.

6.13 **Interchangeability of Parts** - In the motors with identical specification and design of any 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,
g) Grease cups,
h) Slipring assemblies,
j) Brush holders and brushes,
k) Body bolts, and
m) Key.

7. EARTHING

7.1 Two 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 clause 12.3.2.2 of IS 3043:1987 `Code of practice for earthing (*first revision*)'.

8. INSULATION AND TEMPERATURE-RISE

8.1 The class of insulation shall be `F' for both, stator and rotor and with temperature rise limited to class `B' in both the components.

8.2 The temperature-rise of windings and other parts shall be within the limits specified for the insulation class `B' in Table-1 of IS 12802:1989 `Temperature rise measurements of rotating electrical machines' when tested in accordance with IS 12802:1989.

The duration of temperature-rise-test shall be as specified in the above standard for periodic duty type ratings. The temperature-rise measurement of windings shall be by resistance method only.

8.3 The temperature of other parts, such as slipring assembly, brush holders etc, may attain such values that will not affect either operational performance or life expectancy in any respect.

8.4 Thermistor shall be provided on the stator winding if specified by the purchaser.

9. LIMITS OF VIBRATION

9.1 Limits of vibration intensity shall be in accordance with normal class of Table-1 of IS 12075:1987 `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', if required by the user.

11. PERFORMANCE CHARACTERISTICS

11.1 **Over Speed** - Motors with 6, 8 and 10 poles shall be designed for a maximum working speed of 2.5 times rated speed or 2000 rev/min whichever is less for a duration of 2 minutes.

11.2 **Pull Out Torque** - The value of pull out torque shall be 275 percent or higher of the rated torque with a permissible tolerance of -10 percent on the guaranteed value.

12. TOLERANCES

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

12.2 Maximum permissible tolerance on rotor voltage given in Tables-1 to 3 shall be $\pm$10%. However, for motors with the same frame size and design of any one manufacturer, the permissible variation shall be $\pm$5% on the guaranteed value.

13. TERMINAL MARKING

13.1 Terminals shall be marked in accordance with IS 4728:1975 `Terminal marking and direction of rotation for rotating electrical machinery (*first revision*)'. Marking shall be provided on both, the leads and the terminal blocks.

14. SELECTION OF FRAME SIZES AND MOUNTING

14.1 The frame sizes and mounting will be restricted as per the needs of individual steel plants as may be given in an Annexure-Z by the individual steel plant. Wherever such Annexure is not enclosed by a plant, details given in Table-1, 2, 3 of IPSS:1-03-003-08 shall apply.

15. RATING PLATE

15.1 A rating plate stating the relevant particulars as 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:1-03-003-08;
b) Manufacturer's name and serial number of the machine
c) Designation of the motor (see clause 16);
d) Output and current rating at the type of duty, for example S4, CDF-60%;
e) No load current at rated voltage;

NOTE: The above information is required to check the motors after rewinding.

f) Number of starts per hour;
g) Bearing designation;
h) Lubrication details (type, quantity and frequency);
i) Moment of inertia (GD^2 value);
j) The mass of motor in kg; and
k) Year of manufacture.
l) Rotor voltage.
m) Rotor current.

15.2 Manufacturer's serial number shall be punched on the rotor shaft also for motors of frame sizes 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. ac crane/mill duty slipring induction motor for use in steel plant and is denoted by MMSR, 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 - A crane/mill duty 6-pole slipring induction motor with IMB3 type of mounting arrangement and with a frame size of 180L shall be designated as follows:

MMSR 180L 6 B3

17. TESTS

17.1 The tests specified in clause 21 of IS 325:1996 shall be applicable to these types of motors. In addition, the over-speed test shall be carried out as a type test (see clause 11.1).

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 A**.

TABLE 1

(Clauses 5.3, 5.4, 6.9)

RATINGS OF ac CRANE/MILL DUTY SLIPRING INDUCTION MOTORS WITH A SYNCHRONOUS SPEED OF 600 rev/min

Frame Number	Rated Output (kW)									Rotor Voltage V	Rotor Current (A)									Maximum Cable Size (mm^2)	
	Duty Type S_3 6 cycles per hour*				Duty Type S_4 150 cycles per hour			Duty Type S_5 300 cycles per hour			Duty Type S_3 6 cycles per hour*				Duty Type S_4 150 cycles per hour			Duty Type S_5 300 cycles per hour			
	Cyclic Duration Factor				Cyclic Duration Factor						Cyclic Duration Factor				Cyclic Duration Factor						
	25%	40%	60%	100%	25%	40%	60%	40%	60%		25%	40%	60%	100%	25%	40%	60%	40%	60%	Stator	Rotor
1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)	13)	14)	15)	16)	17)	18)	19)	20)	21)	22)
A. MOTORS WITH HIGHER VALUES OF SECONDARY VOLTAGES																					
315 S	70	60	52	44	56	50	44	42	37	380	117	100	87	74	94	84	74	70	62	185	185
315 M	87	75	65	55	70	62	55	53	46	365	152	130	113	95	121	105	95	92	80	2X95	2X95
355 M	115	100	85	73	93	83	73	70	62	370	197	171	147	125	160	142	125	120	106	2X150	2X150
355 L	145	125	100	92	117	105	92	88	78	450	243	214	181	154	195	174	154	147	130	2X185	2X185
400 M	180	160	135	115	146	130	115	110	87	427	267	237	200	171	217	193	171	163	144	3X150	3X150
400 L	230	200	170	145	185	165	145	140	123	455	323	281	239	204	260	232	204	197	173	3X185	3X185
B. MOTORS WITH LOWER VALUES OF SECONDARY VOLTAGES																					
315 S	70	60	52	44	56	50	44	42	37	235	163	156	135	114	146	130	114	109	96	185	185
315 M	87	75	65	55	70	62	55	53	46	295	180	154	134	112	144	128	112	108	94	2X95	2X95
355 M	115	100	85	73	93	83	73	70	62	295	240	205	178	150	191	172	150	144	128	2X150	2X150
355 L	145	125	108	92	117	105	92	88	78	354	262	226	195	167	211	190	166	159	141	2X185	2X185
400 M	180	160	135	115	146	130	115	110	87	300	355	315	265	228	288	257	228	219	193	3X150	3X150
400 L	230	200	170	145	185	165	145	140	123	375	390	333	290	249	316	222	250	240	212	3X185	3X185

NOTE : The recommended cable sizes are for PVC insulated aluminium conductor cables.

* The figure 6 is calculated from the standard-duty cycle time of 10 minutes for duty type S_3. It is not an exact value, it represents the condition in which starting current should not significantly affect temperature rise.

TABLE 2

(Clauses 5.3, 5.4, 6.9)

RATINGS OF ac CRANE/MILL DUTY SLIPRING INDUCTION MOTORS WITH A SYNCHRONOUS SPEED OF 600 rev/min

Frame Number	Rated Output (kW)									Rotor Voltage V	Rotor Current (A)									Maximum Cable Size (mm^2)	
	Duty Type S_3 6 cycles per hour*				Duty Type S_4 150 cycles per hour			Duty Type S_5 300 cycles per hour			Duty Type S_3 6 cycles per hour*				Duty Type S_4 150 cycles per hour			Duty Type S_5 300 cycles per hour			
	Cyclic Duration Factor				Cyclic Duration Factor						Cyclic Duration Factor				Cyclic Duration Factor						
	25%	40%	60%	100%	25%	40%	60%	40%	60%		25%	40%	60%	100%	25%	40%	60%	40%	60%	Stator	Rotor
1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)	13)	14)	15)	16)	17)	18)	19)	20)	21)	22)
A. MOTORS WITH HIGHER VALUES OF SECONDARY VOLTAGES																					
160 M	5.5	5.2	4.5	4.1	5.2	4.8	4.1	nil	nil	198	17	16	14	12	16	15	12	nil	nil	10	10
160 L	8.2	7.5	6.7	5.5	7.5	6.7	5.3	nil	nil	222	24	22	20	16	22	20	16	nil	nil	10	10
180 L	11.5	10	8.5	7.5	9.5	8.5	7	7	6.5	234	32	28	24	21	26	24	19	19	18	10	10
200 L	16.5	14.5	12.5	11	14	12	11	10.5	9.5	262	42	37	32	28	30	31	28	27	24	16	16
225 M	28	25	22	18.5	23	20	18.5	17.5	16	270	64	57	50	42	52	45	42	40	36	25	25
250 M	42	37	32	27	34	30	27	26	24	330	80	70	61	51	65	57	51	59	49	70	70
280 S	57	50	44	37	47	41	37	35	32	259	139	122	107	90	115	100	90	85	78	120	120
280 M	73	63	55	47	60	52	47	45	41	341	134	116	101	86	110	95	86	83	75	150	150
315 S	93	80	70	60	75	66	60	57	52	317	185	159	139	119	149	131	119	114	103	2x70	2x70
315 M	115	100	88	75	95	83	75	72	65	357	202	176	155	132	167	146	132	126	114	2x150	2x150
355 M	185	160	140	120	150	132	120	115	105	475	221	184	161	139	190	167	152	146	133	3x150	3x150
B. MOTORS WITH LOWER VALUES OF SECONDARY VOLTAGES																					
160 M	5.5	5.2	4.5	6.1	5.2	4.5	4	2.8	3.8	135	28.6	27	23.4	20.8	27	23.4	20.8	20.8	19.8	10	10
160 L	8	7	6	5.5	7	6	5.5	5.5	5.2	170	31.8	28	23.5	22	25	23.5	22	22	20.8	10	10
180 L	11.5	10	8.5	7.5	9.5	8.5	7	7	6.5	210	35	31	26	22	30	26	21	21	20	10	10
200 L	16.5	14.5	12.5	11	14	12	11	10.5	9.5	250	42	37	32	28	36	31	28	27	24	16	16
225 M	28	25	22	18.5	23	20	18.5	17.5	16	258	71	63	56	47	58	51	47	44	41	25	25
250 M	42	37	32	27	34	30	27	26	24	330	80	70	61	51	65	57	51	59	49	70	70
280 S	57	50	44	37	47	41	37	35	32	200	173	150	132	112	141	123	112	106	97	120	120
280 M	73	63	55	47	60	52	47	45	41	250	179	154	134	114	147	127	114	109	99	150	150
315 S	93	80	70	60	75	66	60	57	52	270	210	180	156	134	169	147	134	127	116	2x70	2x70
315 M	115	100	88	75	95	83	75	72	65	340	205	178	155	134	169	147	134	127	117	2x150	2x150
355 M	185	160	140	120	150	132	120	115	105	435	258	225	196	168	211	185	168	161	147	3x150	3x150

NOTE : The recommended cable sizes are for PVC insulated aluminium conductor cables.

* The figure 6 is calculated from the standard-duty cycle time of 10 minutes for duty type S_3. It is not an exact value, it represents the condition in which starting current should not significantly affect temperature rise.

TABLE 3

(Clauses 5.3, 5.4, 6.9)

RATINGS OF ac CRANE/MILL DUTY SLIPRING INDUCTION MOTORS WITH A SYNCHRONOUS SPEED OF 600 rev/min

Frame Number	Rated Output (kW)									Rotor Voltage V	Rotor Current (A)									Maximum Cable Size (mm^2)	
	Duty Type S_3 6 cycles per hour*				Duty Type S_4 150 cycles per hour			Duty Type S_5 300 cycles per hour			Duty Type S_3 6 cycles per hour*				Duty Type S_4 150 cycles per hour			Duty Type S_5 300 cycles per hour			
	Cyclic Duration Factor				Cyclic Duration Factor						Cyclic Duration Factor				Cyclic Duration Factor						
	25%	40%	60%	100%	25%	40%	60%	40%	60%		25%	40%	60%	100%	25%	40%	60%	40%	60%	Stator	Rotor
1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)	13)	14)	15)	16)	17)	18)	19)	20)	21)	22)
132 M	5	4	3.5	3	4	3.5	3	3	2.5	110	29	23	20	17	23	20	17	17	14	10	10
160 M	8	7	6	5.5	7	6	5.5	5.5	5	180	28	24	21	19	24	21	19	19	17	10	10
160 L	11.5	10	8.5	7.5	9.5	8.5	7.5	7	6.5	260	28	24	20	18	23	20	18	17	16	10	10
180 L	16.5	14.5	2.5	11	14	12.5	11	10.5	9.5	230	45	40	34	30	38	34	30	29	26	16	16
200 L	23	20	17.5	15	19	17	15	14	13	255	57	49	43	37	47	42	37	34	32	25	25
225 M	34	30	26	22	28	25	22	21	19	290	73	65	56	48	60	54	48	45	41	35	35

NOTE : The recommended cable sizes are for PVC insulated aluminium conductor cables.

* The figure 6 is calculated from the standard-duty cycle time of 10 minutes for duty type S_3. It is not an exact value, it represents the condition in which starting current should not significantly affect temperature rise.

TABLE 4

(Clauses 6.2 and 6.4)

(See Fig.1)

DIMENSIONS OF FRAMES FOR FOOT MOUNTED ac CRANE/MILL DUTY SLIPRING INDUCTION MOTORS

All dimensions in millimeters

Frame Number	Fixing Dimensions						Shaft Extension					Key		
	H	A	B	C	K	LC Max	D	D_2	D_4	E	E_2	F	G	GA
132 M	132	216	178	89	12	790	38	32.6	M 20x1.5	80	54	8	32	41
160 M	160	254	210	108	15	885	42	33.8	M 24x2	110	82	10	35	43
160 L	160	254	254	108	15	940	42	33.8	M 24x2	110	82	10	35	43
180 L	180	279	279	121	15	990	48	39.8	M 30x2	110	82	12	41	49
200 L	200	318	305	133	19	1060	55	46.8	M 36x3	110	82	14	47.5	56.5
225 M	225	356	311	149	19	1220	60	49.5	M 42x3	140	105	16	51.4	61.4
250 M	250	406	349	168	24	1340	70	59.5	M 48x3	140	105	18	60.4	71.4
280 S	280	457	368	190	24	1445	80	67	M 56x4	170	130	20	69.3	81.3
280 M	280	457	419	190	24	1495	80	67	M 56x4	170	130	20	69.3	81.3
315 S	315	508	406	216	28	1555	90	77	M 64x4	170	130	22	77.8	91.8
315 M	315	508	457	216	28	1605	90	77	M 64x4	170	130	22	77.8	91.8
355 M	355	610	560	254	28	1865	100	83.5	M 72x4	210	165	25	86.9	100.9
355 L	355	610	630	254	28	1935	100	83.5	M 72x4	210	165	25	86.9	100.9
400 L	400	686	710	280	35	2025	100	93.5	M 80x4	210	165	25	96.9	110.9

NOTE - For further details, please see IS 1231:1974 `Dimensions of three phase foot mounted induction motors (*third revision* )' and IS 8223 :1999 `Dimensions and output ratings for foot mounted rotating electrical machines with frame numbers 355 to 1080(*first rev)* '.

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All dimensions in millimetres.

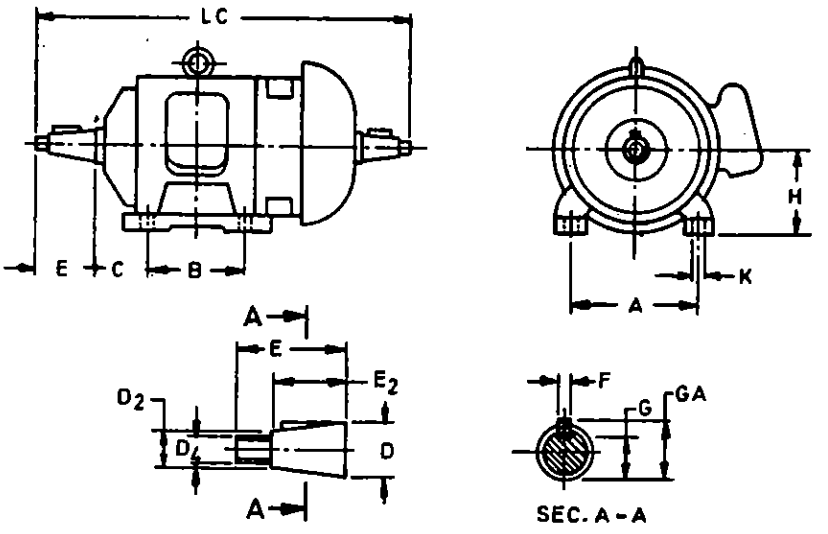

Fig.1
(See table 4)

FOOT MOUNTED ac MILL/CRANE DUTY SLIPRING INDUCTION MOTORS

All dimensions in millimetres.

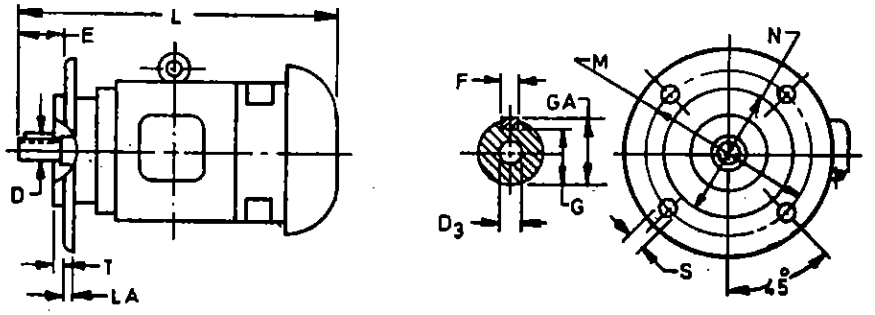

Fig.2
(See table 5)

FLANGE MOUNTED ac MILL/CRANE DUTY SLIPRING INDUCTION MOTORS

TABLE 5

(Clauses 6.2 and 6.4)

(See Fig.2)

DIMENSIONS OF FRAMES FOR FLANGE MOUNTED ac CRANE/MILL DUTY SLIPRING INDUCTION MOTORS

All dimensions in millimeters

Frame Number	Fixing Dimensions					Shaft Extension			Key			L,Max
	M	N	S	T	LA	D	E	D3	F	G	GA	
160 M)) 160 L)	300±0.5	250 j 6	19	5	13	42 k 6	110	M 16	12	37	45	740 785
180 L	300±0.5	250 j 6	19	5	13	48 k 6	110	M 16	14	42.5	51.5	860
200 L	300±0.5	300 j 6	19	5	15	55 m 6	110	M 20	16	49	59	920

NOTE - For further details, please see IS 2223:1983 `Dimensions of flange mounted ac induction motors (*first revision*)'

TABLE 6

FEET THICKNESS RANGE
(Clause 6.3.3)

(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

TABLE 7

TERMINAL BOX SIZES
(Clause 6.9.1)

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:1-10-033-93.

APPENDIX A
(Clause 18.2)

PROFORMA FOR TECHNICAL PARTICULARS OF
ac MILL/ CRANE DUTY SLIPRING INDUCTION MOTORS

1. Manufacturer's name
2. Serial number and year of manufacture of the motor
3. Rated output in kW (see Tables 1 to 3)
4. Rated voltage:
5. Speed in rev/min
6. Stator current in A at — a) Rated output, and; b) No load
7. Rotor voltage: V
8. Rotor current: A
9. Torque in Nm — a) Full load torque; b) Pull out torque
10. Motor inertia in GD^2
11. Cyclic duration factor: %
12. Number of starts per hour
13. Duty type:
14. Type of enclosure
15. Type of cooling:
16. Class of insulation: Stator -; Rotor -
17. Frame size
18. Mass in kg
19. 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.

20. Type and quantity of grease and frequency of re-greasing
21. Details of brushes:

a)	Number of brushes per ring
b)	Total number of brushes
c)	Make
d)	Grade
e)	Size

22. Details of winding:

		Stator	Rotor
a)	Number of slots		
b)	Coil pitch in number of slots		
c)	Conductor size in mm		
d)	Type of winding		
e)	Number of turns per coil		
f)	Winding connection		
g)	Mass of copper in kg		
h)	Phase resistance in Ohms in cold condition (at.....°C)		